Optimizing Working Capital Management through Credit Control at M/S Sarada Builders & Suppliers

Final Submission for the Project on Business Data Management

Submitted by

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1. Executive Summary:

M/S Sarada Builders & Suppliers located at Swarupnagar Bazar, West Bengal, is a construction-materials trading business dealing primarily in stone, sand, bricks, and cement. Founded by Suman Ghosh, the firm's major challenge is inefficient management of customer credit, leading to delayed payments, liquidity pressure, and blocked working capital. Growth opportunities exist, but cash is tied up in receivables. The project focuses on three core problems: measuring payment delays and their impact on cash flow, identifying the customers and products most responsible for dues, and developing a data-driven credit policy to reduce risk.

The study uses 222 invoices from May–November 2025, digitized from handwritten records. The dataset captured invoice value, payments, dues, customer category, product details, profit and cost. Descriptive statistics quantified sales distribution, outstanding balances, and delay levels. Advanced analytical methods were applied: RFM analysis for customer behaviour, ABC analysis for product revenue concentration, FSN analysis for inventory movement, and a decision-tree model for credit-risk classification. These techniques together created a comprehensive view of cash-flow, receivables and credit exposure.

The results show average effective delay of 7–8 days, and about 26–28% of sales value remaining unpaid at any time. Dues are concentrated among builder customers and a few key products, particularly 5/8" Stone; bricks show the highest delay ratio. Fast-moving products also carry high receivable balances, while non-moving items add carrying-cost pressure. The decision-tree model confirms that due ratio and due amount are the strongest indicators of high risk.

The findings reveal that the core issue is payment delay, not lack of demand. Recommendations include segmented credit limits (RFM-based), decision-tree-guided due thresholds, stricter terms for stone and brick sales, builder-focused collection discipline, FSN-guided inventory reduction, and digital receivable monitoring. Initial application of recommendations has already improved follow-up discipline and visibility of dues, supporting stronger cash flow and more controlled working-capital usage.

2. Detailed Explanation of Analysis Process / Method:

2.1 Overview of Methodologies Used:

This study follows a problem-focused approach to analyse working capital and credit management at M/S Sarada Builders & Suppliers. In the mid-term stage, descriptive analysis was first used to understand sales, payments, outstanding dues, profit levels, and customer and product patterns. This helped identify high dependence on credit sales, concentration of revenue among a few customers, and uneven product-wise contribution.

Building on this base, three structured methods were applied:

- RFM analysis to segment customers based on recency, frequency, and monetary value of purchases.
- ABC analysis to classify products by their contribution to total sales value.
- FSN analysis to study inventory movement as fast-, slow-, or non-moving items.

Together, these methodologies form an integrated analytical framework that links customer behaviour, product importance, and inventory movement. The combined use of descriptive analysis, RFM, ABC, and FSN techniques enables a comprehensive assessment of the firm's working capital challenges and supports data-driven recommendations for improving cash flow stability and operational efficiency.

2.2 Detailed Analysis Methodologies Employed:

1. Data Collection: The dataset contains primary sales invoice data digitized from handwritten registers of M/S Sarada Builders & Suppliers. A total of 222 invoices from May–November 2025 were entered into a spreadsheet. Each record includes customer details, product details, quantity, rate, total amount, payments received, dues, cost price, profit, payment method, and remarks. Because the data came from manual records, it required careful cleaning and validation before analysis.

2. Data Cleaning and Preparation: Data were cleaned and prepared by standardizing column names, assigning proper data types, and converting sale dates to usable date format. Remarks were normalized and mapped into consistent status categories: Paid, Partially Paid, Unpaid, and Other. Invalid invoices with zero or negative totals were removed. Collected amounts were standardized, and negative dues were set to zero. Key numeric fields (Total Amount, Payment, Due Payment, Cost Price, Profit) were checked for missing or abnormal values. A Due Ratio (Due ÷ Total Amount) was created and capped between 0 and 1. Customer and product names were cleaned to remove duplicates from spelling variations. Overall, messy handwritten records were converted into a structured, analysis-ready dataset.

3. Analysis of Payment Delays and Cash Flow Impact:

3.1 Data Processing and Preparation:

The invoice dataset was first cleaned and validated prior to analysis. Missing values in payment fields were checked, and inconsistencies between billed amount, collected amount, and due amount were reconciled. Derived variables were then created to enable quantitative assessment of delays, including:

- Due Ratio (%) = Due Payment / Total Amount
- DSO Proxy (Days Sales Outstanding) based on outstanding proportion of invoice value
- Delay Buckets grouped by number of days of effective delay

These transformations provided the foundation for delay measurement.

3.2 Delay Measurement Approach:

Invoices were classified into delay categories based on the estimated DSO proxy. The analysis focused on identifying:

- average delay duration
- proportion of invoices delayed
- distribution of dues across ageing classes

In addition, invoice ageing was mapped against total receivables to quantify working-capital blockage arising from delay.

3.3 Visualization and Interpretation:

Bar charts and ageing-bucket graphs were used to illustrate:

- the share of invoices in each delay bucket
- proportion of value locked in dues vs collections
- month-wise billed vs realised collections trend

This enabled evaluation of both frequency of delay and financial magnitude of delay, linking receivable ageing directly to liquidity pressure.

4. Customer-wise Segmentation of Outstanding Receivables:

4.1 Customer-Type Classification: Customers were grouped into Retail, Contractor, and Builder segments. For each category, total outstanding dues were computed and compared to total sales to assess exposure concentration.

4.2 High-Risk Customer Identification:

Customer-wise aggregation was conducted to compute:

- total billed value
- total collected value
- outstanding due balance

Top-due customers were identified based on cumulative unpaid balance. This allowed quantification of credit concentration risk, where a small number of accounts contributed disproportionately to receivables.

4.3 Exposure Distribution Assessment:

Receivable concentration was examined using the 80/20 principle, evaluating whether:

- few customers hold majority of dues
- dues are evenly distributed across the base

This step provided a risk-based lens for prioritizing recovery actions and designing differentiated credit policies.

5. Product and Category Association with Delay:

5.1 Product-Type Receivable Mapping:

Invoices were grouped by product type, and total dues were calculated for each category such as Stone, Sand, Bricks, Cement, and Dust. This facilitated identification of:

- materials generating highest unpaid balances
- linkage between product mix and receivable accumulation

5.2 Delay Ratio by Product Type:

For each product type, the average due ratio was computed. This distinguished between:

- products causing high unpaid value
- products showing higher probability of delayed payment

This dual lens highlighted whether risk was value-driven or behaviour-driven.

6. ABC Analysis for Product Contribution and Credit Exposure:

6.1 Classification Procedure: ABC classification was conducted based on cumulative contribution to total sales value.

Products were sorted in descending order of sales and assigned classes:

- Class A – top 70% of sales
- Class B – next 20%
- Class C – remaining 10%

6.2 Overlay of Receivable Risk:

Outstanding dues were superimposed on ABC categories to determine whether:

- high-revenue items also carried high unpaid value
- low-revenue items contributed materially to dues

This integration provided a revenue–risk matrix, supporting product-specific credit policies rather than uniform rules.

7. FSN Analysis of Inventory Movement and Payment Behaviour:

7.1 Movement Classification:

Products were categorized based on the days since last sale into:

- Fast-moving
- Slow-moving
- Non-moving

This enabled assessment of demand velocity.

7.2 Linking FSN with Credit Risk:

The FSN results were compared against outstanding dues to identify:

- fast-moving products generating high receivables
- non-moving products carrying dormant dues

This helped distinguish cash-flow risk from inventory-holding risk, guiding stocking and credit policy simultaneously.

8. RFM-Based Customer Behaviour Segmentation:

8.1 Metric Construction:

RFM metrics were derived as follows:

- Recency(R) – days since last purchase
- Frequency(F) – count of transactions
- Monetary(M) – total purchase value

Quartile-based scoring was applied to derive composite RFM scores. (RFM Score= R+F+M)

8.2 Segmentation Approach:

Customers were segmented into:

- high-value active customers
- moderate-value regular customers
- dormant/at-risk customers

Linking RFM score with outstanding dues provided insight into whether best customers were also biggest credit users.

9. Decision Tree–Based Credit Risk Classification:

9.1 Model Development:

A decision tree model was built to classify invoices into Low, Medium, and High credit-risk categories. It used key engineered variables such as due ratio, due amount, total invoice value, invoice age, and month risk index. To prevent overfitting, tree depth and minimum samples were controlled, and accuracy was checked through cross-validation.

9.2 Model Interpretation:

The model identifies a clear rule:

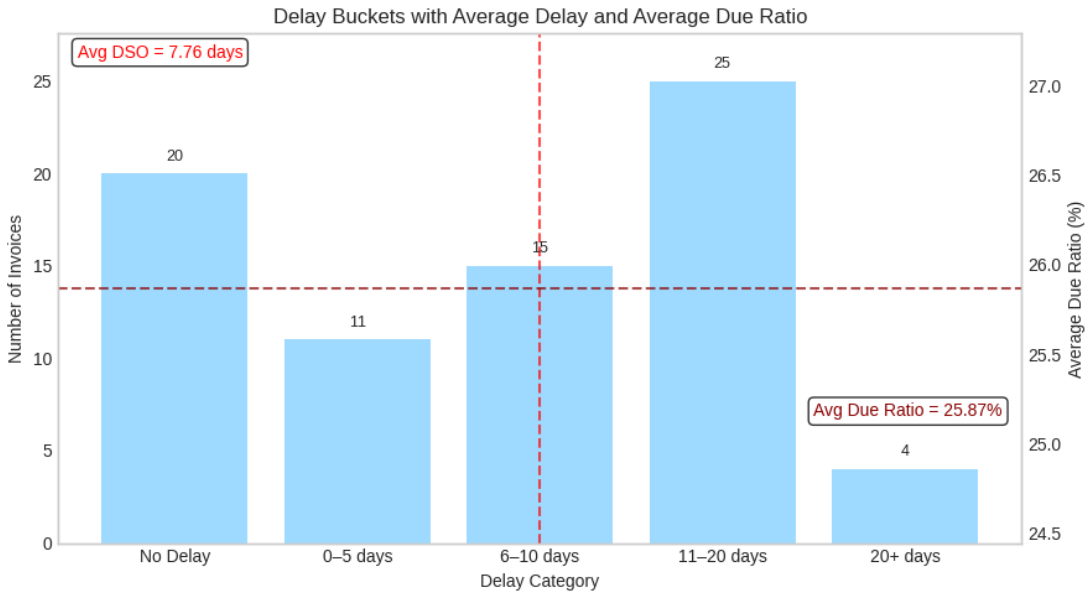
- higher unpaid proportion and higher outstanding dues → higher credit risk
- lower unpaid proportion and smaller dues → lower credit risk

The tree's first split is mainly driven by Due Ratio, followed by Due Payment, indicating that both the percentage and absolute value of dues determine risk. Feature-importance results confirm these as the dominant predictors, while invoice age and RFM score provide secondary support.

3. Result and Findings:

3.1 Analysis of Payment Delays and Their Impact on Cash Flow:

3.1.1 Extent of Effective Payment Delay:



(i) Key quantitative results:

- Average Days Sales Outstanding (DSO proxy) ≈ 7.76 days.
- Average Due Ratio ≈ 25.87%

(ii) Explanation:

- DSO proxy is calculated as:

  DSO ≈ Due Ratio × 30 days
- It captures the effective number of days for which sales value remains unpaid.
- It reflects delay in cash conversion, not just delay in billing dates.

(iii) What this reveals:

- About 25–26% of invoice value is unpaid at any given time.
- Sales are recognized first, cash is collected later.
- Delay in number of days is moderate, but delay in value proportion is significant.
- Cash flow therefore depends strongly on customers clearing dues on time.

(iv) Implication:

- The business is operating more on credit-driven sales than cash sales.
- Revenue recognition and cash realization are not synchronized.

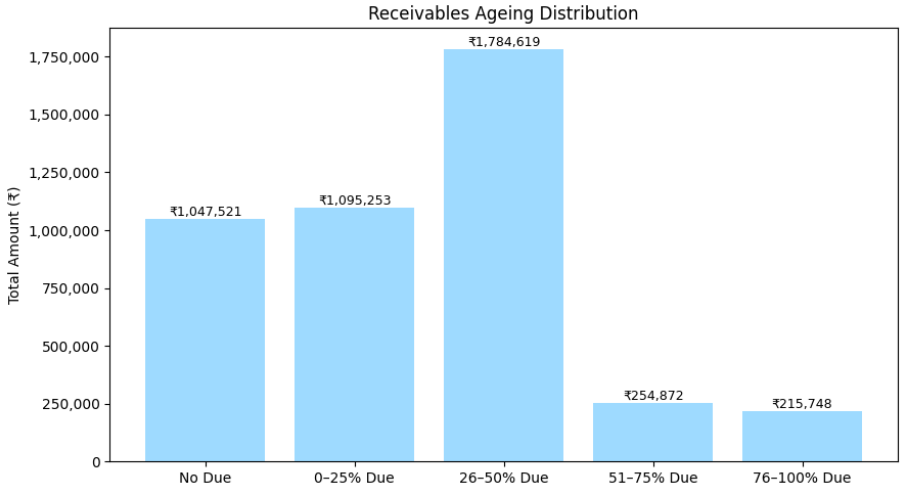
3.1.2 Distribution of Invoices Across Ageing Buckets:

Receivables were grouped based on how much of each invoice is still unpaid. Most of the amount lies in the 26–50% due bucket, followed by 0–25% due and no-due invoices. A smaller share falls in the 51–75% and 76–100% due categories, but these are still important because they indicate serious non-payment risk.

(i) This shows that:

- payments are usually delayed partially, not fully unpaid.

- many invoices remain half-paid for a long time.
- customers are paying in small instalments instead of clearing full dues.
- overall credit discipline is weak.

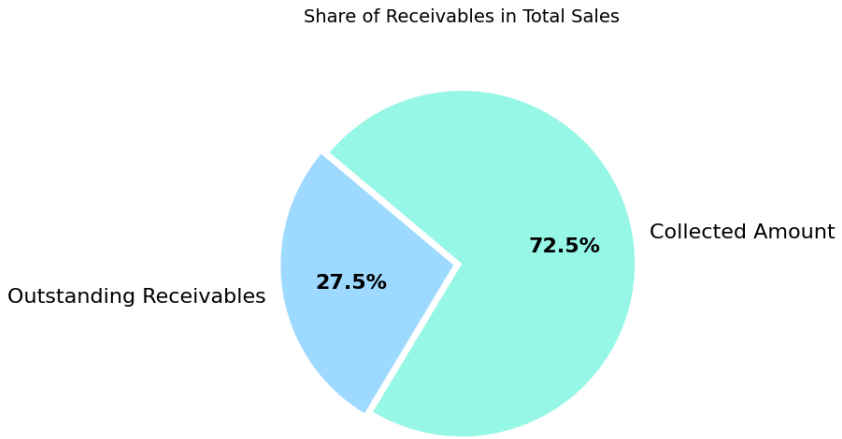


3.1.3 <u>Proportion of Receivables Locked in Dues</u>:

The pie chart shows that about 27–28% of total sales value remains outstanding as receivables, while around 72–73% has already been collected.

(i) <u>What this reveals</u>:

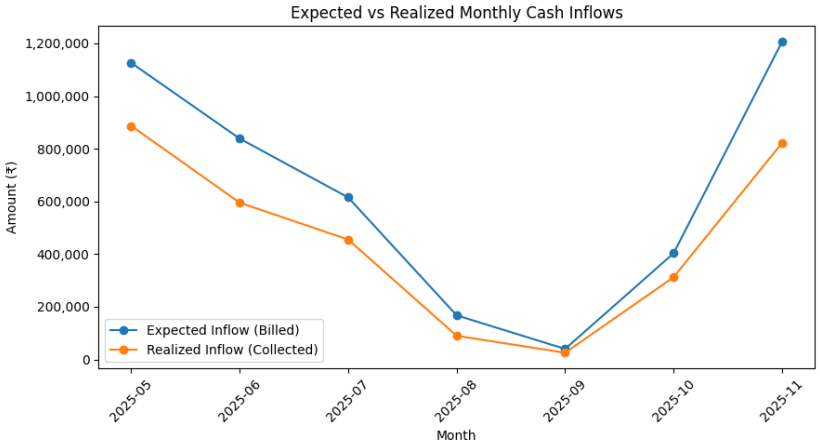
- More than one-quarter of revenue is still unpaid.
- A sizeable portion of money recorded as "sales" has not yet turned into cash.
- Day-to-day operations must run while waiting for customers to pay.



(ii) <u>Implications for the business</u>: A significant share of working capital is tied up in receivables. This can force reliance on owner funds or short-term loans, increasing exposure to delay and default risk. Managing cash flow becomes as critical as increasing sales.

3.1.4 <u>Trend of Expected vs. Realised Monthly Cash Inflows</u>: Monthly trend analysis comparing expected inflows (billed amount) and realised inflows (actual collection) demonstrates a consistent

positive gap, meaning that collections systematically lag behind billing.



(i) <u>The gap is particularly pronounced in</u>:

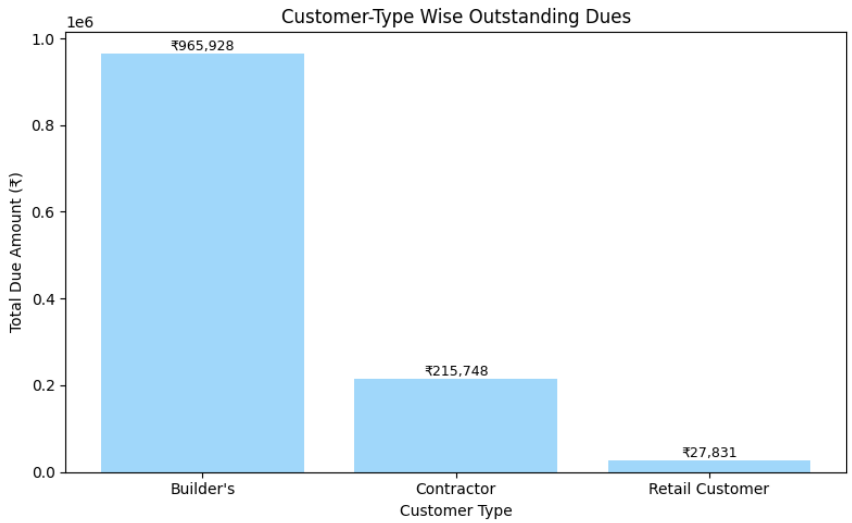
- May, June, and November, where billing is high but realization is considerably lower
- August and September show seasonal contraction in both billing and collections, but the gap persists even at lower scale
- The persistence of the collection gap indicates that delays are structural rather than episodic.

(ii) <u>This gap directly contributes to</u>:

- cash-flow volatility
- planning uncertainty
- constraints on reinvestment and procurement cycles

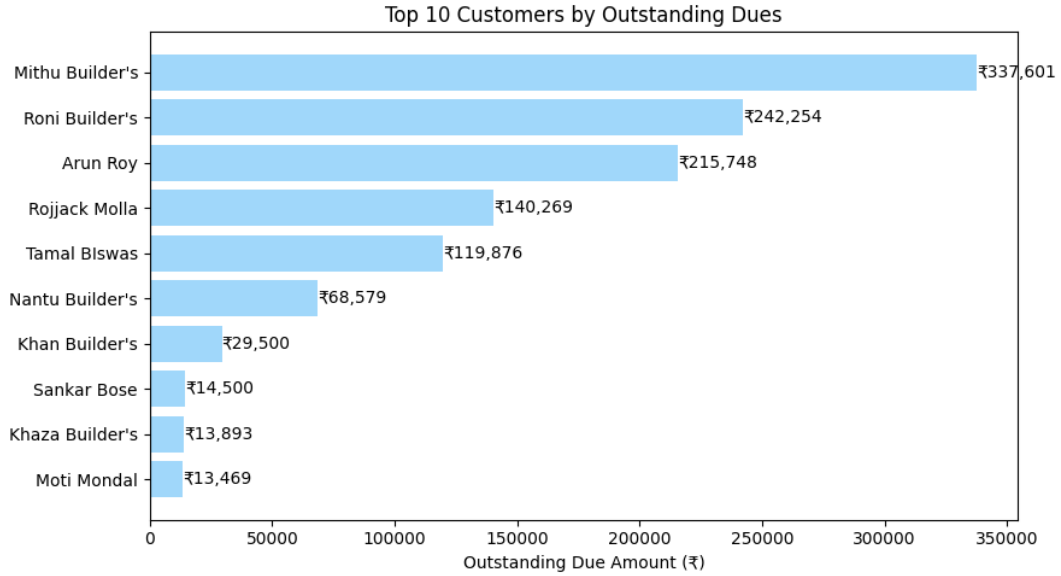
3.2 <u>Distribution of Outstanding Amounts Across Customer Types and Segments</u>:

3.2.1 <u>Customer-type wise outstanding due pattern</u>: The customer-type analysis shows that outstanding dues are heavily concentrated among Builder customers. Builders account for the largest share of total dues (₹9.66 lakh approx.), followed by Contractors, while Retail Customers contribute only a negligible portion of outstanding amounts.



This indicates that the firm's credit exposure is primarily linked to large institutional buyers rather than individual retail customers, implying higher ticket sizes but greater payment risk.

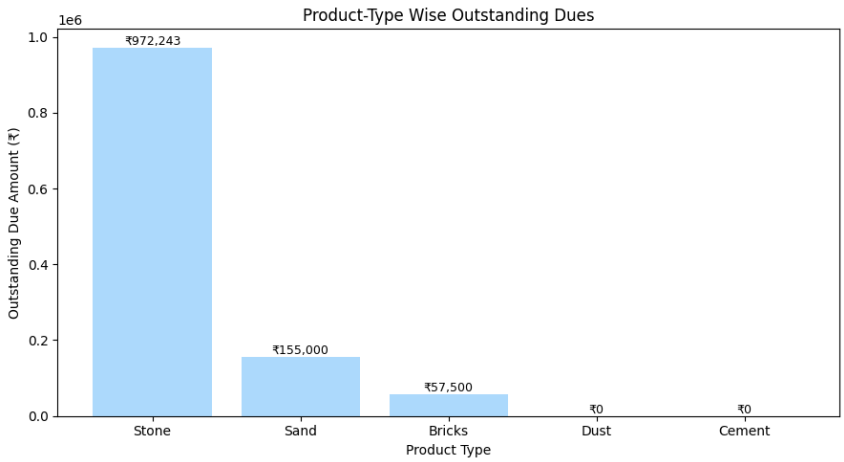
3.2.2 <u>Identification of customers with consistently high dues</u>:



Customer-wise analysis shows that a few accounts drive most receivables. The top three—Mithu Builder's, Roni Builder's, and Arun Roy—each owe about ₹2–3.4 lakh, creating significant concentration risk. Many smaller customers exist, but their dues are minor. Overall, a small group of large customers holds a disproportionately high share of total outstanding amounts.

3.3 <u>Product and category-wise association with payment delays</u>:

3.3.1 <u>Product-type dues:</u> The product-wise analysis shows that Stone accounts for the overwhelming majority of outstanding dues (around ₹9.72 lakh), followed by Sand and Bricks. Dust and Cement show negligible or zero dues.This indicates that receivable risk is driven primarily by stone and sand transactions, which are also the highest-volume and high-ticket materials in the firm's portfolio.



Concentration of dues in a few material types implies that payment risk is linked more to product mix than simply customer count.

3.3.2 <u>Delay ratio by product type</u>:

While stone contributes the highest absolute dues, the highest average delay ratio is observed in Bricks (≈ 40.8%), followed by Stone (≈ 27%) and Sand (≈ 21.9%). Cement and Dust have no delay ratio because they have no dues in the dataset.

This distinction is important:

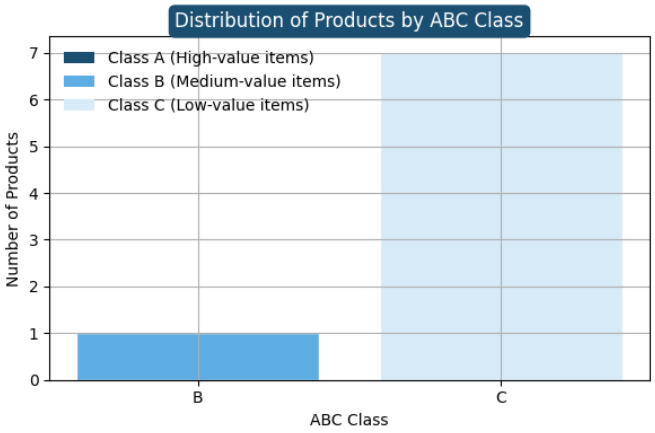
- Bricks → highest probability of delayed payment

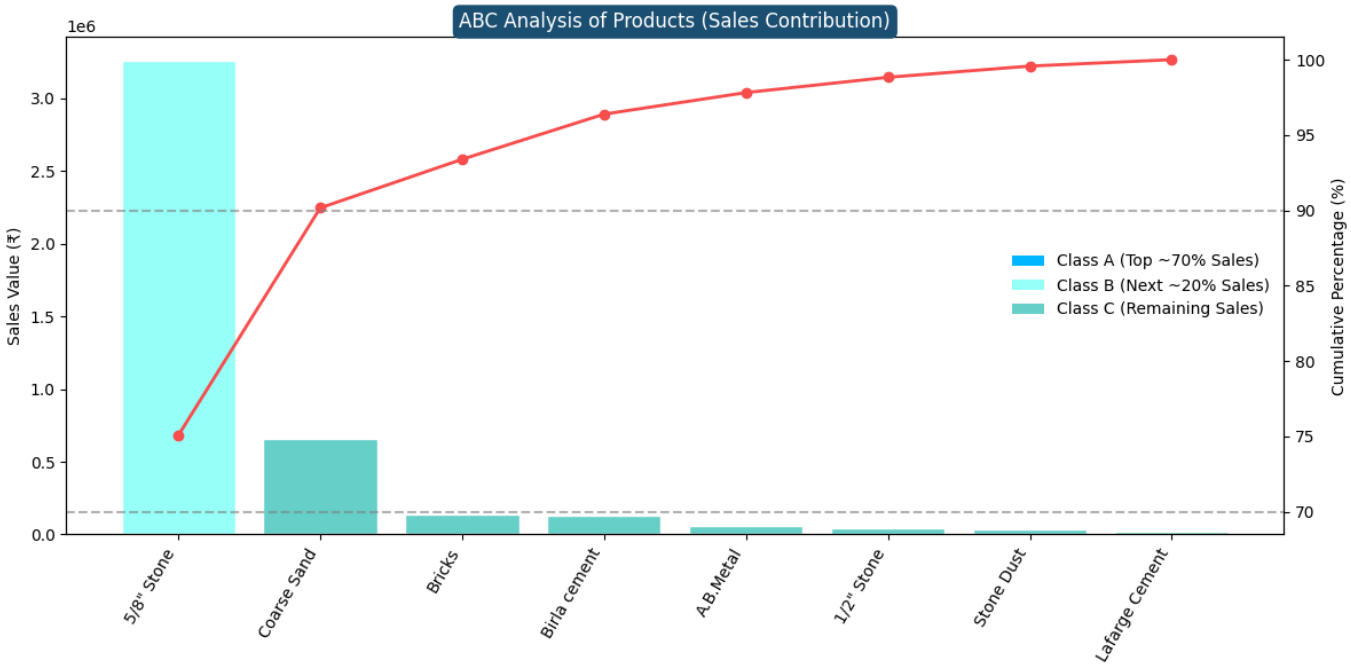
- Stone → highest value locked in delays

So, Bricks show behavioural payment risk, whereas Stone shows financial magnitude risk. The combination of high value and high delay in core materials suggests the need for tighter controls for these specific product types.

3.4 ABC Analysis of Product Contribution and Credit Exposure:

	Product Name	Sales Value	Cumulative %	Class
0	5/8" Stone	3258478	75.074101	B
1	Coarse Sand	655000	90.165054	C
2	Bricks	140000	93.390601	C
3	Birla cement	130000	96.385751	C
4	A.B.Metal	62031	97.814922	C
5	1/2" Stone	44044	98.829679	C
6	Stone Dust	32296	99.573767	C
7	Lafarge Cement	18500	100.000000	C





3.4.1 Classification of products into A, B and C categories:

ABC analysis was carried out to classify products based on their contribution to total sales value. Products were first sorted in descending order of sales, and cumulative percentage contribution was computed.

The cut-offs used were:

- Class A → top 70% of sales value
- Class B → next 20% of sales value
- Class C → remaining 10%

The resulting classification indicates a highly skewed distribution of revenue.

Contrary to the typical scenario where multiple products fall under A and B categories, the dataset shows:

- no product falling in Class A
- only one major product falling in Class B
- almost all remaining items grouped under Class C

This suggests that revenue is heavily dominated by a single core product, rather than a diversified product basket.

3.4.2 Revenue contribution of A, B and C classes:

The analysis highlights that:

- 5/8” Stone alone contributes approximately 75% of total revenue, placing it in Class B (since it crosses 70% but remains below 90%)
- all remaining items such as Coarse Sand, Bricks, Cement and others contribute small individual sales values
- collectively, the C-class products only account for a small proportion of total turnover

This confirms a classic “long-tail” structure where one item drives the majority of sales and several others exist with thin contribution.

From a business sustainability perspective, this creates dependence risk — any disruption in sales or collections related to the dominant product directly affects firm revenue.

3.4.3 Outstanding dues concentration across ABC classes:

The ABC analysis was extended by overlaying credit exposure (outstanding dues) on product categories. Findings show that:

- the same product that dominates sales — 5/8” Stone — also contributes the highest amount of overdue receivables
- Class C products carry relatively negligible dues
- the distribution of receivables is therefore not diversified, but instead clustered around very few materials

This implies that credit risk is not evenly associated with all inventory lines; rather, it is product-specific and tied closely to the main revenue driver.

3.4.4 Identification of high-revenue and high-due items: The overlap of revenue and dues highlights high-revenue, high-risk products. 5/8" Stone fits this profile with the highest sales, highest overdue amount, and frequent repeat orders, placing it in the “monitor closely” zone for inventory–credit policy. Granting easy credit on such items causes large overdue balances, locks working capital, and strains liquidity. These products therefore need shorter credit periods, stricter follow-ups, advances or milestone billing, and customer-level risk checks before dispatch.

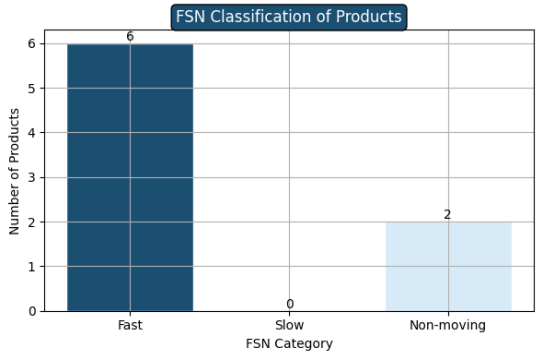
3.4.5 Managerial implication of ABC findings:

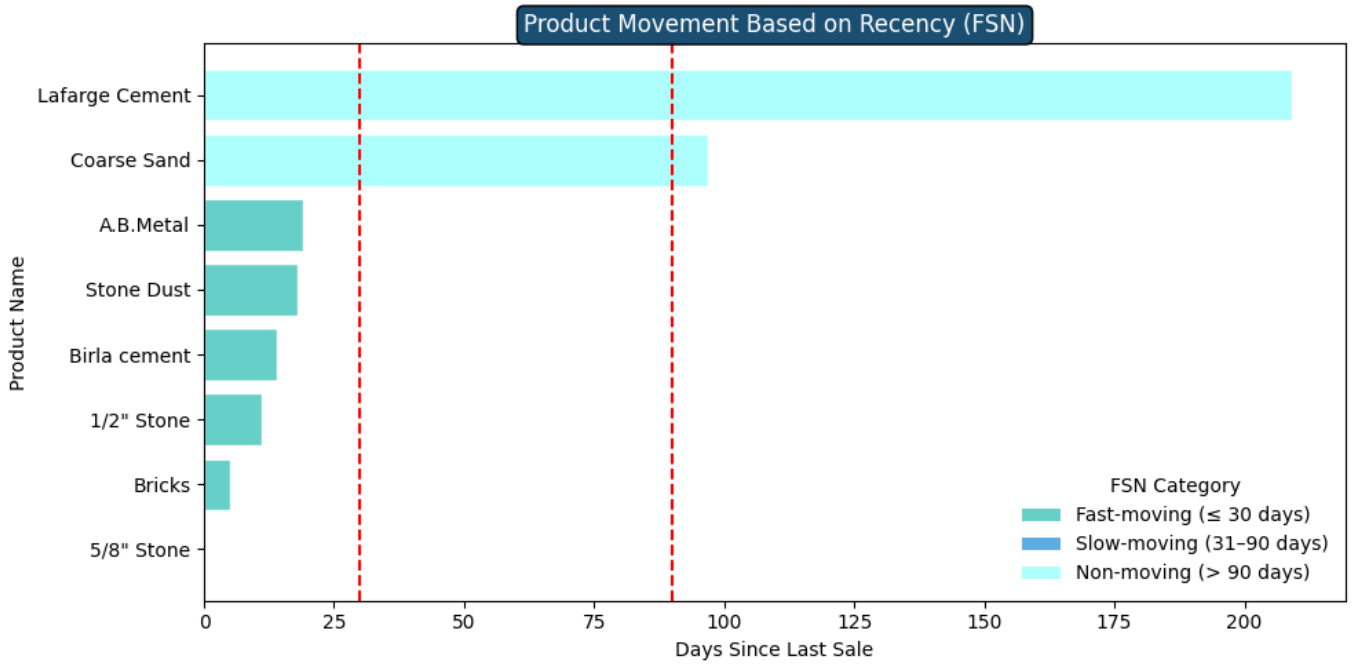
Managerial interpretation of ABC results suggests that:

- the firm does not require equal attention on all inventory items
- credit management should be prioritized on high-contribution items
- Class C products can follow relaxed credit norms
- Class B dominant products demand stringent credit control

3.5 FSN Analysis of Inventory Movement and Payment Behaviour:

	Product	Category	Days Since Last Sale	Total Quantity Sold	Unit
0	5/8" Stone	Fast	0	1816770.0	KG
1	Bricks	Fast	5	14000.0	PIECE
2	1/2" Stone	Fast	11	40040.0	KG
3	Birla cement	Fast	14	500.0	BAG
4	Stone Dust	Fast	18	40370.0	KG
5	A.B.Metal	Fast	19	40020.0	KG
6	Coarse Sand	Non-moving	97	9550.0	CFT
7	Lafarge Cement	Non-moving	209	50.0	BAG





3.5.1 Classification into Fast, Slow and Non-moving categories:

FSN (Fast–Slow–Non-moving) analysis was conducted based on the number of days since last sale for each product. The logic applied was:

- Fast-moving → last sale within 0–30 days
- Slow-moving → 31–90 days
- Non-moving → more than 90 days

The results show that:

- six products fall in the Fast-moving category
- zero products in the Slow-moving category

- two products are Non-moving

Products such as 5/8” Stone, Bricks, 1/2” Stone, Birla Cement, Stone Dust and A.B. Metal are fast-moving and record frequent transactions.

On the other hand, Coarse Sand and Lafarge Cement have not been sold for 97 and 209 days respectively, placing them firmly in the non-moving segment.

This indicates an uneven pattern of inventory consumption, where a few items move very frequently while others remain idle for extended periods.

3.5.2 Relationship Between Movement Category and Outstanding Dues:

The FSN output was compared with credit data to understand whether payment delays are linked with item movement speed.

The key observations are:

- many Fast-moving items (e.g., Stone, Bricks) also have high outstanding dues
- Non-moving items do not significantly contribute to receivables simply because their sales volumes are low
- receivable risk is therefore concentrated primarily in high-turnover products

This means the firm is currently extending credit aggressively on items that move very quickly, resulting in a fast cycle of sales but a slow cycle of cash. It creates the classic problem of “sales increasing but cash not increasing”, leading to blocked working capital.

3.5.3 Identification of Non-moving Items with High Outstanding Amounts:

Non-moving items don’t add much to total dues, but they carry a different kind of risk. They stay unsold for long periods, small unpaid amounts are hard to recover, and holding costs keep rising without revenue. Coarse Sand and Lafarge Cement show this pattern, suggesting reduced demand or shifts in price, competition, or customer preference. These items create double risk: possible inventory obsolescence and low chances of recovering outstanding dues.

3.5.4 Managerial implications of FSN analysis:

Fast-moving items require tighter credit control because they create both high sales and high dues. Non-moving items should be reduced, discounted, or discontinued. Pricing, stocking, and procurement must differ by movement category, with priority on fast movers. Credit policy should link product movement speed with payment risk.

In summary:

- Fast-moving + high dues → cash flow risk
- Non-moving + low sales → inventory carrying risk

3.6 RFM-Based Customer Segmentation and Credit Behaviour:

Customer Name	Recency	Frequency	Monetary	R_score	F_score	M_score	RFM_Score	Due Payment
Anirban Das	209	1	40400	1	1	1	3	0
Arun Roy	0	3	215748	4	3	3	10	215748
Bharat Builder's	11	2	108220	4	2	3	9	0
Hasan Mondal	209	2	50500	1	2	1	4	0
Khan Builder's	158	2	129000	2	3	3	8	29500
Khaza Builder's	18	6	403093	3	4	4	11	13893
MD. Mozam Mondal	17	1	68800	3	1	2	6	800
MD.Sukurali Mondal	14	1	130000	4	1	3	8	0
Mithu Builder's	6	14	850351	4	4	4	12	337601
Moti Mondal	119	1	43469	2	1	1	4	13469
Naim Mondal	18	2	94327	3	3	2	8	12031
Nantu Builder's	126	3	202079	2	3	3	8	68579
Rasid Daptry	189	3	44000	1	3	1	5	500
Rojjack Molla	5	9	518569	4	4	4	12	140269
Roni Builder's	15	13	783854	3	4	4	11	242254
S.R.Builder's	23	1	63310	3	1	2	6	0
Saha Builder's	41	1	66300	2	2	2	6	0
Sankar Bose	82	1	40000	2	2	1	5	14500
Tamal Biswas	172	8	470506	1	4	4	9	119876
Tutul Molla	162	1	75487	1	2	2	5	487

3.6.1 Construction of RFM metrics:

RFM analysis evaluates customers on three behavioural dimensions:

- Recency (R) – days since the last purchase
- Frequency (F) – number of transactions made
- Monetary value (M) – total purchase value

Each variable was converted into quartile-based scores:

- Recency → lower days receive higher score
- Frequency and Monetary → higher values receive higher score

The composite RFM Score = R + F + M, ranging from 3 to 12, was used to segment customers.

3.6.2 Identification of high-value and loyal customers:

Customers with RFM scores between 10 and 12 are identified as prime customers.

They purchase recently, purchase frequently, and generate high monetary value.

Mithu Builder's, Rojjack Molla, and Roni Builder's score 11–12 and are key revenue contributors. They form the core customer group and should receive priority service, pricing benefits, and preference during supply constraints.

3.6.3 Customers with high value but outstanding dues:

High-RFM customers such as Mithu Builder's, Rojjack Molla, and Roni Builder's have both high purchase values and large outstanding dues. The RFM distribution shows most customers in the mid range, with a small high-RFM group that drives both revenue and receivables. This means the best customers are also the biggest credit users, increasing working-capital pressure. They should be managed with tighter credit limits, milestone billing, and regular reminders—not disengaged.

3.6.4 Dormant and at-risk customer segments:

Customers with low RFM scores (3–5) show long purchase gaps, few transactions, and low spending. Examples include Anirban Das, Hasan Mondal, and Rasid Daptry. They are dormant or at-risk customers with limited revenue potential but higher bad-debt risk if dues remain unpaid, as the relationship is already weakening.

3.6.5 Distribution of customers by RFM score:

The histogram of RFM scores shows:

- most customers concentrated between 5 and 9
- small clusters at the highest score end (10–12)
- minimal customers at extremely low scores

This suggests a moderately engaged customer base, with a small but powerful elite group generating the majority of cash flows and receivables.

3.6.6 Credit policy implications from RFM:

RFM findings translate directly into segmented credit strategy:

- High RFM (10–12)

  Strategic accounts, allow credit with monitored limits
- Medium RFM (6–9)

  Standard credit, stronger follow-up discipline
- Low RFM (3–5)

  Advance payment or minimal exposure only

This shifts the firm from uniform credit terms to behaviour-based lending discipline, reducing overall receivable risk without harming strong relationships.

3.7 Decision Tree for Credit Risk Classification:

A decision tree–based classification model was built to predict the credit risk level of individual invoices. The model classifies each invoice into three categories:

- Low risk – dues fully cleared
- Medium risk – partial dues or short-term delay
- High risk – persistent outstanding dues and aging invoices

The model was trained using engineered financial features including due ratio, outstanding amount, invoice age, RFM customer score, and month risk index.

The final tree reveals a dominant behaviour pattern driven primarily by the proportion of unpaid dues:

- invoices with low due ratio and low due amount are classified as Low or Medium risk
- invoices with very high unpaid proportion combined with aging invoices are classified as High risk

The model achieved strong performance:

- Overall accuracy: 92–93%
- High recall for high-risk invoices (no high-risk invoice misclassified)
- Balanced performance across classes despite class imbalance

This confirms that the structure learned by the decision tree is both statistically stable and business interpretable.

3.7.1 <u>Structure of the Learned Decision Rules</u>:

The root node of the tree shows the most powerful discriminator: Due Ratio (Unpaid portion of invoice) is the primary split customers with a very high unpaid share trigger risk flags immediately.

Key rule segments that emerged:

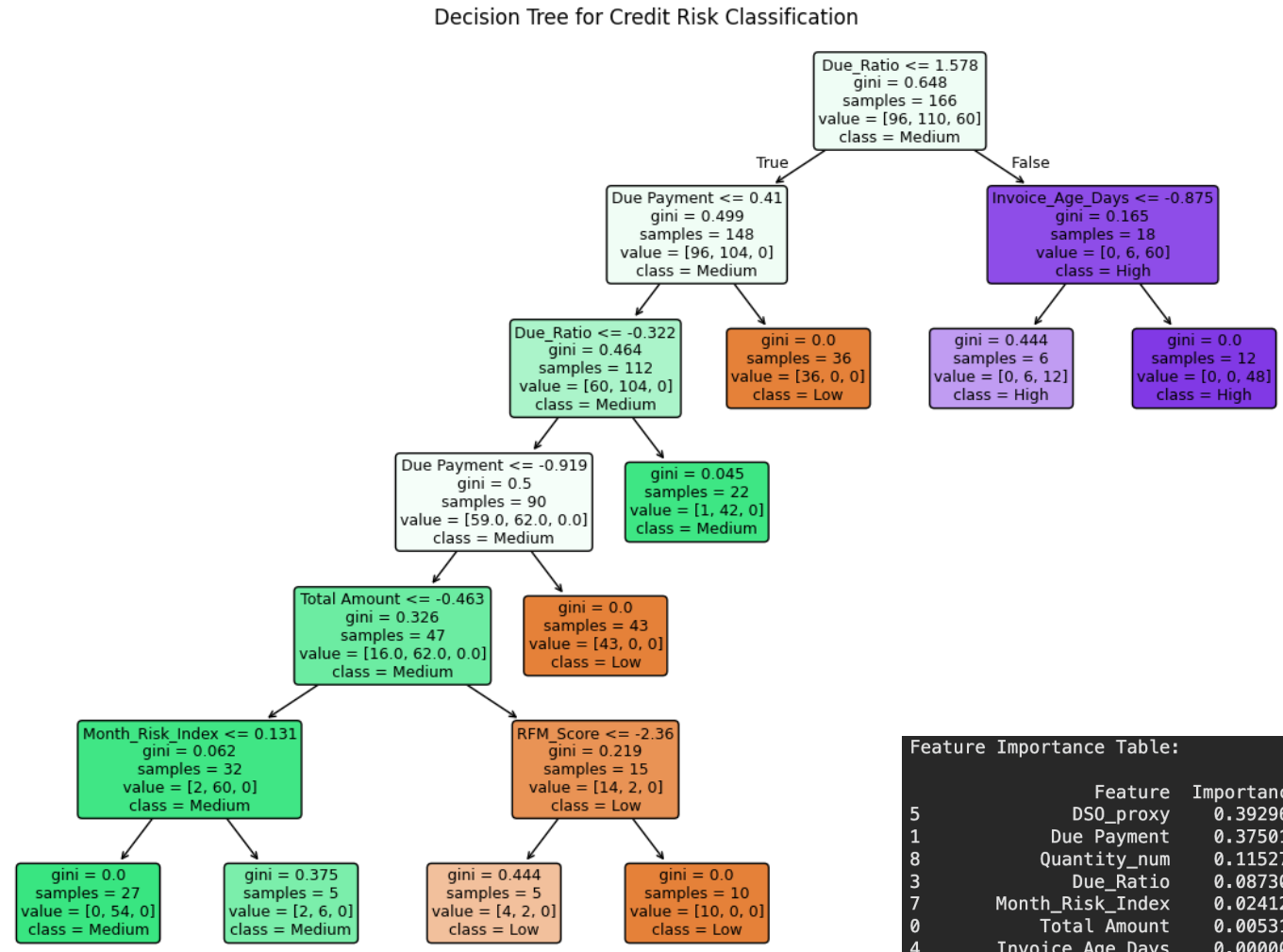
1. High-Risk Region
    - Due_Ratio extremely high
    - Invoice Age high
    - Large dues remain unpaid
2. These observations consistently fall into the High credit risk class.
3. Medium-Risk Region
    - Moderate unpaid ratio
    - smaller outstanding amounts
    - some delay but not severely overdue
4. Low-Risk Region
    - Zero or near-zero Due_Ratio
    - invoices already cleared
    - irrespective of original invoice value

3.7.2 <u>Feature Importance Analysis</u>: The decision tree shows Due_Ratio as the most important predictor, followed by Due Payment. Total Amount has moderate importance. Invoice Age contributes only marginally, while Month Risk Index and RFM Score add very little to the model.

<u>Interpretation:</u>

- the model is fundamentally learning how much is unpaid
- absolute dues and percentage unpaid both matter

- customer loyalty (RFM) and month seasonality play supporting roles rather than driving roles



Classification Report Table:

	precision	recall	f1-score	support
0	1.000000	0.878788	0.935484	33.000000
1	0.809524	0.944444	0.871795	18.000000
2	0.833333	1.000000	0.909091	5.000000
accuracy	0.910714	0.910714	0.910714	0.910714
macro avg	0.880952	0.941077	0.905457	56.000000
weighted avg	0.923895	0.910714	0.912656	56.000000

Feature Importance Table:

	Feature	Importance
5	DSO_proxy	0.392965
1	Due Payment	0.375018
8	Quantity_num	0.115276
3	Due_Ratio	0.087303
7	Month_Risk_Index	0.024121
0	Total Amount	0.005318
4	Invoice_Age_Days	0.000000
2	Collected	0.000000
6	RFM_Score	0.000000
9	Cust_Builder's	0.000000
10	Cust_Contractor	0.000000
11	Cust_Retail Customer	0.000000
12	Prod_Bricks	0.000000
13	Prod_Cement	0.000000
14	Prod_Dust	0.000000
15	Prod_Sand	0.000000
16	Prod_Stone	0.000000
17	Prod_nan	0.000000
18	ABC_B	0.000000
19	ABC_C	0.000000
20	FSN_Fast	0.000000
21	FSN_Non-moving	0.000000

4. <u>Interpretation of Results</u>:

- The firm's working-capital strain is driven primarily by delayed cash inflows rather than weak sales performance. Sales are happening; cash is late to the party.
- Payment delays are structural and recurring, not random mishaps. Expected-versus-realised inflow trends show a persistent, month-after-month gap.
- A significant portion of invoice value remains unpaid for 1–3 weeks after billing, creating continuous pressure on liquidity even when sales volumes are high.
- Receivables are highly concentrated among a small number of builder-category customers, meaning risk is not widespread but clustered.

- The highest-value RFM customers also hold the largest unpaid balances, showing that "top customers" are also the biggest credit users.
- Product-wise, the business is effectively dominated by Stone products, which lead revenue, profit, dues, and risk simultaneously.
- FSN analysis shows that fast-moving items also carry the largest receivable balances, while non-moving items mainly create inventory carrying-cost risk.
- Credit risk is not random across customers or products; it is sharply focused in a narrow combination of:
    - specific builder clients
    - high-value stone and brick transactions
- The decision-tree model demonstrates a clear managerial rule:
  larger dues and higher unpaid proportion = higher default risk.
- The model identifies threshold behaviour — once outstanding dues cross certain levels, risk increases sharply rather than gradually.
- The findings confirm that behavioural payment practices, not demand or operational inefficiency, are the primary drivers of stress.
- The firm is commercially strong but financially stretched — profit exists on paper while cash waits politely at the door.
- Credit management therefore functions as a strategic activity, not clerical bookkeeping. It directly determines:
    - liquidity stability
    - ability to reinvest
    - sustainability of growth

5. Recommendations:

5.1 Implement segmented credit policy:

Credit terms should differ by customer behaviour, not be uniform.

Use RFM and payment history:

- High-RFM with regular payments: normal credit, monitored
- High-RFM but large dues: restricted credit, strict follow-up
- Low-RFM or inactive customers: advance or cash only

In essence, credit will be based on payment behaviour, not just relationship.

5.2 Set credit thresholds using decision-tree insights:

The decision-tree analysis shows that risk increases sharply beyond certain due amounts.

Actions:

- define a maximum due limit per customer
- generate automatic alert when dues cross the limit
- stop further credit supply until part payment is received
- restart supply only with milestone-based clearance

This prevents dues from growing silently into bad debt.

5.3 Strengthen collection discipline for builder customers:

Builders:

- buy the most
- delay the most
- hold the highest dues

Recommended control measures:

- written commitment dates on every large order
- part payment with each delivery
- monthly due statements (WhatsApp or printed)
- personal follow-up for repeated delays

5.4 Tighten credit on Stone and Brick transactions:

Analysis shows:

- Stone = highest revenue + highest dues
- Bricks = highest delay percentage

Business actions:

- shorter credit period on stone and bricks
- partial advance before dispatch
- freeze large orders if old dues remain unpaid
- early-payment discounts instead of penalties

This protects cash while keeping sales stable.

5.5 Reduce non-moving inventory:

FSN shows:

- Coarse Sand and Lafarge Cement are non-moving

Actions:

- stop fresh purchase unless demand revives
- clear old stock through discount if required
- negotiate terms with supplier for slow products

Non-moving stock = money blocked without return.

5.6 Focus working capital on fast-moving items:

Based on FSN:

- 5/8" Stone, 1/2" Stone, bricks = fast moving

So:

- invest more in fast-moving, high-turnover items
- avoid extra capital in slow and low-demand products

This speeds up cash cycle and improves liquidity.

5.7 Introduce simple digital credit monitoring:

Instead of only handwritten registers, use Excel or Google Sheets to track customer-wise dues, product-wise dues and sales, monthly billing vs collections, and ageing buckets (0–30, 31–60, 60+ days). This improves visibility and reduces disputes.

5.8 Link sales performance with collection, not just billing:

Right now billing happens even when dues are high.

Policy change:

- reward collection plus sales
- discourage only “bill and forget” selling
- track DSO (Days Sales Outstanding) per salesperson

This aligns team effort with cash flow, not only turnover.

5.9 Review high-risk accounts periodically:

High-risk = high-RFM + high dues + delay.

Actions:

- quarterly credit review
- delivery hold for repeated defaulters
- senior-level discussion for large overdue customers

This keeps risks visible and controlled.

5.10 Treat credit control as a strategic function, not clerical work:

Findings show:

- main problem = late payment
- not lack of customers
- not lack of sales

Management actions:

- include receivable review in monthly meetings
- track working-capital cycle regularly
- assign clear responsibility for collections

Sales bring revenue and Credit control turns revenue into real cash.