Streamlining Project Deadlines and Resource Allocation in a Competitive Construction Market

A Final report for the BDM capstone Project

Submitted by

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1. Executive Summary

Mohra Company Limited, a leading construction enterprise, has established a robust presence in Riyadh over the past 15 years, focusing on diverse projects such as fuel stations, high-end villas, restaurants, showrooms, and warehouses. The company operates with its subsidiaries, Atobake, and Atom Middle East, the latter handling import operations. Despite its strengths, Mohra faces two main challenges: meeting project deadlines and navigating intense market competition.

The report evaluates project performance and client profitability using a combination of quantitative and qualitative analysis. A deep dive into seven months of invoice data using Python, along with stakeholder interviews, provided a comprehensive view of Mohra's operations. Key findings highlight Mohra's ability to handle various construction projects, unaffected by seasonality, with institutional and residential projects yielding the highest gross profit margins, while industrial projects generate the highest revenue per order.

Moreover, the analysis revealed that clients such as Al-Afaq Al-Mumtada Co. Ltd. and Industrial Resin Factory offer the highest customer lifetime value (CLV) and profitability. The variability in CLV among top clients suggests opportunities to enhance customer frequency and retention through tailored strategies. The correlation heatmap indicates that purchase value significantly impacts overall profitability, whereas order frequency has a limited influence.

The report provides actionable recommendations, including focusing on high-value clients with personalized services and long-term contracts, utilizing tools like Buildertrend or CoConstruct to improve project tracking and communication, expanding into smart building solutions to attract high-profile clients and align with global trends, and diversifying into profitable sectors such as commercial real estate to reduce reliance on individual clients. By adopting these strategies, Mohra Company Limited will significantly boost its profitability, improve its competitive edge, and secure sustainable growth for the long term.

2. Detailed Explanation of Analysis Process/Method

The analysis of Mohra's data combines quantitative methods (revenue, cost, profit, and client analysis) with qualitative interviews to assess project performance and client profitability. This dual approach suits the construction industry's varied project scales and financial outcomes. To gain a deeper understanding of the construction business and develop a more effective approach to problem-solving, around 20 days were spent learning key concepts such as quality control, cash flow management, competition, and other core metrics. The learning resources included the Principles of Construction Management course by Prof. Sudhir Misra from IIT Kanpur and a course on Construction Business Management by Tom Stephenson.

Data Collection:

A quantitative analysis of seven months of invoice data, with some additional relevant data requested directly from Mohra employees, was conducted to track monthly revenue, profit margins, and costs, addressing the problem statement. Since it is typical of the construction data industry to generate high-value, low-frequency projects for a given duration, Python was used to handle the compact dataset. All the results and findings from the data were verified and assessed using expanded construction data to validate credibility.

To address data gaps, qualitative interviews with stakeholders provided insights into the functioning of the business, operational challenges, client expectations, and project-specific cost drivers, enriching the analysis and offering a comprehensive view of performance.

Analysis and Methods Aligned with Problem Statement and Objectives:

To address **project deadline challenges** comprehensively, a detailed analysis of project durations was conducted, focusing on both average timelines and deviations to identify trends and exceptions. This included visualizing the distribution of project durations to highlight clusters of short and long-term projects.

Resource allocation efficiency was critically assessed by leveraging metrics such as the "Number of Orders," "Total Cost (SAR)," and "Profit (SAR)." These metrics were analyzed through scatter plots and correlation heatmaps to uncover relationships between resource usage, costs, and project delays. The analysis revealed strong correlations between extended project durations and increased profits and costs, underscoring the importance of optimizing long-term projects without compromising profitability.

Furthermore, project items were grouped by category, such as industrial, commercial, residential, or institutional, to better understand their impact and project categories were segmented to compare their respective durations and gross profit margins. Industrial projects, for instance, were observed to generate the highest revenue per order but also had longer durations, necessitating better cost control. Institutional and residential projects, in contrast, were found to have the highest gross profit margins with relatively moderate timelines, offering opportunities to maximize returns through efficient cycles.

Visualization techniques, such as duration versus profit and cost analyses, enabled a granular understanding of the trade-offs between timelines and financial outcomes. These insights informed strategies to streamline processes, optimize resource allocation, and prioritize high-value projects with manageable durations.

The analysis also evaluated **market competition** through client segmentation and profitability, calculating revenue and profit margins by client type and project category.

High-value client clusters were identified using client frequency and profitability trends. Retention rates and average revenue per client assessed loyalty and financial value, while profit margin analysis highlighted high-margin repeat clients, guiding strategies to strengthen relationships and retain valuable customers. Metrics like gross profit margins (averaging 20% in construction), resource costs, and Client Lifetime Value (CLV) were examined to prioritize valuable clients and optimize resource allocation.

$$CLV = Customer\, Value \times Average\, Customer\, Lifespan$$

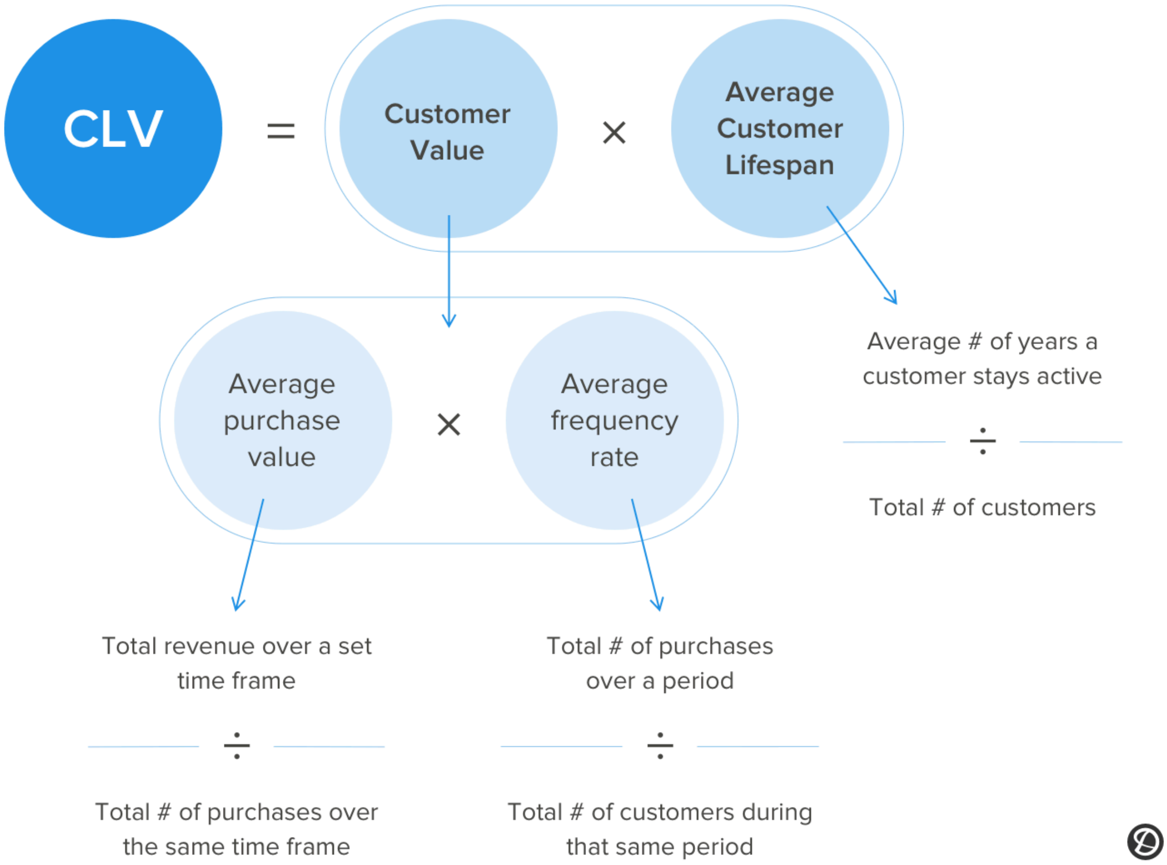
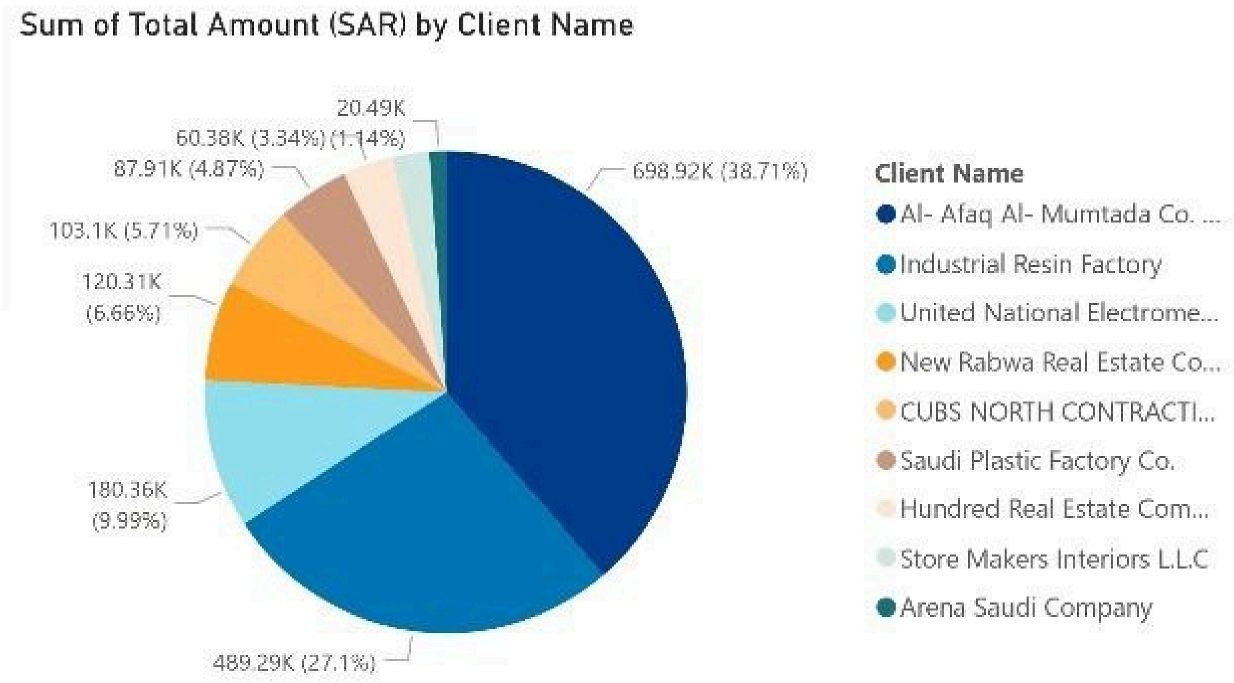


Figure 1: Formula for Customer Lifetime Value

This figure illustrates the formula for calculating Customer Lifetime Value, demonstrating the relationship between customer value and lifespan, supported by average purchase value and frequency. (Delighted Editorial Team, n.d.)

3. Results and Findings

3.1 Insights Overview



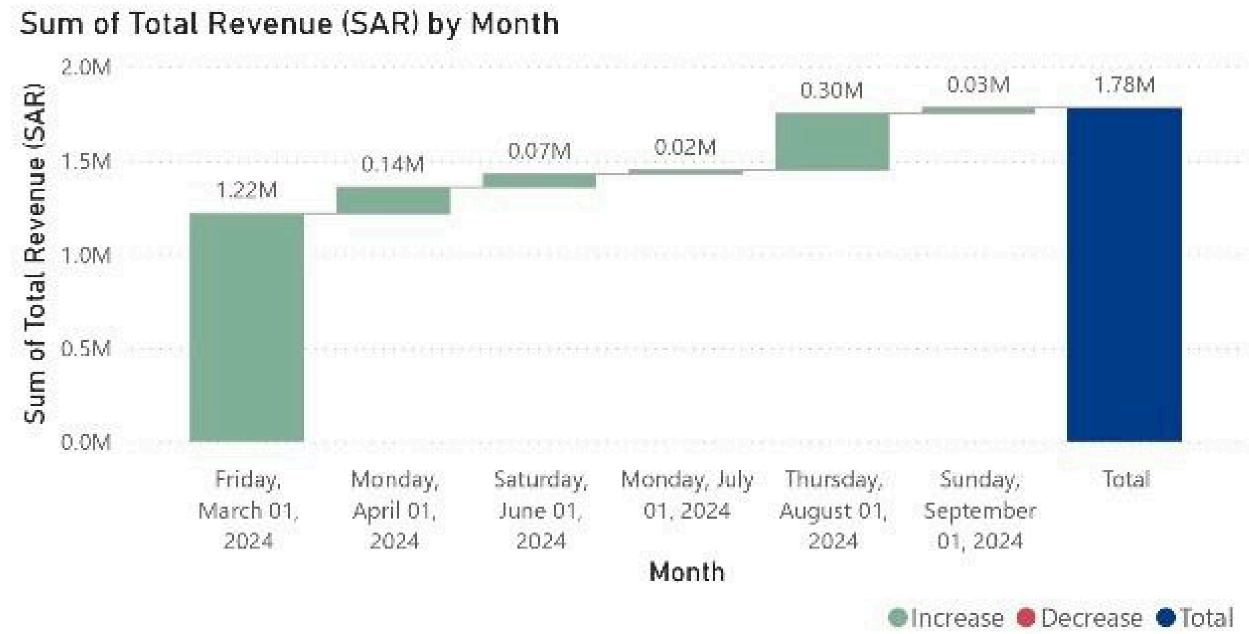


Figure 2: Total Revenue by Client and Month

Al-Afaq Al-Mumtada Co. Ltd. is the leading revenue generator, contributing 38.7% of the total revenue, followed by Industrial Resin Factory at 27.1%. Together, these two clients account for more than two-thirds of the total revenue, underscoring their significant role in Mohra's client portfolio. This dominance can be attributed to the nature of small construction businesses in Riyadh, which often rely on long-term contracts with a few major clients to ensure a steady revenue stream. Other clients, such as United National Electromechanical Co. and New Rabwa Real Estate Company, show moderate contributions. In contrast, smaller clients, including Arena Saudi Company and Store Makers Interiors L.L.C., contribute less than 5% each, indicating a revenue distribution heavily reliant on a few key clients..

The revenue fluctuations observed in the historical data for the past seven months are closely linked to the inherent project-based nature of the industry. The peak revenue in March of SAR 1.22M likely reflects the completion of a large-scale project or multiple overlapping contracts, which temporarily boosted earnings. The sharp decline in April and subsequent months, culminating in July's minimal revenue of SAR 0.02M, underscores the dependency on project availability and contract timelines. Unlike retail or tourism industries, where seasonal trends significantly influence demand, the construction business in Riyadh operates on a project-driven basis. As confirmed during discussions with the business manager, revenue variations arise primarily from the irregular inflow of contracts and the timeline for project completions, rather than predictable seasonal factors. This emphasizes the need for proactive project acquisition strategies to smooth revenue streams and ensure financial stability amidst the cyclical nature of the industry.

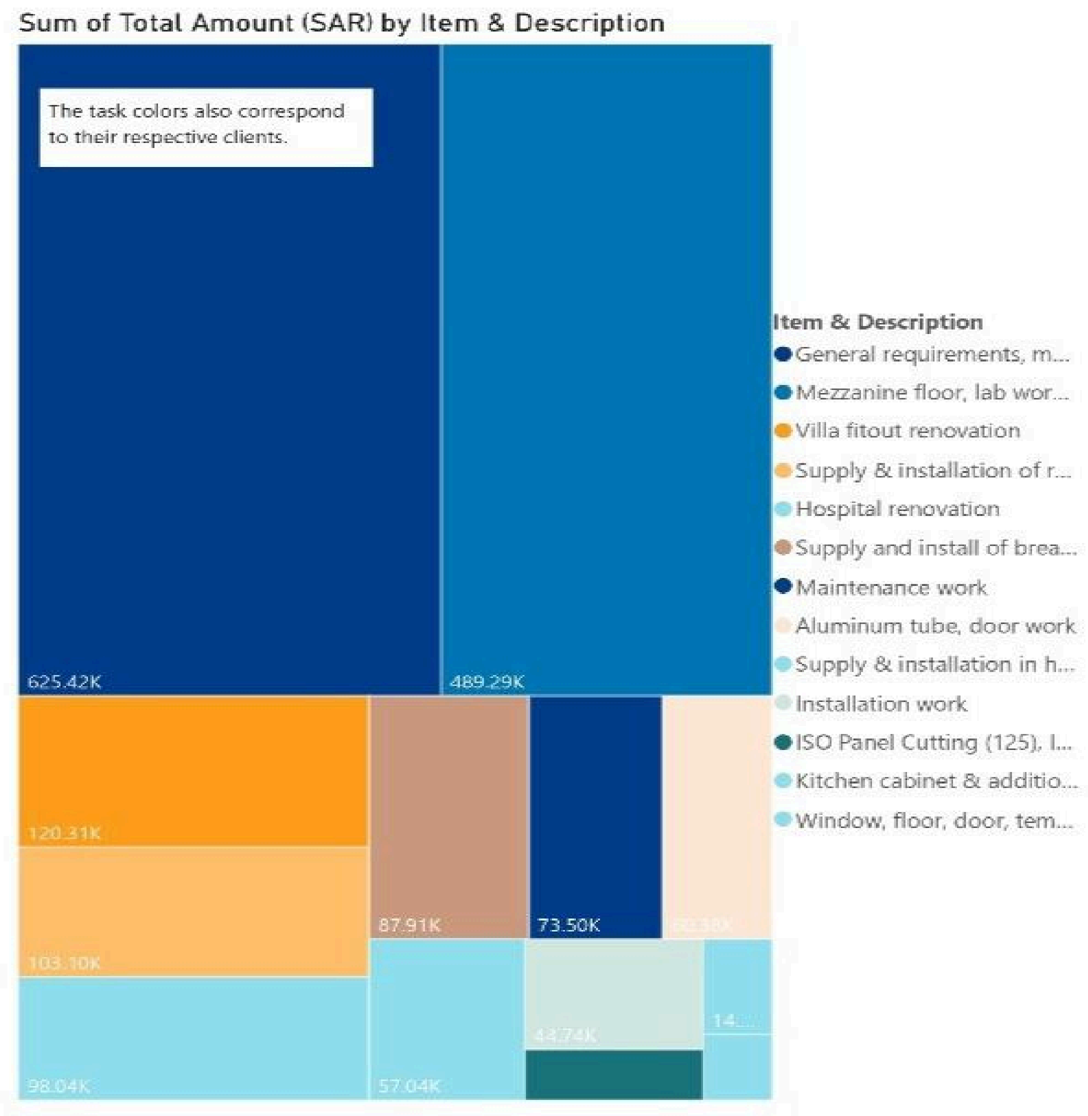


Figure 3: Revenue by Project

The dominance of categories such as "General requirements, masonry work, and metalwork," generating SAR 625.42K, and "Mezzanine floor, lab work, and interlocking," at SAR 489.29K, highlights the core focus of Mohra on high-demand industrial and commercial projects. These tasks typically require extensive materials, skilled labor, and longer project timelines, resulting in higher revenue generation. Tasks like villa fit-out renovation and supply & installation of roof marine plywood contribute moderate amounts. Meanwhile, smaller specialized jobs like ISO Panel Cutting and kitchen cabinet installations contribute significantly less but represent a broader range of service offerings. The distribution indicates a clear dominance of large-scale industrial and commercial work while smaller tasks remain consistent contributors in volume.

3.2 Results and Insights from Project Deadline Analysis

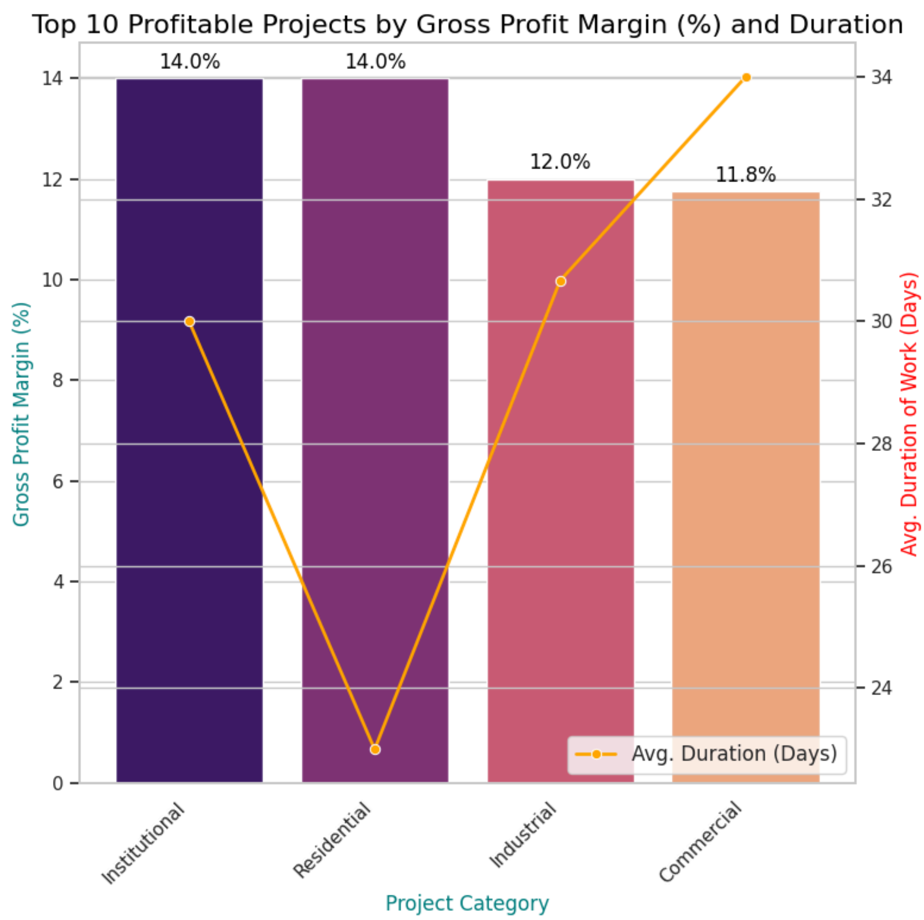


Figure 4: Profitability and Efficiency Across Project Categories

Institutional and residential projects deliver the highest profit margins, while industrial projects show balanced profitability and shorter durations.

This visualization highlights the distribution of profitability by project category. Institutional and residential projects yield higher gross profit margins due to standardized requirements and efficient resource utilization. Institutional projects, like schools or healthcare facilities, have well-defined scopes and budgets, enabling precise cost management. Residential projects benefit from streamlined processes and repetitive designs, leading to quicker turnaround times and reduced labor costs. However, their shorter durations can limit scalability for more complex undertakings. This highlights the importance for Mohra to balance project selection to optimize both profitability and operational capacity.

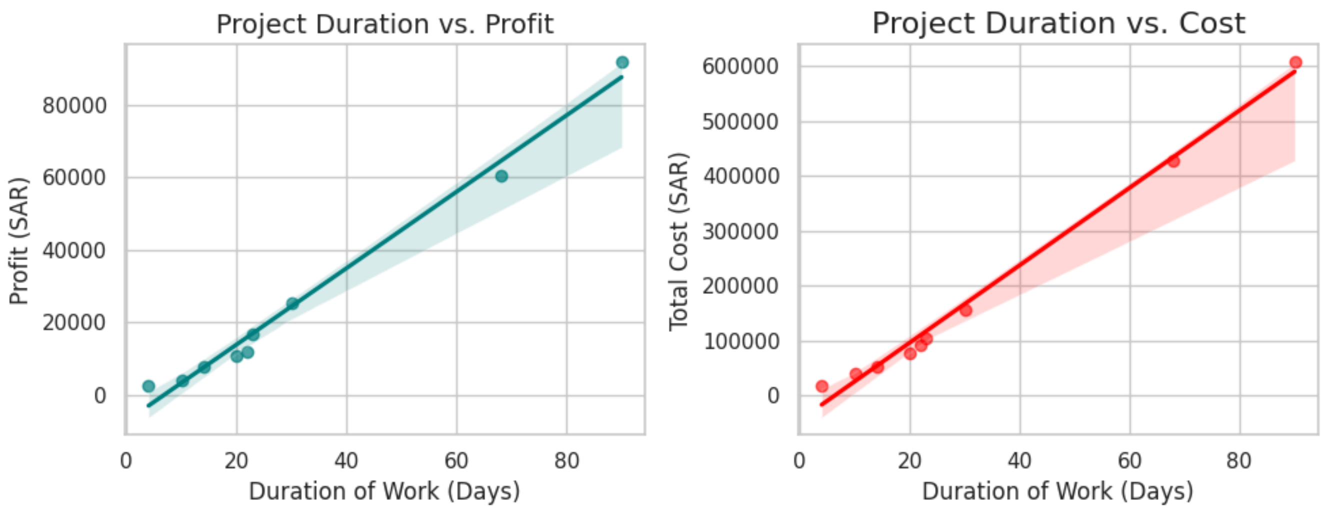


Figure 5: Relationship Between Project Duration, Profit, and Cost

Longer project durations correlate strongly with increased profits and costs, emphasizing the need for cost-effective time management.

There is a clear correlation between the duration of a project and the profit generated, with longer-duration projects yielding higher profit. This suggests that larger-scale, long-term projects are more profitable for Mohra. However, the complexity of these projects makes them prone to delays and resource inefficiencies.

Findings on Client Cluster Patterns:

Table 1: Client Clusters Based on Selected Features: Total Revenue (SAR), No. of Orders, Total Cost (SAR), Profit (SAR), Gross Profit Margin (%), and Duration of Work (Days)

Client Name	Project Category	Cluster
Arena Saudi Company	Industrial	1
Industrial Resin Factory	Industrial	2
United National Electromechanical Co	Institutional	1
Store Makers Interiors L.L.C	Commercial	0
CUBS NORTH CONTRACTING COM.	Commercial	1

Client Name	Project Category	Cluster
Al- Afaq Al- Mumtada Co. Ltd.	Commercial	2 🟢
Saudi Plastic Factory Co.	Industrial	1 🟡
Hundred Real Estate Company	Commercial	1 🟡
New Rabwa Real Estate Company	Residential	1 🟡

Cluster 0: Short-duration, cost-sensitive clients ideal for quick projects.

This group represents clients with relatively lower project durations and profit margins. They tend to engage in smaller-scale or short-term commercial projects, as seen with clients like Store Makers Interiors L.L.C. These clients often prioritize cost-effectiveness over extended timelines, making them ideal for quick turnaround projects.

Cluster 1: Balanced, versatile clients generating stable revenue across various project categories.

The largest cluster includes clients with balanced project characteristics, featuring moderate gross profit margins, project durations, and revenue. These clients, such as Arena Saudi Company and United National Electromechanical Co, engage in diverse project categories like industrial and institutional work. They represent a stable and predictable revenue stream.

Cluster 2: High-value clients with long-term, resource-intensive projects that yield substantial profits.

Clients in this cluster, like Industrial Resin Factory and Al-Afaq Al-Mumtada Co. Ltd., exhibit the highest project durations, revenues, and profit margins. They are primarily involved in large-scale or long-term projects, such as commercial and industrial categories. These clients are highly profitable but require more resources and extended timelines to manage.

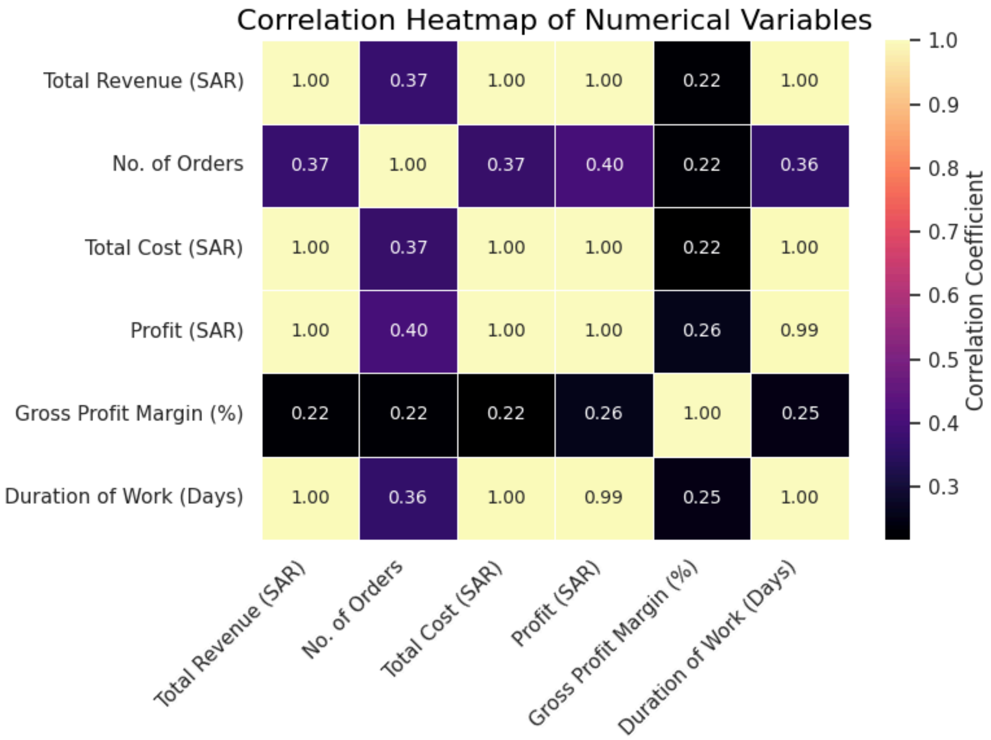


Figure 6: Key Correlations Among Business Metrics

Duration of work aligns closely with both profit and total cost, while gross profit margin shows limited correlation with other variables, signaling a focus on cost control for profitability.

This heatmap uncovers the interconnections between numerical variables. Notably, project revenue and profit have the strongest correlation, while frequency of orders has minimal impact on overall profitability. This suggests a strategy focused on high-value, fewer orders rather than high volume.

3.3 Results and Insights from Market Competition Analysis

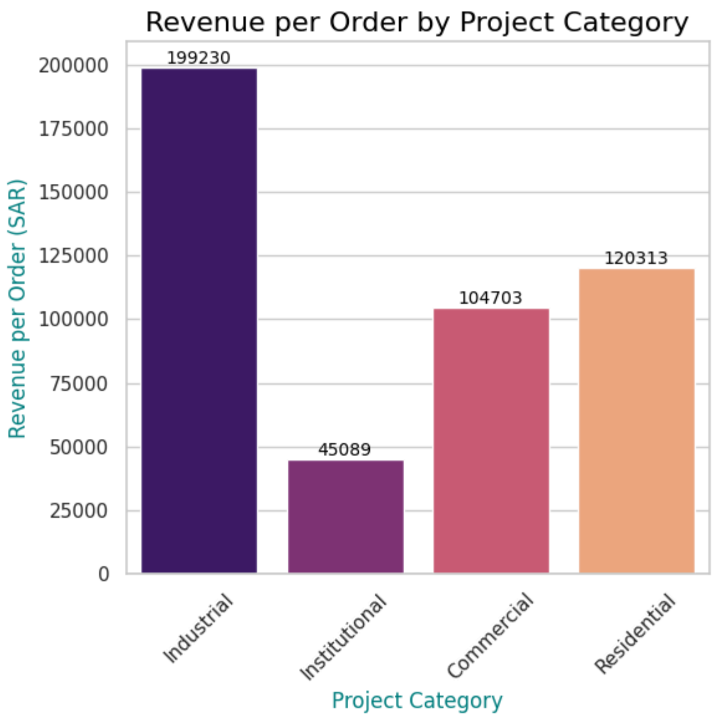


Figure 7: Revenue Performance Across Categories

Industrial projects significantly outperform others in revenue generation per order, demonstrating their vital role in overall profitability.

The chart illustrates revenue distribution per order across project categories. Industrial projects lead significantly, with a revenue per order of SAR 199,230, indicating a strong pricing or demand advantage. This aligns with the substantial investments in Saudi Arabia's industrial construction sector, a significant contributor to the total construction output value in 2023 (Knight Frank).

In contrast, Institutional projects generate the lowest revenue per order at SAR 45,089, likely due to more stringent budget constraints and standardized project scopes. Residential and Commercial projects lie in between, showing moderate yet stable contributions to revenue, aligning with the increasing residential building supply in Saudi Arabia (BIG5 Constructs Saudi).

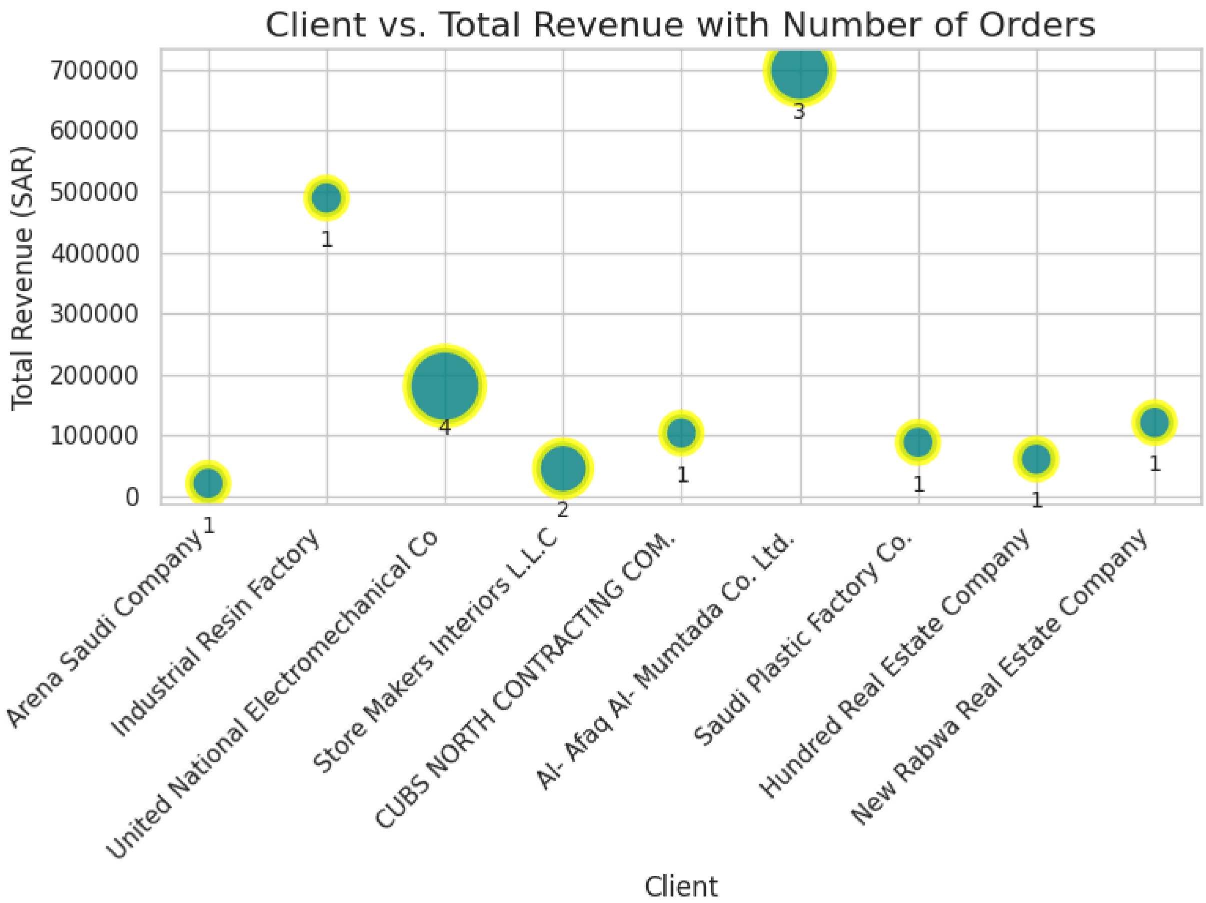


Figure 8: Relationship between Total Revenue and Number of Orders by Client

The chart illustrates the correlation between total revenue and the number of orders across clients. Around 50% of revenue comes from repeat clients like United National Electromechanical Co. and Al-Afaq Al-Mumtada Co. Ltd.

Al-Afaq Al-Mumtada Co. Ltd. leads with over SAR 700,000 from just three orders, highlighting its high-value projects. Clients such as United National Electromechanical Co. and Store Makers Interiors L.L.C. have frequent but smaller projects, leading to a higher number of orders but relatively lower total revenue. These smaller-scale, recurring services could strain resources without yielding high profits. Clients like Industrial Resin Factory and

New Rabwa Real Estate Company generate significant revenue with fewer orders, emphasizing their large-scale, high-value contracts. This suggests focusing on high-value clients while finding ways to boost revenue from frequent, smaller-scale clients. While these clients can bring in high-value contracts, relying solely on them may lead to long gaps between projects.

Findings on Customer Lifetime Value Patterns:

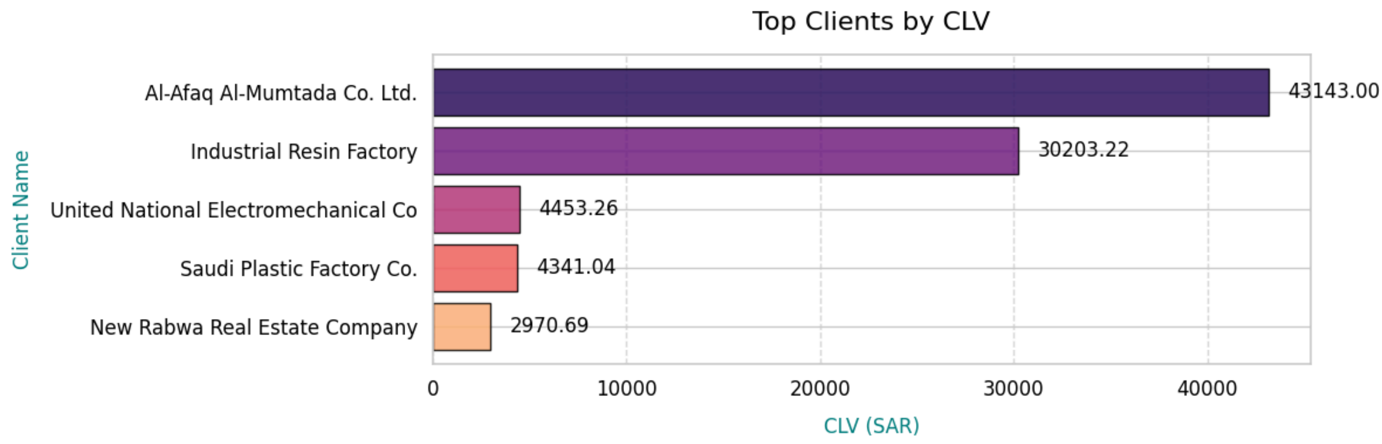
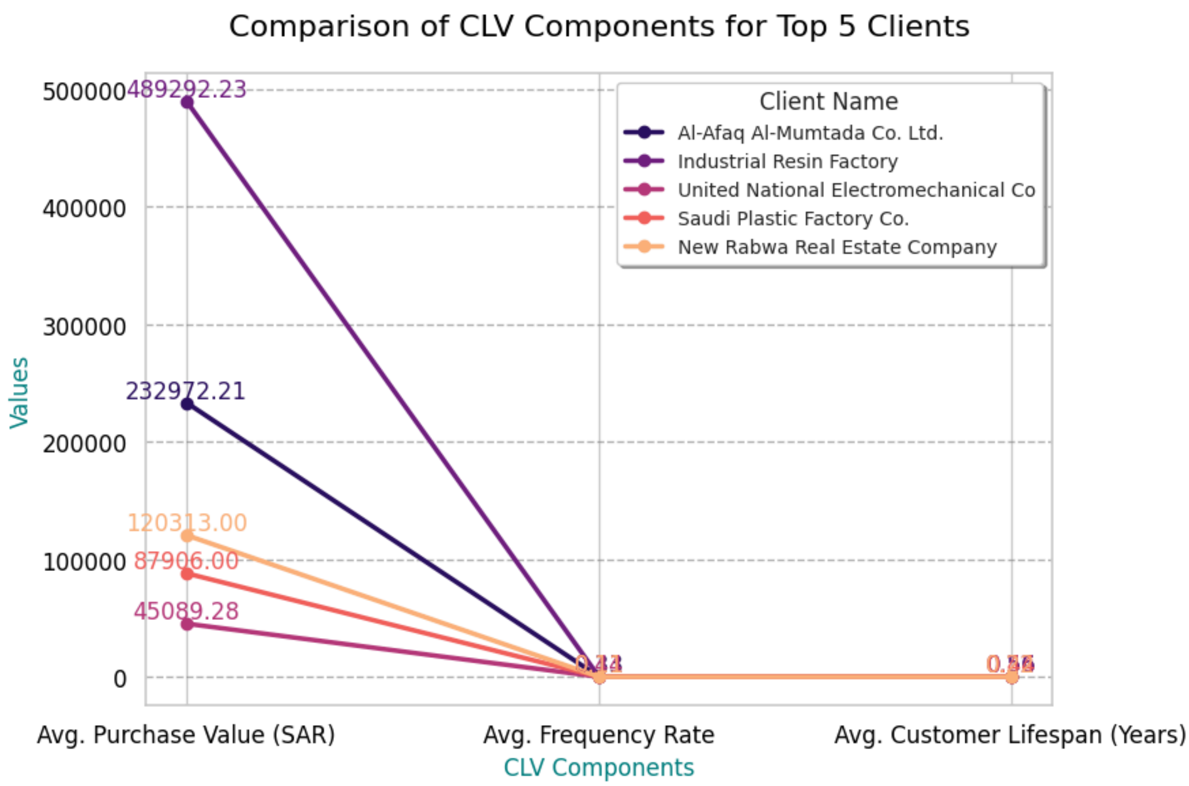


Figure 9: Key Clients Driving Business Value

Clients like Al-Afaq Al-Mumtada Co. Ltd. and Industrial Resin Factory account for substantial customer lifetime value, emphasizing their importance in sustaining growth.

The bar chart clearly identifies the top 5 clients contributing the highest Customer Lifetime Value (CLV) for Mohra, with Al-Afaq Al-Mumtada Co. Ltd. and Industrial Resin Factory being the most significant contributors. These clients account for a major portion of the revenue, emphasizing their critical role in sustaining and growing the business. Mid-range CLV clients, such as United National Electromechanical Co. and Saudi Plastic Factory Co., present moderate value and offer upselling and cross-selling opportunities.



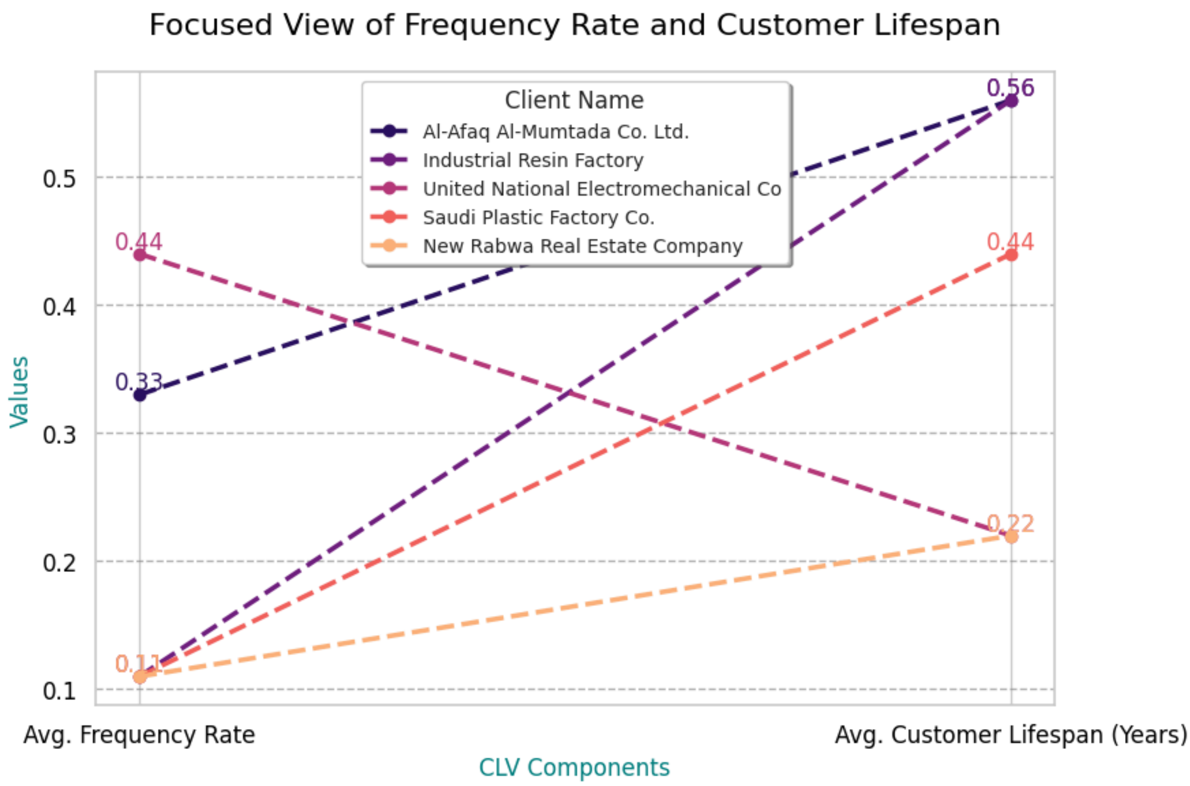


Figure 10: Analyzing Key Metrics for Top Clients

The breakdown of purchase values, engagement frequencies, and customer retention illustrates strategic opportunities for client relationship management.

The charts provide a breakdown of CLV components—Average Purchase Value, Frequency Rate, and Customer Lifespan—across the top clients. Significant variability is observed, such as Industrial Resin Factory showcasing a high purchase value but a lower frequency rate, suggesting potential for increasing repeat business. On the other hand, United National Electromechanical Co. has a balanced distribution across components, indicating a strong but less intensive client relationship.

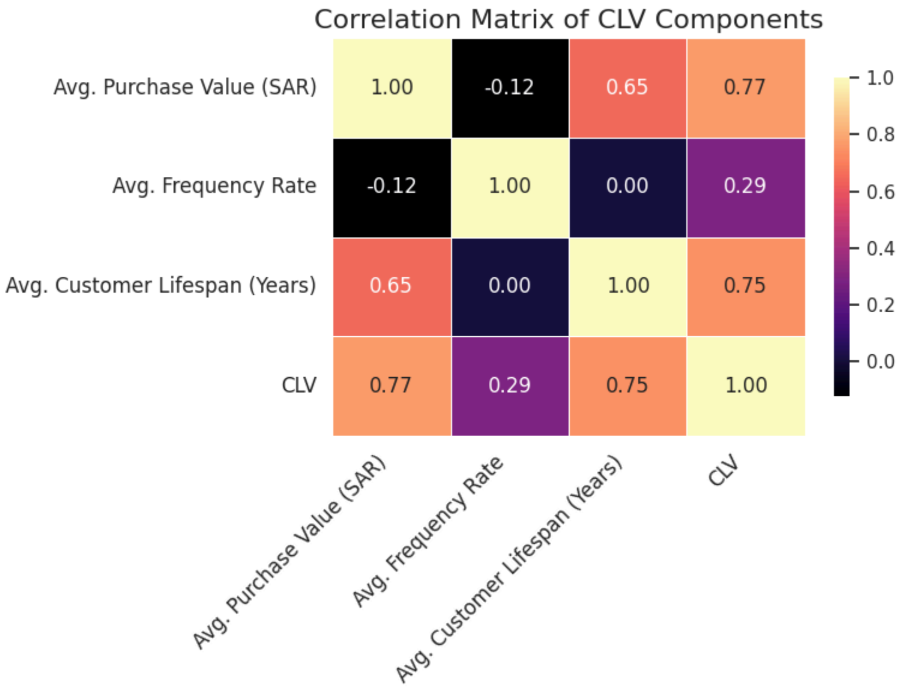


Figure 11: Interrelationships Between Profitability Drivers

High purchase values emerge as the strongest factor influencing lifetime value, underscoring their importance in revenue growth.

The heatmap underscores that Average Purchase Value is the strongest determinant of CLV (correlation = 0.77), suggesting that higher-value transactions directly impact overall client value. The weaker correlation of Frequency Rate (0.29) suggests an opportunity to increase repeat transactions for sustained growth in CLV.

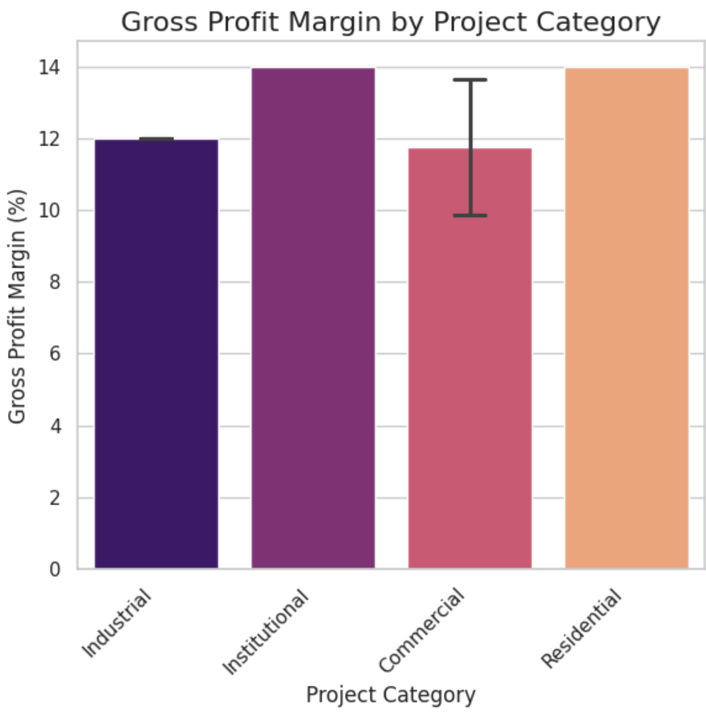


Figure 12: Profitability Trends in Project Segments

Institutional and residential projects consistently achieve higher profit margins, highlighting their potential for strategic focus.

Institutional and Residential projects yield the highest gross profit margins (~14%), while Industrial projects, despite generating the highest revenue, show slightly lower margins due to higher costs.

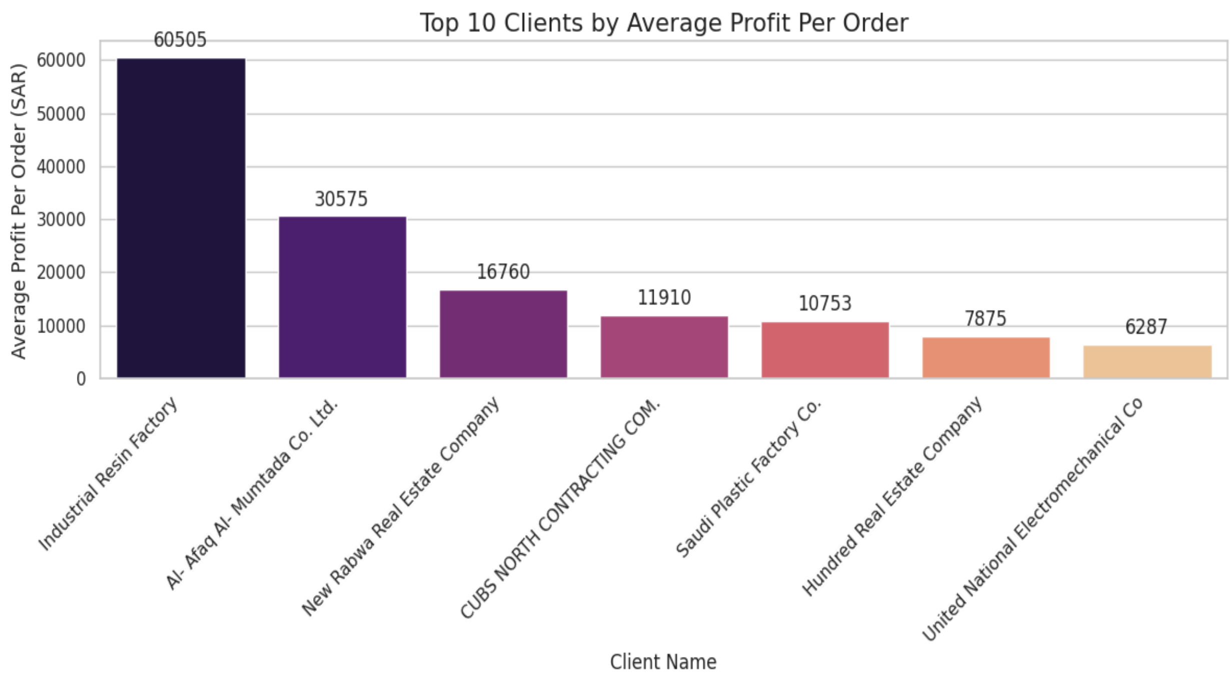


Figure 13: Clients Delivering the Highest Returns

Industrial Resin Factory leads in average profit per order, setting the standard for high-value client contributions.

Industrial Resin Factory and Al-Afaq Al-Mumtada Co. Ltd. deliver the highest profit per order. The chart indicates that profitability is concentrated among a few key clients, with potential to expand profit margins among mid-tier clients through tailored strategies.

4. Interpretation of Results and Recommendation

4.1 Insights on Project Duration and Management Patterns

The analysis of project durations reveals that most projects are short-term, typically clustering around 20-30 days, suggesting that the business primarily handles smaller, time-constrained assignments. In contrast, a smaller subset of projects lasts over 80 days, indicating long-term, potentially resource-intensive tasks that could benefit from improved resource planning and timeline management.

There are two distinct types of projects: standard, repetitive ones that usually take around 20 days, and large-scale, customized projects requiring about 80 days and more planning and coordination. The gap between 40-70 days suggests a lack of mid-range projects, pointing to either an untapped market opportunity or inefficiency in targeting and executing these projects.

While longer projects yield higher profits, they also incur substantially higher costs, making it crucial to closely monitor profitability margins to ensure these projects are worth the investment. Optimizing costs for longer-duration projects is essential to improve profit margins, whereas shorter projects may offer better cost efficiency but should be evaluated against their potential profitability.

To accurately predict the duration of construction projects, it is crucial to consider a comprehensive set of influencing factors. Incorporating these features into predictive models will enhance precision and lead to better planning and resource allocation. Key features include project characteristics like size, type, and cost; design specifications such as complexity and materials used; site conditions including location, topography, and weather; resource availability like labor force and equipment; regulatory factors such as permits and compliance; management factors involving scheduling techniques like the **Critical Path Method (CPM)** and contractual agreements; and external factors like economic conditions and community impact. By integrating these features, Mohra can achieve more accurate forecasts of project durations, ensuring efficient and timely completions.

Prioritizing high-margin projects, specifically Institutional and Residential ones, is essential as they offer the highest gross profit margins and are both profitable and manageable within moderate durations. To enhance efficiency in Commercial projects, a detailed analysis should be conducted to identify bottlenecks, given their highest average duration. Implementing process improvements and better coordination will help reduce project timelines without compromising quality.

Leveraging **predictive analytics based on historical data** will enable proactive adjustments to project schedules, minimizing delays and improving deadline management. To effectively meet project deadlines, it is recommended that Mohra implements construction management software such as **CoConstruct.** These platforms offer real-time project tracking, automated scheduling, and transparent client communication, which will streamline operations and ensure timely project delivery.

Embracing **prefabrication and modular construction techniques** can be a game-changer. By manufacturing components off-site, Mohra can control the quality and timeline better, reducing on-site construction time and mitigating weather-related delays. This approach not only ensures timely project delivery but also enhances productivity, allowing the company to undertake more projects simultaneously.

4.2 Insights on Navigating Market Competition

For **high-value clients with few orders,** focus on delivering high-quality results to secure repeat business. Additionally, Mohra can offer incentives for additional projects (e.g., discounted rates for second projects) or encourage these clients to sign long-term contracts. Clients like Industrial Resin Factory and New Rabwa Real Estate Company represent high-value, low-frequency contracts, which are essential for scaling up the company. Meanwhile, United National Electromechanical and Store Makers Interiors L.L.C. offer smaller, frequent projects, helping with consistent cash flow.

Clients like Al-Afaq Al-Muntada Co. Ltd. show higher revenue potential, as they generate large revenue ranges. However, the **variability in revenue** suggests that these clients may offer irregular or project-specific opportunities. For clients like New Rabwa Real Estate Company, which require **diverse services,** bundling complementary services (e.g., installation with maintenance) could increase the average revenue per order and strengthen client loyalty. To ensure steady revenue from such clients, Mohra should focus on long-term contracts or service agreements to smooth out the variability. Implementing loyalty programs will help ensure steady revenue and optimize resource allocation.

Combining the interpretations of profit and CLV reveals that the highest Customer Lifetime Value (CLV) for Mohra is attributed to Al-Afaq Al-Mumtada Co. Ltd. and Industrial Resin Factory, who represent stable and significant revenue streams. These clients also rank at the top of the list of high-profit clients, underscoring their significant value to the business. Therefore, it would be prudent for Mohra to prioritize these **high-value, high-profit clients.** Developing long-term partnerships with these clients through exceptional service, discounts for repeat business, or loyalty rewards is crucial. Minimizing effort on low-CLV clients unless there's potential to increase their value is also important.

Client clusters should be targeted based on their specific needs. For Cluster 0, which includes **short-duration, cost-sensitive clients** like Store Makers Interiors L.L.C., Mohra should streamline operations and standardize offerings to ensure quick and cost-effective service. For Cluster 1, **balanced and versatile clients** such as Arena Saudi Company and United National Electromechanical Co., diversifying services and enhancing client engagement through construction management software can improve operational efficiency. Cluster 2, comprising **high-value, long-term clients** like Industrial Resin Factory and Al-Afaq Al-Mumtada Co. Ltd., should have dedicated resources and advanced project management tools to meet complex requirements.

Cross-cluster strategies should focus on optimizing residential and institutional projects for higher profit margins, controlling costs in industrial projects, and enhancing customer retention through loyalty programs and personalized engagement. Prioritizing high-value projects and leveraging predictive analytics will further drive profitability and competitiveness.

Mohra's reliance on a few high-value clients is typical for small construction companies. Seeking out new clients in similar sectors (e.g., industrial manufacturing or large-scale real estate) will provide a more stable revenue stream and mitigate risk if a major client slows down.

To further bolster its market position, Mohra should expand its service offerings to include smart building solutions. With the growing demand for sustainable infrastructure, providing integrated systems for energy management, security, and maintenance will attract high-profile clients and align with global trends. Additionally, enhancing worker safety and training programs through comprehensive safety training and wearable technology will improve project efficiency and worker satisfaction, ensuring high productivity and timely delivery. By implementing these strategies, Mohra Company Limited can navigate market competition effectively and ensure consistent project delivery, solidifying its reputation as a leader in the construction industry.

4.3 Essential Strategies, Tools, and Techniques

Table 2: Actionable Tools and Approaches for Enhancing Mohra's Operational Efficiency and Market Competitiveness

This table outlines key strategies, tools, and methods to optimize project management, client retention, revenue generation, and competitive positioning in the construction industry.

Category	Tools & Approaches	Purpose
Project Duration Analysis	Critical Path Method (CPM)	Improve timeline predictions and identify task dependencies to avoid delays.
	Predictive Analytics	Leverage historical data to adjust schedules proactively, minimizing deadline risks.
	Modular Construction	Reduce on-site construction time and improve efficiency by manufacturing components off-site.
	Process Optimization for Commercial Projects	Analyze and address bottlenecks to reduce duration without compromising quality.
	CoConstruct / Buildertrend Software	Real-time project tracking, automated scheduling, and transparent client communication.
Market Competition (Revenue Optimization and Profitability Management)	Client Clustering	Tailored strategies for short-term, balanced, and high-value clients.
	Loyalty Programs	Retain high-value clients with rewards for repeat business or discounted contracts.

Category	**Tools & Approaches**	**Purpose**
	Bundling Complementary Services	Increase average revenue per order by offering bundled services (e.g., installation + maintenance).
	Targeting High-Value Clients	Focus on clients like Industrial Resin Factory and Al-Afaq Al-Mumtada Co. Ltd. for profitability.
	Diversifying Client Base	Reduce reliance on a few clients by exploring new sectors like real estate.
	High-Margin Projects	Prioritize Institutional and Residential projects for better profit margins.
	Cost Control for Long-Duration Projects	Reduce costs on industrial projects without sacrificing quality.
Growth Opportunities	Smart Building Solutions	Attract high-profile clients by offering energy management, security, and maintenance systems.
	Worker Training & Safety Programs	Enhance productivity with wearable tech and comprehensive training to minimize disruptions.

[1] End of Report

[1] Thank You
We appreciate your attention to this report and look forward to discussing its findings further.

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