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Inventory Control Models in Indian SMEs: An Empirical Assessment Based on Enterprise Classification

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Abstract

Inventory control remains a cornerstone of operational efficiency in Small and Medium Enterprises (SMEs) in India, yet systematic evaluation across enterprise classifications—micro, small, and medium has been limited. This study empirically investigates the adoption and effectiveness of key inventory control models, including Economic Order Quantity (EOQ), Just-In-Time (JIT), and ABC analysis, in a cross-sectional sample of 450 SMEs across manufacturing clusters in Maharashtra, Tamil Nadu, and Gujarat. Findings indicate that microenterprises prefer heuristic and manual methods, whereas medium enterprises exhibit higher adoption rates of quantitative models such as EOQ and JIT. A chi-square analysis confirmed significant differences in model adoption across enterprise classifications. The study further identifies the primary drivers and inhibitors of model adoption, including digital readiness, training levels, and working capital constraints. The implications are crucial for policymakers and practitioners aiming to tailor inventory interventions to SME sub-types. This research bridges a critical gap in inventory literature by aligning control models with real operational contexts within the SME spectrum in India.

1. Introduction

Micro, Small, and Medium Enterprises (MSMEs) are often referred to as the backbone of developing economies due to their role in employment generation, innovation, and regional development. In India, MSMEs contribute approximately 30% to the national GDP and account for over 48% of exports, spanning sectors such as textiles, engineering goods, food processing, and auto components (Ministry of MSME, 2023). According to a report by the Confederation of Indian Industry (CII, 2022), India houses more than 63 million MSMEs, making it one of the world's most dynamic and diverse SME ecosystems. Despite this expansive role, these enterprises face persistent operational challenges—among which inventory control stands out as a major determinant of cost efficiency, customer responsiveness, and supply chain reliability (Kumar et al., 2020).

Inventory control is the process of managing stock levels—raw materials, work-in-progress, and finished goods—to minimize costs without compromising service levels (Stevenson, 2018). Efficient inventory management directly influences working capital, cash flows, and profitability, particularly in resource-constrained SMEs (Sharma & Ghosh, 2017). The traditional view holds that inventory optimization through scientific models such as Economic Order Quantity (EOQ), Just-In-Time (JIT), and ABC classification can enhance operational performance (Heizer, Render, & Munson, 2020).

However, empirical evidence from Indian SMEs suggests a misalignment between the theoretical sophistication of inventory models and their practical applicability in small-scale industrial contexts (Rajeev, 2008). SMEs in India are classified based on investment in plant and machinery and annual turnover, as per the revised MSME Development Act, 2020. This classification—micro (up to ₹1 crore investment), small (up to ₹10 crore), and medium (up to ₹50 crore)—serves as a lens to understand enterprise-level capability in technology adoption, decision-making, and inventory model suitability (Goel et al., 2021). The literature on inventory management has largely treated SMEs as a monolithic group, overlooking nuanced differences in

inventory challenges across these classifications (Chong et al., 2009; Ahuja & Khamba, 2010).

Micro-enterprises typically lack digital tools, formalized processes, and trained staff to implement model-based inventory control. Their inventory decisions are often heuristic and experience-driven (Prajogo & Olhager, 2012). Small enterprises show some level of standardization, using simplified EOQ models or safety stock calculations, often supported by spreadsheet tools (Subramanian et al., 2022). Medium enterprises, on the other hand, are more likely to implement ERP systems, integrate forecasting tools, and adopt JIT methodologies (Kamble, Gunasekaran, & Gawankar, 2020). This heterogeneity necessitates a differentiated analysis of inventory control practices across enterprise types.

The lack of understanding of the relationship between enterprise classification and inventory model adoption impedes the design of effective policies and support mechanisms. For example, the Technology Upgradation Fund Scheme (TUFS) and the Zero Defect Zero Effect (ZED) certification promoted by the Indian government assume a degree of operational maturity that may not be present in micro and small units (MSME Report, 2023). This leads to poor incentive uptake, underutilization of inventory technologies, and continued reliance on traditional inventory methods (Patel & Desai, 2020).

International studies have shown that inventory control models must be contextually adapted to firm size, sector, and resource capability (Christopher, 2016; Wild, 2017). In Indonesian SMEs, Rachmania et al. (2021) found that the adoption of ABC analysis increased significantly only in medium-sized enterprises due to the requirement for skilled labor and access to software. Similarly, a study of South African SMEs by Fatoki (2014) found that microenterprises perceived formal inventory models as “too technical,” favoring physical stock counts and visual reorder cues instead.

In the Indian context, the findings remain limited and fragmented. While a few sector-specific studies have been conducted—for instance, in textile MSMEs (Bhattacharya & Sinha, 2018), agro-processing units (Rathi & Tiwari, 2022), and engineering goods (Mukherjee et al., 2021)—there is a lack of pan-sectoral empirical research that systematically examines inventory control preferences across micro, small, and medium enterprise categories. Without this, it becomes difficult for supply chain consultants, policymakers, and technology providers to design size-specific interventions.

Inventory management is further complicated by macroeconomic shocks such as the COVID-19 pandemic, which exposed serious vulnerabilities in MSME supply chains (Jain, Sharma, & Yadav, 2021). A survey by FICCI (2021) revealed that 78% of Indian MSMEs reported stockouts or excess inventory during the pandemic, largely due to poor demand forecasting and inflexible inventory models. This reinforces the need to assess not just the presence of inventory models but also their resilience, adaptability, and alignment with the enterprise's size and operational structure.

Another factor influencing inventory model selection is the enterprise's digital maturity. Research by Deloitte (2022) shows that digital inventory systems, such as barcoding, mobile stock tracking, and cloud ERP, are increasingly available but underutilized among smaller SMEs. The cost-benefit equation often deters micro and small enterprises from investing in advanced inventory tools unless incentivized or supported through cluster-based platforms (Mehta & Singh, 2019).

Additionally, cultural and behavioral dimensions also affect inventory control practices. Studies have shown that Indian SME owners often exhibit high risk aversion, reluctance to delegate, and a preference for intuitive decision-making over data-driven planning (Venkatesh & Ghosh, 2020). These behavioral traits must be considered while recommending inventory models. For instance, visual Kanban or two-bin systems may suit micro firms better than stochastic inventory models requiring software literacy and continuous monitoring.

The current study seeks to fill these crucial gaps by conducting a comparative empirical assessment of inventory control models used by Indian SMEs, classified by enterprise type. The key research objectives include:

1. To identify and categorize the inventory control models used across micro, small, and medium Indian SMEs;
2. To analyze the statistical association between enterprise classification and the type of inventory model adopted;
3. To explore operational, digital, and behavioral barriers to model implementation across enterprise types;
4. To suggest size-specific policy and technology recommendations for improving inventory control effectiveness.

By adopting a multi-state sample of 450 SMEs and employing quantitative methods such as chi-square tests and regression analysis, this study offers statistically validated insights that go beyond anecdotal or sector-specific findings. It aligns with the call by global scholars such as Cachon and Terwiesch (2019) and national frameworks, such as the Digital MSME Scheme, to ensure evidence-based operational improvement.

This research will contribute to both theory and practice. On the theoretical front, it brings granularity to the literature on SME inventory control by linking it with enterprise typology. On the practical front, it equips government agencies, NGOs, and private consultants with targeted strategies to improve inventory performance in SMEs of varying sizes. As India aspires to become a $5 trillion economy, enhancing operational efficiency in its vast MSME sector through better inventory control becomes not just desirable but imperative.

2. Literature Review

2.1 Theoretical Foundations of Inventory Control

Inventory control is a critical domain of operations management concerned with maintaining optimal inventory levels to ensure supply chain continuity, cost-efficiency, and service responsiveness (Silver, Pyke, & Peterson, 1998). Foundational models such as Economic Order Quantity (EOQ), Just-In-Time (JIT), and Material Requirements Planning (MRP) are widely cited in literature for minimizing holding and ordering costs while avoiding stockouts (Nahmias & Olsen, 2015). More recently, hybrid and AI-based models such as stochastic inventory control, demand sensing, and inventory optimization through machine learning have been gaining traction (Bertsimas & Thiele, 2006; Salameh & Jaber, 2000). However, the effective implementation of these models remains contingent on the organization's operational maturity and digital readiness, particularly in SMEs.

2.2 Inventory Practices in SMEs: Global Evidence

Small and Medium Enterprises (SMEs) often exhibit fragmented inventory practices due to resource limitations, lack of structured processes, and informal decision-making (Ayyagari, Demirgüç-Kunt, & Maksimovic, 2011). Studies of European SMEs suggest that while awareness of scientific inventory models exists, their implementation is often ad hoc, relying heavily on owner intuition and manual logs (Hvolby & Trienekens, 2010). Similarly, Kurniawan and Widodo (2020) found that Indonesian SMEs adopted simplified ABC analysis and reorder point models but lacked formal documentation and automation.

In African SMEs, Mungai and Makori (2015) reported widespread reliance on visual tracking and experience-based stock estimation, leading to issues like overstocking and production delays. In Latin America, Lopez and Gonzalez (2018) observed that while EOQ and JIT were taught in managerial training, less than 25% of SMEs surveyed had implemented these models due to perceived complexity and high implementation costs.

These patterns are consistent with broader theories on SME behavior that highlight informality, managerial bandwidth constraints, and reactive planning as core inventory challenges (Love & Roper, 2015). The SME context, therefore, demands customized, simplified, and context-sensitive inventory solutions rather than direct transplantation of models from large enterprises.

2.3 Indian Context of SME Inventory Management

The Indian MSME sector is marked by diversity in sector, scale, and technological sophistication. Yet inventory control remains a common operational pain point. Banerjee and Mondal (2020) observed that many Indian SMEs follow outdated inventory practices, such as bulk procurement driven by supplier push rather than demand pull. Even in organized clusters like Coimbatore or Ludhiana, firms rarely use statistical forecasting or automated replenishment systems (Deshmukh, Seth, & Vrat, 2013).

Mohite et al. (2025) underscore the competitiveness challenge Indian SMEs face in supply chain performance due to the limited integration of industrial engineering principles. Their study highlights how manual inventory control impedes cycle-time reduction and cost minimization, particularly in microenterprises. Another study by Sharma, Chaurasiya, Mohite, and Akre (2025) on India's defense supply sector found significant inefficiencies in inventory visibility and coordination among small subcontractors due to the absence of standardized models.

Building on this, Sharma et al. (2025) further elaborate on "inventory woes and logistic bottlenecks" in Indian defense MSMEs, where inadequate warehouse digitization and unoptimized buffer stock led to delays and operational rigidity. While defense SMEs face greater regulatory oversight, inventory control mechanisms still vary widely by enterprise size and supplier type.

2.4. Classification-Based Inventory Studies

The role of enterprise classification—micro, small, or medium—influencing inventory management has received increasing attention. Research by Ogunlana et al. (2017) on Nigerian SMEs indicated that micro-units rarely formalize inventory policies due to a lack of trained staff, while small and medium firms showed structured procurement and safety stock methods. In India, Kadam and Gokhale (2019) examined inventory management techniques across 120 SMEs in Maharashtra and found that microenterprises relied on physical inspection, while medium-sized firms adopted EOQ and forecast-based reordering.

Their regression analysis revealed a statistically significant correlation between firm size and inventory control sophistication ($p < 0.01$). Pandey and Aggarwal (2021) conducted a comparative case study across textile, electronics, and food processing SMEs in Gujarat and found that medium enterprises invested in ERP-integrated inventory systems, enabling them to switch to JIT models post-pandemic. In contrast, micro-enterprises still relied on ledger books and suffered from stock obsolescence. These studies validate the hypothesis that inventory control is not homogeneously applied across SMEs. Instead, it is shaped by enterprise classification, sectoral needs, and owner-manager knowledge levels.

2.5 Digital Readiness and Inventory Automation in Indian SMEs

Digital transformation has been a major policy push for Indian MSMEs through initiatives like Digital MSME and ZED certification. However, its impact on inventory control remains uneven. According to Pande and Sharma (2022), only 14% of Indian MSMEs surveyed had real-

time stock visibility through barcode or RFID-enabled systems. Saxena and Vohra (2020) argue that while low-cost mobile apps such as KhataBook and Vyapar have increased adoption of basic inventory logs, they are rarely linked to decision-support systems, such as EOQ calculators or demand forecasting engines. This limits their utility for scientific inventory control.

Recent innovations in cloud-based ERPs and AI-based inventory monitoring tools have shown promise, but uptake remains low due to affordability, skill gaps, and fear of data misuse (Rathi, 2021). The adoption of JIT or VMI (Vendor-Managed Inventory) models is particularly low in rural or semi-urban SME clusters due to erratic supplier reliability and poor digital infrastructure.

2.6 Behavioral and Managerial Influences

The decision to adopt a particular inventory model is not just operational but also behavioral. Owner-manager characteristics such as openness to innovation, education level, and risk tolerance play a key role (Osei & Zhuang, 2020). A study by Yadav and Tripathi (2018) on Uttar Pradesh-based SMEs found that, even when inventory tools were available, their use was low due to resistance to change and limited delegation of control. Sridharan and Arunkumar (2021) found that in many family-owned microenterprises, inventory decisions were centralized and intuitive, often resisting the use of data-driven tools. They emphasized the need for inventory training programs integrated into entrepreneurship development schemes.

2.7 Emerging Inventory Techniques for SMEs

To address SME constraints, researchers have proposed simplified or hybrid inventory models. Shukla and Barua (2019) proposed a modified EOQ model with uncertainty buffers suitable for SMEs with volatile demand patterns. Mukhopadhyay et al. (2022) tested a simulation-based stochastic model in Gujarat SMEs and reported a 16% improvement in service levels without increasing inventory cost. Additionally, the concept of Lean Inventory—adapted from Lean Manufacturing—has been gaining ground in medium-sized Indian enterprises, especially in the auto parts and electronics sectors. However, its applicability to micro firms remains limited due to a lack of process stability and skilled manpower (Gupta & Jain, 2021).

2.8. Synthesis and Research Gap

The literature converges on several important themes:

- Inventory control practices are highly heterogeneous across SME classifications.
- Adoption of scientific inventory models is positively correlated with enterprise size.
- Indian SMEs, particularly micro and small firms, face unique structural and behavioral barriers in adopting inventory control systems.
- Limited research exists that quantitatively links inventory control models with firm classification in the Indian context across sectors and geographies.

Despite increasing policy emphasis and academic inquiry, there remains a clear empirical gap in understanding how inventory control models are adopted (or rejected) across micro, small, and medium enterprises in India. The current literature largely focuses on either generalized SME behavior or on sectoral case studies without a classification lens. Thus, this study aims to bridge that research gap through a large-scale empirical assessment of inventory control models across 450 Indian SMEs, classified by enterprise type. It offers a needed intersection of quantitative analysis, contextual adaptation, and policy relevance in the domain of inventory management.

3. Materials and Methods

3.1 Research Design and Scope

This study adopts a quantitative research design, supported by an empirical survey methodology. The primary objective is to examine the relationship between enterprise classification (micro, small, and medium) and the adoption of inventory control models in Indian manufacturing SMEs. A stratified random sampling approach was used to ensure that each enterprise category—micro, small, and medium—was proportionately represented in the sample.

The rationale for choosing a stratified approach lies in the operational diversity across the three classes of enterprises, as defined by the Ministry of Micro, Small, and Medium Enterprises (2023), which directly influences their inventory capabilities and decision-making structures. This methodological choice aligns with prior SME research, such as that of Kumar, Singh, and Shankar (2020), which emphasizes the use of quantitative tools to evaluate operational model adoption.

Moreover, by focusing solely on manufacturing SMEs, the study ensures uniformity in operational structure, excluding service-sector SMEs, where inventory practices are often irrelevant or vary widely. The study primarily evaluates the usage and relevance of five types of inventory control models across Indian SMEs. These models include:

1. Economic Order Quantity (EOQ)
2. Just-In-Time (JIT)
3. ABC Classification
4. Two-Bin System
5. Heuristic/Manual Control Systems

The empirical investigation was designed to test the following hypotheses:

- H1: There is a statistically significant difference in inventory model adoption across micro, small, and medium enterprises.
- H2: Enterprise classification significantly influences the probability of using structured inventory models (e.g., EOQ, JIT) over manual/heuristic methods.
- H3: Adoption of structured inventory models is positively associated with digital readiness and ERP usage.

3.2. Sample and Data Collection

The study's fieldwork was conducted between July and November 2024 across three industrial states in India, selected based on their vibrant SME manufacturing ecosystems and availability of clustered firms:

- Maharashtra: Pune (automotive and precision engineering) and Boisar (chemical and steel fabrication)
- Tamil Nadu: Tirupur (textiles and hosiery) and Hosur (automobile components)
- Gujarat: Vadodara (electrical and heavy machinery) and Surat (textile processing and plastics)

A total of 450 manufacturing SMEs were surveyed using structured questionnaires and face-to-face interviews with either the inventory supervisors or operations managers. The sample distribution was as follows:

Table 1. Sample Distribution

Enterprise Type	Sample Size	Percentage
Micro	200	44.4%
Small	150	33.3%
Medium	100	22.3%

3.3. Sampling Framework

The lists of registered SMEs were sourced from the respective district industries centers (DICs), MSME Development Institutes (MSME-DIs), and cluster associations, such as COSIA and SIDBI-promoted industrial parks. Enterprises were selected based on their current manufacturing activity status and willingness to participate in the research.

3.4. Questionnaire Design

The survey instrument was divided into five sections:

1. Enterprise demographics (type, age, sector, turnover, employees)
2. Inventory management tools and systems used
3. Awareness and use of structured inventory models
4. Perceptions of inventory model effectiveness
5. Constraints in inventory control

The questionnaire was pilot-tested on 20 SMEs in Pune and revised for clarity. Data collection was conducted in local languages where required (Marathi, Tamil, and Gujarati) with translation assistance to ensure high response quality. Response Rate: Of 580 SMEs approached, 450 completed responses were received, yielding a 77.6% response rate, which is statistically sufficient for generalizing results at a 95% confidence level (margin of error ~4.5%).

3.5. Inventory Model Categorization

Based on literature synthesis (e.g., Stevenson, 2018; Mohite et al., 2025), five inventory models were identified for inclusion:

1. EOQ (Economic Order Quantity): A quantitative model minimizing total ordering and holding costs. Requires demand predictability and data consistency.
2. JIT (Just-in-Time): Inventory arrives as needed, reducing carrying costs. Demands a reliable supply chain and high coordination.
3. ABC Classification: Segregates inventory into A, B, and C categories based on consumption value, improving control focus.
4. Two-Bin System: Simple reorder-based method used in low-tech firms; relies on visual inspection and buffer stocks.
5. Heuristic/Manual Control Systems: Informal, experience-driven decisions without reliance on data or formal algorithms.

Respondents were asked to identify the primary inventory model used, and any secondary models occasionally implemented.

3.6. Analytical Techniques

The collected data were cleaned, coded, and analyzed using IBM SPSS Statistics Version 26. The analysis followed a structured analytical framework combining descriptive and inferential statistical techniques to address the study objectives and test the proposed hypotheses.

Descriptive statistics were first employed to summarize and profile the dataset. Frequency and percentage distributions were computed to examine patterns of adoption of the inventory control model across micro, small, and medium enterprises. In addition, measures of central tendency and dispersion, including mean, median, and standard deviation, were used to evaluate firm characteristics such as enterprise size, inventory turnover rate, and the frequency of inventory model usage. These descriptive measures provided an initial overview of inventory management practices and facilitated comparison across enterprise classifications.

To test Hypothesis H1, a Chi-square test for independence was conducted to assess whether the adoption of inventory control models is statistically dependent on enterprise classification. A contingency table was constructed with enterprise classification

(micro, small, and medium) as the row variable and inventory model type (EOQ, JIT, ABC classification, Two-Bin system, and manual or heuristic methods) as the column variable. The test was performed under standard assumptions of independence of observations and adequacy of expected cell frequencies, with at least 80% of the cells meeting the minimum expected count of five.

To test Hypotheses H2 and H3, a binary logistic regression was conducted to identify the key determinants of the adoption of structured inventory control models. The dependent variable was dichotomized, with firms using structured models (EOQ, JIT, or ABC classification) coded as one and those relying on manual or heuristic systems coded as zero. The independent variables included enterprise classification (dummy-coded), ERP usage (yes/no), workforce training level (low, medium, or high), and the degree of inventory digitization (manual, partially digital, or fully digital). This multivariate approach enabled the assessment of the relative influence of organizational, technological, and human-capital factors on inventory model adoption. The logistic regression model is specified as:

$$Logit(P) = \beta_0+\beta_1 \cdot EnterpriseType+ \beta_2 \cdot ERPUsage + \beta_3 \cdot TrainingLevel + \beta_4 \cdot DigitizationLeve l+ \varepsilon$$

The significance and adequacy of the logistic regression model were evaluated using multiple diagnostic measures. Model fit was assessed through the Hosmer–Lemeshow goodness-of-fit test, which examined the alignment between observed and predicted outcomes and indicated an acceptable model fit. The overall explanatory power of the model was further evaluated using Nagelkerke R^2, providing an indication of the proportion of variance in structured inventory model adoption explained by the predictor variables. In addition, Wald statistics were used to assess the individual contributions and statistical significance of each independent variable in the regression model.

To ensure the robustness of the measurement instrument, reliability and validity were assessed. Internal consistency reliability for multi-item constructs was evaluated using Cronbach's alpha; values exceeding 0.75 were considered acceptable, indicating satisfactory reliability. Furthermore, content validity was established using the Content Validity Index (CVI), in which the questionnaire items were reviewed and validated by three domain experts in operations and supply chain management. This expert validation process ensured that the survey instrument adequately captured the conceptual dimensions of inventory management practices and SME operational characteristics.

4. Results and Discussions

This section presents and discusses the empirical findings from a survey of 450 manufacturing SMEs in India. The data were analyzed using SPSS version 26, employing both descriptive statistics and inferential techniques to test the study hypotheses. The analysis focuses on understanding patterns of inventory control model adoption across micro, small, and medium enterprises, while statistically validating the observed differences and interpreting their managerial implications.

The result reveals marked differences in inventory control practices across enterprise classifications, clearly demonstrating that inventory management sophistication increases systematically with enterprise size and organizational maturity. Five inventory models were identified in the surveyed firms: Economic Order Quantity (EOQ), Just-in-Time (JIT), ABC Classification, Two-Bin System, and Manual or Heuristic methods. As shown in Table 3, micro enterprises predominantly rely on manual or heuristic approaches, with 60.8% of firms using informal, experience-based inventory control systems. This heavy dependence reflects limited digital infrastructure, weak record-keeping practices, and reliance on owner intuition and visual stock inspection. The two-bin system, adopted by 28.2% of micro enterprises, further reinforces the preference for simple, low-cost inventory methods that do not require extensive data, forecasting capability, or technological investment. In contrast, the adoption of structured inventory models among micro firms remains minimal, with only 12.5% using EOQ, 7.0% implementing JIT, and 9.3% applying ABC classification, underscoring significant constraints in analytical capability and supply chain coordination.

Table 2. Inventory Model Adoption by Enterprise Type

Inventory Model	Micro (%)	Small (%)	Medium (%)
EOQ (Economic Order Quantity)	12.5	41.3	73.5
JIT (Just-In-Time)	7.0	33.2	65.1
ABC Classification	9.3	24.6	51.0
Two-Bin System	28.2	16.7	10.5
Manual/Heuristic System	60.8	29.8	9.7

Small enterprises exhibit a transitional pattern in inventory management, positioned between informal and structured practices. While manual or heuristic systems are still used by 29.8% of small firms, their prevalence declines substantially compared to microenterprises, indicating a gradual shift toward formalized inventory control. At the same time, the adoption of structured models is increasing significantly, with 41.3% of small enterprises implementing EOQ and 24.6% using ABC classification. The uptake of JIT (33.2%) suggests that improving supplier relationships and basic process synchronization is needed, although full real-time coordination remains limited. Many small enterprises employ hybrid approaches, combining structured models with spreadsheet-based tracking or partially digitized systems, reflecting both growing

awareness of inventory optimization benefits and persistent resource constraints.

Medium enterprises demonstrate the highest level of inventory management sophistication, with a clear dominance of structured, data-driven inventory models. More than 73.5% of medium firms adopt EOQ, while 65.1% implement JIT, indicating strong analytical capability, reliable supplier networks, and advanced process integration. Additionally, 51.0% of medium enterprises use the ABC classification, indicating the ability to perform SKU-level analysis and prioritize inventory based on value contribution. In contrast, reliance on manual or heuristic methods drops sharply to 9.7%, and the use of the two-bin system declines further to 10.5%, signaling a near-complete transition away from informal inventory practices. The progression observed in Table 2 provides compelling empirical evidence that enterprise classification is a decisive determinant of inventory model adoption, with larger and more mature firms exhibiting greater capacity to implement structured, technology-enabled inventory management systems.

Table 3. Result of Chi-Square (χ^2) test

Inventory Control	Chi-Square (χ^2)	p-value
EOQ (Economic Order Quantity)	61.23	< 0.01
JIT (Just-in-Time)	48.90	< 0.01
ABC Classification	37.65	< 0.01
Manual/Heuristic Methods	67.55	< 0.01

Table 3 presents the results of the Chi-square tests examining whether the adoption of different inventory control models varies significantly across enterprise classifications. The statistical analysis confirms that enterprise size has a strong, statistically significant association with inventory control behavior, as evidenced by p-values below 0.01 across all examined models. These findings indicate that the observed adoption patterns are not random but systematically influenced by organizational scale and capability.

The adoption of the Economic Order Quantity (EOQ) model shows a particularly strong association with enterprise size, as reflected in a Chi-square value of 61.23. EOQ usage increases sharply from 12.5% among micro enterprises to 73.5% among medium enterprises, highlighting the growing feasibility of analytical inventory optimization as firms scale up. This significant variation can be attributed to the data-intensive nature of EOQ, which requires reliable demand forecasting, accurate cost estimation, and consistent record-keeping. Microenterprises, which often operate with informal or nonexistent inventory records, typically lack the data infrastructure needed to support EOQ calculations. In contrast, medium-sized enterprises are more likely to possess structured data systems and trained personnel capable of implementing EOQ effectively, which explains the strong size-based disparity.

Similarly, the adoption of Just-in-Time (JIT) inventory management shows a statistically significant dependence on enterprise classification, with a Chi-square value of 48.90. While over 65% of medium enterprises report using JIT, adoption among micro enterprises remains minimal. JIT systems depend heavily on synchronized supply chains, reliable suppliers, and real-time inventory monitoring—conditions that are difficult to achieve in micro-level operations characterized by supplier uncertainty, irregular order cycles, and limited technological integration. The significant Chi-square result underscores that JIT is inherently unsuitable for highly uncertain and fragmented operational environments but becomes increasingly viable as enterprises grow and stabilize their supply chain relationships.

The results for ABC Classification also indicate a statistically significant adoption gradient across enterprise sizes, with a Chi-square value of 37.65. Although the increase in adoption from micro to medium-sized enterprises is more moderate than for EOQ and JIT, the pattern remains consistent. ABC classification requires SKU-level data, inventory valuation, and analytical segmentation based on consumption value—capabilities largely absent in micro enterprises. As firms transition into small and medium categories, improved record-keeping and partial ERP adoption enable more systematic inventory categorization, making ABC analysis operationally feasible. The statistical significance of this relationship confirms that data availability and organizational structure are critical to enabling value-based inventory segmentation.

In contrast, manual and heuristic inventory methods demonstrate the strongest inverse association with enterprise size, as indicated by the highest Chi-square value of 67.55. These methods are most prevalent among micro enterprises, where 60.8% of firms rely on experiential knowledge, visual stock inspection, and rule-of-thumb decision-making. As enterprise size increases, reliance on such informal practices declines sharply, reflecting a gradual shift toward standardized, analytical inventory systems. This finding aligns with prior studies, which emphasize that microenterprises tend to prioritize simplicity and flexibility over optimization due to resource constraints and managerial informality. The strong statistical association reinforces the conclusion that manual inventory control is not a matter of preference but a structural response to limited capability and scale.

Thus, the statistical evidence presented in Table 4 provides robust support for the study's central argument that enterprise classification significantly shapes the adoption of an inventory control model. The consistent significance across all models confirms that organizational scale, data infrastructure, and supply chain maturity are decisive factors in determining whether firms adopt structured, technology-enabled inventory systems or continue relying on informal methods. These results empirically validate the

hypothesis that inventory management sophistication increases systematically with enterprise size and operational maturity.

Table 4. Logistic Regression Analysis

Predictor	β Coefficient	Wald Stat.	p-value
Enterprise Type	1.62	38.73	<0.001
ERP Usage	1.13	27.88	<0.001
Training Level	0.74	16.54	<0.01
Digitization Level	0.89	21.11	<0.001

Table 4 presents the results of the binary logistic regression analysis conducted to identify the key determinants of adopting structured inventory control models (EOQ, JIT, or ABC classification) rather than manual or heuristic methods. The model demonstrates strong explanatory power, with a Nagelkerke R^2 value of 0.58, indicating that the selected predictors collectively explain a substantial proportion of the variance in inventory model adoption among manufacturing SMEs.

Among the predictors, enterprise type emerges as the most influential factor, with a positive and highly significant regression coefficient ($\beta = 1.62$, $p < 0.001$) and a strong Wald statistic (38.73). This result indicates that as firms move from micro to small and from small to medium classification, the likelihood of adopting structured inventory models increases markedly. The magnitude of this coefficient highlights the central role of organizational scale and maturity in enabling analytical inventory practices. Larger enterprises typically possess more formalized processes, better access to financial and human resources, and greater operational stability, all of which facilitate the implementation of data-driven inventory models.

ERP usage is identified as the second most powerful predictor of structured inventory model adoption ($\beta = 1.13$, $p < 0.001$). Firms with ERP systems are substantially more likely to employ EOQ, JIT, or ABC models than those relying on manual systems. ERP platforms provide real-time inventory data, demand histories, and cost information, which are essential inputs for structured inventory decision-making. The strong statistical significance of these variables underscores the critical enabling role of digital infrastructure in transitioning SMEs from intuitive to analytical inventory control.

The regression results also reveal that training level has a positive and statistically significant influence on inventory model adoption ($\beta = 0.74$, $p < 0.01$). This finding suggests that firms with better-trained personnel are more capable of understanding, implementing, and sustaining structured inventory models. Inventory optimization techniques require not only data availability but also analytical skills to interpret outputs and translate them into operational decisions. The significance of training emphasizes the importance of human capital development as a complement to technological investment.

Similarly, digitization level has a strong, highly significant effect on the likelihood of using a structured inventory model ($\beta = 0.89$, $p < 0.001$). Firms that have moved from manual processes to partially or fully digitized inventory systems are significantly more inclined to adopt formal inventory models. Digitization enhances data accuracy, visibility, and accessibility, thereby reducing uncertainty and enabling systematic analysis. This result reinforces the argument that digitization acts as a foundational prerequisite for advanced inventory management, particularly in data-driven environments.

Taken together, the results in Table 4 demonstrate that structured inventory model adoption is driven by an interaction of organizational scale, technological readiness, and human capability. While enterprise classification sets the structural conditions for adoption, ERP usage and digitization provide the necessary technological backbone, and training ensures effective utilization of these tools. The findings provide strong empirical support for the view that inventory management modernization in SMEs requires an integrated approach combining size-related capacity building, digital transformation, and workforce skill development.

The regression results indicate that enterprise classification is the strongest predictor of structured inventory model adoption, confirming that medium enterprises are significantly more likely to implement formal inventory control techniques such as EOQ, JIT, and ABC classification. This finding reflects the higher levels of organizational maturity, resource availability, and process formalization typically associated with medium-sized firms, enabling the effective use of data-driven inventory systems. In contrast, micro and small enterprises often lack the financial, technological, and managerial capacity required to sustain structured inventory models, leading to continued reliance on informal or heuristic approaches. This size-dependent adoption pattern is consistent with prior studies that emphasize the roles of firm scale and organizational capability in operational decision-making (Rajeev, 2008; Kurniawan & Widodo, 2020).

The analysis further demonstrates that ERP implementation substantially increases the likelihood of using a structured inventory model, with firms using ERP systems approximately 3.1 times more likely to adopt formal inventory control methods. ERP systems provide real-time inventory visibility, historical demand data, and integrated cost information, which are essential inputs for analytical inventory models. This finding reinforces existing evidence that digital infrastructure acts as a critical enabler of advanced inventory management practices in SMEs (Kamble et al., 2020; Mehta & Singh, 2019).

In addition, workforce training and the level of inventory digitization are critical enabling factors for the adoption of structured inventory models. Well-trained employees are better equipped to interpret inventory data, operate digital systems, and translate analytical outputs into operational decisions. Similarly, higher levels of digitization improve data accuracy, accessibility, and transparency, reducing uncertainty and supporting systematic inventory planning. These results align with prior research highlighting the complementary roles of human capital development and digital transformation in enhancing SME operational performance and supply chain efficiency (Osei & Zhuang, 2020; Mohite et al., 2025; Sharma et al., 2025).

5. Conclusions

This study set out to empirically assess the adoption and application of inventory control models across Indian SMEs, classified by enterprise type, namely micro, small, and medium. Based on a structured survey of 450 manufacturing SMEs across Maharashtra, Tamil Nadu, and Gujarat, the findings confirm that the adoption of inventory models is significantly influenced by enterprise classification. While medium enterprises demonstrate a higher adoption of structured models such as EOQ, JIT, and ABC classification, micro enterprises continue to rely heavily on heuristic or manual inventory practices.

Small enterprises show transitional characteristics, using a mix of both structured and informal systems. Statistical analyses, including chi-square tests and logistic regression, confirm the association between firm size and the use of an inventory model. The presence of ERP systems, higher levels of employee training, and digital infrastructure emerged as key enablers of structured inventory management. Conversely, cost constraints, resistance to change, and lack of digital literacy were identified as major barriers, particularly in micro and small enterprises.

Importantly, this study does not suggest that one-size-fits-all inventory solutions are feasible across all SME categories. Rather, the findings point toward the need for a tiered policy of interventions, technological and educational, tailored to the specific capacities and constraints of each enterprise type. While structured inventory models offer operational advantages, their relevance and usability depend on enterprise maturity, sector dynamics, and infrastructural readiness.

The study contributes to both theory and practice by aligning inventory control research with enterprise classification, a dimension that has been overlooked in prior work. Future research could extend this framework to sector-specific studies, longitudinal adoption tracking, or cost-benefit analyses of model implementation in different SME contexts. Overall, a differentiated and supportive approach is essential to strengthening inventory management practices across the diverse landscape of Indian SMEs.

The findings have important practical and policy implications. Inventory management solutions should be tailored to enterprise capacity, with simplified mobile-based tools for micro firms, spreadsheet-integrated analytical models for small enterprises, and fully integrated ERP and warehouse management systems for medium firms.

Digital literacy and inventory analytics training programs should be expanded through cluster-based initiatives and national skill development schemes. Furthermore, technology adoption incentives should be tiered by enterprise classification, offering greater support to micro and small firms transitioning to structured inventory systems. Such targeted interventions can accelerate the diffusion of scientific inventory management practices while accounting for the diverse capabilities of Indian SMEs.

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