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RESEARCH PAPER

Development of performance indicators using Business Intelligence to optimize the offshore recruitment and selection process in a maritime transport company

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ABSTRACT

Goal: This study aims to develop and implement performance indicators using Business Intelligence (BI) tools to optimize the offshore recruitment and selection process in a maritime transport company, reducing approval time and operational costs.

Design / Methodology / Approach: A quantitative case study was conducted through eight stages: data collection, processing, analysis, process mapping, PDCA (Plan-Do-Check-Act) cycle application, time study, cost analysis, and use of quality tools. Data was obtained from internal company records and analyzed using Microsoft Power BI for visualization and the Fluig system for process automation.

Results: Process automation reduced the average approval time for Personnel Movement Requests (MP) from 24 to 6 days, representing approximately a 75% improvement. Statistical analyses, including descriptive statistics, Welch two-sample t-test, and effect size evaluation, demonstrated that the reduction was statistically significant ($p < 0.001$) and operationally relevant. Additionally, the process optimization generated cost savings of approximately USD 134,548.21 within one quarter (a 73.7% reduction in related expenses). The use of BI dashboards enabled real-time monitoring and improved managerial decision-making.

Limitations of the investigation: The research focused on a single company in the offshore maritime sector, which limits the generalization of results and does not explore behavioral effects of digital transformation.

Practical implications: The study demonstrates that integrating BI tools with continuous improvement methodologies enhances process efficiency, transparency, and cost control in human resource management.

Originality / Value: This research provides empirical evidence of how BI and workflow automation can improve recruitment performance and operational efficiency in high-complexity environments such as offshore logistics.

Keywords: Business Intelligence, Process Optimization, Recruitment and Selection, Offshore Industry, Continuous Improvement.

1 INTRODUCTION

The maritime support industry plays a pivotal role in both the Brazilian and global economies, demanding high levels of productivity, quality, and innovation to address challenges such as inadequate infrastructure and elevated operational costs. According to the Brazilian National Waterway Transport Agency (ANTAQ), Brazil currently operates more than 400 offshore support vessels, positioning the country strategically in the global maritime scenario (ABEAM, 2024).

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This figure represents the highest number of vessels since 2014, and the sector accounts for approximately 19% of the national Gross Domestic Product (GDP) (NAVSUPPLY, 2024).

Despite its significance, the maritime transport sector in Brazil remains underexploited. As noted by Cecatto (2002), the country's extensive coastline and vast hydrographic network present great potential; however, issues such as inadequate port infrastructure, bureaucracy, and high tariffs hinder its full development. Nevertheless, the sector handles over 350 million tons of cargo annually and serves as a key source of employment in shipbuilding, transportation, and port operations. Strategic modernization and process optimization could considerably expand its economic contribution.

According to Caesar (2024), sustaining this transformation requires a skilled and resilient maritime workforce capable of adapting to the digitalization and automation trends reshaping global logistics. The author argues that long-term workforce development, continuous training, and technology-driven HR practices are essential to maintaining competitiveness and ensuring the sustainability of human capital in the maritime sector.

Maritime transport is essential for Brazil's economic integration, both domestically and in international trade, and is vital for competitiveness and national security. However, the lack of infrastructure and the high costs associated with operations continue to constrain its growth. Substantial investments in this sector are necessary to reduce logistical expenses, improve transport efficiency, and enhance competitiveness in global markets.

According to Ribeiro, Fraga, and Clarkson (2017), the effective application of information technologies plays a decisive role in addressing logistical bottlenecks within the Brazilian port and maritime sectors. Their comparative analysis of BRICS ports demonstrates that digital tools such as optimization systems, RFID, and intelligent transportation technologies can mitigate inefficiencies, enhance cargo flow, and strengthen international competitiveness. This perspective underscores the broader relevance of digital transformation and process automation initiatives for sustaining operational performance and cost efficiency in the maritime industry. In this context, effective cost management becomes a central element for maintaining competitiveness, enabling organizations to reduce waste, optimize resources, and ensure financial sustainability.

Given the competitive nature of the maritime industry, companies must implement continuous improvement initiatives to sustain high performance. Technological advancement has intensified market dynamics, requiring organizations to adapt rapidly through innovation, process reengineering, and human resource development. In line with these technological trends, Siqueira et al. (2024) demonstrated that the retrofitting of industrial machinery through automation and programmable logic controllers (PLCs) can substantially improve operational efficiency, precision, and safety. Their study on the modernization of a vertical lathe revealed drastic reductions in setup time, from ten minutes to approximately five seconds, and an 80 percent decrease in corrective stoppages, alongside significant gains in machining accuracy. Such findings reinforce the transformative potential of automation and control systems in driving productivity, standardization, and risk mitigation, thereby illustrating the broader relevance of digital transformation initiatives across industrial sectors.

As Nascimento (2022) highlights, the Human Resources (HR) function has evolved from a merely administrative role to a strategic component of organizational success. Since the Industrial Revolution, HR has increasingly focused on employee well-being, productivity, and strategic alignment, culminating in the development of human capital as a key competitive advantage.

Recruitment and selection (R&S) are therefore fundamental processes for attracting and retaining skilled professionals capable of sustaining operational excellence. As Guimarães and Arieira (2005) argue, recruitment and selection constitute essential management tools that ensure the inclusion of qualified professionals capable of contributing effectively to organizational success. The authors contend that well-structured R&S processes minimize training needs, improve performance outcomes, and strengthen competitive advantage by aligning employee competencies with organizational demands. This perspective reinforces the strategic nature of human resource management in complex operational environments such as offshore logistics.

Complementarily, Pires, Costa, Amorim, and Pereira (2023) highlight that the increasing use of digital platforms, communication software, and AI-based systems has redefined recruitment and selection practices by reducing operational time and cost while expanding the reach of organizational hiring. Their findings indicate that online recruitment strategies enhance process transparency and efficiency, allowing organizations to identify candidates more effectively in competitive markets.

The selection process has become more data-driven and methodologically rigorous, incorporating stages such as competency analysis and performance evaluation. As Martins et al. (2022) emphasize, with the advent of Industry 4.0, decision-making in organizations has become heavily dependent on data analytics and automation technologies. In this context, data science plays a crucial role in transforming raw data into actionable insights.

Decision Support Systems (DSS) and BI tools are vital in enabling data-driven management. Despite the increasing adoption of BI, workflow automation, and HR Analytics in organizational environments, previous studies have predominantly examined these technologies in manufacturing systems, enterprise resource planning, warehousing operations, or general human resource management. Existing research consistently reports improvements in operational efficiency, decision-making quality, and information integration; however, these studies rarely investigate recruitment and selection processes operating in highly complex, time-sensitive environments, such as offshore maritime logistics.

Moreover, most previous investigations have focused on describing the implementation of digital technologies or evaluating isolated technological solutions, without examining how the combined application of BI, workflow automation, continuous improvement methodologies, and performance indicators contributes to process stabilization, reduction of operational variability, and strategic human resource management. Consequently, the mechanisms through which digital transformation generates sustainable operational improvements in offshore recruitment processes remain insufficiently understood.

This limitation is particularly relevant in offshore operations, where recruitment delays directly affect vessel staffing, operational continuity, regulatory compliance, and labor costs. Unlike conventional recruitment environments, offshore logistics involves multiple organizational stakeholders, sequential approval stages, strict certification requirements, and highly time-constrained personnel replacement processes. These characteristics create a unique operational context that has received limited attention in the BI and HR Analytics literature.

Accordingly, this study addresses an important gap by empirically examining how the integration of BI dashboards, workflow automation, performance indicators, and continuous improvement practices influences recruitment process performance in a high-complexity maritime environment. Beyond reporting operational improvements, this research contributes to the literature by providing quantitative evidence of process stabilization, demonstrating the relationship between digital process integration and HR operational performance, and proposing a replicable analytical framework that may support future studies involving digital transformation in complex organizational settings.

Therefore, this study seeks to answer the following research question:

"How can BI tools and workflow automation improve operational efficiency and reduce approval time in offshore recruitment and selection processes?"

Based on this research question, the following hypothesis is proposed:

H1: The integration of BI tools and workflow automation significantly reduces approval time and operational costs in offshore recruitment and selection processes.

BI systems facilitate the collection, organization, and analysis of information to generate insights that support more assertive decisions. Roy (2010) highlighted that BI systems can support cross-functional decision-making by integrating operational data and analytical models to optimize organizational performance. According to the author, BI-based approaches enhance managerial coordination and contribute to more efficient operational planning in complex organizational environments. Meanwhile, Enterprise Resource Planning (ERP) systems provide integrated data management, consolidating essential information for BI applications. Studies have demonstrated that BI implementation enhances decision-making efficiency, reduces operational time and costs, and generates competitive advantages. Nicoletti Junior et al. (2018) demonstrated that ERP implementation projects contribute significantly to process standardization, information reliability, and operational integration. Their findings reinforce the importance of integrated enterprise systems in improving organizational coordination and supporting data-driven management environments.

In this regard, Dias and Sousa (2015) emphasize that BI applied to Human Resource Management enables organizations to transform HR data into strategic insights, improving workforce planning and decision-making accuracy. Their findings highlight that BI systems not only automate information processing but also enhance the analytical capacity of HR departments, supporting evidence-based strategies that align human capital management with corporate objectives.

Similarly, Souza and Lopes (2023) emphasize that BI operates not merely as a technological solution but as a strategic instrument that enables organizations to convert data into actionable insights for competitive advantage. Their findings demonstrate that BI systems support evidence-based decision-making, process agility, and improved organizational positioning through advanced data consolidation and visualization. The authors also highlight that such systems can personalize services and optimize operations by integrating information across departments, reinforcing the role of BI as a critical enabler of strategic and operational excellence in highly dynamic markets.

The maritime support industry, while challenged by infrastructure and cost constraints, offers significant opportunities for technological transformation. Tabim et al. (2024) demonstrated that

digital transformation initiatives supported by data integration and process digitalization significantly improve operational maturity and organizational responsiveness in logistics environments. Their findings reinforce the strategic role of digital technologies in enhancing process visibility, operational coordination, and decision-making efficiency in complex operational systems. To remain competitive, organizations in this sector must invest in digitalization, professional training, and continuous process improvement. The integration of BI systems and data analytics into human resource processes, particularly in offshore recruitment and selection, can substantially increase productivity, efficiency, and strategic agility. Ultimately, digital transformation and cost-efficient management contribute not only to operational excellence but also to the broader advancement of Brazil's maritime support sector.

From a theoretical perspective, this study contributes to the BI, HR Analytics, and digital transformation literature in three complementary ways. First, it extends previous research by demonstrating that the benefits of BI are not limited to manufacturing, logistics, or enterprise resource planning environments, but can also be successfully applied to offshore recruitment and selection processes characterized by high operational complexity, multiple decision-makers, and time-critical staffing requirements.

Second, this research advances the understanding of digital transformation in human resource management by showing that operational improvements are achieved not only through the implementation of digital technologies themselves, but also through their integration with workflow automation, performance measurement systems, and continuous improvement methodologies. The findings therefore reinforce the view that organizational performance emerges from the interaction between technological capabilities and structured process management rather than from isolated technological adoption.

Third, the study contributes to HR Analytics by providing empirical evidence that performance indicators can support not only process monitoring but also process stabilization and evidence-based managerial decision-making. The statistical analyses demonstrate that digital integration contributes simultaneously to reducing average process time, operational variability, and process uncertainty, thereby expanding the current understanding of how HR Analytics can create organizational value in complex operational settings.

Accordingly, rather than representing a company-specific implementation, this study proposes an analytical framework that integrates BI, workflow automation, continuous improvement practices, and performance indicators into a unified approach for improving recruitment performance. This framework may serve as a theoretical reference for future investigations examining digital transformation in human resource processes operating under high levels of operational complexity.

In alignment with this perspective, Theotokas, Lagoudis, and Raftopoulou (2024) argue that maritime human resource management must evolve alongside shipping digitalization, addressing critical challenges such as workforce reskilling, organizational adaptation, and the integration of digital technologies across sea and shore operations. Their framework underscores that HR strategies are pivotal in facilitating the industry's digital transition while ensuring sustainability and competitiveness. The present study complements this perspective by providing empirical evidence of how digital technologies, when combined with structured process management and performance measurement, can translate digital transformation initiatives into measurable operational improvements.

2 METHOD

This research adopts a quantitative case study approach conducted within a maritime support company, aiming to evaluate and enhance its offshore recruitment and selection process. The methodological framework, illustrated in Figure 1, was structured into eight sequential stages: data collection, data processing, data analysis, process mapping, PDCA cycle application, time study, project management, and the use of quality tools.

The initial stage involved gathering quantitative data related to process performance metrics, historical records, and employee feedback. These data were obtained through interviews, questionnaires, and analysis of internal company documents. Once collected, the data was processed using BI tools, particularly Microsoft Power BI, to ensure consistency, reliability, and standardization. This stage aimed to transform raw information into structured datasets suitable for analytical interpretation.

After data treatment, an in-depth analysis was carried out to identify patterns, bottlenecks, and inefficiencies that could compromise the effectiveness of the recruitment and selection process. Subsequently, the process was mapped in detail to document each stage of the recruitment

workflow, providing a comprehensive understanding of the operational flow and areas requiring improvement.

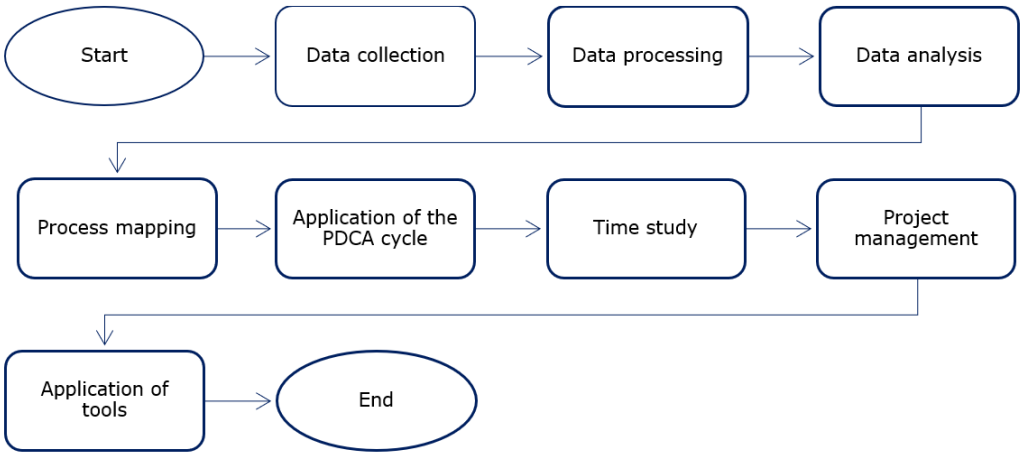

Figure 1 - Research methodological framework
Source: The authors themselves.

The PDCA cycle was employed as a continuous improvement methodology. As defined by Abrantes (2009), the PDCA cycle establishes a structured approach to process control and incremental optimization. In this study, the PDCA cycle guided the planning of improvement actions, the implementation of solutions, the verification of results, and the standardization of enhanced practices. This methodology aims to make management processes more agile, transparent, and performance oriented.

A study was conducted to evaluate the duration of each step within the recruitment and selection process, identifying opportunities to reduce process time and increase productivity. According to Barnes (1977), time studies were originally developed by Taylor in the early twentieth century to establish standard times for work performance, incorporating allowances for rest and pauses. This analysis was critical in determining process inefficiencies and supporting the development of optimization strategies.

In parallel, a cost analysis was performed to assess expenses associated with overtime payments (“double shifts”) resulting from delays in the approval of MP. This assessment aimed to quantify financial gains achieved through time reduction, following the principle established by Slack et al. (2009) that operational efficiency directly influences cost reduction and organizational competitiveness.

Project management practices were integrated throughout the study to ensure adherence to timelines, appropriate resource allocation, and coordination among departments. Regular meetings and progress reviews were conducted to maintain alignment with project objectives and facilitate cross-functional collaboration.

Finally, quality management tools such as Ishikawa diagrams and flowcharts were applied to analyze root causes of inefficiencies and to support the design of process improvements. These instruments enabled the identification of key contributing factors affecting the recruitment process and ensured that corrective actions were both data-driven and sustainable.

The combination of these methodologies provided a comprehensive analytical framework, enabling the company to enhance operational efficiency, reduce process time, and improve decision-making within its offshore recruitment and selection workflow.

3 RESULTS AND DISCUSSION

Based on the methodological framework presented in the previous section, this section details the findings and analyses derived from the implementation of the improvement project in the offshore recruitment and selection process.

The data were collected through questionnaires and system reports related to MP, which form part of the recruitment and selection workflow. These documents included variables such as request date, position, reason for the request, approval status, and vessel or department information. The initial dataset was obtained directly from employees and managers involved in the offshore recruitment process.

Following data collection, the information was standardized and cleaned to ensure reliability and consistency. Since the forms were completed by different departments, such as operations

management and logistics, standardization was crucial for integrating the data into a unified structure suitable for BI analysis. The dataset was then visualized using a Power BI dashboard (Figure 2), allowing real-time monitoring of process performance and the identification of inefficiencies.

Figure 2 - Business Intelligence dashboard of offshore recruitment and selection processes
Source: The authors themselves.

The dashboard consolidated key metrics and performance indicators (KPIs) in a single interface, enabling faster and more assertive decision-making. Novochadlo and Paladini (2024) emphasized that real-time performance indicators and digital monitoring systems contribute substantially to operational transparency, process stability, and continuous improvement initiatives. Their study demonstrated that data-driven monitoring enables faster identification of process inefficiencies and supports more effective managerial interventions. One of the primary issues identified was the extended approval time for MP, which significantly delayed the recruitment cycle. To support process monitoring and managerial decision-making, the following Key Performance Indicators (KPIs) were established and monitored throughout the study:

- Average Approval Time (days): calculated as the mean elapsed time between MP request submission and final approval completion.
- Approval Time Reduction Rate (%): calculated by comparing pre- and post-implementation approval times.
- Operational Cost Reduction (USD): measured as the difference between projected overtime costs before process optimization and actual overtime expenses after implementation.
- Process Stability Index: evaluated through the reduction in process variability using standard deviation and coefficient of variation.

These KPIs enabled continuous monitoring of process performance and provided quantitative evidence regarding the operational impacts of workflow automation and BI integration.

Before processing optimization, approval requests were conducted via email and required validation from four different stakeholders: the position manager, the operations general manager, the operations director, and the logistics coordinator. The recruitment team generated a PDF form for each request and manually distributed it for approval. This manual workflow caused significant delays and hindered process transparency.

To quantify the inefficiencies, 49 samples from different vessels and departments were analyzed. The results observed are consistent with Simão et al. (2023), who demonstrated that the implementation of Power BI dashboards significantly enhances management visibility, reporting automation, and continuous performance evaluation. Their study confirms that BI-driven monitoring enables real-time tracking of key performance indicators, promoting transparency and facilitating strategic decisions. In a similar way, the integration of Power BI in the present research provided managers with an accessible and dynamic platform to analyze recruitment metrics and streamline decision-making processes.

The average approval time was 24 calendar days, equivalent to approximately three weeks. Process mapping (Figures 3 and 4) revealed several bottlenecks, particularly in the sequential and manual nature of approvals.

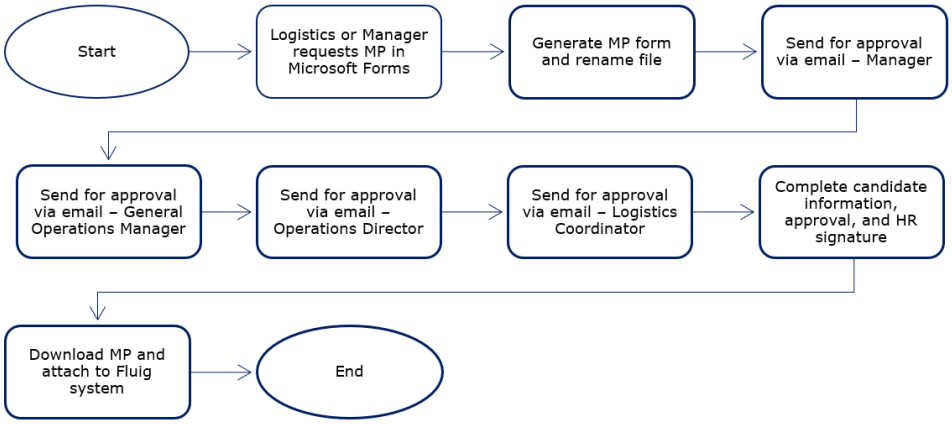

Figure 3 - Personnel Movement Request (MP) approval via email
Source: The authors themselves.

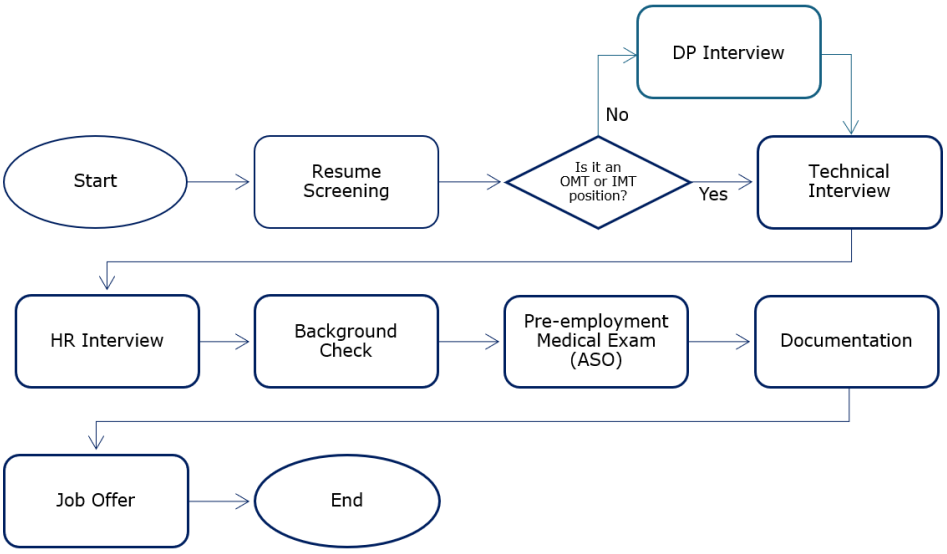

Figure 4 - Offshore recruitment and selection process flow
Source: The authors themselves.

To further illustrate the approval inefficiencies, Table 1 presents detailed data of the approval time for MP before the process automation. These data were collected from 49 samples across different vessels and departments, showing that the average approval time was 24 calendar days.

Table 1 - Approval time data before process automation

Submission date	Position	Vessel type	Final approval date	Approval time (days)
06/07/2024	Deck Officer	RSV	06/27/2024	20
04/11/2024	Offshore Nurse	RSV	05/14/2024	33
03/22/2024	Engine Room Seaman	RSV	03/28/2024	6
03/27/2024	Deck Seaman	PSV	04/10/2024	14
01/09/2024	Deck Officer	PSV	01/16/2024	7
02/21/2024	Chief Engineer	RSV	07/09/2024	139
Average				**24 days**

Source: The authors themselves.

A detailed study confirmed that the final approval phase, which depended on multiple managerial validations, represented the main delay. This finding guided the application of the PDCA cycle, which structured the improvement actions into planning, execution, verification, and standardization stages. These findings align with Blumen and Cepellos (2022), who demonstrated that the use of technology and artificial intelligence in recruitment and selection processes significantly improves time efficiency, cost reduction, and process transparency. Their study also points out that while technological tools, such as automated workflows and AI-based analysis, enhance performance, organizations must maintain a balance between digital efficiency and human interaction to preserve ethical and relational dimensions in recruitment practices.

During the planning phase, the project team analyzed each stage of the process to identify unnecessary or redundant activities. Tasks such as manual generating, renaming, and emailing forms were identified as non-value-added steps.

In the execution phase, a benchmarking analysis was performed against other internal approval workflows. As a result, manual procedures were replaced with an automated digital flow implemented through the Fluig system, an enterprise workflow management platform already available within the company. The integration of Fluig allowed direct validation, centralized storage, and real-time monitoring of approvals. Employees received targeted training to adapt to the new system, and the initial implementation phase included continuous monitoring to ensure smooth transition.

The verification phase demonstrated tangible results. The average approval time decreased from 24 to 6 days, representing approximately a 75% improvement. This reduction was accompanied by greater process transparency, decreased rework, and faster decision-making. Furthermore, BI dashboards facilitated continuous tracking of approval times, enhancing control over the recruitment workflow.

In the standardization phase, the new process was formalized and documented within the company's internal management system (Unisea). Ongoing training and periodic reviews were established to ensure sustainability and continuous improvement.

A second study was performed after process automation, analyzing 69 samples from various vessels and departments. The average approval time of 6 days confirmed the substantial efficiency gain. To provide a more robust quantitative validation of the operational improvements achieved through workflow automation, a comparative statistical analysis was conducted between the pre-implementation and post-implementation periods. Table 2 presents the descriptive and inferential statistical results, including mean, median, standard deviation, coefficient of variation, and statistical significance tests. The analysis demonstrates not only a substantial reduction in approval time but also a considerable decrease in process variability and operational dispersion after the implementation of the Fluig automated workflow system.

Table 2 - Descriptive and inferential statistical analysis of MP approval time

Indicator	Before implementation	After implementation
Number of observations (n)	49	69
Mean (days)	24.5	6.35
Median (days)	20.0	5.0
Standard deviation (days)	27.3	3.39
Minimum value (days)	6	0
Maximum value (days)	139	17
Coefficient of variation (%)	111.4%	53.4%
Statistical test	Welch two-sample t-test	
p-value	< 0.001	
Mean difference (days)	18.11	
95% Confidence Interval	(10.13, 26.09)	
Effect size (Cohen's d)	1.03 (large effect)	

Source: The authors themselves.

A Welch two-sample t-test demonstrated a statistically significant reduction in approval time after implementation ($T = 4.57$, $p < 0.001$). The mean approval time decreased from 24.5 days before implementation to 6.35 days after implementation, representing an approximate 74% reduction in processing time. The estimated mean difference was 18.11 days (95% CI: 10.13–26.09).

Additionally, the post-implementation process exhibited substantially lower variability, with the standard deviation decreasing from 27.3 days to 3.39 days. The coefficient of variation also decreased from 111.4% to 53.4%, indicating greater process stability and operational predictability

after workflow automation. Furthermore, Cohen's d effect size analysis resulted in a value of 1.03, indicating a large practical effect according to Cohen's classification. This finding demonstrates that the implemented improvements produced not only statistically significant results but also substantial operational impact.

The observed reduction in approval time cannot be attributed solely to the adoption of digital technologies. Rather, the results suggest that the operational gains emerged from eliminating structural sources of process inefficiency that had accumulated throughout the approval workflow. Before automation, the recruitment process was characterized by sequential approvals, manual document handling, fragmented information flows, and limited visibility regarding request status. These characteristics increased waiting times, generated unnecessary rework, and reduced the responsiveness of managerial decision-making. The implementation of the automated workflow addressed these limitations by integrating information, standardizing approval procedures, and improving process traceability, thereby reducing both process delays and operational uncertainty.

This interpretation is consistent with continuous improvement theory, particularly the PDCA philosophy, which argues that sustainable organizational performance is achieved through systematic identification and elimination of process variability rather than isolated technological interventions. From this perspective, BI dashboards functioned not merely as reporting tools but as mechanisms that enabled continuous monitoring, rapid identification of bottlenecks, and evidence-based managerial interventions. Consequently, the reduction in approval time should be interpreted as the outcome of a broader organizational learning process supported by digital technologies and structured process management.

The findings are also consistent with the growing HR Analytics literature, which emphasizes that digital transformation improves organizational performance when operational decisions become increasingly data-driven. However, unlike many previous studies that primarily evaluate recruitment outcomes, candidate attraction, or hiring effectiveness, the present research demonstrates that HR Analytics can also improve the internal operational dynamics of recruitment processes through continuous monitoring of workflow performance, process variability, and managerial responsiveness. This broader interpretation extends the application of HR Analytics beyond traditional personnel management metrics.

Moreover, the magnitude of the observed improvement indicates that the benefits of digital transformation extend beyond efficiency gains alone. The substantial reduction in process variability, reflected by the lower standard deviation and coefficient of variation after implementation, suggests increased process stability and greater predictability of recruitment operations. From an operations management perspective, process stability represents an important organizational capability because it enhances planning accuracy, resource allocation, and operational reliability. Therefore, the contribution of the present study is not limited to demonstrating faster recruitment approvals but also to showing how digital integration can create more stable and resilient organizational processes.

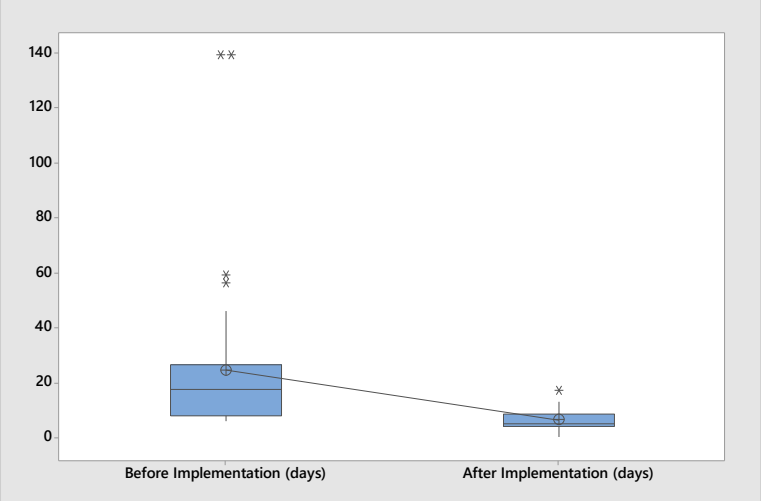

Figure 5 - Boxplot distribution of MP approval times before and after workflow automation implementation
Source: The authors themselves.

Figure 5 illustrates the distribution of approval times before and after process automation through a boxplot analysis. The graphical representation demonstrates a substantial reduction in data dispersion and extreme values after implementation. While the pre-implementation period

presented high variability and significant outliers, the post-implementation scenario exhibited greater concentration of approval times within lower intervals, indicating improved process stability and operational predictability.

Table 3 summarizes the approval time data collected after the implementation of the automated workflow in the Fluig system. The analysis demonstrates a significant reduction in approval time, with an average of six days, confirming the positive impact of digital transformation.

Table 3 - Approval time data after process automation (Fluig System)

Request date	Position	Vessel type	Final approval date	Approval time (days)
03/24/2025	Deck Officer	PSV	04/04/2025	11
03/21/2025	Offshore Nurse	RSV	03/26/2025	5
01/31/2025	Engine Officer	AHTS	02/05/2025	5
02/14/2025	Cook	MPSV	02/18/2025	4
12/12/2024	Offshore Nurse	RSV	12/19/2024	6
10/18/2024	Deck Officer	WSSV	10/28/2024	10
Average				**6 days**

Source: The authors themselves.

Figures 6 and 7 illustrate the post-implementation process flow and BI dashboard.

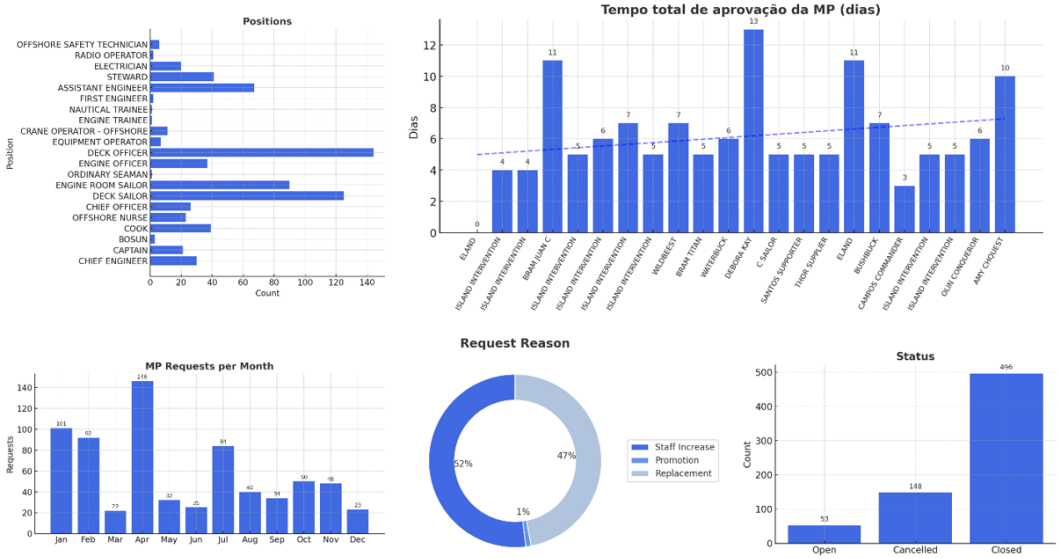

Figure 6 - Business Intelligence dashboard of offshore recruitment and selection processes after implementation
Source: The authors themselves.

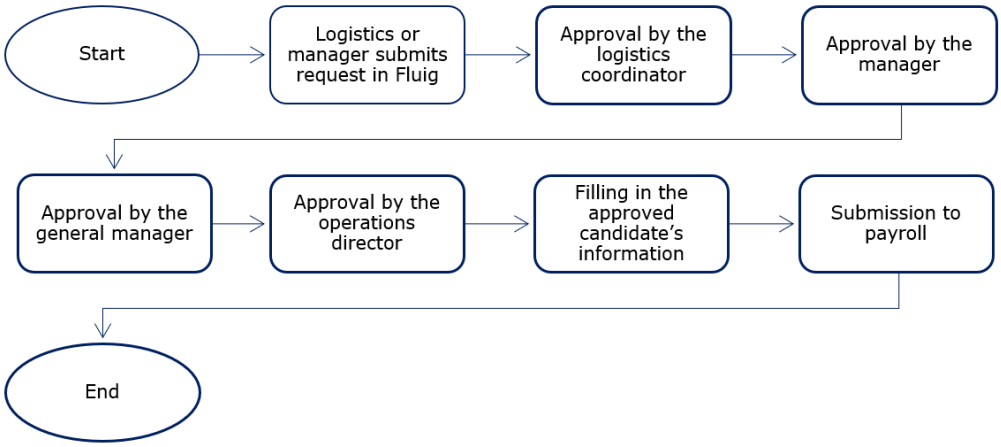

Figure 7 - MP Approvals via Fluig (System)
Source: The authors themselves.

Beyond time optimization, the project generated measurable financial benefits. Delays in MP approval previously required the payment of "double shifts" to onboard professionals while awaiting replacements, a significant logistical cost in offshore operations. After process optimization, the company achieved a total cost reduction of USD 134,548.21 between the last quarter of 2024 and the first quarter of 2025, representing a 73.7% decrease in expenses compared to the pre-implementation scenario.

Table 4 presents the cost analysis results, comparing projected expenses before the improvement with the actual costs after automation. The reduction in approval time directly contributed to the elimination of excessive overtime ("double shifts"), leading to substantial financial savings.

Table 4 - Cost comparison before and after process improvement

Position	Vessel type	Days saved	Daily overtime rate (USD)	Projected cost without improvement (USD)	Actual cost (USD)	Savings (USD)
Deck Officer	PSV	13	139.29	3,343.01	1,810.80	1,532.21
Offshore Nurse	RSV	19	37.53	965.86	764.64	201.22
Engine Officer	AHTS	19	93.67	2,410.49	1,406.12	1,004.37
Cook	MPSV	20	42.69	1,098.47	915.39	183.08
Captain	RSV	20	225.19	5,795.14	4,829.29	965.86

Source: The authors themselves.

This improvement directly resulted from reduced approval times, minimizing the need for extended shifts and emergency personnel adjustments. Figure 8 demonstrates the relationship between costs avoided, savings achieved, and remaining overtime expenses.

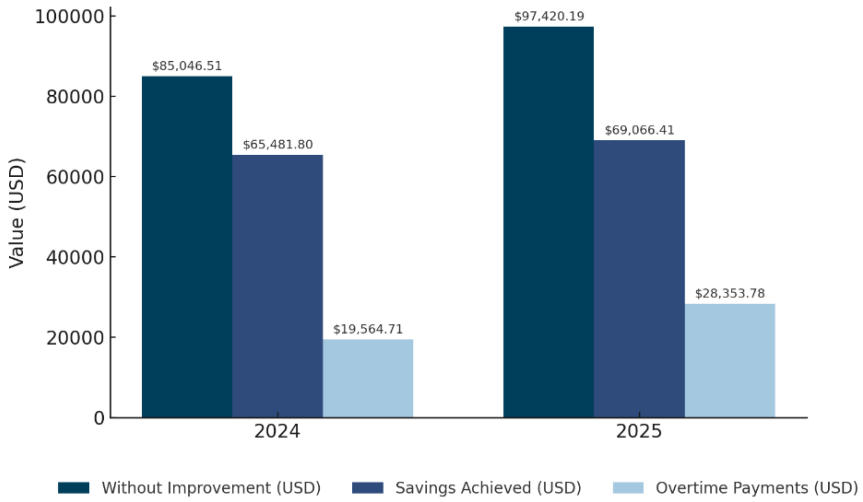

Figure 8 - Comparison of quarterly financial performance before and after process improvement
Source: The authors themselves.

An Ishikawa (fishbone) diagram was employed to identify the primary factors contributing to delays before automation. The analysis categorized causes into six dimensions:

- Methods: excessive manual steps, reliance on email communication, and lack of workflow automation.
- Manpower: dependency on multiple approvers and inconsistent prioritization of approvals.
- Machines: absence of system integration between PDF forms and Fluig.
- Materials: manual handling of documents and version control issues.
- Environment: bureaucratic approval culture and absence of defined response times (SLA).
- Measurements: lack of performance indicators or alerts to monitor approval progress.

The implementation of automation through Fluig effectively addressed these root causes, leading to improved process traceability, reduced manual errors, and enhanced communication among stakeholders.

The results confirm that process digitalization and data-driven management significantly enhance operational efficiency in human resource workflows, particularly in complex environments such as offshore operations. Comparable outcomes were reported by Silva and Goussain (2025), who applied the Lean Six Sigma (LSS) approach to optimize the chemical dosing process in the

water-treatment system of an FPSO unit. By following the DMAIC framework, the researchers achieved a 40 percent reduction in oxygen-scavenger consumption and a 24 percent decrease in acidic and alkaline agents used for membrane cleaning, yielding cost avoidance exceeding R$450,000. Their findings corroborate the effectiveness of structured continuous-improvement methodologies, such as LSS and PDCA, in reducing waste, enhancing process visibility, and reinforcing cross-functional collaboration within offshore operations.

The reduction in process time aligns with the principles of lean management and continuous improvement, reinforcing the strategic importance of integrating BI and workflow automation systems. Furthermore, the financial outcomes underscore the direct relationship between process efficiency and cost performance. By automating the approval process, the company not only reduced turnaround time but also strengthened decision-making, transparency, and accountability across departments.

Overall, the findings demonstrate that the integration of BI and workflow automation systems can significantly enhance operational efficiency in offshore recruitment environments. The statistical evidence reinforces that the observed improvements were not merely operational perceptions but measurable and statistically significant outcomes. The large effect size reinforces that the observed improvement was not only statistically significant but also operationally meaningful. These results corroborate prior studies on digital transformation and HR analytics, supporting the argument that data-driven process management contributes not only to cost reduction and productivity gains but also to process stabilization and decision-making quality in complex operational environments.

Beyond confirming the operational effectiveness of the proposed solution, the present findings also contribute to the theoretical understanding of BI, HR Analytics, and digital transformation. Previous studies have generally associated BI with data visualization, reporting automation, and decision support. The results of this study suggest a broader perspective in which BI functions as an enabling capability that integrates information management, workflow orchestration, performance measurement, and continuous improvement into a unified managerial system. From this perspective, BI extends beyond technological infrastructure and becomes an organizational mechanism for coordinating operational processes through evidence-based decision-making.

Likewise, the findings contribute to the HR Analytics literature by demonstrating that recruitment performance should not be evaluated exclusively through hiring outcomes but also through process-oriented indicators, such as approval time, process variability, workflow stability, and operational responsiveness. The significant reduction observed not only in the average approval time but also in process variability suggests that digital transformation contributes simultaneously to efficiency and process reliability, two dimensions that have received comparatively less attention in previous recruitment analytics studies.

Furthermore, the present study advances the digital transformation literature by reinforcing that organizational performance improvements emerge from the integration of complementary managerial practices rather than from technology adoption alone. The observed gains resulted from combining BI dashboards, workflow automation, standardized performance indicators, and continuous improvement practices under the PDCA framework. This finding supports the argument that digital transformation should be interpreted as an organizational capability integrating technology, process redesign, and managerial decision-making instead of merely implementing digital tools.

Therefore, the contribution of this research extends beyond the specific offshore case investigated. Although the empirical evidence originates from a single organization, the analytical relationships identified between BI, workflow automation, process stabilization, and operational performance may provide theoretical support for future investigations involving complex service operations, logistics systems, and digitally enabled human resource management.

This study presents some limitations that should be acknowledged. First, the research was conducted within a single offshore maritime support company, which limits the generalizability of the findings to other industrial or organizational contexts. Second, the analysis focused primarily on operational and quantitative performance indicators, without deeply exploring behavioral or organizational aspects related to technological change and employee adaptation. Third, although the statistical analysis demonstrated significant operational improvements, the study did not compare the implemented model with alternative state-of-the-art HR analytics frameworks or machine learning approaches. Therefore, future studies should expand the analysis to multiple organizations and incorporate broader organizational, behavioral, and predictive dimensions.

4 CONCLUSION

This study investigated how the integration of BI, workflow automation, and continuous improvement methodologies can optimize offshore recruitment and selection processes in a maritime transport company. The results demonstrated that digital process integration significantly reduced the average approval time for Personnel Movement Requests from 24 to 6 days, decreased process variability, and generated substantial operational cost savings. The statistical analyses confirmed that these improvements were both statistically significant and operationally meaningful.

Beyond the practical outcomes, this research contributes to the literature in three important ways. First, it extends current BI research by demonstrating that BI can support not only information visualization and reporting but also process stabilization and evidence-based decision-making in complex human resource environments. Second, it advances the HR Analytics literature by showing that recruitment performance can be evaluated through operational process indicators, including approval time, process variability, and workflow stability, rather than exclusively through hiring outcomes. Third, the study reinforces the digital transformation literature by demonstrating that sustainable performance improvements emerge from integrating technological solutions with workflow automation, performance measurement, and continuous improvement practices rather than from technology implementation alone.

From a managerial perspective, the proposed approach offers organizations a practical framework for integrating BI dashboards, workflow automation, and performance indicators to improve operational efficiency, transparency, and decision-making in recruitment processes. Although developed within the offshore maritime industry, the proposed analytical framework may also support digital transformation initiatives in other complex organizational environments characterized by multiple stakeholders, sequential approval processes, and time-critical operations.

This study is subject to some limitations. The findings are based on a single case study, which limits the generalizability of the results, and the analysis focused primarily on operational performance indicators without investigating behavioral or organizational dimensions associated with digital transformation. Future research should evaluate the proposed framework in different organizational contexts, incorporate predictive analytics and artificial intelligence techniques into recruitment decision support systems, and examine the long-term organizational impacts of digital process integration on workforce management and operational performance.

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