

Report On  
**Product Support of Earthmoving Solutions Limited**

By

Abdullah Al Masud  
22164013

An internship report submitted to BRAC business school in partial fulfillment of the requirements for the degree of Master of Business Administration

BRAC Business School  
BRAC University  
August 2024

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## **Declaration**

It is hereby declared that

1. The internship report submitted is my/our 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.

### **Student's Full Name & Signature:**

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**Abdullah Al Masud**  
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### **Supervisor's Full Name & Signature:**

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**Dr. Md. Abdul Hoque**  
Professor, BRAC Business School  
BRAC University

### **Co-Supervisor's Full Name & Signature:**

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**Dr. Md Arif Hossain Mazumder**  
Assistant Professor, BRAC Business School  
BRAC University

## **Letter of Transmittal**

Dr. Md. Abdul Hoque  
Professor  
Department  
BRAC University  
66 Mohakhali, Dhaka-1212

Subject: Submission of Internship Report

Dear Sir,

I am pleased to present the functional details of the product support modalities at Earthmoving Solution Ltd., where I have been employed since October 2018 and currently hold a mid-management position.

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

I trust that the report meets the standard requirement of the BRAC University.

Sincerely yours,

---

Abdullah Al Masud  
22164013  
BRAC Business School  
BRAC University  
Date: August 31, 2024

## **Non-Disclosure Agreement (NDA)**

This agreement is made and entered into by and between Earthmoving Solutions Limited and the undersigned student at BRAC University who is a mid-level manager of the organization as well. The purpose of this NDA is to protect the confidential information disclosed by the Disclosing Party which is Earthmoving Solutions Limited to the Receiving Party or the student.

## **Acknowledgement**

**September 15, 2024**

Dr. Md. Abdul Haque  
Professor, BRAC Business School  
BARC University  
Dhaka, Bangladesh.

**&**

Dr. Md Arif Hossain Mazumder  
Assistant Professor, BRAC Business School  
BRAC University

Dear Sirs,

It is a great pleasure for me to submit the affiliation report on Product Support Operations of Earthmoving Solution Ltd. I sincerely believe that this would help me in the long run and also enrich my managerial capabilities. I am grateful for your valuable advice and humble cooperation in completing this report.

I tried my best to go deep into the report and make full use of my capabilities in making the report reflective of the actual scenario of my internship work and meet your expectation. There may have some perfection. For any of your further queries I would be at your disposal at your convenience.

Sincerely,

**Abdullah Al Masud**

ID: 22164013

Major in Operation Management

MBA Program

## **Executive Summary**

Earthmoving Solution Ltd. (EMSL) is a leading supplier of construction equipment in Bangladesh, offering an extensive range of heavy machinery and solutions tailored for various construction projects. EMSL's product portfolio includes rigs, cranes, excavator, compactor, dozer, dump truck, concrete mixer truck and concrete batching plant. Additionally, EMSL specializes in providing equipment for asphalt road construction, including asphalt making plant, bitumen distributor, and asphalt paving machine, tandem roller, tire roller and single drum rollers.

EMSL also offers solution for soil stabilization with pre-fabricated vertical drains (PVD) and facilitates the production of alternative bricks, Uni paver, kerbstone, river protection blocks and other concrete products with concrete block making machine. As an exclusive dealer of XCMG, a leading brand in China for heavy construction equipment, EMSL ensure top-quality machinery for clients. Furthermore, our partnership with AMMANN, a Switzerland based brand for asphalt road machinery, underscores EMSL's commitment to delivering excellence. EMSL is also exclusive dealer of ZENITH, a Germany based Block making machinery manufacturer.

While EMSL's sales team cater to all products, we have dedicated service teams for each type of machinery, ensuring specialized and efficient support. Whether it XCMG, AMMANN or ZENITH equipment, EMSL is dedicated to providing unparalleled service and solution to meet the diverse needs of our clients across Bangladesh in Construction sector.

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## **List of Acronyms**

EMSL	Earthmoving Solution Ltd
AIT	Advance Income Tax
TDS	Tax Deducted from Source
L/C	Letters of Credits
T/T	Telegraphic Transfer
FOB	Free on Board
CIF	Cost. Insurance and Freight

# **Chapter 1**

## **An Overview of the Internship Job**

### **1.1 Student Information**

Name: Abdullah Al Masud

ID: 22164013

Program: MBA

Major: Operation Management

BRAC Business School

BRAC University

## **1.2 Internship Details**

1.2.1. Period: June 01, 2021- Till Now

Job Position: Senior Manager

Company Name: Earthmoving Solution Ltd.

Department: Product Support

Address: 7A/B, 1<sup>st</sup> Colony, Mazar Road, Mirpur-1, Dhaka-1216

1.2.2. Supervisor Information:

Name: Engr. Md. Monjurul Islam

Designation: General Manager

### **Job Responsibility:**

#### **a) Leading the Service Team:**

i) Manage and lead the service team responsible for Block machine & Crusher machine maintenance and repair. Allocate specific tasks and responsibilities to each team member based on their skill and expertise.

ii) Provide guidance, support and direction to the team member to ensure efficient and effective service delivery. Identify training needs and organize training sessions to keep the teams with the latest technologies and best practices.

iii) Oversee diagnostic procedure to accurately identify issues in block machines and crusher machines.

iv) Ensure the team uses the correct repair techniques and follow safety protocol.

#### **b) Reporting & Analysis:**

i) Generate monthly and early report on spare parts sales, receivable, ensuring accuracy and timeliness.

ii) Analyze sales data to identify trends and opportunity for improvement.

iii) Prepare details service report, documenting the nature of repairs, parts used, time taken and any other relevant information.

iv) Maintain comprehensive maintenance logs for each machine, tracking their service history and performance metrics.

**c) Client Communication:**

i) Act as a primary point of contact (PoC) between clients and manufacturer, facilitating clear and effective communication.

ii) Address clients' inquiries, concern and request in timely and professional manner.

iii) Collect and analyze client feedback to improve service quality and customer satisfaction.

**d) Database Maintenance:**

i) Maintain a comprehensive database of machine population and service history, including maintenance records and clients' information.

ii) Ensure data accuracy and completeness for informed decision and effective service delivery.

**e) Schedule Management:**

i) Develop and manage installation, commissioning and service schedules, coordinating with clients and internal teams to ensure timely execution.

ii) Optimize scheduling to maximize resource utilization and minimize downtime for clients.

**f) Inventory Management:**

i) Oversee the maintenance of spare parts inventory, including procurement, Stock tracking, and replenishment.

- ii) Implement inventory control measure to prevent stockouts and excess inventory, optimizing cost -efficiency.

## **1.3 Internship Outcome**

### **1.3.1. Contribution to the company:**

Since my joining EMSL in June 2021, I identified a significant need for systematic procedures and system for managing spare parts sales data, service records, and inventory. EMSL was not utilizing any software for these tasks. Therefore, my first objectives were to develop a system that would enable effective tracking and management for myself and management team.

I created a comprehensive database using Excel with macros to manage block machine population data. This database tracks the number of machines in operation, their commissioning dates, warranty status, customer details, factory contacts, and machine serial numbers. Additionally, I developed another Excel-based system to monitor the service status of these machine, including service dates, issues addressed, service engineer details and job completion time.

As the person responsible for spare parts sales, I focused on ensuring parts availability and minimizing lead time while keeping inventory cost low. Previously parts were imported only after customer order were confirmed, leading long lead time and customer dissatisfaction. I identified the most frequently consumed and critical parts, analyzed past invoices, and initiated regular stocking of these parts in our warehouse based on demand forecast. I established pricing strategies considering parts cost, shipping, customs duties, and warehouse overheads. I also developed an inventory tracking system using Excel to monitor sales, stock levels, and reorder needs.

Our agreement with the manufactures allows us to use letter of Credit (L/C) for orders over USD 10000, while orders below this amount requires Telegraphic Transfer (T/T). To optimize cost and enjoy L/C benefits, I scheduled reorder accordingly.

During my tenure, I achieved a 15% increase in spare parts sales in 2022 and a 17% increase in 2023. Additionally, I managed to reduce cost by minimizing waste and response time, achieving reduction of 3% in 2022 and 5% in 2023.

### **1.3.2. Benefits to the student:**

Joining EMSL has been a transforming experience, allowing me to applying my engineering knowledge in practical, real-world scenarios. This opportunity has not only enhanced my technical skill but also broadened my understanding of various engineering disciplines and improve my managerial and commercial acumen.

#### **a) Technical Knowledge and Skill**

Working in EMSL has given me extensive hand-on experience on diverse machinery, including block machine, cranes, rigs, and excavator. I have gained a deep understanding of their working principle, usage, assembly, servicing, repair, dismantling process. Specifically, my involvement with block machine has enabled me to

**Read and Interpret Electric Schematic Diagram:** I have learned how to read electrical schematic, perform machine wiring, and troubleshoot faults using these diagrams.

**Mechanical and Electric Engineering Integration:** Although my academic background is mechanical engineering, I have acquired substantial knowledge in electrical engineering. This includes understanding the intricacies of machine wiring and fault diagnosis.

**Civil Engineering Insight:** My work with block machine also necessitated an understanding of civil engineering principles, particularly concerning machine foundation drawings. I have



learned how to interpret these drawings and effectively communicate with their requirements to customers.

#### **b) People Management and Customer Relationship**

EMSL has provided invaluable experience in people management. I have learned how to

**Lead and Motivate Teams:** Managing team and effective and efficient task completion have been a significant part of my role. I have developed skill in team motivation and leadership.

**Customer Relationship Management:** Handling customer relationship taught me how to manage customer needs, address their concerns, and mitigate dissatisfaction. This has been crucial in maintaining customer loyalty and trust.

#### **c) Commercial and Logistical Knowledge**

Working at EMSL has expanded my understanding of commercial and logistical operation.

Key learning includes

**Incoterms and Financial instruments:** I have gained a comprehensive understanding of commercial incoterms such as L/C (Letter of Credit), T/T (Telegraphic Transfer), Deferred L/C, FOB (Free on Board), and CIF (Cost, Insurance and Freight). I have learned to open L/C and T/T's and scrutinize draft copy of these financial instruments.

**Customs regulation and Import Duties:** I have familiarized myself with custom regulation in Bangladesh and the duties and tax applicable to the machinery EMSL imports and sells. This includes dealing with CNF (Custom and Freight) agent to ensure compliance with all legal requirements.

#### **d) Sales and Marketing in Heavy Machinery Industry**

EMSL has offered me profound insights into the sales and marketing dynamics of heavy machinery industry. Key aspects include

**Lead Generation and Conversion:** I have learned how leads are generated and converted into deals within the heavy machinery sector. This involves understanding customer needs and effectively communicating the benefits of our machinery.

**Spare Parts Sales:** I have developed strategies for selling spare parts, including sourcing parts both locally and internationally. I have learned customer tendencies to seek alternative sources for spare parts and to persuade them to choose OEM parts over locally made alternatives.

#### **e) Managing Multiple Responsibilities and Working Under Pressure**

The demanding environment at EMSL has taught me how to manage multiple responsibilities efficiently and effectively. I have learned to work under pressure, prioritize tasks and ensure that all duties are performed to the highest standards.

In conclusion, my tenure at EMSL has been an enriching experience that has significantly broadened my technical knowledge, enhanced my managerial capabilities, and provided me a deep understanding of commercial and logistical operation. This comprehensive exposure has equipped me with the skills necessary to excel in the engineering field and business studies, offering students a real world's perspective on the diverse application of their academic learning.

#### **1.3.3. Problem/Difficulties**

While my tenure at EMSL has been immensely rewarding and educational, I have encountered several challenges that have impacted my work. These difficulties highlight areas where improvements could significantly enhance operational efficiency and overall performance.

##### **Lack of a proper HR Department**

One of the primary challenges has been the absence of a structured Human Resource (HR) department. HR is crucial in any organization for variety of function, including recruitment, employee training and skill enhancement. At EMSL, lack of organized skill training programs

has limited opportunities of employees for professional development. This has been particularly challenging as continuous learning and skill enhancement are essential for staying updated with industry advancement and improving job performance.

### **Financial Management Issue**

The absence of skilled chartered accountant and audit personnel has created numerous problems related to VAT and Tax compliance. Many customers in Bangladesh have limited understanding of VAT and AIT (Advance Income Tax) obligation and are often reluctant to pay these charges. This complicates transaction and compliance, causing delay and confusion. Additionally, some customers deduct TDS (Tax Deducted from Source) from invoice but fail to provide necessary documentation promptly, further complicating financial management and reconciliation.

### **Inefficient Inventory and Billing System**

Another significant challenge has been the lack of dedicated software for inventory management and invoicing. Although I have developed Excel-based system to track those data, they are not as efficient or robust as a centralized Enterprise Resource Planning (ERP) system. The absence of such system makes it difficult to manage inventory, generate challans, and track account receivable effectively and efficiently. This inefficiency can lead to errors, and increased operational cost.

### **Warehouse Management Challenges**

EMSL does not follow standardized procedure for warehouse organization, which has led to inefficiency and difficulties in managing stocks and fulfilling order promptly. This issue is partly due to lack of skilled personnel with expertise in warehouse management and partly due

to space constraint. A well-organized warehouse is critical for maintaining inventory accuracy, reducing lead time, and improving overall operational efficiency.

### **Service Charge Collection Issue**

Collecting payment for service work has been another significant difficulty. Many customers in Bangladesh are hesitant to spend money on service work, preferring to receive free service even for machine that are out of warranty. EMSL has often provided free services to build customer loyalty and capture market share, given the company's new presence in the industry. However, this practice has made it challenging to establish standard charges due to the diversity of machinery and service requirements. The lack of standardized service charges complicates billing and affect revenue.

### **Challenges with Collecting Due Payments**

Collecting due payments and managing account receivable has been a persistent challenge. While some corporate customers pay their due regularly, others, particularly those without a strong corporate culture, often delay payments. Individual customers also tend to delay payments, requiring significant effort to collect outstanding dues. This delay in payment collections increases operational cost and reduces the monetary value of receivables and ultimately affecting profitability.

### **Post Covid Dollar Crisis**

The dollar crisis following the COVID-19 pandemic has significantly impacted EMSL. As our business relies on importing parts, we have faced challenges in opening Letters of Credit (L/C) for parts and maintaining timely inventory levels. The fluctuating dollar rate has further complicated this issue by making it difficult to calculate cost and set standard pricing. Price sensitive customers often turn to local suppliers for cheaper, low-quality parts, which poses a significant competitive challenge.

#### **1.3.4. Recommendations**

To address the challenges faced during my tenure at EMSL, several strategic recommendations are essential for enhancing operational efficiency, financial management, and overall organizational performance.

##### **Establish a Structured HR Department**

Developing a structured Human Resource department is critical. This department should focus on comprehensive recruitment processes, employee training, and skill enhancement programs. By offering regular training sessions and professional development opportunities, EMSL can ensure that employees remain updated with industry advancements, thereby improving their job performance and satisfaction.

##### **Strengthen Financial Management**

Hiring skilled chartered accountants and audit personnel is crucial for resolving VAT and tax compliance issues. These professionals can provide the necessary expertise to navigate complex financial regulations and ensure timely documentation and compliance. Additionally, conducting workshops for customers to educate them on VAT, AIT, and TDS can mitigate confusion and delays in financial transactions.

##### **Implement an ERP System**

Adopting a centralized Enterprise Resource Planning (ERP) system will streamline inventory management and invoicing processes. An ERP system can automate and integrate essential business functions, reducing errors and operational costs. This system will facilitate efficient tracking of inventory, generation of challans, and management of accounts receivable, enhancing overall operational efficiency.

##### **Optimize Warehouse Management**

Standardizing warehouse procedures and investing in training for warehouse personnel will improve inventory accuracy and operational efficiency. Additionally, exploring options for expanding warehouse space or optimizing existing space can alleviate storage constraints, enabling better stock management and order fulfillment.

### **Establish Standardized Service Charges**

To address service charge collection issues, EMSL should develop standardized service charges based on machinery types and service requirements. This will simplify billing processes and ensure consistent revenue from service work. While building customer loyalty is important, clear and standardized service charges will help maintain financial stability and profitability.

### **Improve Payment Collection Processes**

Enhancement of the payment collection process is vital. Implementing stricter payment terms and utilizing automated reminders for due payments can encourage timely payments of customers. For persistent defaulters, considering legal actions or partnering with collection agencies might be necessary to recover outstanding dues efficiently.

### **Mitigate Post-COVID Dollar Crisis Impact**

To mitigate the impact of the post-COVID dollar crisis, EMSL should explore long-term contracts with suppliers to stabilize pricing. Additionally, diversifying the supplier base to include local manufacturers for certain parts can reduce dependency on imports and fluctuating dollar rates. Regularly reviewing and adjusting pricing strategies based on market conditions will also help in managing cost variations and maintaining competitiveness.

Implementing these recommendations will significantly improve EMSL's operational effectiveness, financial health, and market position, ensuring sustainable growth and success in the competitive construction industry.

## **Chapter 2**

### **Organization Part**

#### **2. Introduction**

##### **2.1. Overview of the Company**

###### **2.1.1. Empowering Bangladesh's Construction Industry: EMSL's Journey**

Established in 2015, EMSL embarked on a mission to revolutionize the construction landscape of Bangladesh. With a commitment to provide top-notch machinery, they set out to elevate the efficiency and quality of construction projects across the nation. EARTHMOVING SOLUTION LIMITED's (EMSL) interests align with the construction business. EMSL is true believer of its clients' success, and hence its success is clients' achievement dependent. EMSL strive to provide customer the timely need for high standard products and services at an affordable range.

EMSL's mission is to gain a deep understanding of its clients' businesses in order to offer the most suitable, high-quality products, delivered on time, while ensuring their long-term functionality. EMSL envisions becoming the most preferred and trusted partner for its customers by consistently exceeding expectations.

###### **2.1.2. Product List and service range**

EMSL offers extensive products from different renowned manufacturers to different construction and industrial purposes. EMSL's offered products can be categorized as follows:

1. Road Construction: Road construction machineries include Asphalt plant (shown below), Tire roller, Asphalt Paver, Bitumen Distributor, Tandam Roller or double drum Roller.



Asphalt Paver

2. Building Construction: For building construction EMSI offers Tower crane, ready-mix concrete pump of XCMG Brand, which is shown below.



Concrete Pump

Bridge Construction: For Bridge construction EMSL offers RIG machine for pilling, different types crane, dozer, excavator etc. from XCMG brand. To transport materials such as sand, sand, stone and asphalt XCMG offers Dump Truck from SINOTRUK



brand, a renowned state-owned vehicle manufacturer from China. A Rough Terrain Crane I shown below



Rough Terrain Crane

3. Industrial Equipment: For different types of industry like FMCG, Steel industry XCMG offers various range of machineries to ease industrial work. Industrial machineries include Forklift, Scissor lift, Wheel loader, Bulk Carrier, Fire truck, Water tanker etc. from XCMG and SINOTRUK brand. Scissor Lift and Telehandler are shown in the following picture.



Scissor Lift and Telehandler

Dump truck also known as dumping truck is used for transporting materials such as dirt, stone, sand, gravel rocks etc. They are indispensable various sectors like construction sectors, mining

and landscaping application as well as municipal and residential waste removal. The picture of a Dump Truck is provided below



#### Dump Truck

4. Concrete Block Industry: Concrete block industry is growing as an alternative to Clay brick industry. Clay bricks are crucial construction material in Bangladesh, with the country being the fourth largest brick producer globally. There are over 7000 bricks kilns in Bangladesh, manufacturing around 23 billion bricks each year, valued at US\$640 million or about 1% of GDP. The industry is expected to grow 6% per year over the next decade. Concrete products like concrete bricks, paver, hollow block, as alternative products, are gaining popularity in Bangladesh as green products and based on durability of the products. EMSL offer Block making machine from QGM-ZENITH brand from China and Germany to the customers, who want to set up a concrete block factory to produce the concrete products mentioned above. Block machine also used to produce river protection block, so the contractor who are in river protection works need this machine and EMSL offer them most reliable Block making machine form QGM-

ZENITH to meet their purpose. The picture of a Block making machine is provided below.

**ZN900CG**  
Block Machine



### Block Making Machine

As a service provider, we not only provide the after-sale service, it also includes trouble shooting and repairs. In case of block machine and Asphalt plant we provide foundation drawings to the customers and give advice and instruction how to prepare the foundation before block plant and asphalt plant came to projects site. Then after machine and plant arrival at site, our engineers go to sites and install and commission the machine and plant. Initially EMSL engineers and engineers from manufacturers do this installation and commissioning job together. In case of vehicle type machinery, there is no need for foundation so when machine arrive at a site, customer informed us and we EMSL mobilizes our team to commission that machine. EMSL provide one-year free service as warranty policy and when warranty period exceeds, EMSL charges for providing every service.

### **Pioneering Partnership**

From its inception, EMSL forged its pivotal partnerships with industry giants to bring cutting-edge technology to Bangladesh. As an exclusive distributor of XCMG (Xuzhou Construction Machinery Group) in the country, EMSL ensured access to the world class machinery as the third largest construction equipment manufacturer globally. Their range of offerings, including drilling rigs, cranes, excavator, compactors wheel loader and dozers, empower construction companies to undertake projects with unprecedented efficiency and reliability.

### **Expanding Horizon**

Building on their success with XCMG, EMSL expanded its portfolio by becoming the sole distributor of SINOTRUK, China's foremost state-owned vehicle manufacturer, in the Bangladesh Market. This strategic partnership enabled EMSL to supply a diverse array of vehicles, including dump trucks, concrete mixer trucks, fire trucks, water tanker, prime movers and small trucks, catering to the multifaceted needs of construction industry.

### **Innovative solution**

In 2017, EMSL further cemented its position as a trailblazer in the industry by securing the dealership of QGM-ZENITH, a German brand under Chinese ownership renowned for its concrete block making machines. This collaboration facilitated the introduction of advanced block making technology to Bangladesh, empowering customers such as Concord Group, Mir Concrete Products Ltd., Rupshi Concrete Products Ltd., Meghna Group, Western Engineering Pvt. Ltd., National Development Engineers Ltd. (NDE), Maisha Construction Ltd. and others to enhance their production capabilities.

## **2.3. Management Practices**

### **2.3.1. EMSL's Management Structure: A Hierarchical Approach**

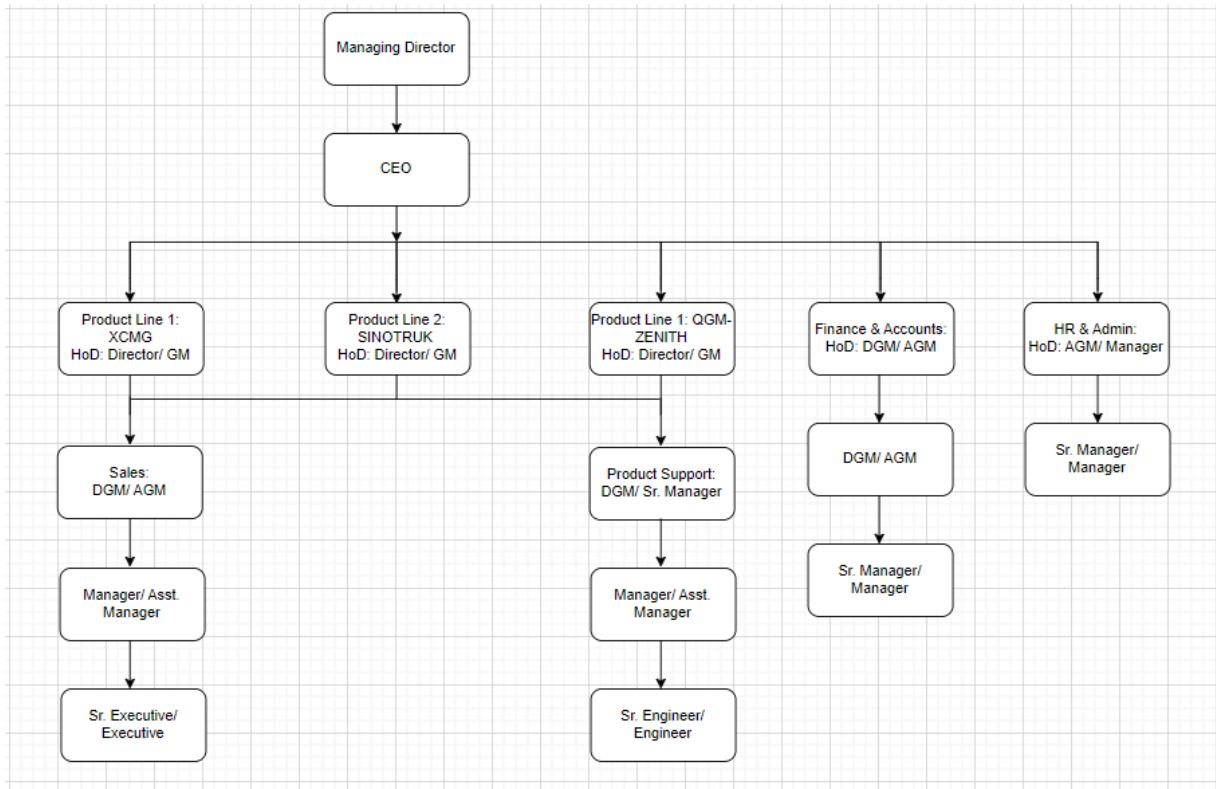
EMSL adheres to a hierarchical management system, where decision making authority emanates from the upper echelons of the organization. At the helm is the Managing Director, who serves as the pivotal figures responsible for setting the strategic direction of the company.

#### **Hierarchical Framework**

Under the managing director, a tiered structure of senior and higher management ensures efficient tactical and strategic alignment. At EMSL, there exists a top-down hierarchy of employees, where an authority flows from higher levels (executives) to lower levels (employees), with each level being responsible for certain functions.

1. Top Management (Strategic Level) comprises Managing Directors and executives like CEO, Directors & General Managers
2. Middle Management (Tactical Level) includes Deputy General Managers, Asst. General Managers & Sr. Managers
3. Lower Management (Operational Level) usually made up of Managers & Asst. Managers

Frontline Employees (Execution Level) are Sr. Executives & Executives for non-technical verticals and Sr. Engineers & Engineers for technical verticals. An organizational hierarchy of EMSL is given below.



**Diagram: Organizational Hierarchy of EMSL**

### **Division & Departments**

Within this framework, various division and departments are delineated, each with its own set of responsibilities and reporting lines. The CEO oversees middle management and front-line executives in the HR, Admin and Logistic departments. The GM of Sales & Marketing manages managers, service engineers and sales executive in the product support department of equipment brand like AMMANN and QGM-ZENITH. Similarly, the DGM of product support oversees managers and service engineers for XCMG and SINOTRUK equipment.

### **Decision Making Dynamics**

Strategic decisions are predominantly the purview of Managing Director and senior management, ensuring coherence with the company’s overarching objectives. However, within individual service department of individual equipment brands, managers retain autonomy to make functional decision tailored to their specific operational needs. These managers are

supported by dedicated account personnel who report to both their respective department head (e.g., Head of XCMG and SINOTRUK service departments and manager of account department).

EMSL's hierarchical management approach ensures clear line of authority and accountability, facilitating efficient decision making and cohesive operation across the organization. By delineating responsibilities and empowering managers within functional departments, EMSL optimizes its ability to deliver exceptional service and support to its clientele in the construction industry.

## **2.4. Marketing Practices of EMSL**

### **Client Base**

EMSL primarily operates in B2B (Business to Business) sector, offering product and services designed for business entities rather than individual consumers. Their clientele includes prominent construction companies such as ABDUL MONEM LTD., MIR GROUP, SPECTRA ENGINEERS LTD., TANVIR CONSTRUCTION LTD., and TOMA GROUP. Additionally, EMSL serves all government-listed contractor and industrial client in manufacturing sector, including major group like BASHUNDHARA GROUP, MEGHNA GROUP, and CITY GROUP.

### **Sales Activities**

As a B2B business, EMSL's sales activities heavily rely on their sales force and person to person communication. The sales team visit the supply chain, procurement and engineering departments of potential customers to meet with responsible personnel. They collect queries, present the EMSL's product portfolio, identify leads and convert those leads into deal.

## **Conferences and Programs**

In addition to direct sales effort, EMSL hosts several conferences and program. These events construction industries players and government officials to learn about EMSL's product and services, thereby educating and raising awareness among potential customers.

## **Customer Loyalty Program**

EMSL arrange customer loyalty programs, offering gifts such as T-shirts, umbrella branded with EMSL logo and name. These initiatives serve as brand activities, enhancing customer engagement and loyalty. Furthermore, EMSL distribute New Year souvenirs like calendars, paperweights, pens and card holders as a part of brand introduction efforts, reminding customer of their market presence.

## **Advertising and Digital presence**

EMSL invests in advertising through print media, such as daily newspaper, and television. They maintain an active presence in digital realm with a Facebook page and You Tube channel. On these platforms, EMSL post productions, activity updates and video showcasing their machinery and work process.

## **Corporate Social Responsibility (CSR) Activities**

EMSL is committed to corporate social responsibility activities. They offer scholarship to talented students from various educational institutions and distribute warm clothing to the poor during the winter season.

## **Marketing Strategy**

Based on the above practices, EMSL follow and integrated marketing strategy that combine direct sales effort, customer relationship management, event marketing, advertising, digital marketing and CSR initiatives. This multifaced approach helps EMSL maintain strong



customer relationships, enhanced brand recognition, and demonstrate their commitment to social responsibility.

## 2.5. Financial performances & Accounting practices

Here I am discussing the financial performances of the Department (QGM-ZENITH product support Department) where I am working. Total sales of Fiscal Year 2019 to 2023 are provided in Table 1.

### SALES FY 2019-2023

Table 1: Total sales of Fiscal Year 2019 to 2023

YEAR	TOTAL SALES (BDT)
2019	2701073
2020	1413180
2021	1633831
2022	2590227
2023	3519673

The comparative total sales are shown by bar charts in Figure 1.

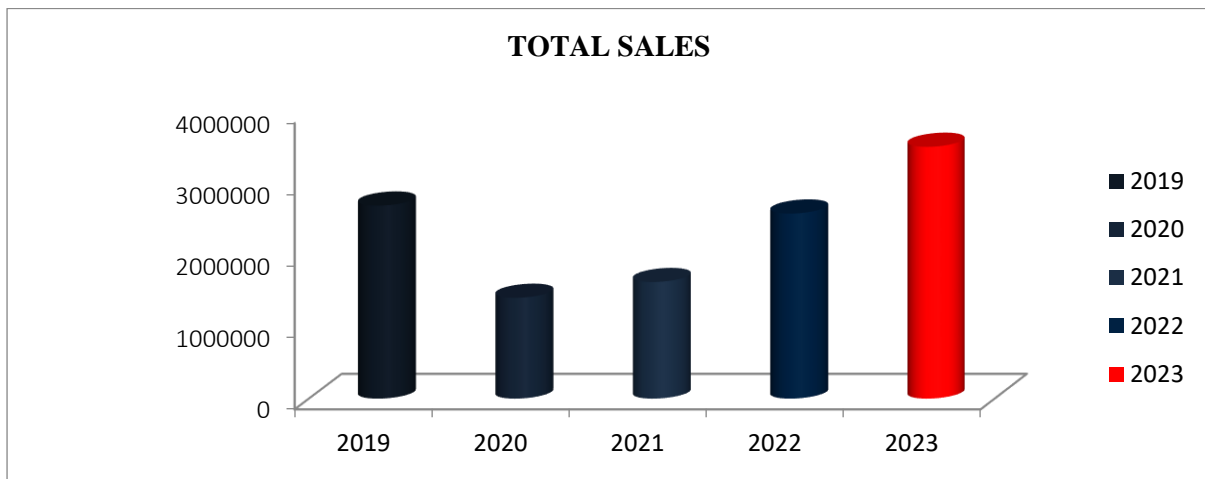


Figure 1: Bar chart of Total Sales of Fiscal year 2019 to 2023

Sales increases by 36% in year 2023 in comparison to year 2022. In 2020 and 2021 sales was much lesser compared to other FY year due to COVID-19 pandemic and Ukraine-Russia war. Total receipts of Fiscal Year 2019 to 2023 are provided in Table 2.

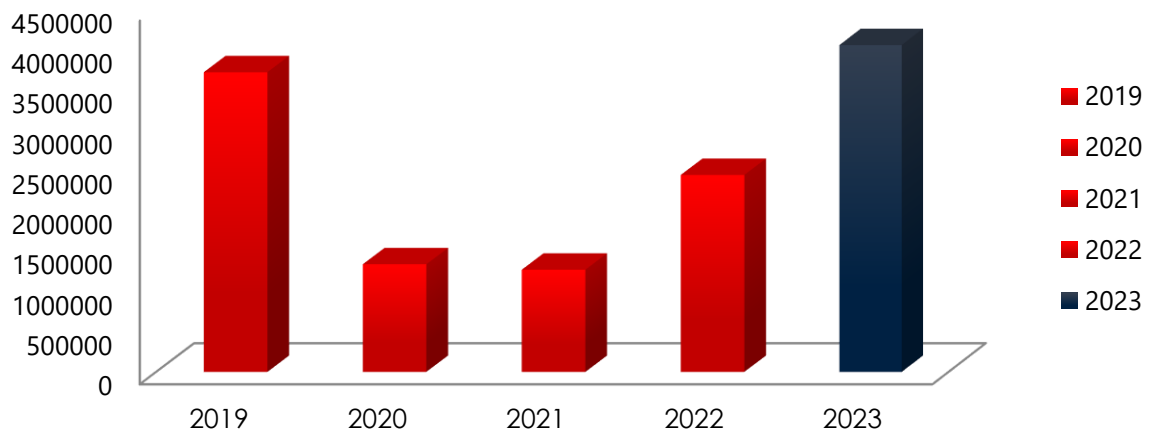
### RECEIPT FY 2019-2023

*Table 2: Receipt of Fiscal year from 2019 to 2023*

YEAR	TOTAL RECEIPT (BDT)
2019	3709500
2020	1334500
2021	1266400
2022	2438900
2023	4045130

Collection of receipt has improved in 2023 compared to 2022. And it has increased by 66% in 2023. Receipt collection improved because in 2023 more sales was in cash sales rather than credit sales. Also, management introduce new rules for credit sales which limits the duration for credit sales in 3 months. The comparative total receipts are shown by bar charts in Figure 2.

### TOTAL RECEIPT



*Figure 2: Total Receipt of Fiscal Year 2019 to 2023*

## PURCHASED FY 2019-2023

Table 3: Purchased of Fiscal year 2019 to 2023

YEAR	TOTAL PURCHASED (BDT)
2019	1320864
2020	374650
2021	853660
2022	6272256
2023	2407457

Total purchase comprises of the parts of block machine we purchase from manufacturers (QGM-ZENITH) for selling it to clients. Before 2022, QGM-ZENITH block machine service department didn't manage or stock parts as inventory. Service department buy parts after they get the work order from clients which made the lead time long as customer wasn't happy for long lead time. To decrease the lead time and response quickly to customers, service department started to maintain inventory o block machines from the year 2022. As a result, the purchase amount is higher in the year 2022 compared to the other years. In 2023 purchased amount decreases as there is parts available in inventory which met the requirements of the clients. The purchase in 2023 were actually for replenish the items which has been out of stock or the emergency item which are not regarded as fast-moving consumable parts.

The comparative total purchased are shown by bar charts in Figure 3.

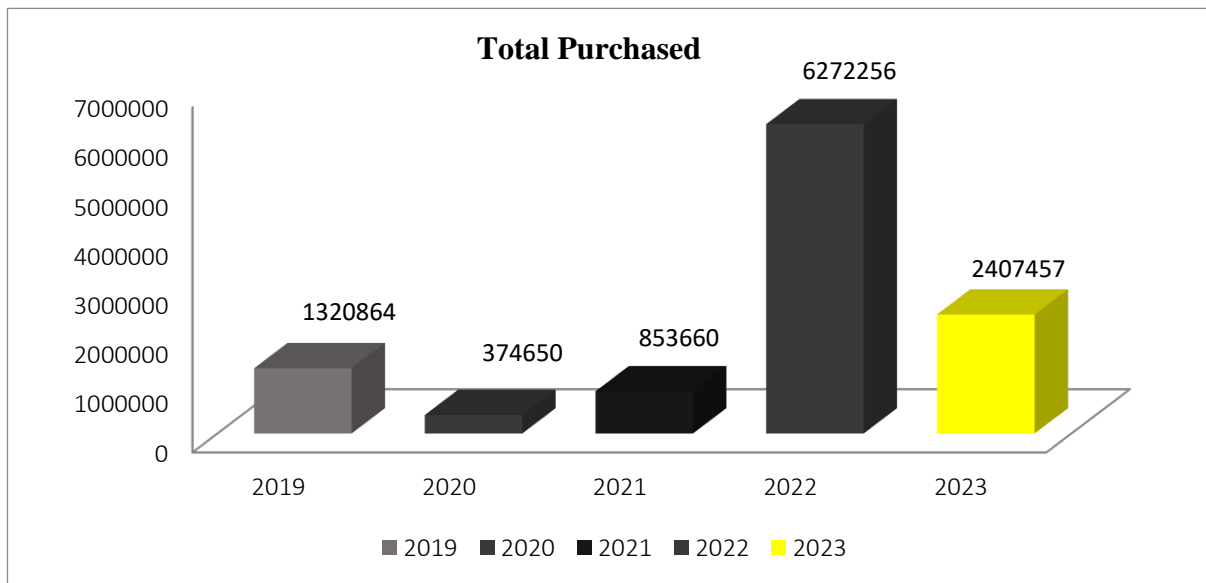


Figure 3: Purchased of Fiscal Year 2019 to 2023

In year 2022 expense against purchasing spare parts for inventory was higher because from 2022 EMSL has started to stock spare parts in their own warehouse. In year 2023 spare parts purchase was much less than year 2022. Beginning inventory of FY2023 was BDT 3682029 and ending inventory was BDT 4777166. Inventory turnover ratio was 1.2.

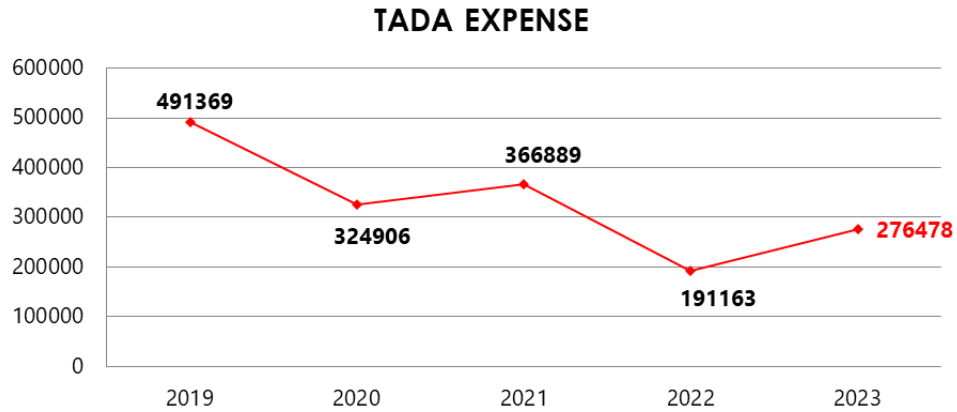
### EXPENSES FY 2019-2023

Comparative expenses (TADA & Salary) from FY 2019 to FY 2023 are shown in Table 4.

Table 4: Expanses of Fiscal year 2019 to 2023

YAER	TADA EXPENSE
2019	491369
2020	324906
2021	366889
2022	191163
2023	276478

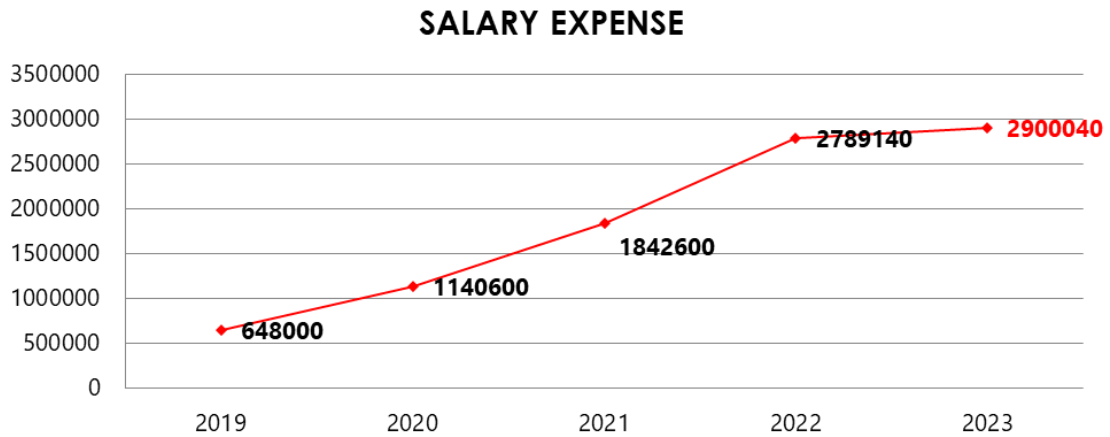
YAER	SALARY EXPENSE
2019	648000
2020	1140600
2021	1842600
2022	2789140
2023	2900040



*Figure 4 : TADA expense of Fiscal Year 2019 to 2023*

TA/DA expense comprises with the travel allowances and daily allowances of service engineers and drivers who drive the service cars. In the period 2019 to 2021, TA/DA increases due to the selling of more block machine and so service people need to stay for more days at the project site for commissioning of the plant. Hence they have to move more from project to project as all the machines were under warranty. In 2022 machine sales dropped as an after effect of Covid-19 pandemic and Ukraine-Russia war. Moreover, machines bought earlier in 2019 and 2020 were out of warranty, and hence service engineers' movement from project to project decreases which in return reduces the TA/DA expense. In 2023 when economy started to become better again and as result machine sales and parts sales also started to increase.

Salary expense increase gradually because of the yearly increment. Each year every employee's salary increases form previous year in certain percentage. Also new employee joined and some employee resigned following a regular process. Which also affects the salary expenses. Normally employees get increment by 5-10% depending on performance. In 2022 increase in the salary expense was comparatively higher than the other years because of the fact that this year higher number of employees receives promotion which also increase the total salary expense. The trend in salary increase is shown in Figure 5.



*Figure 5: Salary Expense of Fiscal Year 2019 to 2023*

Compare to year 2019, 2020, 2021 in comparison with FY2023 TA/DA allowance (Travel and Daily) allowances decreases due to improved operational efficiencies that ensure effective service delivery in a shorter amount of time. As anticipated, salary expenses increased each year in accordance with company policy adjustment.

## 2.6. Industry and competitive analysis

### 2.6.1. SWOT analysis of EMSL

#### Strength

##### Experienced sales team

EMSL's sales team is composed of seasoned engineers who have been with the company since its inception. Their technical expertise allows for precise and clear explanation of machinery specification to customers.

##### Strong Customer Relationship Management

EMSL excel in building trust and reliability with customers by assisting them beyond the scope of their business, thereby strengthening customer loyalty.

##### Highly Skilled Service Team

The service team is prompt, skilled and dedicated, providing on time response, remote assistance and after hour support to ensure customers' satisfaction.

### **Supportive Work Environment**

EMSL foster open and friendly work environment where new members receive support and encouragement from seasoned employees, promoting quick adaptation and skill enhancement.

### **Weakness**

1. **Service Team Under Sales Head:** The structure sometimes creates conflict of interest, potentially compromising service and parts sales for the sake of machine sales.
2. **Lack of Centralized Software system:** EMSL does not have a centralized system for tracking machine sales, maintaining service records, and managing inventory, leading to inefficiency.
3. **Inadequate knowledge of VAT & TAX Issue:** The company lacks skilled personnel to handle VAT and TAX related matters.
4. **Insufficient Sales Team Members:** The current numbers of sales team is inadequate to meet the market demand and potential growth.

### **Opportunities**

1. **Growing Construction Industry in Bangladesh:** With Bangladesh development into a middle-income country, there is significant demand for infrastructure development, including roads, highways, bridges, and power plants, driving the demand for construction machinery.

2. **Government initiative on Concrete Block:** The government's push to replace clay brick with concrete block to reduce carbon emission and protect agricultural land creates a growing market for block making machine.
3. **Long-term Market Growth:** The construction and block making machinery market is expected to grow for next decade, providing a substantial opportunity for EMSL.

### **Threats**

1. **Economic and Political Instability:** Unstable dollar rates, dollar shortage and political instability could affect pricing, L/C opening, and overall market growth.
2. **Increasing Competition:** As demand grows, more competitors are entering the market, making it more challenging to maintain market share.
3. **Technological Change:** Rapid technology advancement can render existing machine obsolete, requiring continuous updates and adaptations.
4. **Market Saturation:** While the market is currently growing, it is expected to reach saturation in next 6-8 years, particularly in the block making machine segment.

### **2.6.2. Industry Analysis**

The construction machinery and block making machine industry in Bangladesh is experiencing robust growth, given by the country's transition from an underdeveloped to developing economy. The government focus on infrastructure projects such as roads, highways, bridges, and power plants which pushes higher demand for machinery to complete those projects. Additionally, the initiative to replace traditional clay brick with concrete blocks opens a significant market for block making machine.



Despite the promising growth prospect, the industry faces several challenges, including economic instability, fluctuating dollar rates and political uncertainties. The competitive landscape is becoming increasingly crowded, with both local and international players vying for market share. Moreover, rapid technological changes necessitate continuous innovation and adaptation to maintain competitiveness.

## **2.7. Summary & Conclusion**

EMSL has positioned itself as a significant player in the construction industry of Bangladesh since its establishment in 2015. Through strategic partnerships with global giants like XCMG, SINOTRUK, and QGM-ZENITH, EMSL has introduced advanced machinery and vehicles that enhance the efficiency and reliability of construction projects across the country. The company's hierarchical management structure ensures clear lines of authority and accountability, facilitating effective decision-making and streamlined operations.

EMSL's marketing practices encompass a multifaceted approach, integrating direct sales efforts, customer relationship management, event marketing, advertising, digital marketing, and corporate social responsibility initiatives. This strategy not only strengthens customer relationships and brand recognition but also demonstrates the company's commitment to social responsibility.

The SWOT analysis reveals EMSL's strengths in its experienced sales team, strong customer relationship management, highly skilled service team, and supportive work environment. However, the company faces weaknesses such as potential conflicts of interest within its service team, lack of centralized software systems, inadequate knowledge of VAT and TAX issues, and an insufficient number of sales team members.

Opportunities abound in the growing construction industry, government initiatives promoting concrete blocks, and long-term market growth. As government trying to attract foreign

investors to invest in Bangladesh and making a number of economic zones for that purpose, demand of construction machineries has been increasing in order to develop those economic zones. Besides to boost industrialization and foreign investment government have taken initiatives to build infrastructure like roads, bridges, tunnels , building utilities infrastructure like power plant for electricity, construct new gas line to supply gas to economic zone and industry area, all these require construction machineries like Rig for pilling, batching plant for making concrete casting, Asphalt plant for making asphalt for making flexible roads, block machine to meet the demand for bricks to build buildings. Nowadays, people tend to use machine like excavator to dig pond or earth hole instead of using manual labor which also pushes the demand for machineries for excavation and transportation. EMSL can grasp those opportunities mentioned above as it has a wide range of demand of machineries from different manufactures like XCMG, SINOTRUK, QGM-ZENITH, to offer the customer in order to meet their requirements.

Nevertheless, EMSL must navigate threats like economic and political instability, increasing competition, rapid technological changes, and potential market saturation. When there is political stability, companies don't want to invest on machineries as there is lesser number of projects available requiring machineries. Political instability unstable the economic situation of the country which also hamper EMSL business like other businesses. As EMSL business mostly depend on L/C (Letter of Credit), customer cannot open L/C due to dollar shortage when there exists an economic crisis.

To address the conflict of interest that EMSL have faced, compromises of its service and parts sales based on machine sales. In this purpose EMSL can establish separate leadership role for service and sales teams to ensure each can focus on their respective goals without conflict of interest. Clear KPI and metrics along with regular communication and collaboration between service and sales teams can eliminate conflict of interest issue. EMSL can invest in a

comprehensive Enterprise Resource planning (ERP) system or Customer Resource Management (CRM) software that integrates sales, service, records and inventory management into a single platform. To handle the VAT and TAX issues, EMSL can hire specialist or outsource VAT and TAX compliance to specialized firms. Implementing regular audit and review of tax practices can ensure compliance and identify areas for improvement.

To tackle the challenge of having an insufficient sales team, EMSL can plan to recruit additional members and invest in a robust training program. This approach will streamline the onboarding process and equip new team members to perform effectively right from the beginning.

The industry analysis highlights robust growth driven by Bangladesh's development and government infrastructure projects. However, challenges such as economic instability, fluctuating dollar rates, and political uncertainties pose risks. The competitive landscape is increasingly crowded, necessitating continuous innovation and adaptation.

In conclusion, EMSL's strategic partnerships, comprehensive marketing practices, and strong internal capabilities can position it well for the continued success.

## **Chapter 3 (Project)**

### **Forecasting Analysis of EMSL Sales**

#### **3.1 Introduction**

EMSL currently does not utilize any forecasting method to predict the demand for spare parts. In this analysis, we aim to determine the most suitable forecasting method for EMSL by examining spare parts sales data, specifically for XCMG machinery spare parts, which constitute the majority of the spare parts sales. We used sales data from the past 24 months, divided into quarters, to evaluate three different forecasting methods as follows:

1. Moving Average Method (3-period)
2. Weighted Moving Average Method (3-period)
3. Exponential Smoothing Method

#### **3.2. Methodology**

To identify the forecasting method that provides the most accurate and least biased results, we have calculated the following error metrics for each of the methods:

Mean Absolute Deviation (MAD)

Mean Absolute Scaled Error (MASE)

Mean Absolute Percentage Error (MAPE)

Additionally, we assessed the bias in each forecasting method using metrics such as the tracking signal and control charts to determine whether errors were within acceptable limits and to identify any trends or cyclic patterns.

#### **Moving Average Method (3-period)**

The 3-period moving average method smooths out short-term fluctuations by averaging sales data from the last three periods to forecast the next period.

### **Weighted Moving Average Method (3-period)**

The weighted moving average method assigns different weights to the sales data from the last three periods, giving more importance to recent periods.

### **Exponential Smoothing Method**

The exponential smoothing method applies decreasing weights to the past sales data, and placing more emphasis on recent observations.

## **3.3 Evaluation Criteria**

**Mean Absolute Deviation (MAD):** Measures the average magnitude of the forecast errors, regardless of direction.

**Mean Absolute Scaled Error (MASE):** Scales the error based on a benchmark method, helping to compare different forecasting methods.

**Mean Absolute Percentage Error (MAPE):** Represents the size of the error in percentage terms relative to the actual sales.

## **3.4 Bias Assessment**

**Tracking Signal:** Indicates the presence of bias in the forecast. A tracking signal within the range of  $\pm 3$  suggests an unbiased forecast.

**Control Chart:** Helps identify whether the forecast errors are within control limits, indicating the stability and reliability of the forecasting process.

The sales data for 8 quarters and the percentage errors considering three consecutive periods are shown in Table 5.

Table 5: Three Period Moving Average forecast and forecasting error for sales

Quarter	Sales	3 period Moving Average Forecast	Error	Error	Error <sup>2</sup>	( Error /Actual) X100
Q1	49285604					
Q2	34020313					
Q3	36922264					
Q4	31462758	40076060	-8613302	8613302	74188977085406	27.4%
Q5	29824606	34135112	-4310506	4310506	18580459102365	14.5%
Q6	18682279	32736543	-14054264	14054264	197522327212187	75.2%
Q7	23907935	26656548	-2748613	2748613	7554871591360	11.5%
Q8	24101966	24138273	-36307	36307	1318222454	0.2%
			-29762992	29762992	297847953213772	129%

To understand the errors in three period moving average forecast method, I first calculate Mean Absolute Deviation (MAD) for the errors. To find out the MAD, I divide the sum of the absolute error |Error| by the number of errors (n). Then I calculated the MASE. Then I calculated Mean Average Percentage Error (MAPE). To find out MAPE I divide the sum of the percentage error by number of percentage error (n). To find out bias of the forecast I calculated the tracking signal. To calculate tracking signal, I divide the sum of the difference between actual sales and forecast by MAD. It relates the cumulative forecast error to the average absolute error. The intent is to detect any bias in error over time (i.e., a tendency for a sequence of errors to be positive or negative).

$$MAD = \frac{\sum |e|}{n}$$

$$MAD = \frac{29762992}{5}$$

$$MAD = 5952598$$

MAD value is 5952598. It indicates that the average differences between the value of actual demand and forecast is 5952598 regardless of the direction of the deviations.

$$MSE = \frac{\sum |e|^2}{n - 1}$$

$$MSE = \frac{297847953213772}{4}$$

$$MSE = 74461988303443$$

MSE value is 74461988303443 which is very large and suggests that the values of the differences between actual demand and forecast are widely dispersed around the mean.

$$MAPE = \frac{\left[ \frac{|e|}{Actual} * 100 \right]}{n}$$

$$MAPE = \frac{129\%}{5}$$

$$MAPE = 26\%$$

The MAPE for this model is 26%. It signifies that 21% average deviation of the forecast from the actual value in the exponential smoothing model.

$$Tracking\ Signal = \frac{\Sigma(Actual - Forecast)}{MAD}$$

$$Tracking\ Signal = \frac{-29762992}{5952598}$$

$$Tracking\ Signal = -5$$

Tracking signal (TS) value is -5 which indicates two things about the forecasting. One, its value is more than 3 suggesting bias is presence in forecasting. Two TS value is negative which indicate demand is lower than expected or forecasted.

Table-6 contains the values of forecasting errors from quarter 4 to quarter 8, values of MAD and upper control limit (UCL) and lower control limit (LCL). It shows the errors from quarter 4 to quarter 8 and corresponding MAD and the upper control limit (UCL) and lower control limit (LCL) of the errors. Control chart is the visual tool for monitor the forecast errors. Errors can exhibit random variation or non-randomness. Control chart is the very useful tool for detecting non randomness in error. Errors are plotted on a control chart in the order they occur, which is depicted in Figure 6. Three lines are drawn in the figure. One is for MAD which is above the zero error line. Another two lines, one above the zero line and another below the zero line, which termed as the upper and the lower control limits because they represent the upper and lower end of the range of acceptable variation of errors. To compute it, I first calculate the MSE. Then I took the square root of the MASE as it is used as an estimate of the standard deviation of the distribution of errors.

Then I calculate the UCL and LCL as follows

$$\text{UCL: } 0 + z\sqrt{MSE}$$

$$\text{LCL: } 0 - z\sqrt{MSE}$$

Here  $z$  value is 2 for 2 standard deviation and for normal distribution 95.74 percent values (errors in this case) can be expected to be fall in within these limits

The values of the forecasting errors from quarter 4 to quarter 8, MAD value and the values of UCL and LCL are shown in Table 6.



Table 6: Values of Forecasting error, MAD, UCL and LCL

Control Charts				
Quarter	Error	MAD	UCL	LCL
Q4	-8613302	5952598	17258272	-17258272
Q5	-4310506	5952598	17258272	-17258272
Q6	-14054264	5952598	17258272	-17258272
Q7	-2748613	5952598	17258272	-17258272
Q8	-36307	5952598	17258272	-17258272

Control chart for the forecasting errors of 3-period moving average model has been shown in Figure 6.

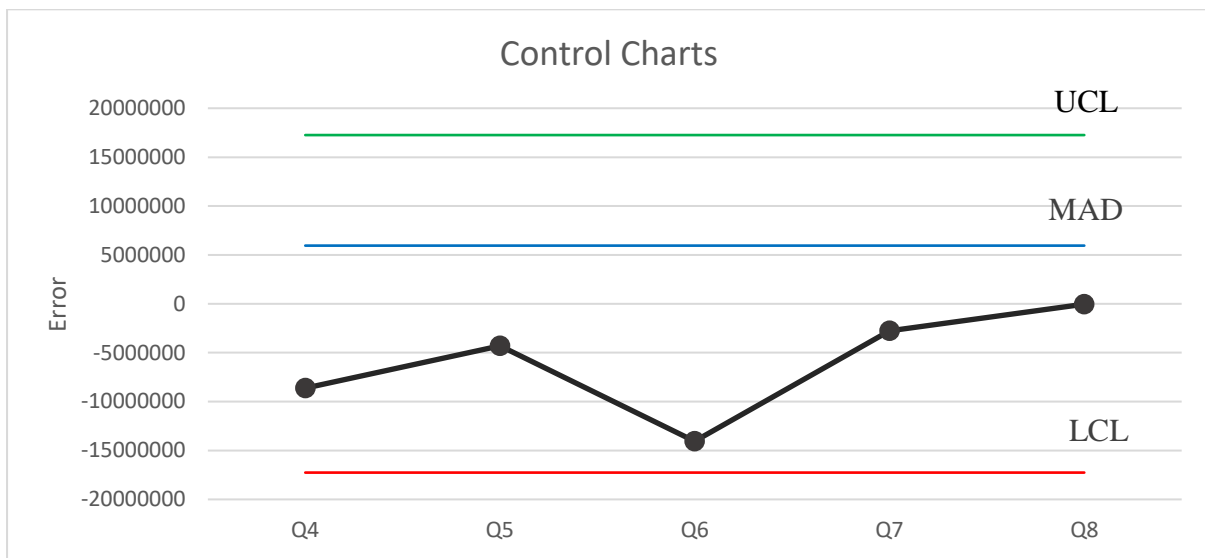


Figure 6: Control chart of three period moving average forecasting

The sales data for 8 quarters and the percentage errors considering three consecutive periods for weighted average forecasting are shown in Table 7.

Weighted moving average is similar to moving average except it assign more weight to the most recent values in a time series. Here I've considered 3 period for weighted moving average forecasting by using the following formula

$$F_t = w_t (A_t) + w_{t-1} (A_{t-1}) + w_{t-2} (A_{t-2})$$

Where

$W_t$  = weight for the period t,  $W_{t-1}$  = weight for the period t-1

$A_t$  = Actual value in period t,  $A_{t-1}$  = Actual value for the period t-1

$F_t$  = Forecast for period t

In my calculation the most recent value is assigned a weight of .45 ( $W_t = .45$ ), the next recent value is assigned a weight of .35 ( $W_{t-1} = .35$ ), the last value is assigned a weight of .20 ( $W_{t-2} = .20$ ).

After calculating the forecasts next I calculate the different types of errors occurs in this forecasting method and calculate Mean Absolute Deviation (MAD), Mean Squared Error (MSE), Mean absolute percentage error (MAPE) following the same procedure done in calculating in 3 period moving average forecasting method previously. The sales data for 8 quarters and the percentage errors considering three consecutive periods are shown in Table 7.

Table 7: Three period weighted moving average forecasting and forecasting error

Quarter	Sales	3 period weighted Average Forecast	Error	Error	Error <sup>2</sup>	( Error /Actual) X100
Q1	49285604					
Q2	34020313					
Q3	36922264					
Q4	31462758	38379249	-6916491	6916491	47837849828028	22.0%
Q5	29824606	33885096	-4060490	4060490	16487579852198	13.6%
Q6	18682279	31817491	-13135212	13135212	172533789030859	70.3%
Q7	23907935	25138189	-1230254	1230254	1513525519643	5.1%
Q8	24101966	23262290	839676	839676.4	705056456717	3.5%
			-24502771	26182124	239077800687446	115%

$$MAD = \frac{\sum |e|}{n}$$

$$MAD = \frac{26182124}{5}$$

$$MAD = 5236425$$

$$MSE = \frac{\sum |e|^2}{n - 1}$$

$$MSE = \frac{239077800687446}{4}$$

$$MSE = 59769450171862$$

$$MAPE = \frac{\left[ \frac{|e|}{Actual} * 100 \right]}{n}$$

$$MAPE = \frac{[115\%]}{5}$$

$$MAPE = 23\%$$

The MAPE for this model is 23%. It signifies that 23% average deviation of the forecast from the actual value in the exponential smoothing model.

$$Tracking\ Signal = \frac{\Sigma(Actual - Forecast)}{MAD}$$

$$Tracking\ Signal = \frac{-24502771}{5236425}$$

$$Tracking\ Signal = -4.68$$

Tracking signal (TS) value is -4.68 which indicates two things about the forecasting. One, its value is more than 3 suggesting bias is present in the forecasting. TS value is negative which indicates that demand is lower than the expected or the forecasted ones.

Table-8 contains the values of forecasting errors from quarter 4 to quarter 8, values of MAD and upper control limit (UCL) and lower control limit (LCL). It shows the errors from quarter 4 to quarter 8 and corresponding MAD and the upper control limit (UCL) and lower control limit (LCL) of the errors. Control chart is the visual tool for monitor the forecast errors. Errors can exhibit random variation or non-randomness. Control chart is the very useful tool for detecting non randomness in error. Errors are plotted on a control chart in the order they occur, which are depicted in Figure 7. Three lines are drawn in the figure. One is for MAD which is above the zero-error line. Another two lines, one above the zero line and another below the zero line, which termed as the upper and the lower control limits because they represent the upper and lower control limits of the range of acceptable variation of errors. To compute it, I first calculate the MSE. Then I took the square root of the MASE as it is used as an estimate of the standard deviation of the distribution of errors.

Then I calculate the UCL and LCL as follows

$$UCL: 0 + z\sqrt{MSE}$$

$$LCL: 0 - z\sqrt{MSE}$$

Here  $z$  value is 2 for 2 standard deviation and for normal distribution 95.74 percent values (errors in this case) can be expected to be fall in within these limits.

The values of the forecasting errors from quarter 4 to quarter 8, MAD value and the values of UCL and LCL are shown in Table 6.

*Table 8: Values of Forecasting error, MAD, UCL and LCL*

Control Charts				
Quarter	Error	MAD	UCL	LCL
Q4	-6916491	5236425	15462141	-15462141
Q5	-4060490	5236425	15462141	-15462141
Q6	-13135212	5236425	15462141	-15462141
Q7	-1230254	5236425	15462141	-15462141
Q8	839676	5236425	15462141	-15462141

Control chart for the forecasting errors of the 3-period weighted moving average model has shown in figure 7.

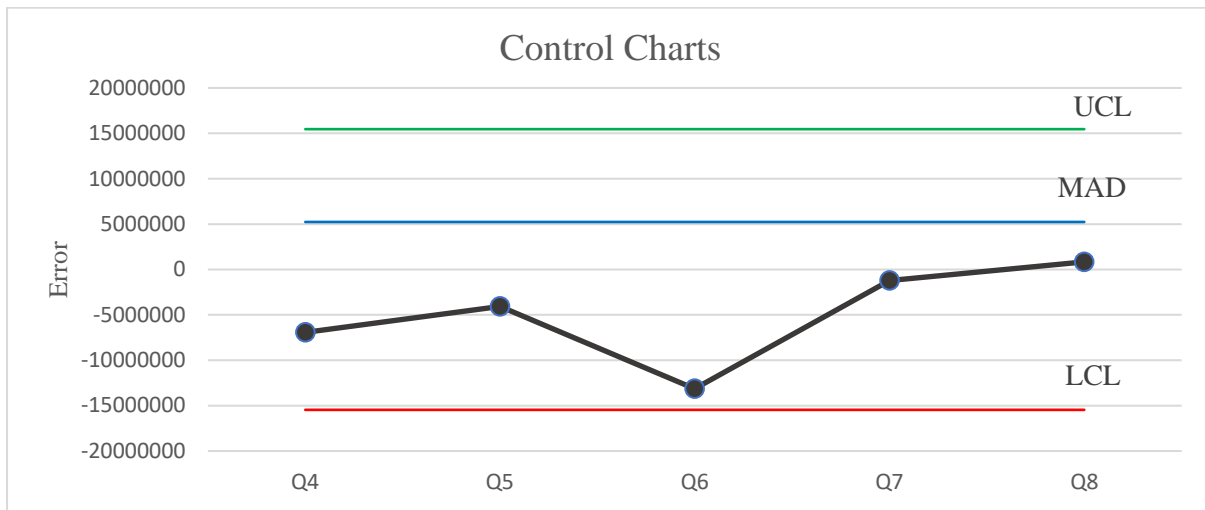


Figure 7: Control chart of three period weighted moving average forecasting

Form Figure 7 it is evident that the most of the forecasting errors are below zero error line which suggest that the actual demand is below than forecasted. And the trend is that after quarter 6, its errors are getting close to zero error line which indicates that in quarter 6 and quarter 8 actual demand and forecast are close to each other.

The sales data for 8 quarters and the percentage errors considering exponential smoothing method are shown in Table 9.

Exponential smoothing is a sophisticated weighted averaging method that is relatively easy to use and understand. This method is a weighted averaging method based on previous forecast plus a percentage of the forecast error. Each new forecast is based on the previous forecast plus a percentage of the difference between that forecast and the actual value of the series at that point, the formula of which is expressed as follows:

$$F_t = F_{t-1} + \alpha (A_{t-1} - F_{t-1})$$

Where,  $F_t$  = Forecast for period t

$F_{t-1}$  = Forecast for the previous period

$\alpha$  = Smoothing constant (percentage)

$A_{t-1}$  = Actual demand or sales for the previous period

In my calculation I take  $\alpha$  value 0.4, 0.6, and 0.9 and found that when value of  $\alpha$  is 0.9, the value of the errors in the forecasting yields minimum. In Table 9 the values are shown assuming  $\alpha$  value of 0.9. A number of approaches can be used to determine the starting forecast, such as average of the first several periods. This approach is called subjective approach. Another approach is to take the first actual value as the forecast for period 2. This method is called naïve approach. In my calculation I have followed the subjective approach.

After calculating the forecast, next I calculate the different types of errors occurs in this forecasting method and calculate Mean Absolute Deviation (MAD), Mean Squared Error (MSE), Mean absolute percentage error (MAPE) following the same procedure done in calculating in 3 period moving average forecasting method previously.

The sales data for 8 quarters and the percentage errors considering exponential smoothing method are shown in Table 9.

*Table 9: Exponential Smoothing method forecasting and forecasting error*

Quarter	Sales	Exponential Smoothing method ( $\alpha=.9$ )	Error	Error	Error <sup>2</sup>	( Error /Actual) X100
Q1	49285604					
Q2	34020313					
Q3	36922264					
Q4	31462758	36922264	-5459506	5459506	29806205764036	17.4%
Q5	29824606	32008709	-2184103	2184103	4770304167327	7.3%
Q6	18682279	30043016	-11360737	11360737	129066351090752	60.8%
Q7	23907935	19818353	4089582	4089582	16724683175815	17.1%
Q8	24101966	23498977	602989	602989.2	363596008360	2.5%
			-14311774	23696917	180731140206291	105%

$$MAD = \frac{\Sigma|e|}{n}$$

$$MAD = \frac{23696917}{5}$$

$$MAD = 4739383$$

MAD value is 4739383. It indicates that the average differences between the value of actual demand and forecast is 4739383 regardless of the direction of this deviation.

$$MSE = \frac{\Sigma|e|^2}{n-1}$$

$$MSE = \frac{180731140206291}{4}$$

$$MSE = 45182785051573$$

$$MAPE = \frac{\left[ \frac{|e|}{Actual} * 100 \right]}{n}$$

$$MAPE = \frac{105\%}{5}$$

$$MAPE = 21\%$$

The MAPE for this model is 21%. It signifies that 21% average deviation of the forecast from the actual value in exponential smoothing model.

$$Tracking\ Signal = \frac{\Sigma(Actual - Forecast)}{MAD}$$

$$Tracking\ Signal = \frac{-14311774}{4739383}$$

$$Tracking\ Signal = -3.02$$

Tracking signal (TS) value is -3.02 which indicates two things about the forecasting. One its value is nearly equal to 3 suggesting very little bias is presence in the forecasting compared to other 3- period moving average forecasting method and 3-period weighted moving average forecasting method .TS value is negative which indicates that demand is lower than expected or forecasted values.

Table-10 contains the values of forecasting errors from quarter 4 to quarter 8, values of MAD and upper control limit (UCL) and lower control limit (LCL). It shows the errors from quarter 4 to quarter 8 and corresponding MAD and the upper control limit (UCL) and lower control limit (LCL) of the errors. To find out the MAD, UCL and LCL, I follow the same procedure that I used in 3-period moving average model and 3-period weighted moving average model in previous section. Here also taken the z value 2.

Formulas that I used to calculate UCL and LCL are as follows.

$$UCL: 0 + z\sqrt{MSE}$$

$$LCL: 0 - z\sqrt{MSE}$$

The values of the forecasting errors from quarter 4 to quarter 8, MAD value and the values of UCL and LCL are shown in Table 10.

*Table 10: Values of Forecasting error, MAD, UCL and LCL*

Control Charts				
Quarter	Error	MAD	UCL	LCL
Q4	-5459506	4739383	13443628	-13443628
Q5	-2184103	4739383	13443628	-13443628
Q6	-11360737	4739383	13443628	-13443628
Q7	4089582	4739383	13443628	-13443628
Q8	602989	4739383	13443628	-13443628



Control chart for the forecasting errors of the exponential smoothing model is shown in Figure 8.

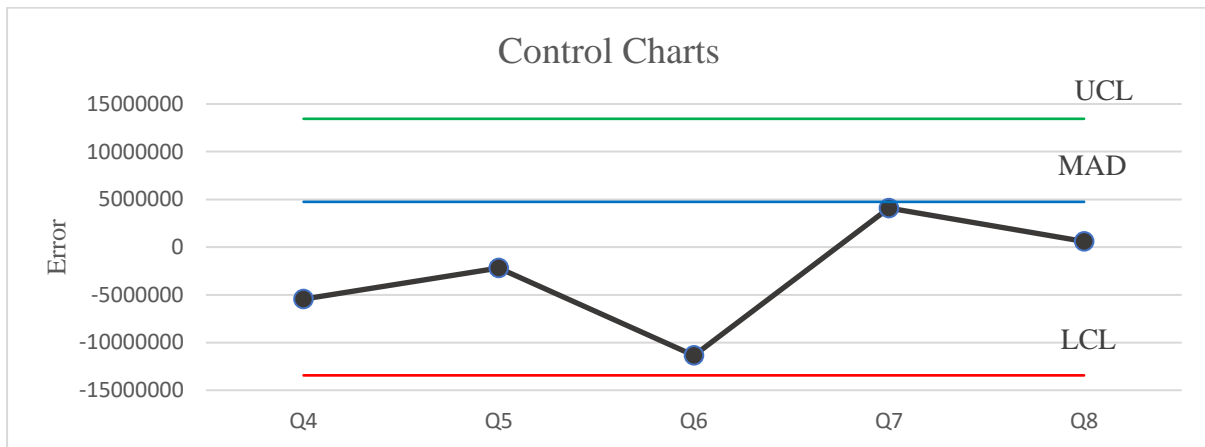


Figure 8: Control chart of exponential smoothing method forecasting

Figure shows that in quarter 4 and quarter 6 errors are under zero error line which indicates that actual demand is lower than the forecasted one. From quarter 7 to quarter 8 errors are above the zero-error line which signifies that actual demand are more than expected one.

### 3.5 Analysis:

Comparison of MAD, MAPE, Tracking Signal and Standard Deviation of Different Forecasting Method is shown in Table 11

Table 11: Comparison of MAD, MAPE, Tracking Signal and Standard Deviation of Different Forecasting Method

Method/Metrics	MAD	MAPE	Tracking Signal	Standard Deviation
3-Period Moving Average	5952598	26%	-5	8629136.011
3- period weighted Moving Average	5236425	23%	-4.68	7731070.442
Exponential Smoothing Method	4739383	21%	-3.02	6721814.119

#### 1. Mean Absolute Deviation (MAD):

The Exponential Smoothing method has the lowest MAD (4,739,383), indicating it has the smallest average error magnitude.

## 2. Mean Absolute Percentage Error (MAPE):

- The Exponential Smoothing method also has the lowest MAPE (21%), indicating it has the smallest average error relative to actual sales.

## 3. Tracking Signal:

- All methods show a negative tracking signal, indicating a tendency to underestimate sales or overestimate the forecasting. However, the Exponential Smoothing method has the smallest absolute tracking signal (-3.02), suggesting it is the least biased.

## 4. Standard Deviation:

- The Exponential Smoothing method has the lowest standard deviation (6,721,814.119), indicating the least variability in forecasting errors.

MAD value is the lowest in exponential smoothing method than 3-period moving average model and 3-period weighted moving average model. It signifies that we get the less differences between actual demand and forecasted one when I follow exponential smoothing model. Exponential smoothing model gives tracking signal -3,02 which is far less than the values given by 3-period moving average and 3-period weighted moving average model. It indicates that exponential smoothing method has less bias than other two models. But all the model gives negative tracking signal which means the model overestimate the demand.

3-period moving average is simple and easy to understand; good for suitable time series with minimal fluctuation. It can be less responsive to recent changes in data; does not handle trend or seasonal patterns well.

3-period weighted moving average is more responsive to recent data compare to moving average; better at capturing short-term fluctuations. It also does not address seasonality or trends; the choice weight can be somewhat arbitrary and affect result.

Exponential smoothing method adapts well to a change in data; accounts for trends and seasonality if parameters are adjusted correctly; consistently the best performance in terms of MAD, MAPE, tracking signal, and standard deviation.

The main difficulties I faced to carrying out my work in collecting the data. The data is not centralized; instead, it is catered and managed by different personnel across various departments. This fragmentation made it challenging to visit each person individually to gather the information and then organize it effectively. Additionally, I needed approval from department heads to access the sales data, which was a complex process. Since this data is confidential and could trigger risk at multiple scale to the company if accessed by competitors, securing that approval proved to be a significant hurdle. But my supervisor helped me to get those approval.

### **3.6 Recommendation:**

Based on the analysis of the above discussed metrics, the Exponential Smoothing method is recommended as the best forecasting method because it consistently shows the lowest error magnitudes (MAD and MAPE), the least bias (tracking signal), and the lowest variability in errors (standard deviation). Exponential Smoothing model provides more accurate and reliable forecasts compared to the other methods evaluated (3-period moving average model and 3-period weighted moving average model).

The forecast can be improved through parameter tuning. For the exponential smoothing method, optimizing the smoothing parameters (alpha, beta, gamma) to better fit the data where beta is the smoothing parameter for the trend analysis and gamma is smoothing parameter for seasonal component. Perform sensitivity analysis to find optimal settings that minimizes error. Using advance forecasting technique like ARIMA (Auto Regressive Integrated Moving Average) or machine learning model that can capture complex patterns can further improve accuracy.

Additionally bias adjustment can enhance the results by addressing consistence underestimation of demand. This can be achieved by adjusting the forecasting model to better handle data with trends and seasonality. Exploring methods like seasonal decomposition can provide insights into understanding and mitigate bias. Continiously monitoring forecasting performance and adjusting model as needed, EMSL can improve the forecasting results through reducing errors.

During my internship, I gained valuable insights into various construction machinery, including their functions and applications. I explored the customer base for these machines and studied different commercial Incoterms and their meanings. Additionally, I compiled a comparative report on sales, purchases, and expenses.

One of my key projects involved forecasting demand for spare parts sales. I found that the exponential smoothing model outperformed both the 3-period moving average and the 3-period weighted moving average models, yielding better forecasts with fewer errors. Specifically, the exponential smoothing method with an alpha value of 0.9 provided relatively accurate predictions. However, I observed that the error values—representing the difference between actual demand and forecasts—remained significantly high. Furthermore, all models I employed indicated a negative tracking signal, which suggested a persistent issue of over-forecasting.

To enhance the accuracy of future forecasts, I recommend exploring regression analysis and the double exponential smoothing method to determine if they can yield better results than the exponential smoothing method I used. Additionally, incorporating trend and seasonality analysis into the forecasting model could further improve the predictions for spare parts demand.

Overall, my internship experience equipped me with practical knowledge and skills, while also highlighting areas for improvement in forecasting methodologies. I look forward to applying these insights in future projects.

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