

Original Article

Digital Transformation in Metallurgical Sector Logistics: A Case Study on the BPM Life Cycle of the Delivery Process Area

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Abstract - The metallurgical sector faces significant logistic challenges to achieve efficient deliveries and increase customer satisfaction. This study analyzes and evaluates the application of the Business Process Management life cycle in the delivery process of a metallurgical company. Observation techniques, interviews, and surveys were used with clients as key actors in the process to evaluate the current logistics situation. Based on the evaluation outcomes, strategies and tools were identified to optimize planning, monitoring, and communication in the delivery process through the implementation of software for route optimization and order tracking in real time. Project management was developed under the Project Management Body of Knowledge methodological framework, which guaranteed efficient implementation and control. The results show significant improvements in operations and customer experience. This outcome emphasizes the importance of the digitalization of logistics to meet the specific demands and efficiency requirements of the metallurgical sector.

Keywords - Business Process Management, Route optimization, Digital transformation, Customer satisfaction, Delivery process.

1. Introduction

Excellence of service in sales and merchandise delivery is crucial for modern-day companies to achieve customer satisfaction and loyalty. Digital transformation is increasingly driving companies to implement technologies that optimize their operations, generating added value for both the organization and its customers. However, the logistics for delivering merchandise to Business-to-Business (B2B) customers are often suboptimal. New systems have therefore been designed to optimize route planning and improve customer satisfaction through an efficient integration of technological tools.

A fundamental shortcoming of traditional merchandise delivery methods is that route planning and merchandise dispatch are performed by human transport personnel. Because this involves multiple considerations (e.g., the cargo weight, specific customer delivery windows, accurate addresses, and traffic along the delivery route), there is potential for introducing errors and delays, thereby causing customer dissatisfaction. The manual management of delivery records also means that information on route commencement, delivery, and warehouse arrival is not available in real time. The lack of technological connectivity prevents different departments (warehouse, sales, and customer) from having

real-time updates. Digital transformation provides an opportunity to address these problems. Its main appeal, particularly in the metallurgical commercial sector, lies in the possibility of implementing logistics systems that achieve intelligent planning and route optimization to guarantee punctual deliveries. An additional benefit is the possibility of real-time monitoring and the issuance of notifications during the delivery process. These are important criteria for achieving customer satisfaction and improved communication within an organization. These benefits are achieved via the interoperability capacity of Application Programming Interfaces (API). This allows a native and transparent integration with a company's SAP system to synchronize delivery notes, normalize weight and volume units (e.g., kilograms and cubic meters), and connect simultaneously with other software to enhance the platform for operational efficiency and increase customer satisfaction.

This perspective naturally prompts the following research question: How does the implementation of a logistics system influence customer satisfaction, operational efficiency, and delivery timeliness within the particular context of the merchandise delivery process of a metallurgical company? The present study sought to answer this question by adopting the Business Process Management (BPM) life cycle through a



design thinking analysis. Specific attention was given to empathizing with internal and external users, analyzing the current (“AS-IS”) process, and using the Project Management Body of Knowledge (PMBOK) framework at the implementation stage for effective project planning, culminating in the validation of the “TO-BE” model. The aim was to demonstrate the impact of route optimization using the logistics system and to compare it to traditional methods in terms of (1) delivery distances and travel times; (2) benefits and effectiveness for drivers and the sales department; and (3) the impact on customer satisfaction and effectiveness of communication among all the parties involved.

The following sections present the BPM life cycle method used by a metallurgical company to improve the merchandise delivery process. First, the AS-IS process is analyzed before applying the TO-BE model. The improvement due to digital transformation is then implemented using the PMBOK framework. Details of the validations in terms of user satisfaction are presented, and the results are analyzed.

2. Literature Review

2.1. Digital Transformation in Logistics

Digital transformation allows companies in any sector to improve their operational processes to gain a competitive advantage [1, 2]. Several authors have argued that the adoption of digital technologies improves supply-chain performance in terms of (1) improved efficiency and precision in various logistic processes, e.g., the real-time monitoring of the merchandise delivery status, (2) cost reduction, (3) delivery-time optimization, and (4) the delivery of the correct quantities of products requested by customers [3-7]. It also helps to automate manual tasks, manage large data volumes in real time, and integrate the entire supply chain [8]. Current logistics often prioritize cost minimization over delivery punctuality and service satisfaction. An important additional benefit of digital transformation is therefore the potential for multi-objective optimization. This would allow the simultaneous reduction of distribution costs and delivery times [9].

2.2. Digital Transformation of the B2B Delivery Process

Digitalization is an important contributor to modern-day companies’ ability to adapt competitively to the changing demands of the market and to improve customer satisfaction through a faster, more efficient, and personalized B2B service. [10]. The B2B delivery process constitutes the final stage of the business transaction.

It faces challenges due to the number of orders submitted daily, the packaging process, established time windows, and shipping times. Optimized route planning can therefore reduce travel durations and avoid the necessity of constantly traveling at the speed limit (and its associated costs in terms of maintenance, vehicle damage, and mileage) [11].

2.3. Digital Technologies used in Delivery Logistics

Enterprise Resource Planning (ERP) is a digital technology tool used by companies for good logistics and delivery management. It integrates all aspects of a company’s processes and information, handles the data needed for centralized administration, and interacts with other value-generating tools. One such tool is the Warehouse Management System (WMS), a digital platform that allows the recording of all movements within a warehouse, the accurate location and management of the inventory in the selection process, and packaging [12-14].

The integration of digital technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and cloud management with digital vehicle-tracking applications in real time optimizes processes through better sustainability and transparency, the creation of more efficient supply chains, and the improvement of customer service and logistics [15-17].

Robotic Process Automation (RPA) is another existing digital technology that allows bots to execute time-consuming operational processes, especially repetitive ones that do not generate value, e.g., monitoring an order status or capturing and verifying data. The efficiency of logistics operations is thereby improved by detecting anomalies through notifications generated during product shipment [18-20]. However, while RPA optimizes repetitive tasks, it is limited by processing speed and lacks robustness to software updates. The present study, therefore, proposes an API-based native interoperability approach. APIs guarantee direct communication between the logistics system and software such as SAP, enabling real-time information processing without intermediaries.

2.4. Implementation of Digital Technologies in Logistics

Various case studies have analyzed and executed transformations in their logistics processes using digital technologies. One example involved the treatment of big data in a road-traffic scenario. A predictive algorithm effectively optimized the logistics distribution in a road network, compared to traditional methods that are less precise and sensitive to changes occurring in real time [21]. AI is also used to support decision-making in real-time traffic management, exploiting support vector regression and case-based reasoning as support tools for its application [22]. Likewise, the integration of electric vehicles with AI improves environmental performance and reduces CO₂ emissions by 40%. In terms of operational performance, delivery times are reportedly reduced by 15%–20%, achieving sustainable last-mile logistics [23].

3. Materials and Methods

This study employed a qualitative-quantitative case-study design that is both descriptive and applied. The aim was to evaluate and improve the BPM life cycle of the delivery process. We systematically implemented the BPM phases,

namely process analysis, redesign, execution, monitoring, and control.

3.1. BPM Cycle Tools Per Phase

3.1.1. Analysis (AS-IS)

The current process was diagnosed by analyzing the AS-IS state and identifying deficiencies and digital limitations as areas for improvement. A structured survey was administered to a selection of ten sales executives who were directly involved in the process.

The survey instrument used a Likert scale from 1 to 5 to evaluate the efficiency of the current process through a descriptive statistical analysis. A survey was conducted on a

random sample of five drivers directly involved in the process. The main difficulties in the delivery process were identified using a multiple-choice questionnaire.

3.1.2. Design Selection of the Logistics System (TO-BE)

The next step was to select a logistics system that mitigates the main shortcomings identified above. This involved creating a multi-criteria decision matrix and choosing the highest-scoring system. We identified three cloud-based “Software as a Service” last-mile delivery systems geared toward B2B/B2C business models. Next, we defined the evaluation criteria identified in the AS-IS analysis. Their respective weights were assigned the values listed in Table 1.

Table 1. Assignment of criteria and their respective weights

No	Criterion	Description	Weight (%)
C1	Functionality	Comprehensive, robust capability for route optimization and management, along with personalized notifications via SMS, WhatsApp, and email.	30
C2	Usability	Easy use and learning.	20
C3	Interoperability	Compatibility with existing software via APIs.	20
C4	Cost-benefit	Relationship between features and cost.	20
C5	Support	Efficient and reliable support.	10
			100

The alternatives were evaluated on a scale of 1-5 per criterion, with 1 signifying “very low” and 5 signifying “excellent.” To identify the highest-scoring logistics system, the total score for each system was calculated as the sum of the products of the scores and their respective weights:

$$\text{Total score} = \sum (\text{Weight}_i \times \text{Score}_i) \quad (1)$$

Once the system was selected, the future-state process (TO-BE) was designed using the BPM mapping methodology

and the Bizagi tool. This design incorporates improvements with the selected logistics system. The design was reviewed and validated by the process owners before implementation.

3.1.3. Implementation

Implementation was managed using the PMBOK framework, which is structured into five process groups comprising specific activities and deliverables, as outlined in Table 2.

Table 2. List of PMBOK framework process groups and their respective activities and deliverables

Process Group	Key Activities	Deliverables
Initiation	Project initiation, formalization and stakeholder identification	Project charter and stakeholder register
Planning	Definition of product scope, deliverables, and project schedule	Scope statement and Gantt chart prepared using Microsoft Project
Execution	Logistics system configuration, API integration, and user training	Project checklist and training materials
Monitoring and Control	Performance testing	Performance Report
Closing	Preparation of the project closure report	Closure report and acceptance

3.1.4. Monitoring and Control

Key Performance Indicators (KPI) were defined to measure the impact of implementing a given logistics system on the merchandise delivery process. Regarding process efficiency, route creation and delivery times were measured using operational records obtained before and after the implementation. Meanwhile, user satisfaction KPIs were

assessed via a structured Likert-scale survey. The survey was validated for consistency (Cronbach’s alpha = 0.87).

3.1.5. Instrument Design and Validation

The survey instruments were conducted using logistics satisfaction scales. The content was validated through a review by logistics experts within the company. Real-time

data-extraction tools were configured to provide delivery metrics to complement the survey data.

4. Results and Discussion

4.1. Results of the AS-IS Process

Regarding the subject of the study, an evaluation was

conducted, and surveys were conducted of sales executives. The results showed that 70% of customers and sales areas experienced significant difficulties in tracking their orders during the delivery process, whereas 30% experienced intermediate difficulties (Figure 1). Other critical points in this process were also identified.

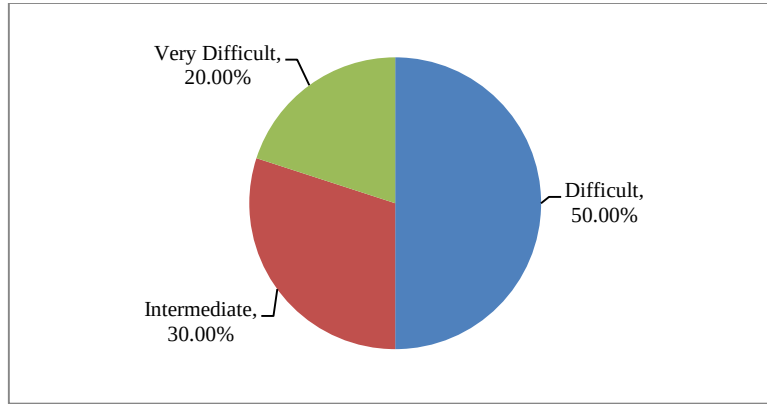


Fig. 1 Difficulty level of the sales area and customers, as experienced when using the traditional delivery method

The AS-IS process for merchandise delivery is summarized in Figure 2. In this process, drivers organize the routes themselves.

There is therefore a greater probability of errors occurring, as concluded by a survey where 100% of drivers reported difficulty in locating customers as the main drawback; 80% reported having difficulty in organizing the order of the

route (with the need to consider load weights, customer-specific delivery-time windows, exact addresses, and road traffic), which causes delays in planning and execution. There was also a lack of knowledge of the status of the order throughout the delivery process on the part of the sales executives, the warehouse managers, and the customers. This resulted from deliveries being recorded on paper in the on-time delivery register. The absence of this knowledge in real time causes constant telephone inquiries about an order status.

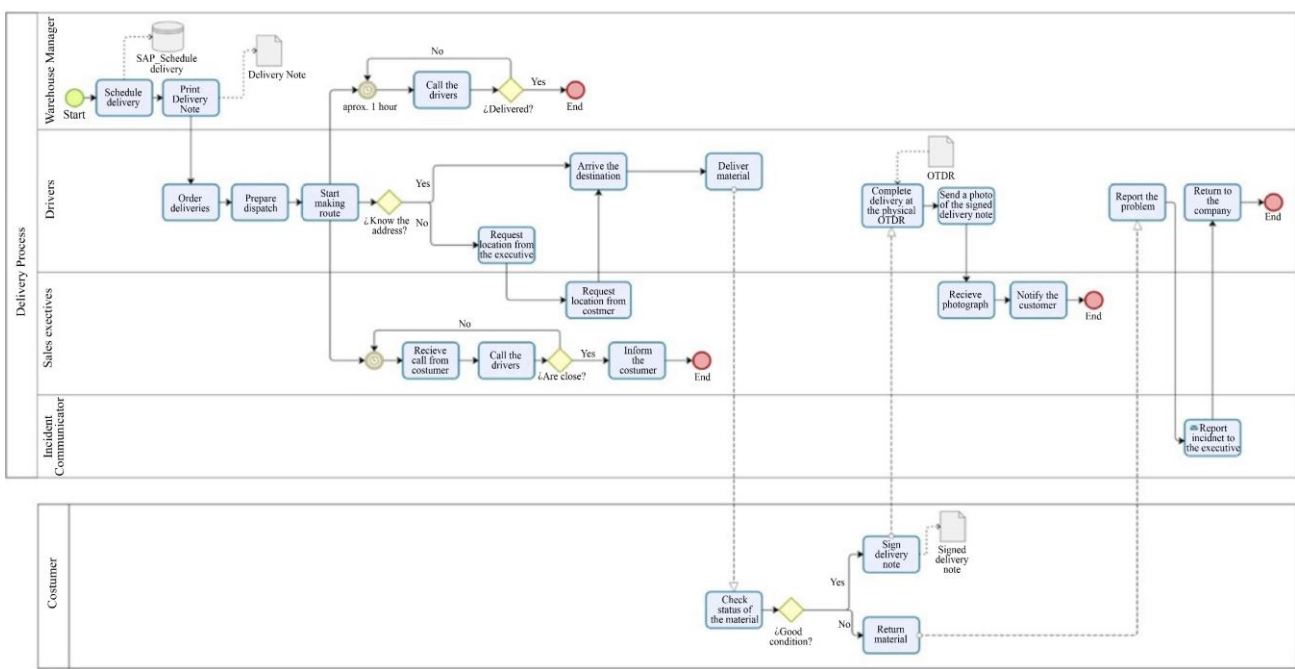


Fig. 2 AS-IS process for merchandise delivery

These shortcomings motivated the proposal for a route optimizer that removes delays and improves customer satisfaction. A survey was therefore conducted within the sales department to evaluate the satisfaction with the implementation of a logistics system. The survey outcome was 100% favorable. The logistics system that showed the best adaptation to the company's needs and mitigated the critical points of the process was therefore evaluated and selected.

4.2. System Selection and the TO-BE Design

4.2.1. Evaluation and Selection of the Logistics System

The company established several standards to optimize routes and improve customer satisfaction during the delivery process. These included the ability to evaluate customer experience from purchase to delivery through a customized survey. Drivers and warehouse management staff also wanted a user-friendly interface. Finally, email and WhatsApp were used for sending notifications. The logistics system was

selected using the multi-criteria decision matrix described in Section 3.1.2. Table 3 lists the weighted scores obtained for each alternative. Simpliroute achieves the highest weighted score (4.7/5.00), standing out for its functionality (specifically, intelligent route generation via machine learning, which uses AI to detect and predict traffic) and its ability to automatically send personalized customer satisfaction surveys via WhatsApp and email after each delivery, thereby facilitating the assessment of the customer's experience. It also shows outstanding interoperability with GEOTAB (using vehicle-connected IoT sensors) and in terms of integration of SAP and Simpliroute APIs. This was done using a plugin that acts as an intelligent logistics filter to streamline the setup. Its ease of use (across both the platform and the driver mobile app) and cost-benefit ratio are also highlighted. Based on these results, Simpliroute was selected for implementation in the merchandise delivery process to resolve the critical issues identified during the AS- IS analysis.

Table 3. A Multi-criteria decision matrix used 1.5 or logistics system selection

Criteria	Weight	Beetrack	Simpliroute	Smart Monkey
Functionality	30%	1.5	1.5	0.9
Usability	20%	0.4	0.8	0.8
Interoperability	20%	0.8	1.0	0.8
Cost-Benefit	20%	0.8	1.0	0.6
Support	10%	0.5	0.4	0.4
Total score	100%	4.0	4.7	3.5

4.2.2. TO-BE Design

Following the system selection, a new TO-BE process model was designed for merchandise delivery using the Simpliroute logistics system, as summarized in Figure 3. The new workflow optimizes routes using data that includes the load weight, delivery windows, and specific customer locations, while also predicting traffic conditions.

Additionally, the platform synchronizes with the driver's app, allowing assigned stops to be viewed in an optimized sequence, ready for loading and delivery. Notifications are generated from the start of the route through to delivery completion, enabling real-time tracking by all parties involved

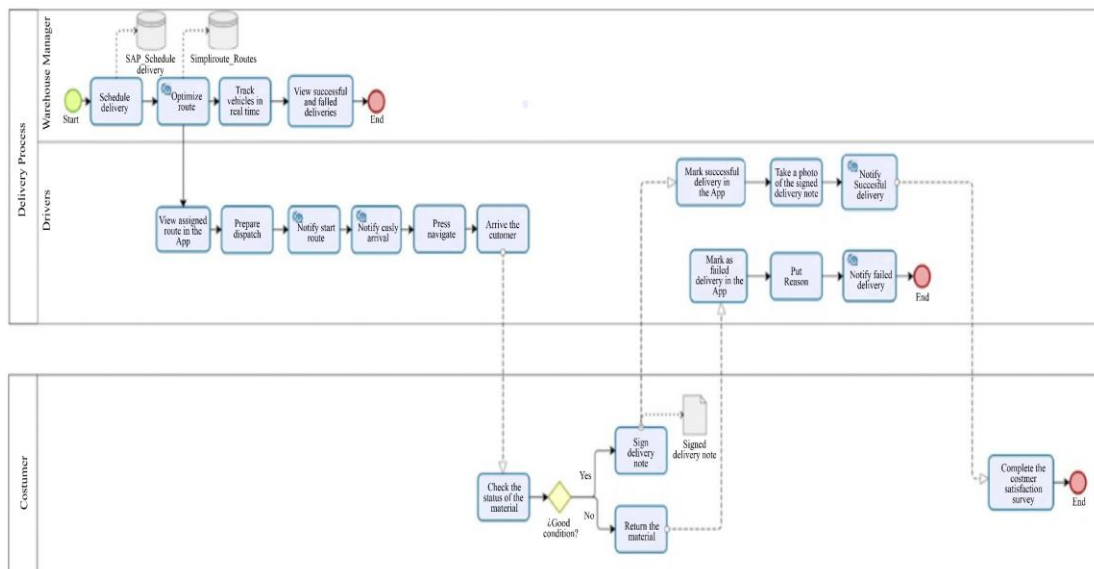


Fig. 3 TO-BE process merchandise delivery exploiting the Simpliroute logistics system

4.3. Implementation and Project Management

4.3.1. Initiation

The project began with the Project Charter, which defined the requirements and costs for the implementation of the Simpliroute logistics system. This system is also integrated with the company's ERP system to enable route optimization, real-time vehicle tracking (using the GPS location and delivery details), and the generation of monthly reports through customized dashboards. The Simpliroute app for drivers automates route assignments and provides navigation options through Google Maps or Waze to optimize delivery. It was possible to record the status of each visit (success or failure), add comments, and provide photographic confirmations of delivery. The Simpliroute system also notified the customer automatically, using WhatsApp and email, of the order status, thereby improving their experience. A satisfaction survey was sent upon completion of delivery. The project involved a multidisciplinary team comprising two stakeholder groups: suppliers and collaborators. Each member fulfilled a specific role. The project manager led the planning and oversaw the implementation of the logistics system. Simpliroute's support team provided technical assistance throughout the implementation process. The external SAP-certified provider ensured the correct, secure, and stable operation of the company's server API (Service Layer), and the programming of precise filters and conditions required by business rules to determine which data was transmitted and when, without compromising the stability or integrity of the SAP system data. Additionally, the company's IT department participated in the system implementation and integration to ensure that the logistics system functioned correctly within the organization.

4.3.2. Planning

A statement of work was prepared, detailing the scope of the Simpliroute logistics system and the project deliverables across phases. The project schedule comprised five phases, spanning from June 14 to August 29, 2023. The development, control and monitoring stages took place between July 3 and August 28, 2023, as shown in Figure 4. Project management was conducted at the facilities of the organization under study, enabling the direct supervision and effective coordination of activities related to the implementation of the logistics system.

Task Mode	Task Name	Start	Finish
	◀ Simpliroute Implementation	6/14/23	8/29/23
	▶ Project Management	6/14/23	6/16/23
	▶ Planning	6/16/23	7/3/23
	▶ Execution	7/3/23	8/8/23
	▶ Control and Monitoring	7/18/23	8/28/23
	▶ Closing	8/28/23	8/29/23

Fig. 4 Project activity schedule

During this stage, the customer satisfaction survey designed for automatic dispatch following delivery was customized. Data mapping was also performed to transfer information from SAP to Simpliroute. To expedite the project, specific fields (such as email addresses and WhatsApp numbers) were added to complete missing data and facilitate their use within Simpliroute. In collaboration with the sales department, restrictions were implemented in SAP to optimize operations. WhatsApp messages were also customized to notify customers of the driver's departure and progress toward the destination. Post-delivery messages were configured to report on the success of delivery, explain reasons for any failure, and provide a comment.

4.3.3. Execution

The first step was to install the Simpliroute platform, create the warehouse manager login credentials, and email them. The company location was configured, and profiles were created for other users, such as the administrators and drivers. Likewise, the trucks were registered on the Simpliroute platform. HTML was used to create email notifications to be sent at three crucial moments: (1) when a driver departs to deliver the merchandise, (2) when the driver approaches the destination, and (3) after completion of the delivery, specifying success or failure. During the implementation of the mobile application, the storage capacity and memory of the drivers' devices were evaluated. The Simpliroute app was installed on all the devices. Drivers received an email with access credentials previously generated through the web platform. Two integrations were developed for the Simpliroute web application. The first was with GEOTAB. During a coordination meeting, all the information required to activate the integration for each vehicle was provided, thereby enabling access to real-time data via IoT sensors installed on the trucks. This integration was made possible by the partnership between Simpliroute and GEOTAB, which eliminated additional costs. SAP and Simpliroute were integrated at a coordination meeting held with the external SAP-certified provider and the system assistant from the organization under study. During this meeting, standard fields were identified, and custom SAP fields were mapped for transfer to Simpliroute.

Between July 13 and 18, the drivers and warehouse manager participated in two one-hour sessions. Attendance by the invited staff was 100%, as the project implementation made the training compulsory. During these sessions, the warehouse manager was trained on Simpliroute's route-planning process, while the drivers received training on the delivery process using the mobile app. Manuals explaining the correct use of the Simpliroute web software and mobile app were distributed subsequently.

4.3.4. Control and Monitoring

Tests of restrictions were conducted in SAP to ensure that the information to be sent during the integration was optimal,

without problems. SAP integration tests with Simpliroute were also conducted to verify the correct transfer of the data. Stress tests of the web software and mobile application were also conducted to evaluate their performance. By integrating GEOTAB with Simpliroute, functionality tests were conducted on the vehicles' GPS systems. The WhatsApp message test was conducted at three key moments, with the final message containing a link to a customer satisfaction survey. Email notifications were also tested, where the last message also included a link to the survey. Upon completion of the project, a Schedule Performance Index of 1.0 was recorded, demonstrating the team's timely and accurate delivery in accordance with standards, as stipulated in the project schedule in Microsoft Project.

4.3.5. Closing

The completion of the project was communicated to the management. Once approved, the implementation was presented to the sales department.

4.4. Monitoring and Control

This stage evaluated the impact of implementing the Simpliroute logistics system on the merchandise delivery process. Three KPIs were measured: the route creation time, the delivery time, and user satisfaction. Each indicator was measured before (AS-IS) and after the implementation of the logistics system (TO-BE). The analysis results are presented in Table 4.

Table 4. KPI evaluation and monitoring results

KPIs	AS-IS	TO-BE	Variation	Test	p-value	Effect
Route creation time (min)	311.5	51.5	-83.47%	T student	<0.001	d = 6
Delivery times (min)	44.5	26.6	-40%	T student	<0.001	d = 4
User satisfaction (1-5)	2.12(42.4%)	4.61(92.2%)	+2.49 points	Wilcoxon	<0.001	r = 0.87

4.4.1. Route Creation Time KPI

The route creation time decreased by 83.47% from 311.5 min in the AS-IS scenario to 51.5 min in the TO-BE scenario. A highly significant and trustworthy result was revealed through statistical analysis, given that the obtained p-value is less than 0.001. Cohen's effect size ($d = 6$) indicates that the magnitude of the difference is large, demonstrating a direct

link between the creation time and the implementation of the Simpliroute logistics system. The route optimizer in this system determines the best path by considering the travel distance, load weight, time windows, and traffic forecasts. This feature contrasts with traditional practice, where drivers organize routes themselves, potentially introducing delays in the planning and execution of merchandise delivery.

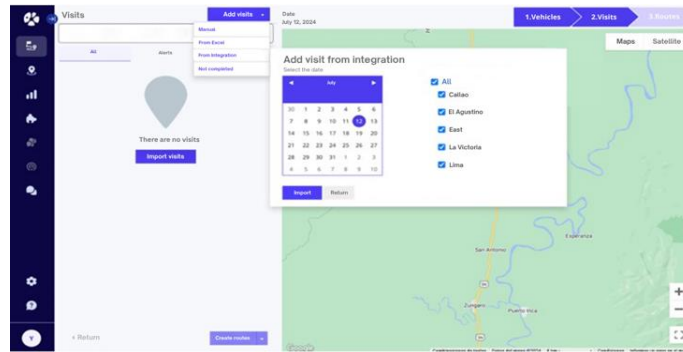


Fig. 5 Adding visits with integration

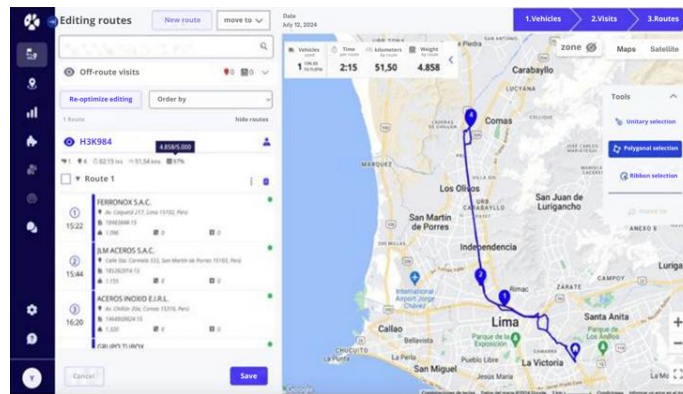


Fig. 6 Optimized route

4.4.2. Delivery Time KPI

The customer delivery time dropped by 40% from 44.5 min in the AS-IS scenario to 26.6 min after implementing the logistics system in the TO-BE scenario. A highly significant and trustworthy result was revealed through statistical analysis, given that the obtained p-value is less than 0.001. Its large magnitude (with Cohen's effect size $d = 4$) implies a direct link between the reduction in delivery time and the implementation of the Simpliroute logistics system. This improvement was achieved thanks to a navigation button in the driver app that utilizes Google Maps or Waze to reach the exact destination while avoiding route delays. Furthermore, the delivery capacity increased to 66.7%, allowing more visits per route than was feasible using the traditional method. The "vehicle load percentage" feature enables stops to be added to the route.

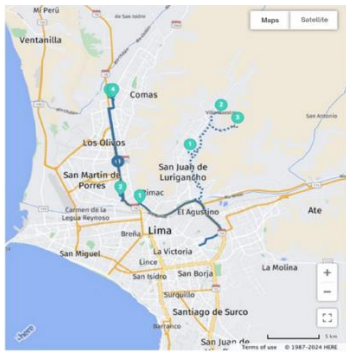


Fig. 7 Real-time route tracking

Simpliroute's system also allows the warehouse manager to view the order status, route start time, customer arrival time, service duration, and delivery status (success or failure) in real time. Traditional delivery records were kept on paper, which prevented the warehouse manager from visualizing the overall process from start to completion. In contrast, Simpliroute allows total control and the real-time tracking of deliveries. Paper usage in the process was reduced by 80%, and previously paper-based records were digitized. A survey of

drivers unanimously found the interface easy to use and helpful for performing tasks more efficiently than by using the traditional method.

4.4.3. User Satisfaction KPI

User satisfaction increased by 2.49 points on a five-point Likert scale. The mean score rose from 2.12 points prior to implementation to 4.61 points afterward, reflecting an improvement from 42.4% to 92.2%. The significance of the difference was confirmed by the Wilcoxon signed-rank test, which yielded a p-value less than 0.001. Rosenthal's effect size ($r = 0.8731$) indicates a large magnitude, confirming the attribution of the improved user satisfaction to the implementation of the Simpliroute logistics system. The number of customer calls and messages regarding deliveries was significantly reduced thanks to the real-time notifications sent via WhatsApp and email at three key stages: route commencement, proximity to delivery, and detailed delivery status (Figure 8). Unlike when using the traditional method, customers no longer experienced uncertainty regarding the status of their orders (Figure 9). Meanwhile, sales representatives, who previously lacked information on their customers' order status, were able to eliminate this uncertainty through real-time email notifications, achieving total satisfaction with this automated system, according to surveys conducted within the sales department (Figure 10).

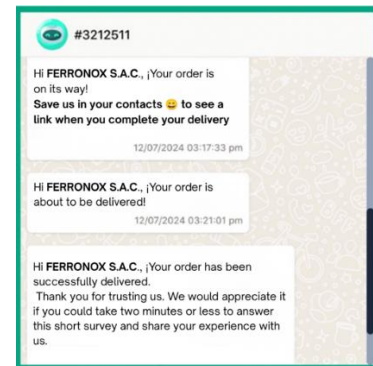


Fig. 8 Notifications communicated during the delivery process

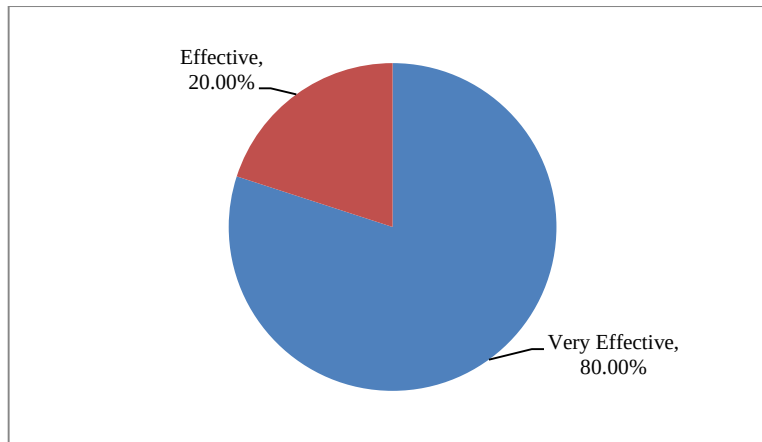


Fig. 9 Level of effectiveness in reducing customer calls or messages regarding deliveries using the Simpliroute logistics system

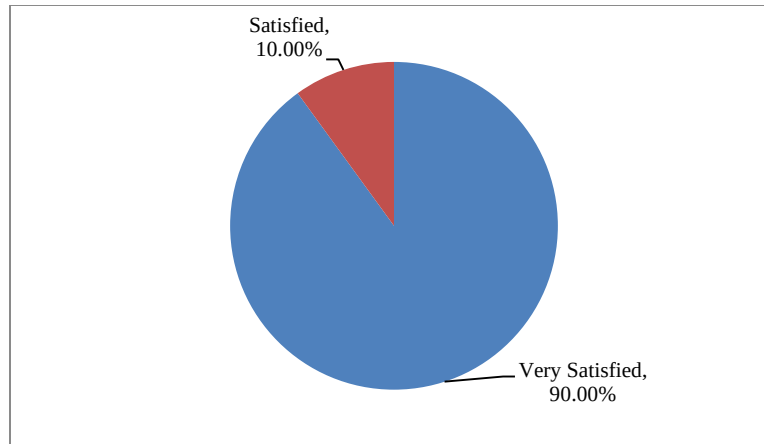


Fig. 10 Level of satisfaction with the notification service for sales executives using the Simpliroute logistics system

5. Conclusion

In conclusion, applying the BPM life cycle enabled the identification of critical points through an analysis of the AS-IS state of the delivery process and the proposal of improvements via digital transformation and the implementation of a logistics system. The use of Simpliroute facilitated route optimization, reducing route creation time by 83.47%. It improved delivery times and enabled real-time tracking. Customer satisfaction thus increased from 42.2% to 92.2%, thereby fulfilling the research objective. The delivery capacity was increased by allowing the addition of more stops along a route, optimizing resources, and boosting the overall operational efficiency. The BPM life cycle, combined with project management based on the PMBOK framework, enabled a structured and replicable implementation. This study, therefore, presents a validated and scalable model for the digital transformation of logistics processes, applicable to other sectors. The limitation of the study is its focus on a single company within the Peruvian metallurgical sector. Extending the study results to other geographical regions or industries, therefore, requires caution. Blockchain technology allows tracking and security in operations because it provides a decentralized and transparent record of an entire supply chain.

This technology gives us a reliable and accessible shared history in real time. It reduces the risks of fraud, errors, and data manipulation. Furthermore, the use of smart contracts would optimize the administrative and operational efficiency by allowing the automation of crucial operations and validations. Future projects should integrate this increasingly popular logistics technology to increase sustainability, visibility, and trust.

Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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