Casi 17ª Edição
Congresso de Administração, Sociedade e Inovação

Artigo completo
De 03 a 05 de dezembro de 2025

Improving Inventory Management Processes in Small and Medium Enterprises: A Case Study for a Brazilian Biological Testing Startup

Gustavo Finotti Rainho, Julia Campos de Lira, Leandro Alves da Silva, Vanessa de Almeida Guimarães

COPPEAD Graduate School of Business, Federal Univerity of Rio de Janeiro

Resumo: Small and medium-sized enterprises (SMEs) play a relevant role in Brazil's economy but often struggle with inventory management, leading to inefficiencies and financial risks. This study presents a case from the laboratory testing sector, involving over 200 types of sample analyses in a highly regulated environment. The research mapped current inventory control processes and identified key gaps such as decentralized storage, manual record-keeping, and the absence of reorder point mechanisms. Based on best practices from literature, a process improvement framework was proposed, including centralized stockroom organization, standardized workflows, and structured spreadsheets with data validation. These recommendations aim to enhance inventory visibility, reduce operational inefficiencies, and improve regulatory compliance. The study offers a replicable model for other SMEs, demonstrating that core operations management principles can be applied effectively without significant investment in technology. The approach reinforces the strategic value of process mapping as a tool for continuous improvement, especially in resource-constrained environments where agility and precision are essential for sustainable growth.

Palavras-Chave: Inventory Management; Process Mapping; Small and Medium Enterprises; Startup

1. Introduction

It is widely recognized that Small and Medium-Sized Enterprises (SMEs) have a significant role to play in economic development, in general (KASIM et al., 2015). The acronym SMEs refers to a group of organizations which, despite being smaller in scale compared to large corporations, represent a significant share of employment and productive activity, specially in Brazil where they account for approximately 99% of all existing enterprises, 30% of the GDP and 62% of private sector employment (SEBRAE, 2025).

The classification of business size is relevant since it helps understanding the reality of the organization and the challenges they currently face business wise. Microenterprises are those with gross annual revenue of up to BRL 360,000, while small enterprises have revenues between BRL 360,000 and BRL 4.8 million (BRASIL, 2006). Medium-sized enterprises are recognized as having annual revenues between BRL 4.8 million and BRL 300 million (BNDES, 2025). Distinguishing among these business sizes is relevant not only for regulatory purposes but also for understanding economic dynamics, management challenges, and the strategic role of SMEs in national development.

Despite the relevance of SMEs for the Brazilian economy, these organizations face many challenges that can be explained by the fact that most Brazilian entrepreneurs lack management skills or are unprepared to face a highly competitive market (ANHOLON et al., 2015). One of the aspects of entrepreneurship that is often mismanaged within SMEs is Inventory Management and Control (IM&C).

IM&C processes are crucial to organizations as mismanagement of inventory may generate a range of problems including loss of productivity, the manufacturing of unwanted items, a reduction in the levels of customer commitment, the accumulation of costly physical inventories and frustration (RAJEEV, 2008). Additionally, it is also possible to understand inventory management (IM) as a leverage for higher revenue and profits, as it can be used to balance the supply and demand of a specific product playing a crucial part of a systematic supply chain of a business (ALAM, THAKUR, ISLAM, 2023). Inventory management encompasses the planning and control of inventory levels (SLACK et al., 2013).

Although this critical role of IM&C for a firm's smooth operation is well recognized in theory, IM&C does not necessarily drive practice in many small and medium enterprises (RAJEEV, 2008). Small firms mostly neglect IM&C by accumulating excessive inventory for a time with cash tied in it, and it leads to the inability to control the flow of inventory effectively (ALAM, THAKUR, ISLAM, 2023). Other difficulties related to inventory management in SMEs can be categorized as divergence between theoretical and real inventory; problems related to product validity; problems related to quality, appearance and conformity of products and problems related to the minimum number of items that can be purchased (ANHOLON et al., 2015).

The topic of IM&C in SMEs has been gaining notoriety in academia of developing countries such as Bangalore (RAJEEV, 2008); Kenya (NYANG'AU, 2013); Ghana (KASIM et al., 2015); Bangladesh (ALAM, THAKUR, ISLAM, 2023) and Brazil (ANHOLON et al., 2015).

However, there appears to be a lack of specific research studies on inventory management and control through the approach of process mapping and improvement.

Given the above, it is possible to raise the following research question: What are the processes of inventory management and control that SMEs can adopt in order to better control their operations? In order to address this research question, this paper will conduct a case study in a Brazilian SME. By doing a case study in firm, this research intends to propose process recommendations for inventory management and control, considering the organization's reality. In this sense, the following specific objectives were defined: (i) map laboratory's current inventory management and control processes (as is); and (ii) redesign the inventory management and control process (to be) for stakeholders considering improvements for efficiency and quality control.

The company is an example of a SME that performs laboratory testing for medical facilities, food and pharmaceutical products. Founded in 2023, fueled by an innovative real-time PCR solution for food testing, the startup was incubated an innovation agency inside a Brazilian Federal University. The revenue expected for 2025 is BRL 3 million, thus being categorized as a SME. The laboratory offers more than 200 types of sample testing, which depends on the client's industry regulation and imposes a complexity for inventory management.

Given the potential of the SME sector relevancy to the Brazilian economy, this study aims to be useful for small scale businesses owner/managers and other stakeholders that may wish to help formulate and implement processes improvements to better manage and control inventory. It will also be useful to the academia and thus form the basis for further research on the topic, specially in the context of Brazil.

From this Introduction, the paper is divided into five sections: literature review about inventory management in SMEs, followed by the research design, findings, discussion of the results and final considerations.

2. Theoretical background

Inventory management – the planning and control of stock levels to balance supply and demand while minimizing holding and stockout costs – is critical to small and medium-sized enterprises (SMEs) yet often receives inadequate attention in practice (SLACK et al., 2013). In Brazil, SMEs account for roughly 99 percent of enterprises, 30 percent of GDP and 62 percent of private-sector employment (SEBRAE, 2025), but many lack formal IM&C processes (ANHOLON et al., 2015). Across developing markets, studies of SME IM&C reveal common weaknesses – reliance on intuition, limited forecasting, ad hoc ordering, paper-based records and significant financial losses – that undermine efficiency and performance.

In Bangalore, India, Rajeev (2008) surveyed forty machine-tool SMEs and found inventory-to-sales turnover ratios between 1 and 4, well below the performance benchmarks of larger firms. Managers relied on rule-of-thumb ordering, gave little importance to demand forecasting, employed random ordering policies, and seldom linked physical stock records to financial

accounts. Computer use was confined to basic office tasks, and no firm used decision-support models or just-in-time techniques. Further, variable supplier lead times and high setup costs exacerbated inventory carrying costs. The author concludes that adopting formal replenishment models (e.g. EOQ, fixed-period review), investing in simple decision-support software and training staff in basic IM&C practices could sharply reduce stocks and improve cash flow.

Similarly, Kasim et al. (2015) conducted a cross-sectional survey of 300 SMEs in Ghana's Northern Region (trading, manufacturing, dressmaking, hairstyling and carpentry). They report that 50.6 percent of firms still track inventory in notebooks, only 0.6 percent use computer software, and 22.5 percent fail to record stock at all. Major concerns were pilferage (61 percent), obsolete or slow-moving items and informal consumption (e.g. by family members). Although 67.3 percent of respondents "often" prepared inventory budgets and 74 percent "often" reviewed stock levels, 70.9 percent based their reorder decisions on owner-manager experience rather than inventory theory. Frequent replenishment orders (88 percent "often" or "very often") signaled lack of optimal stock levels or reorder points. Importantly, Kasim et al. found a strong positive relationship (Spearman's rho = .742, $p < .01$) between efficient IM&C practices (EIM) and SMEs' financial performance, underscoring the need for simple IM&Ctools.

In Kenya, Nyang'au (2013) surveyed fifty-seven MSEs in Kisii Town and identified four major challenges: inventory-related costs (40.3 percent "very great extent"), demand variability (67.7 percent), inadequate information-sharing (25.8 percent) and difficulty setting stock levels (31.6 percent). Correlation analysis revealed strong negative associations between these challenges and IM&C effectiveness (e.g. demand variability $r = –.673$, $p < .01$). The author recommends computerizing records, training personnel, forecasting demand more accurately and strengthening supplier and customer communication to mitigate the "bullwhip effect."

Likewise, Alam, Thakur, and Islam (2023) used semi-structured interviews with ten Bangladeshi SME owners to explore raw-material sourcing and IM&C systems. Most firms sourced inputs locally; some imported from China, Korea or rural suppliers (e.g. recycled goods). Online platforms and social media (e.g. Facebook) were beginning to aid procurement, but financial constraints, waste and spoilage led to 10–15 percent losses on average. Owners lacked formal safety-stock calculations and reported ad hoc ordering; very few tracking or control systems were in place. The authors call for reduced import tariffs, SME-specific raw-material markets, and greater adoption of digital procurement and basic IM&C software.

Finally, Anholon et al. (2015) surveyed fifty-one construction-sector micro and small enterprises in Jundiaí, Brazil. They found that tax burdens (46 percent) and strategic management gaps (52 percent) were primary concerns, but IM&C issues also loomed large: 41 percent reported discrepancies between recorded and actual stock; 35 percent faced material-handling challenges; and 31 percent designated pilferage as a key problem. Note-taking in notebooks (50.6 percent) and surprise counts (17.8 percent) predominated; less than 1 percent used computerized systems. Anholon et al. recommend low-cost digitization of records, bulk-purchasing cooperatives to reduce costs and formal reorder-point procedures.

Table 1 summarizes the key findings and recommedations of the studies described in the previous paragraphs. These studies illustrate that although IM&C theory (e.g. EOQ, safety-stock, MRP) is well established, most SMEs in emerging economies rely on manual processes, intuition and reactive ordering. The complexity of their operating environments, coupled with intense competition, exacerbates these difficulties (MATTHEWS et al., 2017).

Table 1: Studies about inventory management in SMEs

Author (year)	Country / Sector	Key Findings	Recommendations
Alam, Thakur & Islam (2023)	Bangladesh / Manufacturing SMEs	Waste/spoilage; no safety-stock; ad-hoc ordering	Develop SME raw-material markets; adopt digital procurement tools
Anholon et al. (2015)	Brazil / Construction micro-SMEs	Record discrepancies; surprise counts; pilferage	Bulk-purchasing cooperatives; formal reorder procedures
Kasim et al. (2015)	Ghana / Mixed-industry SMEs	Notebook tracking; pilferage; reactive ordering	Low-cost digitization; set formal reorder points
Nyang'au (2013)	Kenya / Micro- and small firms	High carrying costs; demand variability; poor info-sharing	Computerize records; improve forecasting & communication
Rajeev (2008)	India / Machine-tool SMEs	Rule-of-thumb ordering; no forecasting; no DSS	Adopt EOQ/fixed-period review; invest in simple DSS

Source: Authors

To deal with the challenges in managing SMEs internal operations, particularly in areas like inventory management and procurement strategies, tools as Process Mapping can be useful. Process mapping serves as a tool for organizations to visualize, analyze, and document the flow of their operations. For SMEs, this practice is vital for enhancing operational efficiency, reducing costs, and informing strategic decisions. It becomes especially critical in projects involving the implementation of Enterprise Resource Planning (ERP) systems and Business Process Reengineering (BPR). ERP systems can only achieve their full potential in SMEs when tightly coupled with BPR, a condition highlighted by Simeroth (2023) as critical for success. The absence or inadequate execution of process mapping is a significant factor contributing to the high failure rate of ERP implementations in SMEs, which can exceed 70% (MONTES et al., 2023).

Despite the recognized importance of process mapping, SMEs encounter significant impediments to its adoption and effective utilization. These challenges are often interconnected and arise from their inherent characteristics. Resource scarcity is perhaps the most persistent obstacle, as SMEs typically operate with limited financial capital, human expertise, and time. These constraints restrict their ability to invest in advanced management techniques, employee training, or complex IT systems such as ERP or Just-In-Time (JIT), which are often perceived as costly and difficult to implement (SCOZZI et al., 2005). In parallel, data and information limitations severely affect decision-making, which often relies on intuition, entrepreneurial experience, and informal processes rather than data-driven insights. Scozzi et al. (2005)

underline the difficulty in collecting relevant information and systematically recording past decisions, which further exacerbates this issue.
In spite of these challenges, various methodologies and tools have been proposed and successfully applied to support SMEs in enhancing their processes. Flowcharts and IDEF (Integration Definition for Function Modeling) models, particularly IDEF0 and IDEF3, are among the most accessible and widely used techniques. Scozzi et al. (2005) note that these tools help firms to visualize their processes and understand interdependencies. IDEF3, specifically, allows for the description of connections between actions within a scenario, which is instrumental in characterizing organizational goals and defining process boundaries.

In the field of inventory management, classical models such as Economic Order Quantity (EOQ), Reorder Point (ROP), and Inventory Turnover (ITO) remain fundamental. Sumantika and Sirait (2023) demonstrated the practical impact of EOQ in optimizing purchasing decisions and minimizing inventory levels. ITO, as an indicator of operational effectiveness, provides insights into how quickly inventory is cycled and, therefore, how effectively the firm responds to demand.

Lean Manufacturing and Total Quality Management (TQM) philosophies offer additional avenues for improvement. Agüero-Barreto et al. (2023) provide evidence of how lean warehousing tools such as the 5S methodology, Standardized Work, Slotting, and Master Planning Schedule (MPS) can contribute to operational gains. Their case study illustrates how inventory turnover can increase, while product extraction time, storage costs, and cycle time decrease significantly. In parallel, TQM contributes to raising quality awareness across the production chain, helping to reduce waste and strengthen consistency (MATTHEWS et al., 2017). As a complementary approach, Operational Process Mapping (OPM), proposed by Simeroth (2023), offers an alternative to traditional flowcharts by capturing detailed elements such as agents, resource pools, events, and time. This richness in data facilitates the application of discrete-event simulation (DES) and the effective operationalization of redesigned processes, especially in the context of ERP implementation.

Process mapping, however, is not merely a tactical tool for short-term operational fixes. It can act as a catalyst for continuous organizational learning and innovation. Thakkar et al. (2011) and Matthews et al. (2017) emphasize that systematic process improvement allows firms to identify and resolve inefficiencies iteratively. This learning dynamic requires fostering individual reflection, encouraging group-level knowledge sharing, and securing managerial support to embed new routines. According to Senge et al. (1994), organizational learning involves the ongoing transformation of experience into collective knowledge, while Burgoyne (1995) highlights the value of experiential learning as particularly compatible with SME environments where formal training is often scarce.

In contexts characterized by uncertainty and variability, supporting managerial decision-making becomes essential. Teerasoponpong and Sopadang (2022) propose the use of artificial intelligence-based Decision Support Systems (DSS), which integrate Artificial Neural Networks (ANN) and Genetic Algorithms (GA). These systems can synthesize observational and empirical data to suggest optimal supplier selections, order quantities, and inventory levels.

In practical applications, these DSS platforms have achieved substantial reductions in raw material procurement and inventory holding costs. Their ability to work with unstructured or incomplete data is particularly relevant for SMEs, offering a viable path for integrating data-driven decision-making without requiring complex statistical literacy from users.

Table 2 summarizes studies about the adoption of process mapping as a support tool to seek for improvements in SMEs.

Table 2: Studies about process mapping and improvement in SMEs

Author (year)	Country / Sector	Key Findings	Recommendations
Agüero-Barreto et al. (2023)	Latin-American toy SME	Lean warehousing tools ↑ inventory turnover and ↓ extraction time, storage costs, and cycle time.	Apply lean-warehousing techniques(5S, Standardized Work, Slotting, MPS).
Matthews et al. (2017)	International / Various SMEs	TQM and organizational-learning practices foster continuous process improvement through quality awareness, waste reduction, and shared routines.	Embed TQM principles and facilitate group-level organizational learning in process redesign.
Montes et al. (2023)	Global SME ERP implementations	↑ 70% ERP projects in SMEs fail due to inadequate process mapping and lack of integration with BPR.	Couple process mapping with BPR when implementing ERP.
Scozzi et al. (2005)	European SMEs	Flowcharts and IDEF0/IDEF3 models effectively visualize processes and interdependencies.	Use flowcharts and IDEF modeling for process analysis in SMEs.
Simeroth (2023)	U.S. SME ERP deployments	OPM captures detailed process elements, enabling simulation and operationalization.	Employ OPM when redesigning processes for ERP/BPR implementations.
Sumantika & Sirait (2023)	Indonesia / Raw material control	EOQ and ROP calculations optimize purchasing decisions and minimize inventory levels.	Implement EOQ and ROP models for inventory and procurement planning.
Teerasoponpong & Sopadang (2022)	Thailand SMEs	AI-based DSS recommends optimal supplier selection, order quantities, and inventory levels, reducing procurement and holding costs.	Adopt AI decision-support systems for sourcing and inventory management.
Thakkar et al. (2011)	Indian SMEs	Systematic process improvement via iterative learning, group reflection, and managerial support resolves inefficiencies and builds routines.	Integrate learning frameworks and iterative process-improvement cycles in operations.

Source: Authors

3. Research Design

Since the objective of this research was to identify viable IM&C processes for SMEs, we adopted an exploratory, single-case study design (CRESWELL, 2013; YIN, 2018). Our unit of

analysis is a Brazilian biotechnology SME founded in 2023, incubated at an innovation agency of a Brazilian federal university. This company was chosen for its complex mix of over 200 test-type SKUs, its stated ambition to grow exponentially in the next few years, and its leadership's receptivity to operational improvement.

Regarding the data collection, one-hour semi-structured interviews was performed with:
1. The CEO, to explore high-level improvement opportunities and validate research focus.
2. The COO (first), to test initial hypotheses from the CEO discussion.
3. The COO (second), to examine detailed operational routines.
4. The inventory manager, to map the current inventory management process end-to-end, but also get insights on the aspirations and limitations of the process to be.

Interview guides were organized around six domains: demand forecasting, procurement, receipt and inspection, storage, issuance, and usage tracking (YIN, 2018). In addition, secondary data was gathered through internal documents such as inventory and purchase controls.

As data analysis, triangulation of interview insights and internal documents ensured a robust understanding of "as-is" processes (CRESWELL, 2013). Process-mapping techniques (SLACK et al., 2013; ALAM, THAKUR & ISLAM, 2023) were emplyed to understand each step — from purchase requisition to laboratory issuance to identify process redundancies, inefficiencies and opportunities for improvement.

Preliminary "as-is" maps and analytical findings were reviewed in iterative feedback sessions with CEO, COO, and inventory manager. Their comments refined the depiction of current practices and informed the subsequent design of a "to-be" inventory management framework. This approach provided the depth and rigor necessary to generate actionable, SME-tailored process improvements for inventory management and control.

4. Findings

Founded in 2023 and incubated at an innovation agency of a Brazilian federal university, this biotechnology research laboratory specializing in quality-control testing across food, water, and cosmetics. Leveraging an innovative real-time PCR platform alongside microbiological and physico-chemical analyses, the laboratory delivers fast, sensitive results. Its management system is certified to ABNT NBR ISO/IEC 17025:2017, reflecting rigorous quality standards. With a team of 9 employees, including masters, PhDs, and post-doctoral researchers offering more than 200 types of sample testing, from drinking and mineral water analyses to food safety testing under Normative Instruction 161/2022 and microbiologically-sensitive cosmetic assessments.

As a representative SME, it faces the typical inventory management challenges of small firms. It must coordinate diverse SKUs of reagents, culture media, kits, standards, and consumables. Balancing the risk of stockouts, which can delay critical test turnaround times, against the financial burden of excess inventory is made more complex by limited working capital, and manual record-keeping.

As a recently founded biotechnology research laboratory, it operates in a highly specialized environment that demands careful coordination of diverse inventory items, from reagents and kits to standards and consumables. With more than 200 types of tests offered, many of them subject to strict regulatory requirements, the company's inventory needs are complex, even in its early stage of development. Within this context, current inventory management practices have emerged organically, shaped by the immediate demands of day-to-day operations and the constraints typical of SMEs.

Currently, the process-as-is, inventory routines are decentralized and rely on a combination of informal procedures. This system allows for a certain degree of adaptability and has proven functional in supporting the lab's initial growth phase. However, it lacks some of the structure and control mechanisms typically associated with more mature inventory systems. In the absence of an integrated digital platform or a centralized stock area, the process depends heavily on staff memory, manual input, and routine stock counts to maintain operational continuity, leading to redundancies and inefficiency.

This manual and reactive approach primarily utilizes a spreadsheet with two main sheets: inventory and transactions. The inventory sheet serves as a static record, with overly detailed and unstructured product fields that mix information like validity and lot number, and inflows and outflows columns that are rarely filled, resulting in a final inventory that does not reflect real-time reality, being updated every 15 days, when the stocks are recounted. The transaction sheet primarily records inflows, but lacks outflows records and often has empty quantities, confirming that the withdrawal process is not being done. This disconnection requires physical recounts and prevents FIFO management or minimum stock control.

These frequent verifications are the primary way the laboratory ensures alignment between actual stock and recorded figures. Although this approach provides short-term visibility, it also reflects the absence of a formalized system capable of continuous tracking. The current method, while practical and flexible, has limitations in terms of consistency, traceability, and process standardization.

One notable feature of the current setup is the lack of a designated warehouse or centralized stockroom. Inventory is stored across various functional areas, often near the point of use, which can complicate material consolidation and tracking. The application of the First-In, First-Out (FIFO) principle for stock rotation has been acknowledged as a guideline but is inconsistently applied in practice, mainly due to the absence of a system to enforce or monitor it systematically.

In terms of procurement, purchases are made every two weeks based on considering the expected consumption according to long term recurrent contracts and also new contracts. A buffer is added to account for fluctuations in demand. This forecasting logic is generally provided by the commercial team, which has closer contact with the client base, the contracts, and upcoming testing schedules. While not formalized within the inventory department itself,

this procedure reflects an effort to anticipate needs based on business knowledge and operational rhythm.

The operational model (high test volume, multiple regulatory domains, and a wide SKU base) demands a nuanced inventory approach. In this scenario, the organization must constantly balance two competing risks: stockouts, which can delay time-sensitive testing processes, or, on the other end, excess inventory, which can tie up financial resources and increase the likelihood of material expiration. These challenges are further amplified by the absence of a mapped process. Without a visual and structured overview of how inventory moves through the system, it is difficult to isolate causes of inefficiencies such as delayed purchase approvals, duplicate ordering, or the misplacement of high-value materials.

Importantly, none of these issues stem from neglect, but rather from the natural challenges of expansion of a dynamic, innovation-driven startup. The current procedures reflect the team's ongoing efforts to respond to demand in an agile and practical way, given available tools and constraints. Indeed, this approach is a common choice for SMEs in the early stages, particularly in environments where resources must be allocated strategically. However, leadership recognizes the limitations of this approach and has identified inventory management as a critical operational constraint. The current decentralized structure generates a substantial workload and presents challenges in maintaining consistency, traceability, and control.

5. Discussion

A qualitative analysis was performed by (1) mapping the current process for inventory management and control and (2) redesigning the inventory management and control process considering improvements from best practices found in literature. So, the primary target of this discussion is to provide practical recommendations for the laboratory and secondly, provide a framework for generalization of possible improvements for inventory management and control in SMEs.

Implementing a centralized system with entry controls and formal procedures can significantly enhance operational resilience by providing a systematic foundation for process redesign. Transitioning from reactive, informal control to structured processes could improve stock visibility, reduce administrative burdens, and boost efficiency. These enhancements are expected to lower costs, prevent testing delays and stockouts, ensure compliance, and ultimately transform inventory management from a limiting factor into a strategic capability that supports its continued growth.

The analysis of current inventory management practices reveals challenges that are typical of SMEs. These include decentralized storage, informal requisition practices, and limited record-keeping systems, all of which constrain inventory visibility and control. As Slack et al. (2013) emphasize, effective inventory management involves ensuring the right items are available at the right time while minimizing unnecessary costs. Yet, in SMEs, operational informality often leads to excessive stock, waste, and service failures (ANHOLON et al., 2015; RAJEEV, 2008).

To address these challenges, as process-to-be, this study recommends the establishment of a centralized storage room as a critical first step. Currently, inventory items are scattered across multiple locations in the office, with laboratory staff withdrawing items as needed, bypassing any formal requisition process. This lack of centralized storage impedes visibility and control, increasing the risk of stockouts, waste, and untraceable usage. Consolidating inventory into a dedicated storage room enables standardized issuing procedures, improves stock monitoring, and supports better planning (CHOPRA & MEINDL, 2019). Centralization is widely recognized as a best practice in inventory management because it reduces duplication and facilitates more accurate demand tracking (SLACK et al., 2013).

Following the creation of a storage room, implementing structured inventory control procedures becomes essential. This includes conducting a thorough stocktaking process to identify all items held, recording quantities, acquisition costs, and expiration dates. Applying the First-In, First-Out (FIFO) method is especially important in laboratory environments, where many items are perishable or have strict expiration requirements.

A further recommendation involves formalizing the requisition process between the laboratory and the inventory team. Laboratory staff should complete standardized order forms specifying their needs, which the inventory team can then fulfill following FIFO discipline and keep track of the transaction in the inventory control spreadsheet.

This demand signaling practice ensures that inventory withdrawals are documented, minimizing very common errors in controlling inventory, such as signaling the wrong product issued or delays between the transactions being made and the records being updated (SLACK et al, 2013). It also creates accountability and enforces traceability, essential elements of quality management.

To support these improvements, the laboratory should begin with a simple, spreadsheet-based inventory system appropriate to typical SME resource constraints. We propose a structured spreadsheet with four dedicated sheets. The first sheet records purchases, containing a table with columns for item name, supplier, purchase date, arrival date, price, and quantity. Upon receipt, the inventory personnel enters the item into the second sheet, which maintains the current inventory position with fields for item name, initial quantity, lot number, expiration date, and supplier. This inventory table is linked to a third sheet that tracks requisitions from inventory (figure 1). The inventory personnel should log the requisition in the spreadsheet, specifying the exact item-supplier-lot-expiration combination used and registering the corresponding quantity withdrawal. That information will automatically reflect in the current inventory position. Finally, the fourth sheet provides a dynamic table for managerial analysis, automatically drawing and summarizing data from the current stock sheet to support decision-making.

While sophisticated software solutions can offer long-term advantages, low-cost digital spreadsheets represent a feasible starting point that can dramatically improve accuracy and traceability (ANHOLON et al., 2015; ALAM, THAKUR & ISLAM, 2023). This step-by-step approach is particularly appropriate for SMEs, which often struggle with resource limitations,

limited IT adoption, and the complexity of large-scale systems (SCOZZI et al., 2005). The usage of a spreadsheet is also an evolution regarding what many SMEs still adopt today with inventory tracking in physical notebooks (KASIM et al, 2015; ANHOLON et al., 2015) as it makes possible safer alternatives for control such as dropdown lists and data validation. It should also be acknowledged that there are limitations regarding spreadsheets considering errors of data insertion like typos, inconsistent item codes, invalid dates and also risk of misuse. Finally, by obtaining a reliable control of inventory the periodic review process can be more efficient, as there wouldn't need for a new recount process every two weeks and also more effective, by minimizing risks of errors in the inventory position of current items. Nevertheless, it is recommended that a recount process should occur every two months as a form of cross checking.

As an evolution, the firm could implement a continuous review system for inventory control by defining reorder points (ROP) for high-value or critical items, reducing the risk of stockouts without resorting to excessive safety stock. Although this approach helps balance cost efficiency with service reliability, a core goal of effective inventory management (CHOPRA & MEINDL, 2019), this practice is still far from effective feasibility for SMEs in particular, as the demand is still maturing and therefore there is no reliable historical base for past analysis. Still, introducing even simple inventory systems can represent a major step forward in moving from reactive to planned inventory control (RAJEEV, 2008).

By adopting these recommendations, they can strengthen its inventory management practices while remaining realistic about its SME context. The proposed changes emphasize process mapping and improvement as a practical path for small businesses to move away from informal, ad hoc practices toward structured, efficient, and quality-driven operations. This approach aligns with broader best practices in SME operations management and supports the company's goal of delivering reliable, high-quality testing services to its clients. Figure 1 illustrate the process for "requision and control to be", while Figure 2 shows the "purchase to be process".

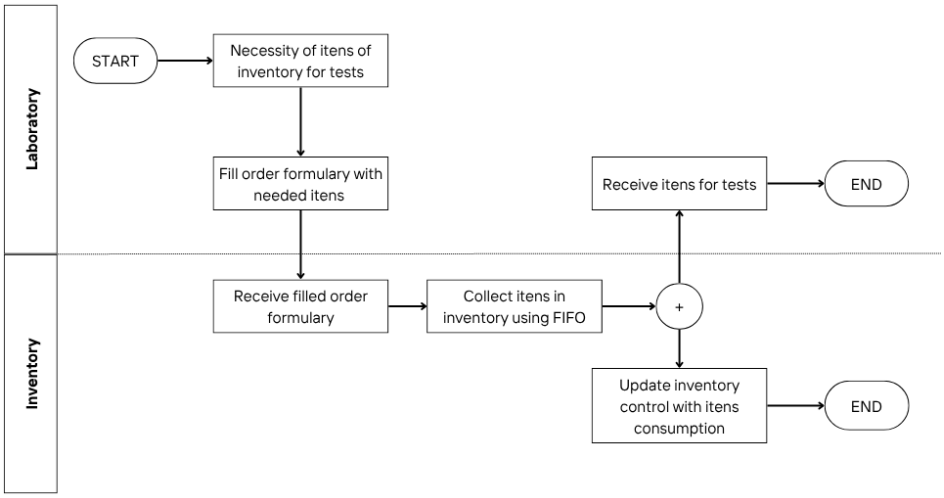

Figure 1: Process for inventory requisition and control *to be.*
Source: Authors

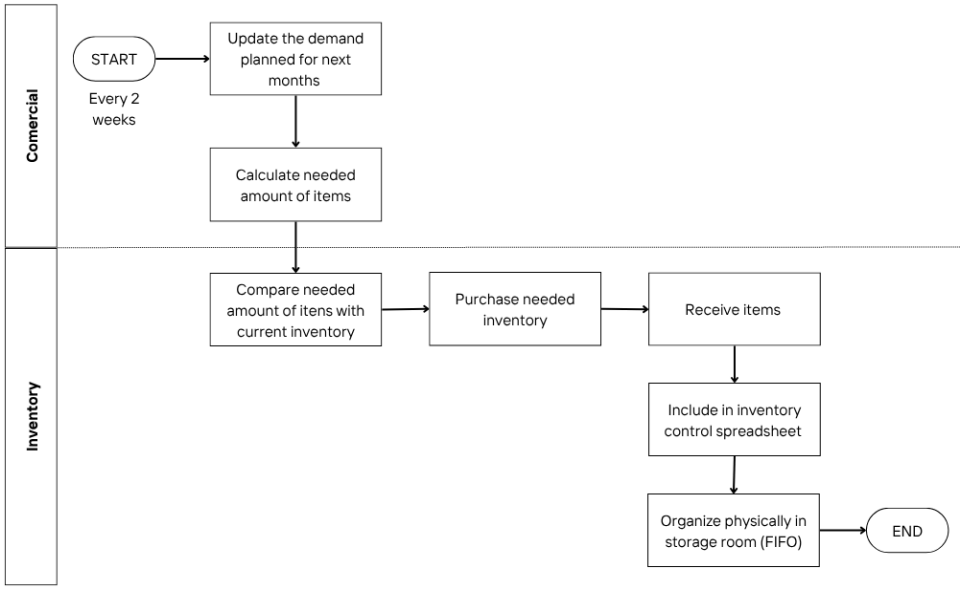

Figure 2: Process for inventory purchase *to be.*
Source: Authors

4. Final Considerations

This study aimed at mapping and improving inventory management at a Brazilian biotech SME, by integrating process-mapping techniques with foundational inventory management concepts. In doing so, we achieved both of our objectives: (i) mapping current "as-is" inventory processes and (ii) designing a practical "to-be" framework to enhance inventory control. Through four semi-structured interviews with the CEO, COO and inventory manager, alongside analysis of inventory and purchase controls, "as-is" routines were documented — characterized by decentralized storage, bi-weekly physical counts, ad-hoc requisitions, inconsistent application of FIFO and the absence of formal reorder controls.

Building on these insights, pragmatic "to-be" framework were proposed. It consists of a centralized stockroom with entry controls, a spreadsheet-based master inventory equipped with data validation and expiration tracking, standardized requisition workflows that enforce FIFO discipline. Adoption of this framework is expected to strengthen stock visibility, reduce both stockouts and excess holding costs, and enhance quality compliance, transforming inventory management from an operational constraint into an enabler capability that supports growth ambitions.

This paper contributes to operations management area by demonstrating how SMEs in regulated environments can systematically apply basic inventory management theories without heavy investments in specialized IT systems. It is important to take into consideration the resources of the company and its limitations in order to assess the improvements to be suggested and implemented.

Despite these contributions, this study has limitations: the single-case design and the authors' reliance on managerial perspectives do limit the generalizability of findings. Frontline staff experiences and direct observation of daily transactions were not formally captured, and the proposed "to-be" framework has yet to be tested in live operations.

To advance both practice and research, we recommend that the firm pilot the new inventory process in its laboratory unit, track key performance indicators such as inventory turnover and stockout frequency, and iteratively refine procedures based on real-world feedback. For future research, comparative case studies of SMEs in other regulated sectors, would help assess the framework's adaptability and uncover sector-specific nuances. Also, investigating organizational change barriers—particularly culture, training needs and IT literacy—will be crucial to embedding new routines sustainably. With advances in these avenues, this laboratory and similar SMEs can build on those findings to achieve more resilient, efficient and quality-driven inventory management.

References

AGÜERO-BARRETO, A. J., HUAYNALAYA-AGUILAR, A. C., & QUIROZ-FLORES, J. C. (2023). **Improvement of inventory turnover by Lean and TQM tools in a toy trader company SME.** Paper presented at the 8th International Engineering, Sciences and Technology Conference, IESTEC.

ALAM, K., THAKUR, O., ISLAM, F. (2023). **Inventory management systems of small and medium enterprises in Bangladesh.** Rajagiri Management Journal Vol. 18 No. 1, 2024 pp. 8-19

ANHOLON, R. *et al.* (2015). **Micro And Small Enterprises Management: Main Administrative Difficulties Observed In Construction Sector Enterprises.** Brazilian Journal of Operations & Production Management 12 (2015), pp 88-99

BNDES. (2025). Company size classification.

BRASIL. (2006). Complementary Law No. 123, of December 14, 2006: Establishes the National Statute of Micro and Small Enterprises.

BURGOYNE, J. (1995). **Learning from experience: from individual discovery to meta-dialogue via the evolution of transitional myths.** Personnel Review, 24(6), 61-6.

CHOPRA, S., & MEINDL, P. (2019). **Supply Chain Management: Strategy, Planning, and Operation**, 7th ed. Pearson.

CRESWELL, J. W. (2013). **Research design: qualitative, quantitative, and mixed methods approaches**. 3. ed. New Delhi: Sage.

KASIM *et al*. (2015). **An assessment of the Inventory Management Practices of Small and Medium Enterprises (SMEs) in the Northern Region of Ghana.** European Journal of Business and Management. ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online) Vol.7, No.20, 2015

MATTHEWS, R. L., MACCARTHY, B. L., & BRAZIOTIS, C. (2017). **Organisational learning in SMEs: a process improvement perspective**. *International Journal of Operations & Production Management*, *37*(7), 970–1006. https://doi.org/10.1108/IJOPM-09-2015-0580.

MONTES, C., LILLO, P., QUEZADA, L., ODDERSHEDE, A., & VALENCIA, A. (2023). **Redesigning the Current Inventory Management Process For an SME.** In C.-Y. Huang et al. (Eds.), Intelligent and Transformative Production in Pandemic Times (Lecture Notes in Production Engineering, pp. 629–638). Springer. https://doi.org/10.1007/978-3-031-18047-2_8.

NYANG‟AU, F. (2013). **Challenges Facing Micro and Small Enterprises in Inventory Management in Kisii Town, Kenya.** IOSR Journal of Business and Management. Volume 13, Issue 5 (Sep. - Oct. 2013), PP 20-29

RAJEEV, N. (2008). **Inventory management in small and medium enterprises: A study of machine tool enterprises in Bangalore**. Management Research News. Vol. 31 No. 9, 2008 pp. 659-669

SCOZZI, B., GARAVELLI, C., & CROWSTON, K. (2005). **Methods for modeling and supporting innovation processes in SMEs.** European Journal of Innovation Management, 8(1), 120–137. https://doi.org/10.1108/14601060510578619.

SEBRAE. (2025). Criteria for classifying micro and small enterprises.

SENGE, P., KLEINER, A., ROBERTS, C., ROSS, R., & SMITH, B. (1994). **The Fifth Discipline Field Book: Strategies and Tools for Building a Learning Organization.** Doubleday, New York, NY.

SIMEROTH, M. (2023). **Operationalizing Process Mapping For Small to Medium Enterprise - ERP Implementation** (Master's thesis, Illinois State University).

SLACK, N.; ALISTAIR BRANDON-JONES; JOHNSTON, R. (2013). **Operations management**. Harlow, England: Pearson.

SUMANTIKA, A., SIRAIT, G., SUSANTI, E., TARIGAN, E. P. L. (2023). **Determination of economic value using the EOQ and ROP approaches in the raw material control system.** Formosa Journal of Applied Sciences, 2 (6), 1051–1064. https://doi.org/10.55927/fjas.v2i6.4323

THAKKAR, J., KANDA, A., & DESHMUKH, S. G. (2011). **Mapping of supply chain learning: a framework for SMEs.** The Learning Organization, 18(4), 313–332.

TEERASOPONPONG, S.; SOPADANG, A. (2022). **Decision support system for adaptive sourcing and inventory management in small- and medium-sized enterprises.** Robotics and Computer-Integrated Manufacturing, 75, 102226. https://doi.org/10.1016/j.rcim.2021.102226

YIN, R. K. (2018). **Case study research and applications: design and methods**. 6. ed. Los Angeles:Sage.