# IoT, RFID, and Lean Tools: An Innovative Strategy to Improve OTIF in the Logistics Chain of a Clothing Marketing Company

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***Abstract*– In the Peruvian fashion retail sector, companies operating with manual processes face significant logistical challenges that affect their OTIF compliance. This study was conducted in a mid-sized company dedicated to the marketing of well-known brand apparel, which has an OTIF level of 81.61%, below the desired standard. Through a detailed diagnosis, three critical causes were identified: errors in manual label placement, incorrect SKU selection, and packaging inspection failures, with impacts of 41.5%, 31.1%, and 15.1%, respectively, on OTIF noncompliance. As a solution, an innovative business model was implemented, based on tool innovation structured in three components: technological innovation and Standardized Work (SW) in the labeling process, RFID, and IoT; Standardized Work (SW) in the picking process; and visual control in the final inspection through Poka-Yoke. The model was validated through a pilot test, achieving an increase in OTIF from 81.61% to 89.44%, reducing operational errors in labeling from 20.72% to 17.16%, order picking from 15.60% to 13.32%, and errors in the inspection of finished packages from 16.90% to 13.56%. In addition, average labeling time and standard picking time were reduced by approximately 58.60 to 47.20 minutes and from 78.72 to 58.21 minutes, respectively. The proposal proved to be technically and economically viable, with favorable financial indicators (NPV, IRR, and WACC). This study demonstrates how business model innovation, combined with accessible technologies, enables mid-sized companies with manual processes to advance toward digital transformation in a profitable and sustainable manner.***

***Keywords-- OTIF, innovation, IoT, RFID, Poka-Yoke***

## I. INTRODUCTION

Imports, by incorporating advanced technology, boost local industrial productivity [1], especially in retail, where physical stores lead the sale of electronics, fashion, and food [2]. Although global trade has slowed down, imports in the apparel sector remain a key item for economies such as the US, Europe, and Asia, due to high post-pandemic demand [3]. This context demands efficiency and precision in logistics in the fashion sector, promoting the transformation of traditional processes through technological innovation [4].

Nowadays, the competitive environment forces companies to adopt increasingly agile and efficient processes to promote their growth and sustained development [5]. In this sense, efficiency in warehouse management has become a key pillar for business competitiveness, allowing a faster response to the customer, minimization of operating costs and improvement in overall productivity [6]. Particularly, the fashion retail clothing sector represents a relevant economic engine in Latin America, given that, only in 2023, the sector reached sales of more than USD 58,000 million, with an annual growth projection of 6.5% [7].

In many cases, the absence of a control and monitoring system for logistics processes increases the risk of errors in the quantity of products delivered, lack of coordination in the reception and distribution of orders, and deficiencies in product labeling and packaging [8]. In the apparel retail sector, logistics efficiency and order delivery compliance are determining factors for customer satisfaction and market competitiveness [9]. Several studies have shown that the OTIF indicator is a key metric in the evaluation of logistics performance, combining punctuality with integrity in order delivery [10]. However, many organizations, especially those that manage their processes manually and without technological integration, have low OTIF levels, generating negative operational and commercial impacts [11]. A low delivery compliance rate can generate a substantial economic impact [12]. Faced with this, intrapreneurship emerges as a strategy to promote business model innovation, allowing companies to adopt an innovative business model with new digital tools that improve their competitiveness and sustainability.

In this context, this article analyzes the case of a Peruvian apparel importer and marketer with a low OTIF level, caused by errors in SKU selection, packaging inspection, and manual labeling. These failures lead to incomplete deliveries, delays, and identification errors, affecting customer satisfaction, increasing operating costs, and reducing logistics efficiency. In this highly competitive sector, order accuracy and timeliness are essential to maintaining a company's reputation and avoiding costs from returns and restocking.

The motivation for this research lies in the need to offer practical and scalable solutions with an innovative business model that allows local companies to improve their operational efficiency and reduce the incidence of errors in their logistics processes. The adoption of technologies represents an opportunity for companies to compete on better terms, offering higher-quality service and more accurate order fulfillment.

The objective of this article is to present an innovative business model for a company in the apparel sector, based on technological and management tools that reduce errors and improve delivery time compliance. The proposal integrates Standardized Work (SW), RFID, IoT, and Poka-Yoke to optimize key processes such as labeling, picking, and inspection of finished packaging, thereby increasing operational accuracy and logistical efficiency. The aim is to strengthen the labeling process through defined standards and smart technologies, minimize deviations in order picking, and promote logistics intrapreneurship by involving employees as active agents of improvement. The effectiveness of the model will be evaluated based on its impact on error reduction, efficient use of resources, and improved customer satisfaction within the Peruvian logistics context.

## II. LITERATURE REVIEW

Supply chain efficiency has become a key strategic factor for business competitiveness in an increasingly globalized and demanding environment [13]. In this context, the OTIF indicator is positioned as a fundamental metric for evaluating an organization's ability to meet delivery expectations, both in terms of time and quantity. The OTIF indicator not only measures operational efficiency but also the effectiveness of planning, coordination, and execution throughout the logistics chain [10]. Poor performance can generate significant additional costs, such as penalties for noncompliance, customer loss, increased safety stocks, and a negative impact on the company's reputation.

Various research indicates that problems in OTIF compliance are usually caused by human errors during order preparation and dispatch, non-standardized processes that do not ensure uniformity in task execution, and the lack of technologies that provide real-time visibility [14]. In response, integrated solutions have been proposed that combine tools such as Standardized Work (SW), the advanced use of disruptive IoT, RFID, and Poka Yoke technologies for error prevention, all of which are integrated to minimize errors and improve traceability. These tools allow for more reliable order management, reducing logistics failures that directly affect OTIF compliance and end-customer satisfaction.

For example, research in Ecuadorian companies revealed that the lack of standardization and visual control in packaging and labeling processes generates defects and economic losses, resulting in delays of up to 20% in deliveries to the final customer [15]. This evidence shows the importance of having orderly, standardized processes supported by technologies that allow increasing productivity and reducing operational errors. Likewise, [16] emphasize that the standardization of logistics activities is key to ensuring repeatability and quality in tasks. The lack of defined procedures generates variability in terms of time and results, affecting delivery compliance. Their model, based on written protocols, training and audits, manages to reduce operational deviations by up to 40% and improve reliability in the supply chain. Also, [17] implemented a management model in an auto parts warehouse, achieving reductions in order preparation times of up to 41.37% in new operators after standardizing the process. The implementation of standardized operating procedures at the distribution company resulted in a reduction in dispatch times of approximately 25% (from 574.3 to 429.1 minutes), a 75% reduction in merchandise damage, and an improvement in OTIF from 93.19% to 95.25%. Furthermore, the reduction in operational errors resulted in a 62.63% decrease in return costs, strengthening efficiency and service levels [18].

Technology also plays a fundamental role. IoT applications provide real-time information on the location, status, and condition of products, improving the ability to respond to deviations. In this case study, IoT adoption represents a key opportunity to optimize logistics management, as it allows real-time monitoring of product location and condition during distribution. Full visibility into inventory and shipments improves the ability to respond to deviations, reduces delays, and facilitates predictive planning. According to [19], companies that implement IoT achieve a 25% increase in their OTIF compliance and achieve significant logistics savings.

For its part, RFID enables automatic product tracking, reducing order preparation time by 30% and improving inventory accuracy [20]. In the case study [21], the integration of technologies such as RFID and IoT is presented as an effective strategy to overcome deficiencies in traceability and accuracy during the logistics process, especially in the labeling and packaging stages. The implementation of smart sensors allows bottlenecks to be identified in real time, which facilitates more agile management and improves the average delivery time. Regarding technological evolution, [22] explores the latest trends in the integration of IoT and RFID with advanced data analytics platforms, showing how big data and artificial intelligence enhance predictive and control capabilities in the supply chain. The study highlights that this technological combination not only improves OTIF but also enables proactive risk management and rapid adaptation to changes in demand or logistical disruptions.

Specific studies have shown that implementing Poka-Yoke in distribution centers can reduce labeling and picking errors by up to 35%, positively impacting OTIF [23]. In a comprehensive analysis, [24] presents a systemic approach where they combine Poka-Yoke, standardized work, and IoT to address non-compliance issues in the logistics chain. It shows that the synergy between these tools not only prevents errors but also standardizes processes and provides real-time information for better decision-making. The joint implementation generated improvements over 50% in the OTIF indicator, demonstrating the effectiveness of a multidimensional approach compared to the isolated management of each technology or method. Also, the joint application of work method standardization and visual control allowed increasing the OTIF from 68.42% to 87.50%, reducing reprocessing and errors in the labeling subprocess. In addition, the material search time was optimized from 48 to 12 min/batch. Furthermore, the total order preparation time decreased from 479 to 399 min/batch, demonstrating that such tools are effective in improving operational efficiency [25].

In recent years, generative Artificial Intelligence has gained relevance as a tool to support supply chain planning and coordination. Recent studies show that its implementation drives collaboration in green supply chains and the adoption of circular economy practices, which translate into improved sustainable performance [26].

While AI provides quantitative improvements in sustainable performance, such benefits often depend on the chain's ability to react to disruptions. [27] study uses SD simulations to show how supply chains with adequate buffers, redundant capacities, and rapid response protocols can maintain acceptable service levels even in the face of major disruptions.

Likewise, digital twins enhance visibility, enabling early monitoring and response. Their adoption represents a new frontier for improving the visibility and responsiveness of supply chains. [28] study identified critical resilience and sustainability factors, including visibility into the flow of information, coordination between actors, and response to real-time data. This approach allows for anticipating disruptions, simulating alternative scenarios, and defining contingency strategies with greater precision.

Importantly, structural complexity (number of links, variety of suppliers, geographic location) and dynamic complexity (variations in demand, instability in lead times, variability in supply patterns) act as moderators in the relationship between green innovation and resilience.

## III. CONTRIBUTION

This project, conceived as a business intrapreneurship initiative, proposes an innovative logistics business model aimed at improving the OTIF indicator, a key factor for competitiveness in the retail sector. By integrating technological tools such as RFID, IoT, Poka-Yoke, and Standardized Work (SW), the company's management of critical processes is transformed. In the case analyzed, deficiencies were identified in processes such as labeling, order preparation, and delivery. This approach, in addition to strengthening competitiveness in a complex logistics environment such as Peru's, is proposed as a scalable and replicable alternative for other companies in the retail sector facing similar challenges in their supply chains. This project is based on three strategic pillars with a solid theoretical and empirical foundation: technological adoption through IoT and RFID systems, Standardized Work (SW), and the implementation of a visual Poka-Yoke tool.

The implementation of IoT and RFID technologies enables real-time traceability in labeling, storage, and distribution, facilitating immediate error detection and potentially reducing inventory errors by up to 40%, improving product location accuracy in high-volume environments [29]. This business model innovation, along with Standardized Work (SW), standardizes critical tasks, reducing variability and increasing efficiency, which is essential in a Lean system to optimize logistics performance. Furthermore, the introduction of error-proofing mechanisms (Poka-Yoke), such as visual controls and checklists, helps prevent human error, reducing errors in packaging verification by up to 70% [30]. All of this is part of an intrapreneurial approach that seeks to innovate business tools and create an innovative business model.

The expected benefits include increased delivery accuracy, reduced contractual penalties, strengthened logistics capabilities, digitalization of processes, and competitive positioning in a dynamic economic environment.

### *3.1. METHODOLOGY*

The methodology for this study was developed through the analysis of the best practices applied in companies in the fashion retail sector, as well as in sectors with similar logistics challenges. Using an exploratory-descriptive approach, the root causes of the company's low level of OTIF compliance were identified. These problems were identified through a review of academic and technical literature, which allowed for the identification of different tools that are most appropriate for addressing operational inefficiencies. This process included a comparative analysis of scientific articles and applied cases that address issues such as garment labeling errors, incorrect SKU selections, and errors in final garment inspection.

The tools selected for the improvement model design are Standardized Work (SW), RFID and IoT, and Poka-Yoke. These tools were chosen for their proven effectiveness in reducing operational errors and improving OTIF compliance levels. This approach represents an innovation in the business model and tools, integrated into a proposal structured under a Lean approach, aimed at improving order picking accuracy, optimizing delivery times, and elevating the quality of the logistics service, thus contributing to an innovative business model.

#### *3.1.1. Proposed Model*

The proposed logistics management model represents an innovative and intrapreneurial response to address the problem of low OTIF compliance in an apparel retail company. Based on specialized literature and cases applied to the fashion retail sector, an innovative business model was designed, structured around three key components: innovative technology and Standardized Work (SW) for labeling, Standardized Work (SW) for order preparation, and Poka-Yoke to strengthen packaging inspection (see Fig. 1).

According to the studies reviewed, various tools can be grouped based on their common operational objectives. For example, technologies such as RFID and IoT contribute significantly to accuracy and traceability in product labeling and coding; meanwhile, tools such as Standardized Work (SW) and Poka-Yoke are aimed at reducing human error during order preparation and review. The combination of these tools represents an innovation in the use of logistics technologies, aligned with the business's operational objectives.

Likewise, this work represents a business model innovation by comprehensively applying tools such as

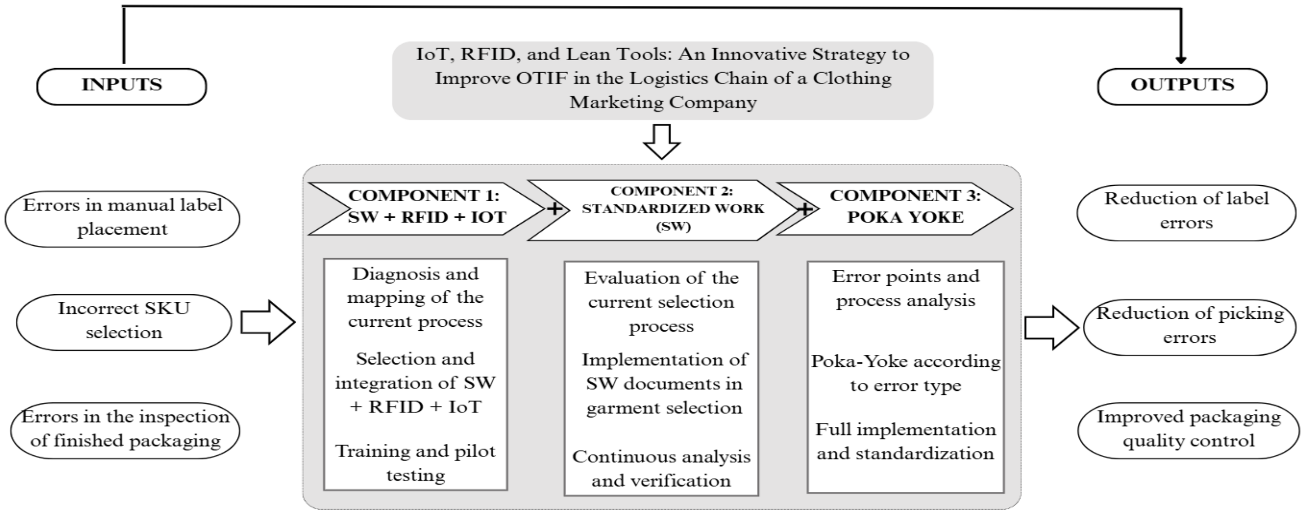


Fig. 1 Proposed model for OTIF improvement

Standardized Work (SW), RFID, IoT, and Poka-Yoke to the logistics process in an apparel marketing company, a sector where their applications have not been widely reported. This encourages their adoption by other organizations in the industry to strengthen their logistics operations and increase their OTIF compliance levels.

*3.1.2. Model Components*

The model is divided into the three components mentioned above.

*3.1.2.1. Standardization and Technological Innovation of the Labeling Process*

This first stage of the innovative business model seeks to reduce human error in label placement and improve product traceability from the warehouse to the end customer. To achieve this, it begins with the integration of advanced technological tools, highlighting RFID, which automates unit coding using smart labels, and IoT, which allows real-time monitoring and sending of information on the product's status within the warehouse, enabling automatic alerts if inconsistencies are detected between the order information and the labeled product. This business tool innovation eliminated manual data entry and enabled automatic alerts in the event of inconsistencies, allowing real-time monitoring of the product's status and location within the warehouse.

Subsequently, Standardized Work (SW) was implemented, developing a detailed procedure to consolidate and formalize garment coding and labeling. Standardized label formats were developed that include key product information such as size, SKU code, brand, and color, to avoid ambiguities and typing errors.

*3.1.2.2. Standardized Work (SW) in Order Preparation (Picking)*

The second stage of the innovative business model focuses on ensuring the correct selection of products (SKUs) during the picking process, guaranteeing accurate, complete, and efficient orders. From an intrapreneurial perspective, the Standardized Work (SW) tool was once again applied, this time focused on picking tasks, using an operational dashboard that details step-by-step product placement, validation, and removal.

Furthermore, the functionality of the RFID system implemented in the previous stage was leveraged, as each operator can electronically validate that the SKU removed from the shelf corresponds to the one requested in the order form. This enables automatic, real-time verification and reduces errors due to incorrect product selection. In turn, the IoT system allows the progress of each order to be displayed on a dashboard, facilitating process monitoring and identifying bottlenecks.

This Standardized Work (SW) has improved compliance with the In Full indicator, as it ensures that each order contains exactly the required products, without omissions or repetitions, and within the established timeframes.

*3.1.2.3. Poka-Yoke for improved inspection of finished packaging*

The third stage of the model focuses on ensuring that the assembled and labeled order meets presentation and quality standards before being shipped. To this end, the Poka-Yoke methodology was implemented as an error-prevention tool. Visual guides were designed showing the correct packaging for each type of garment, as well as the proper way to organize the garments inside the box or bag.

Likewise, checklists were developed to validate that products are correctly identified, labeled, and in optimal condition. This standardization of the inspection process establishes uniform visual criteria that ensure impeccable order presentation and prevent item omissions.

This final stage results in a substantial improvement in the quality of the final order, reducing the number of returns and complaints for poorly presented or damaged products. It also reinforces compliance with the On-Time indicator, as it allows errors to be identified before shipping and prevents delays due to reprocessing.

*3.1.2.4. Indicators*

To evaluate the effectiveness of the model, the following key performance indicators were defined:

TABLE I
*MODEL INDICATORS*

| | Indicator | Formula |
|---|---|---|
| Proposal | % OTIF | $\frac{\text{Number of orders delivered on time and in full}}{\text{Total number of orderes delivered}}$ |
| Tool 1: SW + RFID + IoT | % of label errors | $\frac{\text{Number of labels with errors}}{\text{Total number of products labeled}}$ |
| | Average labeling time (min) | $\frac{\text{Total labeling time}}{\text{Total number of labeled garments}}$ |
| Tool 2: Standardized Work (SW) | % of garments selected from incorrect SKUs | $\frac{\text{Number of SKUs selected incorrectly}}{\text{Total number of prepared products}}$ |
| | Standard picking time (min) | $\text{Standard picking time} = T_O \times F_f \times F_P$ |
| Tool 3: Poka-Yoke | % of inspection errors | $\frac{\text{Number of packets completed with detected errors}}{\text{Total number of packets verified}}$ |

## IV. VALIDATION

*4.1. Scenario Description*

This stage is key to verifying the effectiveness of the innovative business model and the real impact of the tools applied in the company's operating environment. Validation was carried out through a controlled pilot test at a Peruvian apparel retailer facing problems with incomplete and late deliveries, affecting its OTIF indicator.

The intervention was carried out in the labeling, order preparation, and fulfillment areas, using a representative group of operators and observed orders. An experimental methodology based on previous logistics studies was applied under real operating conditions, and the proposed devices were evaluated individually.

*4.2. Initial Diagnosis*

A comprehensive diagnosis of the company's logistics process was conducted, focusing on order preparation and delivery stages. This analysis identified the root causes of the indicator's poor performance, which stood at 81.61%, below the industry standard (95%). Furthermore, this deficiency represented a 5% impact on the company's logistics costs. The diagnosis was based on a review of operating records and direct field observations.

The first reason identified was the delivery of incomplete orders, evidenced by missing or incorrect products upon arrival at the customer. This was caused by incorrect SKU selection, with a 31.1% impact, due to the lack of standardized procedures and visual mechanisms to guide picking; and errors in the inspection of finished packaging, with a 15.1% impact, due to the absence of a structured final quality control system, without checklists or double-checking, which generated frequent complaints and returns.

The next most common reason for delays in order fulfillment was delayed in order preparation and shipping, and errors in manual labeling accounted for 41.5%. This problem stemmed from the use of manual records and non-integrated spreadsheets, which led to errors in the placement of codes, prices, or garment sizes.

*4.3. Validation Design*

Validation was carried out through a pilot test under real-world conditions within the company's main warehouse. The methodology included staff training in the proposed tools and the progressive implementation of solutions in critical areas. Data was collected before and after the pilot, and a comparative analysis of operational indicators was conducted.

The pilot began with an intervention in the garment labeling process, as this represented one of the main causes of delays due to typing errors. RFID was implemented in the labels, and readers were installed at strategic points in the warehouse (labeling and dispatch). The data generated will be sent to an IoT-based system, where codes, sizes, and prices will be automatically recorded, eliminating the need for manual entry.

In parallel, Standardized Work (SW) tools and dashboards were applied to establish clear operating instructions, standard times, and verification sheets. This reduced human errors, improved the traceability of each garment, and accelerated the flow of information for order preparation.

Fig. 2 Use of RFID tags and reader equipment

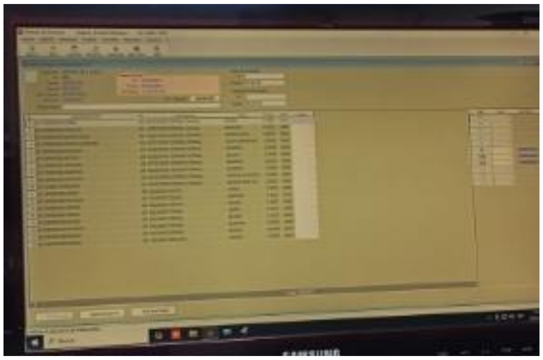

Fig. 3 IoT system for data logging

As part of the innovative business model, an intrapreneurship approach was implemented that included training operators on the use of the IoT system, which enables real-time monitoring and generates alerts for inconsistencies. This innovative business tooling reduced labeling errors from 20.7% to 17.16% and reduced the average labeling time per batch from 58.6 to 47.2 minutes.

Subsequently, the picking process was modified, applying Standardized Work (SW) principles through SOPs, operational dashboards, and observation sheets. In addition, garment distribution was redesigned, and visual routes were implemented to facilitate identification.

The physical locations of the most frequently rotated garments were reorganized, and visual routes were assigned throughout the warehouse. Operators received a product identification and location guide, as well as a validation table for each garment family. Thanks to this intervention, picking errors were reduced from 15.60% to 13.32% and the average standard time improved from 78.72 minutes to 58.21 minutes.


Fig. 4 Standardized board assignment and visual process guides

Third, the final verification and packaging inspection phase was developed, focused on avoiding incomplete and damaged shipments. This phase was addressed with the Poka-Yoke tool, a business innovation consisting of review checklists, content verification cards, and visual traffic lights indicating the order status (complete, incomplete, pending review).

The implementation of visual inspection and cross-validation stations in the final stage of the process was the result of an intrapreneurial approach aimed at improving delivery quality. Thanks to this innovation, packaging errors decreased from 16.90% to 13.56%.


Fig. 5 Packaging Inspection Tracking Cards

In addition, internal audits were conducted to verify compliance with Standardized Wrk (SW), proper use of the RFID-IoT system, and the correct application of Poka-Yoke. These results reinforce the effectiveness of the innovative business model, based on technology and continuous improvement.

As part of the validation of the innovative business model, key indicators were defined to measure the impact of each proposed tool on operational efficiency and order picking accuracy. To this end, three scenarios were established: the current situation (As Is), the target scenario (To Be), and the results obtained through a pilot test. These indicators consider critical aspects such as the level of OTIF compliance, the incidence of labeling errors, SKU selection accuracy, average labeling and picking times, and the effectiveness of final packaging inspection.

TABLE II

*RESULTS OF THE INDICATORS*

| | Indicator | As Is | To Be | Normal Pilot |
|---|---|---|---|---|
| Proposal | % OTIF | 81.61% | 95% | 89.44% |
| Tool 1: SW + RFID + IoT | % of label errors | 20.72% | 15.50% | 17.16% |
| | Average labeling time (min) | 58.60 min | 42.19 min | 47.2 min |
| Tool 2: Standardized Work (SW) | % of garments selected from incorrect SKUs | 15.60% | 11.10% | 13.32% |
| | Standard picking time (min) | 78.72 min | 51 min | 58.21 min |
| Tool 3: Poka-Yoke | % of inspection errors | 16.90% | 10% | 13.56% |

| | Indicator | As Is High demand (+50%) | Pilot High demand |
|---|---|---|---|
| Proposal | % OTIF | 76.40% | 88.20% |
| Tool 1: SW + RFID + IoT | % of label errors | 24.50% | 19.80% |
| | Average labeling time (min) | 72 min | 58 min |
| Tool 2: Standardized Work (SW) | % of garments selected from incorrect SKUs | 18.60% | 15.10% |
| | Standard picking time (min) | 74.23 min | 62.23% |
| Tool 3: Poka-Yoke | % of inspection errors | 19.40% | 15.50% |

## V. DISCUSSION OF RESULTS

The results of the normal pilot project confirmed the success of the innovative business model, achieving a significant improvement in the OTIF indicator, which increased from 81.61% to 89.44%, representing a 7.83% increase, thanks to the application of innovative tools such as RFID, IoT, Standardized Work (SW), and Poka-Yoke. This progress, driven by an intrapreneurship strategy, demonstrates the positive impact of business model innovation on a company that previously operated manually and without technological integration.

TABLE III
EVOLUTION OF THE PILOT RESULTS ACCORDING TO THE OTIF

| N° observations | On Time (%) | In Full (%) | PILOT OTIF (%) |
|---|---|---|---|
| 1 | 91.80% | 92.50% | 84.92% |
| 2 | 92.50% | 92.60% | 85.66% |
| 3 | 92.80% | 92.40% | 85.75% |
| 4 | 93.80% | 93.00% | 87.23% |
| 5 | 93.70% | 93.60% | 87.70% |
| 6 | 93.10% | 93.20% | 86.77% |
| 7 | 94.30% | 93.50% | 88.17% |
| 8 | 94.00% | 93.00% | 87.42% |
| 9 | 94.29% | 93.71% | 88.36% |
| 10 | 93.26% | 93.60% | 87.29% |
| 11 | 92.91% | 94.29% | 87.60% |
| 12 | 93.26% | 93.37% | 87.08% |
| 13 | 93.14% | 93.60% | 87.18% |
| 14 | 93.83% | 93.60% | 87.82% |
| 15 | 93.71% | 94.29% | 88.36% |
| 16 | 94.86% | 94.29% | 89.44% |

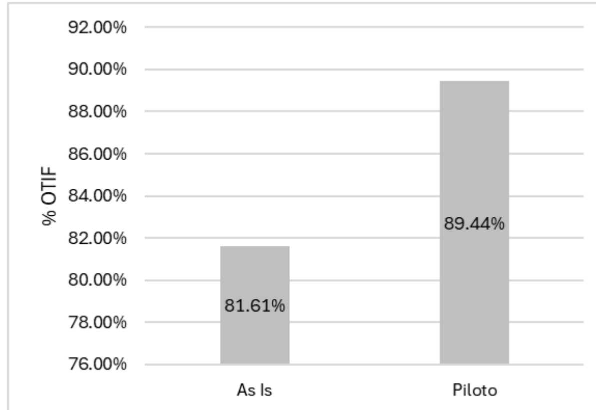

Fig. 6 %OTIF antes vs %OTIF Piloto

In the high-demand scenario (+50%) compared to the pre-pilot scenario, the results show a significant deterioration in performance compared to the no-intervention condition, where the OTIF level drops to 76.40% due to congestion in picking and labeling operations, as well as an increase in the error rate (24.5% in labeling and 18.6% in SKU selection). This behavior reflects the vulnerability of the current system to sudden increases in order volume. In contrast, under the pilot test condition in the high-demand scenario, the OTIF reaches 88.20%, demonstrating greater operational resilience thanks to the implementation of RFID and IoT, which reduce identification errors and improve traceability, along with process standardization that mitigates variability in operating times. While an increase in marginal costs per order is observed, the improvement in delivery compliance and reduction in rework justify the applicability of the intervention in contexts of high seasonal turnover.

Likewise, the percentage of label errors was reduced from 20.72% to 17.16%, and the average labeling time increased from 58.60 minutes to 47.2 minutes. Although the target of 15.50% errors and 42.19 minutes in time were not reached, a partial improvement was achieved. This result can be explained because the IoT system was still in the testing phase, and staff required more adaptation time. Studies indicate that it reduces the time to provide materials by up to 60% in labeling processes that require at least six months of continuous use of the RFID system [31].

In the garment selection process (picking), errors were reduced from 15.60% to 13.32%, while the standard time decreased from 71.80 to 58.29 minutes. Although the expected optimal level was not reached, the improvement is clear. Standardization increases with repetition and continuous feedback.

Final inspection errors decreased from 16.90% to 13.56%, approaching the 10% goal. The implemented visual tool facilitated the identification of incomplete packaging, although its effectiveness will depend on the frequency of audits and the control culture developed. While the results did not reach the proposed ideal values, all variables improved compared to the initial scenario, demonstrating that the innovative business model generates a positive, sustainable, and replicable impact.

Greater usage time and digital integration are expected to improve performance in subsequent cycles.

These operational improvements are attributed to the use of standardization boards and visual guides, which facilitated critical tasks even for inexperienced operators. Innovation in business tools, particularly the integration of IoT and RFID, enabled the digitization of manual processes, improved traceability, and increased efficiency. It also significantly reduced errors in product identification, increased the speed of the labeling process, and improved inspection of finished products. As the use of these technologies becomes more widespread, improved levels of performance and sustainability are expected to be achieved over time.

A financial evaluation was conducted to determine the economic viability of the proposed model. With a total investment of approximately 33,450 PEN for the implementation and training of the proposed tools, a 5-year cash flow was projected. The results showed a Net Present Value (NPV) of 37,416.77 PEN, indicating the project's viability, and an Internal Rate of Return (IRR) of 55%, well above the Weighted Average Cost of Capital (WACC) of 12.90%, confirming its profitability. Furthermore, the cost-benefit ratio was 1.12, and the investment payback period was estimated at 1.88 years, demonstrating the innovative model's economic sustainability.

TABLE IV
PROJECT FINANCIAL INDICATORS

| Criterion | Value |
|---|---|
| WACC = | 12.90% |
| NPV = | 37,416.77 PEN |
| IRR = | 55% |
| PRD = | 1.88 years |
| RBC = | 1.12 |

While the results obtained in this work show an increase in the OTIF level after applying these tools, it is essential to recognize certain limitations and risks that affect the validity and applicability of the findings. The first limitation relates to the quality and availability of the historical records used in the model validation. The records collected come from manual data; these may present inconsistencies or be incomplete, generating potential biases in the calibration and accuracy of the model. The validation was based on a limited period (first half of 2025), which prevents capturing seasonal patterns and restricts the applicability of the results to other contexts and industries. The model relies on simplifying assumptions (constant rates, averages, homogeneous responses), which facilitates analysis but does not reflect all the variability of actual operations.

Furthermore, from the critical analysis of the pilot, opportunities were identified to enhance the innovative business model in the future. The intrapreneurship fostered not only improved logistics processes but also identified new areas of application to continue innovating the business model and its tools.

First, it is proposed to expand the use of the IoT system, currently applied to labeling, to the receiving and inventory processes, which would strengthen traceability and real-time control. Second, it is recommended to incorporate a TMS (Transportation Management System) to automate route assignment, optimize deliveries, and improve the "On Time" component of OTIF. Likewise, linking the model to a Transportation Management System (TMS) would enable the optimization of delivery routes, load consolidation, and compliance with customer time windows. Similarly, the incorporation of digital twins would offer a virtual representation of the supply chain, facilitating the simulation of strategic scenarios such as product expansion, the opening of new distribution centers, or responding to external disruptions.

The continuation of this work must also consider the dimension of logistics sustainability. Incorporating indicators such as carbon footprint per order, energy consumption per operation, and percentage of recyclable packaging would expand the model's scope to include environmental impact assessments. This approach is relevant in the current context, where companies not only seek operational efficiency but also compliance with environmental regulations and corporate social responsibility objectives.

However, a phased implementation plan is proposed, beginning with the automation of the labeling process using RFID, followed by the integration of IoT for traceability, and subsequently, the connection with TMS and AI for strategic optimization. Each phase should be evaluated in terms of profitability (ROI, IRR) and organizational feasibility, considering staff training and change management. This approach reduces financial and technical risks and ensures that technological adoption is sustainable over the long term.

Finally, it is suggested that this innovative model be replicated in other retail product lines, such as footwear or accessories, evaluating its scalability. This proposal represents a business tool innovation strategy that can be applied by companies seeking to technologically innovate their operations and improve efficiency in manual logistics environments.

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## CONCLUSIONS

The results of this research confirm that applied intrapreneurship enabled the development of an innovative business model in the fashion retail sector, integrating technological tools such as RFID, IoT, Standardized Work

(SW), and Poka-Yoke. This innovation in the business model and tools significantly improved critical processes such as labeling, picking, and packaging inspection, raising the OTIF indicator from 81.61% to 89.44%, an increase of 7.83%. This directly contributed to narrowing the existing technical gap with respect to industry standards, reducing late or incomplete deliveries and their associated economic impacts. This progress validates the adopted approach, where technological innovation, error prevention, and real-time operational visibility are consolidated as determining factors in the efficient and timely fulfillment of orders.

Specifically, the labeling process achieved a reduction in the error rate from 20.78% to 17.6%, a 3.18% reduction, and the average labeling time decreased by 11.4 minutes, from 58.6 to 47.2 minutes, demonstrating a significant improvement in operational efficiency. The incorporation of RFID smart tags and automated scanning helped eliminate error-prone manual activities and optimized the flow of information between departments.

Regarding SKU selection, the error rate was reduced by 2.28%, from 15.6% to 13.32%, while picking time decreased from 78.72 to 58.21 minutes, reflecting the positive impact of the implemented Standardized Work (SW). This enabled more consistent execution of operational tasks, reducing performance variability between operators and ensuring more precise real-time inventory control.

Regarding packaging verification, one of the critical points of quality control, the error rate was reduced from 16.90% to 13.56%, a 3.34% decrease, with clear visual indications and tracking that validated the contents before shipping.

Although significant progress has been made with this innovative business model, there is still room to reach the OTIF target of 95%. Therefore, it is recommended to continue innovating in areas such as demand planning, inventory, and final distribution to consolidate the benefits achieved.

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