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Shipyard Manpower Digital Recruitment: A Data-Driven Approach for Norwegian Stakeholders

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Abstract: This study examines the effectiveness of digital recruitment platforms in addressing labor shortages within Norway's shipbuilding and ship-repair industry. Through a data analysis of 446 job applications over a 12-month period, this study evaluates key recruitment metrics, including application response times (ARTs), candidate acceptance rates (CARs), and the impact of machine learning on hiring outcomes. The findings reveal that specialized digital platforms can significantly improve recruitment efficiency, with 70% of applications being received within 24 h, highlighting the platforms's great potential for time-sensitive sectors. Additionally, pre-vetting candidates enhances hiring precision, achieving a CAR of 90% and reducing mismatches. The application of machine learning algorithms provides predictive insights that support real-time adjustments to job postings, optimizing recruitment strategies. This study contributes uniquely to the literature on cross-border digital recruitment, aligning with the European Union goals of sustainable labor mobility and economic resilience.

Keywords: digital recruitment; labor mobility; labor shortages; Norway shipyards; maritime industry

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1. Introduction

The Norwegian maritime industry, encompassing both shipbuilding and ship-repair, is a critical sector for Norway's economy, yet is increasingly strained by severe labor shortages. With an employment rate of 69.7% as of early 2023, Norway ranks among the EU/EEA countries with the highest workforce engagement; however, these statistics mask a growing issue of skill shortages in high-demand sectors (EURES, 2023). Recent labor market data indicate that Norway's workforce lacks adequate skilled labor in fields such as engineering and manufacturing, with a deficit of around 70,000 employees across multiple sectors. This shortage is exacerbated by regional imbalances, particularly in Northern and North-West Norway, where up to 70% of companies report unmet needs for qualified workers, underscoring the critical nature of this skill gap (EURES, 2023).

Norway's shipbuilding industry is affected by these shortages, facing recruitment challenges despite high labor costs, mostly due to reliance on knowledge-intensive segments that demand specific expertise (OECD, 2017). The economic downturn following the

2015 oil price collapse intensified pressures on the industry, with declining investments and increased operational costs forcing a shift towards specialized segments to maintain competitiveness. To manage a fluctuating demand, the industry has increasingly relied on migrant labor, particularly from Eastern Europe, adapting to changing market conditions (OECD, 2017).

Romania's pool of skilled industrial and shipyard technicians represents a potential solution to Norway's pressing labor shortages, particularly in the shipbuilding and ship-repair industry. Romania stands out due to its surplus of qualified professionals in fields such as industrial construction, shipbuilding, and metalworking, which align closely with the specialized skills required in Norway's maritime industries (OECD, 2017, 2024). Compared to other labor-surplus regions, Romania benefits from a longstanding tradition of industrial and maritime trades that is supported by established technical education programs and vocational training systems that continuously supply a competent workforce. In addition, wage differentials between Norway and Romania create an economic incentive for cross-border recruitment, ensuring cost-efficient solutions for Norwegian stakeholders. The geographic proximity between the two countries, combined with Romania's EU membership, facilitates smoother labor mobility by reducing regulatory and administrative barriers, such as visa requirements and qualification recognition.

By utilizing digital recruitment platforms that facilitate pre-vetting and candidate–job matching, Norwegian stakeholders can effectively streamline access to Romania's skilled labor pool. This approach would not only alleviate immediate labor shortages but would also ensure process quality by sourcing candidates with the precise qualifications and certifications needed in the maritime and industrial sectors. Consequently, Romania has emerged as a uniquely positioned partner to address Norway's labor market challenges both efficiently and sustainably.

A systematic review of the existing literature (covering publications available up until November 2024) was conducted using the Web of Science and Scopus databases to identify research on labor shortages, digital recruitment strategies, and the maritime industry, particularly in Norway's shipbuilding sector. The following keyword combinations were used to ensure comprehensive coverage: (1) "digital recruitment" AND "ship*"; (2) "labor shortages" AND "shipbuilding"; (3) "digital recruitment" AND "labor shortages"; (4) "digital recruitment" AND "Norway" AND "shipyards"; (5) "labor shortages" AND "maritime industry"; (6) "digital recruitment" AND "maritime".

The searches yielded the following results:

- Combination 1: Web of Science (11), Scopus (6)—studies that broadly examined digital recruitment in various industries but lacked a focus on shipbuilding;
- Combination 2: Web of Science (5), Scopus (37)—articles that addressed labor shortages in shipbuilding but provided no digital recruitment solutions;
- Combination 3: Web of Science (5), Scopus (3)—a few studies that linked digital recruitment with labor shortages, although those that did failed to address sector-specific challenges;
- Combination 4: Web of Science (0), Scopus (0)—no studies combined digital recruitment and Norwegian shipyards;
- Combination 5: Web of Science (25), Scopus (16)—articles that discussed labor shortages in global maritime industries but lacked regional specificity or digital methodologies;
- Combination 6: Web of Science (6), Scopus (4)—research on digital recruitment in maritime logistics provided limited relevance to shipbuilding or repair.

These findings reveal a clear research gap at the intersection of digital recruitment and labor shortages within the maritime sector, specifically in the Norwegian shipbuilding and

ship-repair industry. While the broader topics of labor mobility and workforce digitalization have received attention, there is limited focus on how these issues intersect in high-demand, knowledge-intensive sectors like shipbuilding.

This study aims to evaluate the potential of digital recruitment platforms in addressing Norway's skill shortage by exploring their effectiveness in candidate sourcing and pre-vetting, and the application of machine learning to improve hiring outcomes. Moreover, it specifically focuses on evaluating the effectiveness of digital recruitment platforms as a long-term strategic solution to Norway's maritime labor shortages. By examining the role of digitalized platforms in candidate sourcing, pre-vetting, and machine learning decision-making, this research addresses a critical gap in the literature on labor mobility and digitalization within the European Union. Given the increasing adoption of digital tools across labor markets (Ciucu et al., 2023), this study contributes uniquely to the literature by offering insights into how digitalization can support sustainable workforce development and economic resilience, both in Norway and across the EU.

The research questions guiding this study are as follows:

- RQ1: how effective are digital recruitment platforms in addressing labor shortages in Norway's shipbuilding and ship-repair industry?
- RQ2: what key metrics, such as the application response time (ART) and candidate acceptance rate (CAR), influence the success of digital recruitment strategies?
- RQ3: how do digital platforms facilitate cross-border labor mobility, particularly between Norway and labor-surplus regions like Romania?

By investigating these questions, this study contributes novel insights into the transformative potential of digital recruitment platforms in addressing workforce challenges specific to the maritime industry.

The structure of this paper is as follows. Section 2 tackles the issue of labor shortages in Norway's shipbuilding and industrial sectors and presents a brief literature review of studies on digital recruitment platforms. The methodology is described in Section 3, while the main findings of this paper are presented in Section 4. The managerial implications and practical applications are discussed in Section 5 while highlighting the paper's main limitations and, finally, the last section concludes the study.

2. Literature Review

2.1. Labor Market Challenges in Norway and the European Union

Norway's shipbuilding and industrial sectors face significant labor shortages, a challenge that highlights broader trends in the EU, where demographic shifts, increased wages, and changing skill demands make labor markets highly competitive (EURES, 2023). Norway's high labor costs pose obstacles, especially in the maritime sector, where a reliance on specialized skills is essential for maintaining a position in high-value, knowledge-intensive markets (OECD, 2017). The Norwegian shipbuilding industry, comprising a network of shipyards, equipment manufacturers, and international shipping companies, is highly dependent on skilled labor to sustain its productivity and meet market demands. In early 2023, reports revealed that more than 46% of Norwegian companies experienced difficulties in recruiting skilled employees, with unmet labor needs impacting regional operational capacities and growth prospects (EURES, 2023).

The shortage of skilled labor in Norway highlights a persistent mismatch between the labor demand and supply within the EU, as shown in Figure 1.

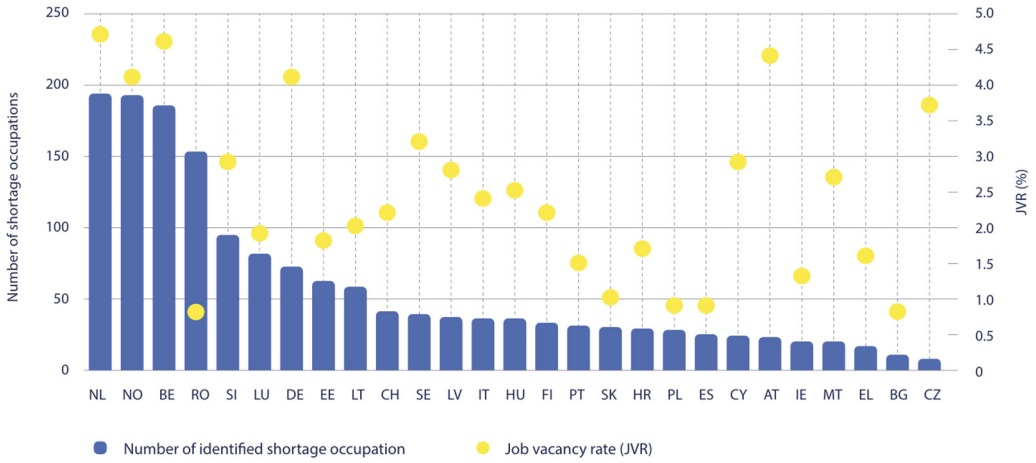


Figure 1. Occupation shortage and job vacancy rate. 2023 Q2. Source: EURES.

The European Labor Authority's (ELA) 2024 report identifies that countries like Romania, Belgium, and Slovenia suffer from imbalances characterized by both surpluses and shortages of occupations (ELA, 2024). Romania, with thousands of skilled workers in fields such as industrial construction, metalworking, and the maritime trades, stands out as a key potential source of labor to meet Norway's demands (ELA, 2024). Eurostat underscores a considerable wage disparity across EU member states, where hourly labor costs in Norway are significantly higher than in Eastern Europe (Figure 2). This economic divergence creates a strong incentive for Norwegian industries to recruit from lower-cost labor markets like Romania (Eurostat, 2023).

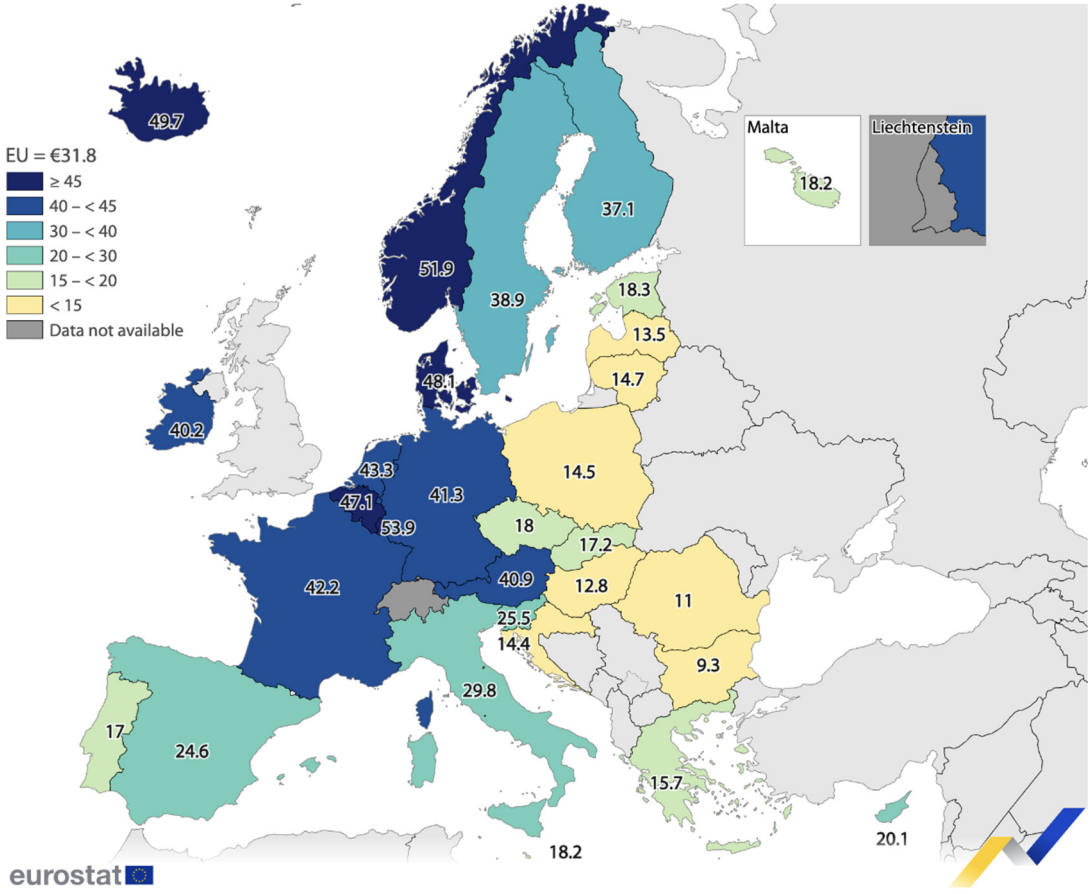


Figure 2. Hourly labor costs in EUR for 2023, enterprises with 10+ employees. Source: EUROSTAT.

2.2. Key Stakeholders in Norway's Shipbuilding Industry: Economic Perspectives and Recruitment Dynamics

The Norwegian shipbuilding and ship-repair industry is a critical contributor to the nation's economy, relying on a diverse network of stakeholders to sustain its competitive edge and address labor shortages. These stakeholders play a pivotal role in driving innovation, shaping recruitment strategies, and enabling workforce development, particularly in the context of increasing digitalization and cross-border labor mobility.

Prominent industrial actors such as the Ulstein Group and Kongsberg Gruppen underscore the economic significance of Norway's maritime sector. The Ulstein Group specializes in high-value vessels, including offshore wind service and expedition cruise ships. Through its shipyard division, Ulstein Verft, the company generates substantial regional employment and advances technological innovation in vessel design (Ulstein Group, 2023). Similarly, Kongsberg Gruppen leads the maritime digitalization and automation market, providing systems such as dynamic positioning and autonomous vessel technologies. In 2021, Kongsberg reported revenues exceeding 2.4 billion euros, highlighting its global impact in the maritime supply chain (Kongsberg Gruppen, 2021).

The GCE Blue Maritime Cluster, located in Møre and Romsdal, serves as a hub for over 200 maritime companies. This cluster facilitates collaboration and innovation, enabling stakeholders to address recruitment challenges and enhance their technological capabilities (GCE Blue Maritime Cluster, 2024). As labor shortages intensify, the cluster plays a vital role in aligning industrial needs with workforce solutions, reinforcing Norway's position in the global shipbuilding market.

Norway's shipbuilding industry faces significant recruitment challenges, with persistent labor shortages that are exacerbated by regional imbalances and high labor costs. According to Statistics Norway (2024), the labor shortages in manufacturing, which includes shipbuilding, are among the most severe since the 2008 financial crisis.

For institutional stakeholders, digital recruitment aligns with broader policy objectives. The Norwegian Shipowners' Association (NSA) actively advocates for policies that support sustainable labor mobility, while Innovation Norway funds projects that promote digital transformation in the areas of recruitment and workforce development (Norwegian Shipowners' Association, 2023; Innovation Norway, 2023). These efforts are critical to maintaining Norway's competitiveness in high-value markets, such as offshore service vessels and chemical tankers.

The economic repercussions of labor shortages are profound, resulting in project delays, operational inefficiencies, and increased costs. Addressing these issues is essential to sustaining the industry's global prominence. The Norwegian-controlled merchant fleets, which include 1634 ocean-going vessels, rank fourth globally by value and operate in key market segments (EURES, 2023). Digital recruitment platforms present a scalable, cost-effective solution to labor shortages, leveraging Norway's ability to attract skilled international labor while aligning with the European Union goals for sustainable economic resilience (Enescu & Szeles, 2024). These technologies enable Norwegian stakeholders to access labor-surplus regions such as Romania, thereby mitigating local workforce gaps (Ciobanu et al., 2022; Moșneanu, 2020).

2.3. Digital Recruitment: Theoretical Framework and Applications

Digital recruitment platforms have emerged as a powerful tool to bridge these labor market disparities by connecting skilled workers in labor-surplus countries with high-demand sectors in need of specific skills, as shown in Figure 3, such as Norway's shipbuilding industry.

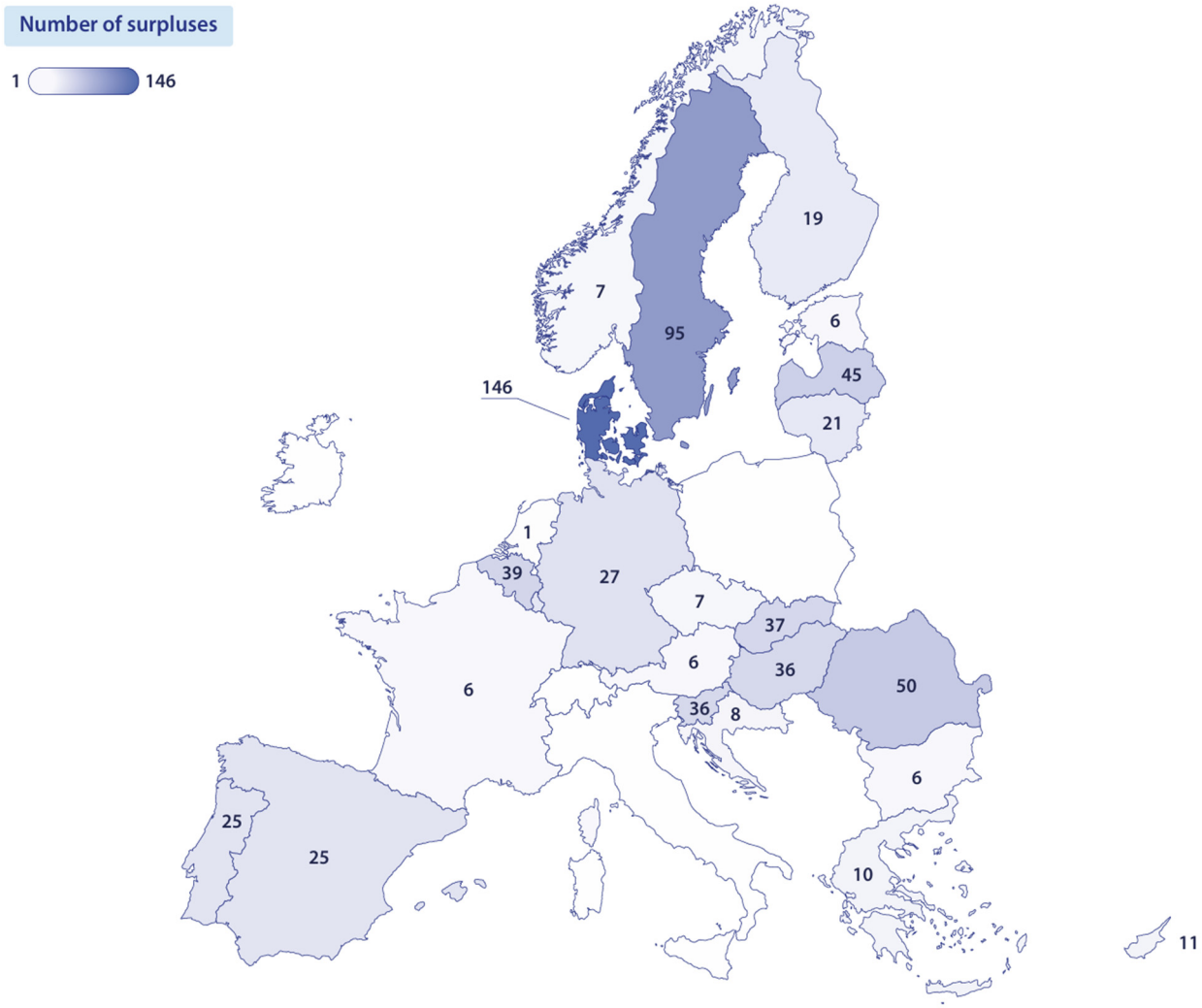


Figure 3. Number of surplus occupations by country, 2023. Source: European Labour Authority.

According to Ciobanu et al. (2022), the European Digital Agenda emphasizes the creation of digital spaces that encourage labor mobility, allow the digitalization of recruitment processes, and address labor shortages in sectors critical to the EU's sustainable economic goals. Brătucu et al. (2022) add that such digital platforms are integral to the EU's environmental and social aims, providing a streamlined, eco-friendly solution to obtaining workforce accessibility across borders.

Digitalization is being increasingly recognized as a transformative force across European industries, and is enhancing operational efficiency, workforce productivity, and business adaptability. Information and communication technologies (ICTs) have been shown to foster innovation and broaden access to valuable information, contributing to productivity gains that align with the European Union's sustainable development goals (Cioacă et al., 2020). The rapid expansion of internet access has reshaped business processes and interactions, with digital entrepreneurship enabling companies to navigate customer relationships more effectively in an increasingly connected market environment (Biclesanu et al., 2021). To remain competitive, especially in rapidly evolving economies in Central and Eastern Europe (CEE), businesses must adopt technological innovations and invest in employee skill development to meet the demands of Industry 4.0, where digitalization becomes integral to all aspects of business (Trască et al., 2019). Despite these advances, challenges such as the digital divide persist within the EU, underscoring the need for comprehensive digital literacy efforts to ensure equitable access to opportunities across

demographic groups (Enescu & Szeles, 2024). As digitalization expands throughout service ecosystems, it not only facilitates new patterns of resource integration but also reshapes the connections between ecosystem actors, creating both challenges to and opportunities for collaboration and efficiency (Alexey et al., 2019).

Studies on digital recruitment reveal the significant efficiency gains brought by digitalization in workforce management. The ability to pre-vet candidates—by verifying their qualifications, experience, and certifications—reduces hiring risks and enhances recruitment accuracy, making it a valuable feature for digital platforms. Moșneanu (2020) highlights the global trend of intense digitalization within recruitment, where specialized recruitment software is increasingly utilized to optimize candidate selection and reduce human biases. This shift underscores the importance of establishing a digital recruitment process that incorporates innovative technology and testing new algorithmic solutions to enhance recruitment precision and efficiency. This process is particularly relevant to Norway, where foreign qualifications for skilled technical roles must be recognized (EURES, 2023).

Machine learning algorithms add further value to digital recruitment by providing data-driven insights that enhance candidate selection processes. Hussain et al. (2024) observed a significant global shift in workplace digitalization, particularly among small and medium enterprises (SMEs), which increasingly integrate digital technology to enhance their product and service innovation. This trend highlights the use of machine learning and digital tools as a strategy for SMEs to gain a competitive advantage, demonstrating how technology-driven insights can optimize operational and recruitment processes. Tóth et al. (2022) describe the convergence of servitization and digitalization as "digital servitization," a transformative trend in modern business. This shift, while fostering adaptability in services such as recruitment, also introduces organizational tensions as companies navigate the complexities of integrating digital tools with traditional operations responding dynamically to real-time labor market demands.

The adoption of digital recruitment aligns with trends in corporate governance, where technology is increasingly prioritized to streamline operations and improve efficiency. For the GCE Blue Maritime Cluster and similar industry hubs, leveraging digital tools for recruitment not only broadens their access to talent but also supports strategic goals relating to sustainability and adaptability. By integrating digital recruitment practices, Norwegian maritime firms can enhance their operational resilience, minimize their reliance on limited local talent pools, and effectively address skill shortages that challenge long-term innovation and growth (Nygård Basso et al., 2024).

The spatial concentration of the ICT sector in Central and Eastern Europe, particularly within service-related industries, underscores the role of ICT as a catalyst for economic growth and productivity. This sector not only drives growth independently but also enhances productivity across related industries through inter-industry collaboration, (Vas et al., 2024). Digital platforms enable the integration of skilled candidates from diverse backgrounds, which is particularly advantageous for labor-intensive industries like shipbuilding. There is evidence that cultural digitization, which enhances accessibility and engagement with online services, correlates positively with both online purchases of cultural goods and consumption expenditure. This suggests that digital transformations in recruitment could similarly enhance the accessibility and inclusivity of high-demand roles, enriching the talent pools available to companies and supporting a more diverse workforce (Fanea-Ivanovici & Pană, 2020).

The rapid expansion of internet-related services has significantly reshaped technology's role in business. As online platforms redefine trade and operational boundaries, the adoption of ICTs offers businesses benefits such as a potentially enhanced operational efficiency, an accelerated hiring processes, and a deeper understanding of candidate pref-

erences (Jula et al., 2024). With fierce competition tightening margins in the shipbuilding and ship-repair industries, achieving cost-efficiency has become essential for stakeholders. Effective shipyard logistics, which include the coordinated flow of materials and operations from the initial stages to ship completion and rely heavily on skilled labor, have become essential for operational success. This need is especially pressing given the limited research available on optimizing these processes (Strandhagen et al., 2020).

2.4. The Role of Digital Platforms in Enhancing Recruitment Efficiency and Workforce Alignment

Digital platforms streamline recruitment by leveraging automated pre-screening and job-matching algorithms. Their ability to quickly align candidate skills with job requirements mitigates delays caused by traditional hiring methods, providing an effective solution to labor shortages in skill-intensive sectors like maritime and industrial industries.

Evidence from maritime and industrial sectors demonstrates that digital platforms not only address labor shortages but also improve job-market transparency and employer–candidate alignment. By reducing recruitment timeframes and supporting cross-border hiring, these platforms present a scalable solution for global industries facing acute skill shortages.

Digital platforms have been shown to streamline recruitment processes by automating manual tasks such as candidate screening and job matching. For example, Baum-Talmor and Kitada (2022) note that digital tools significantly reduce recruitment timelines while enhancing precision, especially in matching candidate skills to job requirements in the shipping industry.

The maritime and industrial sectors often struggle with acute skill shortages, particularly in roles requiring specialized expertise. Bottalico (2021) highlights how digital platforms create structured skill repositories that facilitate the identification of niche talent pools. This has proven especially valuable in logistics and shipping sectors, where specialized knowledge is critical.

Traditional recruitment methods are time-consuming and often inefficient. Digital platforms mitigate these delays by automating the vetting and application processes, significantly reducing the time-to-hire for critical roles. Tang and Zhang (2021) emphasize that such efficiency is crucial for sectors like shipping and logistics, where operational continuity depends on timely recruitment.

By ensuring better candidate–role alignment, digital recruitment platforms also help improve retention rates. Kim et al. (2019) demonstrate that pre-vetting candidates and matching them to roles based on verified skills and certifications lead to longer job tenures and reduced turnover rates in the maritime industry. Recruitment platforms also enable access to underrepresented regions and demographic groups. As Kikkawa et al. (2021) report, these platforms help integrate remote candidates into global job markets, diversifying the labor pool and addressing shortages in hard-to-fill roles.

2.5. Hypothesis Development

The diffusion of innovation theory (Rogers, 2003) provides a foundational framework for understanding the adoption of digital recruitment platforms in maritime and industrial sectors. This theory explains how technological innovations are embraced to address specific challenges, particularly in industries that require the rapid recruitment of skilled candidates. Pan et al. (2023) emphasize the role of artificial intelligence (AI) in bridging skill gaps by automating screening and matching processes. These platforms enable organizations to optimize their recruitment timelines, reducing inefficiencies associated with traditional hiring methods. Van Esch et al. (2019) further highlight that industry-specific recruitment platforms alleviate operational burdens on recruiters and align workforce

capabilities with employer expectations. By integrating features such as skill-based candidate pools and automated job matching, these platforms address the critical challenges of time-sensitive industries. Based on these insights, the first hypothesis is formulated as follows:

Hypothesis 1. *A specialized digital recruitment platform can meet the needs of the maritime and industrial sectors, where the employment of skilled candidates on short notice is critical.*

The role of pre-vetting candidates in improving recruitment outcomes is best understood through the lens of signaling theory (Spence, 1973), which posits that verified credentials serve as reliable signals to employers, reducing uncertainty and fostering confidence in hiring decisions. Sahut and Lissillour (2023) argue that pre-vetting is particularly advantageous in industries with stringent skill requirements, as it ensures that only qualified candidates enter the recruitment process. This approach is complemented by transaction cost economics theory (Williamson, 1975), which highlights the cost-saving benefits of pre-vetting due to minimizing resources spent on unqualified applicants. Empirical evidence supports these theoretical perspectives. Kim et al. (2019) show that rigorous verification processes lead to higher acceptance rates, greater recruiter confidence, and more efficient workflows. These insights lead to the second hypothesis:

Hypothesis 2. *Pre-vetting candidates, including verifying qualifications, experience, certifications, and personal documentation, significantly improves the acceptance rate for job applications within the maritime and industrial sectors.*

Machine learning algorithms, which form a core part of this study, are grounded in the task-technology fit model (Goodhue & Thompson, 1995). This model posits that technological tools are most effective when their capabilities align with the specific demands of a task. Machine learning enables the analysis of complex factors that influence recruitment, such as candidate behavior, job attractiveness, and response times. Behl et al. (2022) demonstrate the utility of predictive modeling in providing actionable insights into key recruitment metrics, enabling data-driven decision-making. Van Esch et al. (2019) emphasize that predictive algorithms enhance recruiter confidence by accurately forecasting acceptance rates and application response times, allowing for proactive adjustments to recruitment strategies. These theoretical and empirical insights support the formulation of the third hypothesis:

Hypothesis 3. *Machine learning algorithms can provide valuable, data-driven insights on candidate suitability and job attractiveness, enhancing the recruitment process by identifying key factors that influence candidate response times and acceptance rates.*

This study evaluates the hypotheses to understand how digital platforms can offer sustainable, scalable solutions to labor market disparities. Through a data-driven approach, this research aims to demonstrate the efficacy of digital recruitment platforms in aligning labor supply and demand across borders. The approach taken of data collection, descriptive analysis, and predictive modeling to assess the ART, the CAR, and the impact of pre-vetting on job matching accuracy is detailed further on. This study also outlines how real-time data analytics was utilized to capture ongoing trends and optimize decision-making.

3. Methodology

3.1. Data Collection and Preparation

Data were sourced from www.romcrew.com (accessed on 3 November 2024), a specialized recruitment platform, with a focus on job applications in the maritime and in-

dustrial sectors. Key metrics include user demographic data, job characteristics, and application outcomes.

The data analyzed in this study were obtained from the only digital recruitment platform in Romania that is tailored specifically to maritime and industrial industries. Unlike traditional recruitment methods prevalent in this sector, this platform incorporates innovative features such as candidate pre-vetting and machine learning-driven job matching, enabling a distinct evaluation of digital recruitment's efficacy in addressing labor shortages.

The dataset comprises 446 job applications submitted by 112 distinct users across 38 job postings and collected within a time span of 12 months (September 2023–September 2024). Each record includes the applicant's ID, ZIP code, and age, alongside job attributes like its duration, location, and benefits, as well as the total number of applicants.

The dataset includes applications for 38 distinct job roles in the maritime and industrial sectors, ranging from technical positions (e.g., welding, fitter) to administrative roles (e.g., project coordinators). These roles vary in complexity, location, and required skill levels, ensuring coverage of a broad spectrum of employment needs within the sector. The candidate demographics further illustrate the dataset's diversity, with ages ranging from 19 to 67 years, representing both entry-level and experienced professionals. Table 1 provides an overview of the job types analyzed and key candidate characteristics, demonstrating the dataset's capacity to capture varied recruitment dynamics in the maritime and industrial sectors.

All users enrolled in the platform have the characteristic of being "validated". A "validated user" refers to a technician who has undergone a thorough registration and vetting process to ensure their qualifications align with both industry and community standards. This vetting process comprises multiple steps: First, the technician must complete a comprehensive online form, detailing personal information, technical experience, and relevant expertise. This is followed by a structured technical interview, conducted over the phone, aimed at rigorously assessing their technical proficiency. This interview is designed not only to verify the technician's skills but also to align their capabilities with the platform's required standards, thereby ensuring a consistent level of professional quality and reliability among its users. Through this process, the platform can confidently recognize these individuals as "validated users", qualified to perform technical functions in line with the established standards of the field.

The data preprocessing included handling missing values, standardizing categorical variables, and normalizing numerical variables. The benefits associated with each job were systematically coded on a scale from 0 to 10, where each increment represents an increasing level of benefit quality provided within the job offer. This coding system enables a structured and quantifiable assessment of job benefit offerings, facilitating comparison across different job roles.

The primary target variable for analysis was the ART, categorized into discrete intervals (e.g., <24 h, 1–5 days, >5 days). The ART for each job listing is defined as the interval between the time at which the job is initially posted and the timestamp at which a candidate submits their application. This metric captures the speed of candidate engagement, reflecting the duration between an opportunity's announcement and the applicant's response. Tracking this response time provides insights into applicant behavior, the immediacy of interest in specific roles, and the visibility of postings, potentially highlighting factors like job attractiveness or competitive urgency within certain industries or job types.

The CAR was also examined, representing the percentage of accepted applications for each job posting. The standardization of job duration and benefits variables ensured comparability across entries, facilitating subsequent analysis steps.

Table 1. Candidate acceptance rate for each job offer analyzed.

Job ID	Skills Required	Location	Duration	No. of Applicants	CAR
1	+GF+ Pipe Fitters	Europe	17 days	2	100.00%
2	Engine Technicians—Medium Speed	Namibia	Long term contract	24	91.67%
3	Pipe Fitters	Denmark	Permanent contract	1	100.00%
4	Mechanical Fitters	Europe	17 days	1	100.00%
5	Engine Repair Technicians	Denmark	Permanent	8	75.00%
6	111/136 Certified Welders	Europe	17 days	2	100.00%
7	Riggers	Europe	17 days	1	100.00%
8	Mechanics for Gear/Thruster department	Denmark	Permanent	5	80.00%
9	Insulators/Technicians	USA Yacht	3 weeks	2	100.00%
10	+GF+ Pipe Fitters	Europe	23 days	2	100.00%
11	Plumber/Pipe Fitter	USA	4 weeks	2	100.00%
12	111/136 Certified Welders	Southampton	2 weeks	2	100.00%
13	Maritime Service Engineer/Superintendent (Scrubber)	World Wide	Permanent	4	75.00%
14	Electro—Mechanic Engineer/Technician (Specialist)	Denmark	Permanent contract	1	100.00%
15	Electricians—High Tech Equipment assembly	Denmark	Permanent contract	1	100.00%
16	Platers/Pipe Fitters/Welders	USA	3 months	31	93.55%
17	Platers/Pipe Fitters/Welders	Australia	3 weeks	49	89.80%
18	Mechanic Engineer	Cruise Ship	9 weeks	2	100.00%
19	Boiler re-tubing [Mech Fitters]	Cádiz—Spain	3 weeks	2	100.00%
20	Cruise Repair	World-wide	2 weeks	27	92.59%
21	Platers/Pipe Fitters/Welders	Caribbean Area	3 weeks	24	91.67%
22	Platers/Pipe Fitters/Welders	Rotterdam	2 weeks	28	100.00%
23	Platers/Pipe Fitters/Welders	Cádiz—Spain	2 weeks	6	100.00%
24	Platers/Pipe Fitters/Welders	Bahamas	2 weeks	14	92.86%
25	Carpenters	USA	4 weeks	5	80.00%
26	Electricians—Equipment assembly	Denmark	Permanent contract	2	100.00%
27	Engine Repair Supervisors	World-wide	Long term contract	17	92.86%
28	Superyacht Repairs—Carpenters	World-wide	4 weeks	1	100.00%
29	Boiler re-tubing [Mech Fitters]	USA	3 weeks	7	85.71%
30	Yacht Repairs—Platers	USA	4 weeks	5	100.00%
31	Welders/Platers	Canada	3 weeks	10	100.00%
32	111/136 Certified Welders	Bahamas	3 weeks	24	86.36%
33	Yacht Repairs—Platers	USA	2 months	27	96.00%
34	Platers/Pipe Fitters/Welders	Spain	3 weeks	31	83.33%
35	Engine Repair Technicians	Denmark	Permanent Contract	16	88.89%
36	111/136 Certified Welders	Rotterdam	3 weeks	18	81.25%
37	Supervisors Plate/Platers	Cadiz	20 days	22	94.74%
38	Platers/Pipe Fitters/Welders	Singapore	15 days	20	87.50%

Source: designed based on authors' research.

3.2. Data Analysis and Findings

3.2.1. Descriptive Statistics

Descriptive statistics provided an initial overview of the data. Key metrics such as the mean, median, and standard deviation were calculated for the ART and CAR, revealing trends that are critical for hypothesis testing. For instance, the ART showed a high concentration of responses within 24 h (70% of applications under 5 days), which is

relevant to Hypothesis 1, indicating that rapid response times may fulfill industry-specific recruitment needs.

The analysis also summarized candidate demographics, showing a concentration of applicants aged between 30 and 60, suggesting a workforce that is experienced and likely to possess the necessary qualifications. Such a descriptive analysis contextualizes the overall recruitment dynamics, with a high CAR (90% acceptance) across the data, lending insight into the reliability of pre-vetting procedures and their role in hypothesis validation.

3.2.2. Correlation Analysis

Correlation analysis was conducted to examine relationships between the ART and key variables such as the user age, job duration, and job benefits. The Pearson correlation coefficient, r, was used to measure linear associations:

$$r = \frac{\sum (X_i - \overline{X})(Y_i - \overline{Y})}{\sqrt{\sum (X_i - \overline{X})^2 \sum (Y_i - \overline{Y})^2}} \quad (1)$$

For the ART and job duration correlation ($r \approx 0.5$), a positive relationship was noted, indicating that jobs with longer durations tend to have a higher ART, likely due to complex qualification requirements. Conversely, the ART and job benefits showed a moderate negative correlation ($r \approx -0.35$), suggesting that more attractive benefits shorten response times. No significant correlation was observed between age and the ART, supporting the assumption that the platform's digital nature does not create accessibility barriers for an older, skilled workforce, which is relevant to Hypothesis 1.

3.2.3. Regression Analysis

To model the impact of predictors on the ART, multiple regression analysis was employed. The model is represented as follows:

$$\text{ART} = \beta_0 + \beta_1 \cdot \text{Age} + \beta_2 \cdot \text{Job Duration} + \beta_3 \cdot \text{Job Benefits} + \varepsilon, \quad (2)$$

where:

- β_0 is the intercept;
- β_1, β_2, and β_3 are coefficients for age, job duration, and benefits;
- ε is the error term.

The model's R^2 value was only 0.31, meaning 31% of the variance in the ART could be explained by these factors. Although the moderate R^2 suggests other unexplored factors may influence the ART, this model marks a foundation for predictive efforts. The beta coefficients indicated that, while age had minimal impact, job benefits had a more substantial, inverse effect on the ART, suggesting the potential to optimize job postings by emphasizing attractive benefits.

3.2.4. Decision Tree Analysis

The decision tree analysis used in this study serves as a predictive model to estimate the CAR based on key job characteristics, specifically the job duration, benefits, and total number of applicants. This method was chosen for its ability to handle complex, nonlinear relationships in a structured, interpretable way, making it ideal for identifying key factors that influence the CAR in recruitment. The CRT (classification tree) method in IBM SPSS was used to predict the CAR. The CRT method, a classification-focused version of the CART (classification and regression tree) method, is specifically designed for categorizing outcomes and works by constructing a binary decision tree that splits data into branches based on factors that most effectively separate CAR categories.

The CRT algorithm uses Gini impurity to determine the best split at each node, with Gini impurity being calculated as follows:

$$\text{Gini}(t) = 1 - \sum_{i=1}^{k} p_i^2, \quad (3)$$

where p_i is the proportion of cases in node t belonging to class i. Each split is chosen to minimize the impurity, creating branches with homogenous CAR outcomes.

Parameters such as the maximum tree depth and minimum cases per node were set to control the model complexity and prevent overfitting. This setup results in a clear, interpretable model that identifies key factors influencing the CAR, allowing recruiters to see which job attributes most effectively drive candidate acceptance. Overall, the CRT method provides actionable insights by generating a straightforward decision tree that helps visualize and predict candidate acceptance based on job features, supporting data-driven recruitment strategies.

4. Empirical Findings

This chapter presents detailed results obtained from the analysis of job application response times, candidate acceptance rates, and user characteristics within the digital recruitment platform. The findings support the tested hypotheses regarding the effectiveness of digital platforms for maritime and industrial recruitment, the impact of pre-vetting processes on job application success, and the utility of machine learning for candidate ranking. This chapter also discusses the broader implications of each result and compares the findings with other related research.

4.1. Job Application Response Time and Recruitment Efficiency

In calculating the ART, the harmonic mean was used instead of the arithmetic mean due to its ability to provide a more accurate representation of response times, especially when dealing with data characterized by a few large values and many smaller values. In the context of ARTs, the harmonic mean allows for a nuanced view that better reflects the speed at which candidates respond, which is a critical factor for timely recruitment decisions in the maritime and industrial sectors.

The harmonic mean is particularly suitable for this metric because it emphasizes the smaller values in the dataset, which is advantageous in understanding response times where quicker responses are more frequent and longer response times are outliers. Mathematically, the harmonic mean is calculated as follows:

$$\text{Harmonic Mean} = \frac{n}{\sum_{i=1}^{n} \frac{1}{x_i}}, \quad (4)$$

where n is the total number of observations, and x_i represents each individual response time.

A histogram analysis of the ART as shown in Figure 4, provides critical insights into the speed and efficiency of the recruitment process on the platform, with approximately 242 applications (57% of total) being submitted within 5 days of the jobs being posted. Among these, around 70% were submitted within the first 24 h. This rapid response time aligns with the demands of the maritime and industrial sectors, which often require a swift recruitment process due to high turnover rates, urgent project timelines, and fluctuating labor demand.

The high concentration of applications submitted within 24 h of the jobs being posted—accounting for 70% of the total ARTs under 5 days—demonstrates the platform's potential to drive recruitment efficiency in the maritime sector. This swift response can translate into substantial cost savings and operational advantages, particularly in industries where

the ability to quickly mobilize qualified personnel is essential to project timelines and financial outcomes.

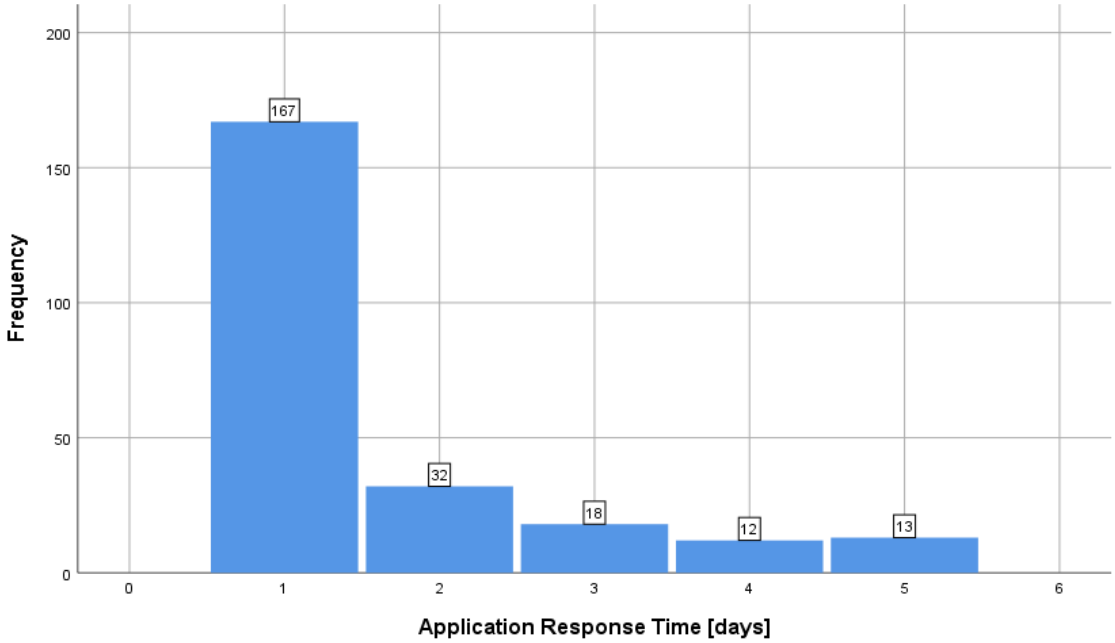


Figure 4. Frequency distribution of ART. Source: authors.

The platform's capability to secure 70% of the received applications within 24 h offers maritime recruiters a powerful tool for addressing urgent staffing needs, reducing dependency on external agencies and enhancing recruitment quality. This emphasis on rapid applicant engagement not only supports immediate operational needs but also offers long-term cost savings by optimizing internal recruitment workflows. For the maritime industry, where quick access to skilled labor can directly influence project outcomes and profitability, the efficiency achieved through rapid ARTs establishes this digital recruitment platform as an invaluable resource.

In high-demand industries, the ability to attract candidates rapidly translates into a competitive advantage. Organizations that can engage and secure talent faster than their competitors can meet project demands promptly, reducing the likelihood of project delays or cancellations. In competitive environments, where skilled industrial personnel are scarce, the platform's high ARTs within the first 24 h enables companies to secure candidates before they are approached by competing firms. The 70% ART within 24 h observed in this study underscores the platform's potential as a critical tool for maritime recruiters aiming to stay ahead in a competitive talent market.

These findings strongly support Hypothesis 1, which postulates that a digital recruitment platform can address the needs of industries with time-sensitive recruitment demands. Research by Faliagka et al. (2012) on e-recruitment effectiveness found that digital platforms generally reduce the time-to-hire by 30–50% due to their ability to reach candidates in real-time. This result aligns with the present study, where a significant proportion of applications were made within 24 h, demonstrating the platform's capacity for immediate candidate engagement and response.

Furthermore, comparing these findings to traditional recruitment approaches highlights the benefits of digital platforms. Studies on traditional recruitment methods, such as those by Holm (2012), indicate that hiring processes often face delays due to manual filtering and evaluation. By contrast, the present digital platform achieves accelerated timelines,

allowing maritime and industrial recruiters to access qualified candidates rapidly, thereby enhancing project readiness.

4.2. Candidate Acceptance Rates and the Impact of Pre-Vetting

The CAR, which measures the percentage of job applications that are accepted, serves as a crucial metric for evaluating the efficacy of the digital recruitment platform. In this study, a high CAR of approximately 90% was observed across all applications, with similar rates for applications submitted within 5 days of the jobs being posted. This high acceptance rate provides valuable insights into the effectiveness of pre-vetting procedures—which include verifying candidates' qualifications, experience, certifications, and eligibility before they apply for jobs—within the maritime and industrial sectors.

Table 1 shows that about 70% of job offers (27 out of 38) have a CAR of 90% or higher. The elevated CAR highlights the platform's effectiveness in ensuring that the candidates presented to employers meet specific job requirements, aligning well with Hypothesis 2, which posits that pre-vetting significantly impacts job application success. The high acceptance rate suggests that pre-vetted candidates are more likely to align with employer needs, reducing mismatches between job postings and applicant qualifications. This reduces the time spent by recruiters on unsuitable applications and enables faster, more accurate hiring decisions.

The maritime and industrial sectors have unique recruitment requirements, often needing candidates with specific technical skills, certifications (e.g., safety and equipment handling), and relevant experience. Unlike generic recruitment platforms, the pre-vetting process on this digital platform includes detailed checks on work history, certifications, personal documents, and even necessary visas, which are essential for industries with strict regulatory compliance needs. For instance, in the maritime industry, roles often require certification in safety protocols and familiarity with specialized machinery or equipment. Pre-vetting ensures that candidates possess these qualifications, minimizing the risks associated with underqualified personnel on critical assignments. This is supported by Thompson and Aspinwall (2009), who emphasized that pre-vetting in high-stakes industries reduces turnover by increasing the likelihood that hired candidates meet the stringent demands of their roles. Consequently, the high CAR on this platform reflects not only the match in qualifications but also a potentially lower risk of attrition and non-compliance issues, which is crucial for project continuity.

The pre-vetting process's efficiency is also evident in the high CAR, as it streamlines the recruitment funnel. A streamlined funnel ensures that only qualified candidates enter the initial stages of the recruitment process, minimizing the time wasted on unsuitable applications. This is particularly advantageous in fast-paced sectors like maritime and industrial recruitment, where hiring delays can result in project setbacks or increased operational costs. In many recruitment processes, pre-vetting candidates' profiles, including automated checks on their certifications, experience, and legal documentation, can reduce the time-to-hire according to Holm (2012). For organizations operating in specialized sectors, this reduction in the time-to-hire translates into cost savings and improved resource allocation. The digital recruitment platform's high CAR therefore reflects both the accuracy of candidate–job matches and the platform's efficiency in accelerating the recruitment process through pre-vetting.

The findings demonstrate that pre-vetting can be a transformative recruitment strategy for industries that demand specific qualifications and compliance. The high CAR observed in this study indicates that the platform successfully filters and presents candidates who meet the industry's stringent requirements, thereby supporting organizational goals related to safety, operational continuity, and compliance. Furthermore, by integrating pre-vetting

into digital recruitment workflows, companies can better manage talent pipelines, ensuring a steady supply of qualified candidates ready for immediate deployment. This is particularly beneficial for maritime projects, which may require skilled workers on short notice to prevent project delays and minimize downtime costs. The high CAR achieved through pre-vetting thus positions the platform as a reliable resource for maritime recruiters looking to streamline recruitment without sacrificing candidate quality. The candidate acceptance rate of approximately 90% strongly underscores the effectiveness of the pre-vetting process in ensuring high-quality candidate matches for job postings in the maritime and industrial sectors. The robust pre-vetting system filters out unqualified candidates early, optimizing the recruitment funnel and saving recruiters valuable time and resources. This efficiency not only supports the platform's functionality in high-demand industries but also aligns with Hypothesis 2, which proposes that pre-vetting significantly influences application acceptance rates. The impact of pre-vetting in specialized sectors with stringent regulatory requirements illustrates the platform's role in enhancing both recruitment speed and quality, benefiting both employers and candidates.

4.3. Correlation Analysis of Application Response Time with Demographic and Job Variables

The correlation analysis conducted in the IBM SPSS software provided insights into the relationship between the application response time (ART) and several predictor variables, including the user age, job duration, and job benefits. Each variable's correlation with the ART was assessed using Pearson's correlation coefficient, which quantifies the linear association between two continuous variables, offering a statistical measure of how closely two variables move together. Table 2 presents these results, showcasing the strength and direction of correlations as determined by SPSS. Each coefficient reflects the impact of specific factors on the ART, helping to identify patterns and insights relevant to recruitment practices in the maritime and industrial sectors.

Table 2. Pearson's correlation between ART and user age, job duration, and job benefits.

Predictor Variable	Correlation with ART		Interpretation
User Age	Person Correlation	−0.104 *	No significant correlation; age does not influence ART.
	Significance Level (*p*-value)	0.033	
	N	422	
Job Duration	Person Correlation	0.516 **	Moderate positive correlation; longer durations lead to higher ART.
	Significance Level (*p*-value)	0.000	
	N	422	
Job Benefits	Person Correlation	−0.348 **	Moderate negative correlation; higher benefits lead to lower ART.
	Significance Level (*p*-value)	0.000	
	N	422	

*: correlation is significant at the 0.05 level (two-tailed); **: correlation is significant at the 0.01 level (two-tailed). Source: designed based on authors' research.

The analysis in SPSS revealed that the user age had no statistically significant correlation with the ART, with a Pearson correlation coefficient close to zero ($r \approx 0.1$). This result suggests that age does not play a role in determining how quickly candidates respond to job postings. This finding is valuable for the maritime and industrial sectors, which often engage an older workforce due to the specialized skills and experience required. The absence of correlation between the age and ART supports the platform's accessibility and usability across different age groups, indicating that the digital recruitment platform does not present a technological barrier to older candidates. By confirming that age does not af-

fect the ART, the platform is shown to be inclusive, aligning well with Hypothesis 1, which suggests the suitability of digital recruitment for the unique requirements of maritime and industrial fields.

A moderate positive correlation was observed between the job duration and ART, with a Pearson coefficient of approximately $r \approx 0.5$. This positive association indicates that longer-duration jobs tend to have higher ARTs, suggesting that candidates take more time to respond to postings for long-term positions. This trend may stem from the greater commitment or specific qualifications often required for longer-term jobs in the maritime and industrial sectors. The positive correlation suggests that, as the job duration increases, the ART also tends to increase, potentially due to the cautious approach candidates take when considering roles with extensive commitments. In recruitment practice, this insight is critical as it implies that positions requiring long-term engagements may benefit from targeted recruitment strategies, such as enhanced job descriptions or additional incentives to reduce ART. This correlation was computed using SPSS's bivariate correlation function, where each job duration was paired with the corresponding ART values to calculate the coefficient. This finding aligns with Hypothesis 3, supporting the premise that job characteristics like duration can significantly impact candidate behavior, which is relevant for refining machine learning algorithms in candidate ranking models.

The analysis in SPSS also highlighted a notable negative correlation between the job benefits and ART, with a Pearson coefficient around $r = -0.35$. This negative correlation implies that positions offering more attractive benefits tend to receive quicker responses from candidates. This trend suggests that benefits act as a strong motivator for prompt engagement, with candidates being more likely to apply quickly to jobs that offer competitive advantages, such as accommodation and food being included, travel allowances, or a better rotation program. The negative correlation between the job benefits and ART underscores the importance of job attractiveness in influencing candidate behavior, particularly in high-demand, competitive fields like maritime recruitment. By offering substantial benefits, employers can expect faster applicant response times, which can accelerate the hiring process and reduce project delays. For recruiters, this insight can guide the design of job postings to highlight benefits prominently, thereby leveraging the attractiveness of the position to engage candidates quickly.

The results in Table 2, calculated and output in IBM SPSS, provide a clear picture of the variables that influence the ART. By examining these correlations, recruiters can make informed decisions on which job characteristics to adjust or emphasize when posting job openings to attract candidates more quickly. For instance, highlighting benefits in job descriptions may reduce the ART, while understanding that longer job durations naturally entail higher ARTs can guide realistic recruitment timelines. These correlation results not only validate Hypothesis 3 but also provide actionable insights into how job and user characteristics impact ARTs. This understanding can support the development of predictive models using machine learning, as correlations between the ART and variables like the job benefits or duration could be weighted in candidate-ranking algorithms, further enhancing the recruitment platform's effectiveness in meeting industry needs.

4.4. Regression Analysis of Factors Influencing Application Response Time

The regression analysis aimed to quantify the influence of variables like age, job duration, and benefits on the ART. The resulting model, with an R^2 value of 0.31, explains only 31% of the variance in the ART, indicating that, while these factors contribute to ART variability, additional, unmeasured factors likely influence response times. Table 3 presents the regression coefficients calculated in IBM SPSS, providing a quantitative summary of how each predictor variable impacts the ART.

Table 3. Regression analysis of factors influencing application response time (ART).

Predictor Variable	Coefficient (β)	Standard Error	t-Value	Significance (*p*-Value)	Collinearity Tolerance	Collinearity VIF	Interpretation
Intercept (β_0)	202.4	35.8	5.63	0.000			Baseline ART when Age, Job Duration, and Job Benefits are zero.
Age (β_1)	−0.823	0.266	−3.09	0.002	0.889	1.125	Age negatively impacts ART, with higher benefits reducing ART.
Job Duration (β_2)	0.291	0.028	10.51	0.000	0.996	1.004	Job Duration positively impacts ART, with longer durations leading to increased ART.
Job Benefits (β_3)	−19.7	4.085	−4.83	0.000	0.892	1.121	Job Benefits negatively impact ART, with higher benefits reducing ART.

Source: designed based on authors' research.

Each coefficient provides insight into how changes in predictor variables affect the ART. The statistical significance of each predictor was confirmed by *p*-values below 0.001, indicating that the relationships observed are unlikely to be due to chance. The values in Table 3 reflect the direction and relative magnitude of influence each variable has on the ART:

1. Intercept (β_0): the intercept represents the baseline ART when all predictor variables are zero. Here, an intercept of 202 suggests that, in the absence of age, job duration, or benefits influences, the ART would be approximately 202 h. While it is a theoretical baseline, this value provides a reference point for understanding how each variable modifies the ART;
2. Age (β_{Age}): the coefficient for age is −0.82, indicating a small but statistically significant negative relationship between age and the ART. This result suggests that, on average, for each additional year in age, the ART decreases by approximately 0.82 h. While the effect size is relatively small, this trend may reflect a tendency for older, more experienced candidates to respond promptly to job postings, possibly due to familiarity with recruitment processes in the maritime and industrial sectors. This negative association aligns with industry expectations, where older candidates—often with extensive experience—may feel more confident in assessing job fit quickly, thereby responding faster. Although modest, this effect supports the platform's inclusivity for a range of age groups, aligning with Hypothesis 1 regarding platform accessibility;
3. Job duration ($\beta_{Duration}$): the job duration exhibits a positive coefficient of 0.29, meaning that, for every additional unit increase in job duration (measured in days), the ART increases by 0.29 h. This positive association indicates that jobs with longer durations tend to elicit slower responses, likely due to the more complex or demanding nature of these roles. This correlation aligns with Hypothesis 3, suggesting that job characteristics like duration influence the ART. In practical terms, this trend may reflect that candidates spend more time evaluating longer-term positions, which often require greater commitment or specific qualifications. For recruiters, this result implies that long-duration roles may benefit from proactive recruitment strategies to expedite candidate engagement;
4. Job benefits ($\beta_{Benefits}$): the coefficient for job benefits is −19.7, indicating a strong negative relationship with the ART. This value suggests that, for each additional unit in the benefits rating (a composite score of various benefits offered), the ART decreases by 19.7 h, showing that jobs with better benefits attract faster responses.

This substantial negative impact implies that job benefits are a powerful motivator for candidates, reducing the ART significantly. In high-demand sectors like maritime and industrial recruitment, attractive benefits such as health insurance, travel allowances, and performance incentives may prompt candidates to prioritize their response. This finding strongly supports Hypothesis 3, underscoring that enhanced job benefits not only increase job attractiveness but also expedite application response times.

To ensure the robustness of the regression analysis, multicollinearity diagnostics were conducted using tolerance and variance inflation factor (VIF) values. The tolerance values for the independent variables—job benefits (0.889), user age (0.996), and job duration (0.892)—were well above the threshold of 0, indicating no serious multicollinearity issues. Similarly, the VIF values for these variables—job benefits (1.125), user age (1.004), and job duration (1.121)—were all close to 1, further confirming the absence of problematic multicollinearity. These results demonstrate that the independent variables in the model are not highly correlated, allowing for reliable interpretation of their individual contributions to the dependent variable, the application response time.

The moderate R^2 value suggests that these factors alone cannot fully explain ART variations, which is common in human behavior models. Other studies in recruitment psychology, such as that by Thompson and Aspinwall (2009), have also found that a substantial portion of response behavior can be attributed to motivational or contextual factors not captured by demographic or job-related variables. Nevertheless, the predictive utility of this model lies in its ability to inform actionable strategies by highlighting which job characteristics can be adjusted to optimize the ART, supporting recruitment efficiency in time-sensitive industries.

The regression analysis conducted in IBM SPSS confirms that job characteristics, particularly the job benefits and job duration, play significant roles in determining the ART. The results underscore the effectiveness of using predictive modeling to understand candidate behavior in response to job postings, enabling recruiters to fine-tune recruitment strategies. As demonstrated in Table 3, higher benefits prompt quicker responses, while longer job durations require more consideration from applicants. These insights, derived from SPSS analytics, serve as a foundation for refining recruitment practices, aligning with Hypothesis 3 by validating the potential of data-driven strategies to optimize digital recruitment platforms.

4.5. Machine Learning for Real-Time Data Analysis: Decision Tree Analysis for CAR

A decision tree model was employed in IBM SPSS to predict the CAR based on job characteristics, including the job duration, benefits, and total number of applicants. The resulting model, shown in Figure 5, consisted of nine nodes, including five terminal nodes and a depth of four levels, providing a structured approach to understanding factors that influence candidate acceptance.

The decision tree analysis showed the following hierarchy in factors influencing the CAR:

- Total number of applicants: serving as the root node, this variable emerged as the most critical predictor for the CAR. Jobs with larger applicant pools exhibited lower CARs, likely due to increased competition, which allows recruiters to be more selective;
- Job duration: as the second most influential factor, shorter job durations were correlated with higher CARs. This trend indicates that candidates prefer roles requiring shorter commitments, which are attractive due to being quick and flexible employment opportunities;

- Job benefits: job benefits did not significantly impact the CAR. This suggests that, within this sector, applicants may prioritize other factors such as job length and competitive positioning over benefits.

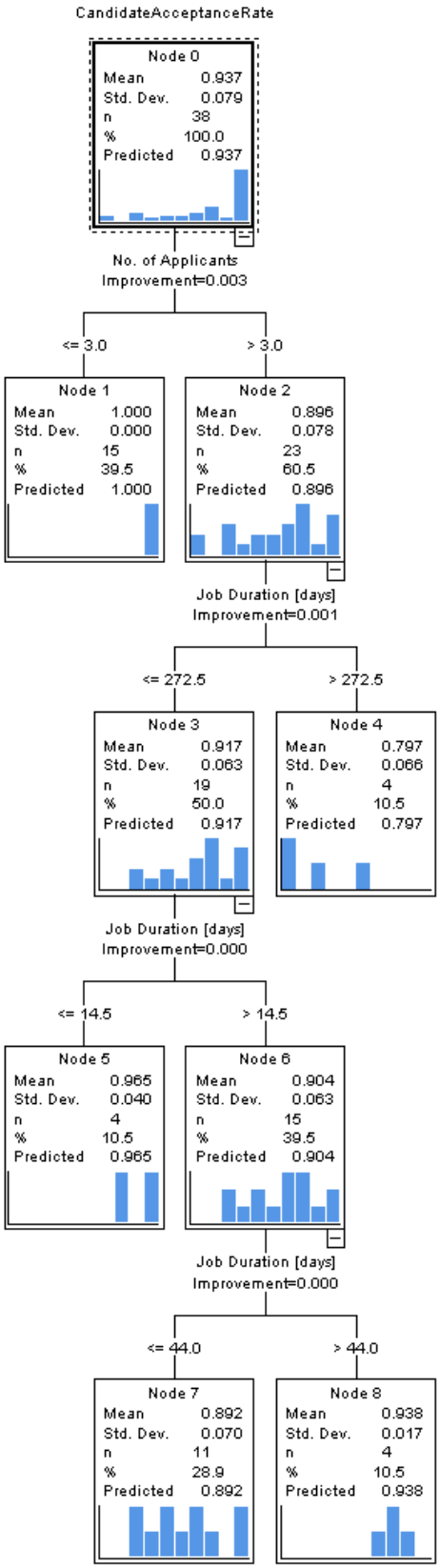


Figure 5. Decision tree analysis for CAR. Source: authors.

This decision tree provides a framework for real-time CAR predictions, allowing recruiters to adjust job postings based on anticipated outcomes. For example, positions with large applicant pools or long durations could be modified or emphasized to meet CAR objectives effectively. The predictive CAR model demonstrated its utility in guiding recruitment strategies. By identifying job types and factors contributing to higher or lower CARs, recruiters can make data-driven adjustments to job postings, such as emphasizing high-demand positions or modifying those with a low acceptance likelihood. These insights translate into a more efficient allocation of resources and improved hiring outcomes.

By identifying the total number of applicants and job duration as primary predictors of the CAR, the decision tree supports Hypothesis 3, demonstrating how machine learning can guide data-driven recruitment practices. This model enhances real-time decision-making, enabling recruiters to tailor job postings dynamically and improve recruitment outcomes.

By addressing these areas, future research can create more responsive, data-driven recruitment models that align closely with the dynamic needs of industries that require rapid, reliable staffing solutions.

5. Discussion: Enfolding with the Literature

The findings from this study demonstrate the considerable potential of digital recruitment platforms to address labor shortages within Norway's maritime sector, offering both immediate recruitment efficiencies and long-term strategic advantages. These findings not only support the proposed hypotheses but also provide novel insights into how these technologies can be applied effectively in skill-intensive industries.

By analyzing the high concentration of applications submitted within 24 h—with 70% of all responses being submitted within 5 days—this study underscores the capability of digital recruitment tools to attract candidates rapidly. This swift response rate translates into cost savings and operational benefits, particularly for time-sensitive industries like shipbuilding, where timely access to skilled labor is critical for meeting project deadlines and managing financial outcomes.

The findings for Hypothesis 1 validate the role of specialized digital recruitment platforms in meeting the critical needs of maritime and industrial sectors. The results demonstrate that platforms tailored to industry-specific requirements enhance recruitment outcomes by reducing the time-to-hire and improving the alignment between job requirements and candidate skills. This aligns with prior research, such as that of Pan et al. (2023) and Van Esch et al. (2019), which highlighted the transformative potential of digital platforms in optimizing hiring processes. Our findings extend these insights by showing that platforms designed for the maritime sector can address labor shortages with a precision that is not achievable through traditional methods. The observed efficiencies reinforce the practical utility of these platforms as indispensable tools in time-sensitive industries.

The pre-vetting process was shown to be a significant factor in recruitment success, with a candidate acceptance rate of approximately 90% across the platform's data. Pre-vetting not only reduces the time spent reviewing unsuitable applications but also increases confidence among employers by presenting a pool of candidates whose qualifications align closely with specific job requirements. This process is particularly valuable in the maritime sector, where specialized skills and certifications are often prerequisites for employment. By minimizing hiring risks and streamlining the candidate selection process, pre-vetting enhances both the speed and accuracy of digital recruitment, making it an invaluable feature for industries with stringent skill needs.

Hypothesis 2 is also strongly supported by the results, which highlight the critical role of pre-vetting candidates in improving job application acceptance rates. The pre-vetting process ensures that only qualified candidates are matched with job postings, reducing

mismatches and improving employer confidence. This aligns with the theoretical underpinnings of signaling theory, as discussed in the literature review. Our findings demonstrate that pre-vetting not only reduces recruitment costs but also improves decision-making efficiency, as previously evidenced by Sahut and Lissillour (2023) and Kim et al. (2019). By confirming the positive impact of pre-vetting on acceptance rates, this study provides empirical evidence to support its broader adoption in digital recruitment strategies.

The application of machine learning algorithms, as seen in the decision tree analysis of the candidate acceptance rates, offers recruiters predictive insights, such as which roles are likely to attract a high number of suitable applicants. By predicting the factors that influence the CAR, machine learning enhances decision-making by allowing recruiters to modify job postings in real-time, optimizing them based on anticipated candidate responses and maximizing recruitment adaptability. The predictive modeling of the CAR offers actionable insights that allow employers to optimize job postings. For example, positions with large applicant pools or prolonged hiring durations can be strategically modified to achieve desired CAR outcomes. By analyzing factors such as the job type, location, and required skills, predictive modeling enhances recruiters' ability to anticipate and improve acceptance rates, ultimately streamlining the hiring process. While this study focuses on the CAR, extending predictive modeling to the ART could provide additional benefits. ART predictions could help identify bottlenecks in candidate engagement or response behaviors, allowing recruiters to adjust their communication timing or application processes. For instance, roles with consistently high ARTs might benefit from automated reminders or simplified application steps, ensuring faster turnaround times and reducing recruitment delays.

The results for Hypothesis 3 confirm that machine learning algorithms provide valuable, data-driven insights that enhance recruitment processes. The predictive modeling of candidate acceptance rates allowed for the identification of job-related factors that influence recruitment outcomes, including the sizes of applicant pools and the durations of job postings. These findings align with those of Behl et al. (2022) and Van Esch et al. (2019), who demonstrated the ability of machine learning to optimize recruitment workflows by predicting key metrics. Furthermore, the results suggest that extending machine learning to additional metrics, such as application response times, could offer further opportunities to refine and streamline recruitment strategies. This iterative potential of machine learning highlights its long-term value in addressing evolving labor market challenges.

The findings align with prior research, showing that digital platforms reduce the time-to-hire and increase retention rates. This is achieved through enhanced candidate profiling and skill compatibility analysis, which streamline decision-making for employers in the maritime sector. Together, these findings illustrate the practical and theoretical implications of integrating digital tools, pre-vetting processes, and machine learning algorithms into recruitment strategies. By addressing the pressing labor shortages in maritime and industrial sectors, this study demonstrates the transformative potential of these technologies in overcoming recruitment challenges and optimizing workforce allocation. The results also provide a foundation for future research to explore additional applications and innovations in recruitment technologies, particularly in other skill-intensive industries.

6. Conclusions and Future Research Directions

This study provides significant insights into the transformative role of digital recruitment platforms in addressing labor shortages in Norway's shipbuilding and ship-repair industry. By answering the initial research questions and empirically testing the proposed hypotheses, the research offers both theoretical contributions and actionable solutions.

1. Connecting findings to research questions:
   - RQ1: how effective are digital recruitment platforms in addressing labor shortages in Norway's shipbuilding and ship-repair industry? This study demonstrated that specialized platforms effectively bridge workforce gaps, achieving a CAR of 90% and ensuring rapid ARTs, with 70% of applications being received within 24 h. This evidence highlights the efficiency of digital tools in aligning candidate skills with job requirements;
   - RQ2: what key metrics influence the success of digital recruitment strategies? By evaluating the ART and CAR as critical recruitment metrics, this study showed that the job duration and total number of applicants significantly influence recruitment outcomes. Predictive modeling using machine learning further identified patterns that optimize candidate–job matching;
   - RQ3: how do digital platforms facilitate cross-border labor mobility, particularly between Norway and labor-surplus regions like Romania? This study emphasized Romania's role as a strategic labor source for Norway. By leveraging pre-vetting and machine learning algorithms, digital platforms enable efficient candidate sourcing and seamless labor mobility, addressing labor imbalances while reducing hiring costs.
2. Key findings and hypotheses:
   - Hypothesis 1: it was confirmed that digital platforms tailored for skill-intensive industries reduce the time-to-hire and improve candidate–job alignment, offering a practical solution to labor shortages in the Norwegian maritime sector;
   - Hypothesis 2: this hypothesis is supported by data showing that pre-vetting candidates significantly enhances acceptance rates, minimizing mismatches and optimizing recruitment efficiency;
   - Hypothesis 3: the results validated the role of machine learning algorithms in providing data-driven insights into factors such as the CAR and ART, enabling real-time adjustments to recruitment strategies.
3. Contribution to the field:
   This research addresses a critical knowledge gap by exploring digital recruitment in a sector-specific context. Unlike general studies, it focuses on high-demand, knowledge-intensive roles in the Norwegian maritime industry, where traditional recruitment methods have proven insufficient. The findings not only align with the European Union goals for labor mobility but also highlight the economic resilience that digital tools can provide across borders.
4. Impact and future directions:
   By integrating digital recruitment platforms into their strategies, Norwegian shipbuilding stakeholders can mitigate persistent labor shortages, reduce operational delays, and enhance workforce adaptability. Future research could explore comparative analyses across industries or regions, integrating qualitative insights to further enrich understanding of digital recruitment dynamics.

This study demonstrates that digital platforms—through pre-vetting, machine learning, and automated matching—offer an innovative, scalable solution to labor market challenges. By leveraging Romania's skilled workforce and technological advancements, stakeholders in Norway's shipbuilding sector can achieve sustainable workforce development while aligning with broader EU economic objectives.

6.1. Managerial Implications and Practical Applications

The findings of this study offer valuable insights for managers and decision-makers in the maritime and industrial sectors. Digital recruitment platforms provide a strategic advantage by streamlining hiring processes and improving workforce alignment. Managers can leverage predictive modeling tools, such as those used in this study, to optimize recruitment strategies by identifying key factors that enhance candidate acceptance rates. For example, jobs with low candidate acceptance rates can be adjusted in terms of their duration or compensation to attract more suitable candidates.

The pre-vetting process highlighted in this research also reduces the time-to-hire and minimizes recruitment inefficiencies. By ensuring that only qualified candidates enter the application pool, managers can focus on evaluating top candidates rather than filtering unqualified applicants. This approach not only reduces operational costs but also improves the decision-making accuracy in high-demand industries.

The realization of these applications requires investment in digital platforms that integrate machine learning algorithms, user-friendly interfaces, and robust candidate profiling systems. It is crucial for organizations to train HR teams in interpreting predictive analytics to maximize these tools' potential. Additionally, ensuring the reliability and transparency of pre-vetting processes builds trust among candidates and recruiters, further enhancing the platform's effectiveness.

These managerial insights underline the transformative potential of digital tools in addressing labor shortages, reducing operational inefficiencies, and ensuring strategic workforce alignment.

6.2. Limitations and Future Research Directions

This study evaluates the potential of digital recruitment platforms using data derived from a single digital recruitment platform in Romania that is specifically designed for the maritime and industrial industries. While the dataset provides valuable insights into the unique recruitment dynamics of this niche sector, it also presents certain limitations that merit discussion.

The dataset is derived exclusively from one platform, which inherently limits the generalizability of the findings. The diversity of candidates and job types within the broader maritime sector may not be fully captured, given that the data reflect the activities and metrics of a single digital platform. This limitation means that the results may not represent the recruitment dynamics across all maritime and industrial stakeholders, particularly those operating in regions with distinct market conditions or relying on alternative recruitment methodologies. This study focuses on recruitment in Romania and its potential to support labor shortages in Norway's maritime industry. While this cross-border perspective highlights the role of digital recruitment in labor mobility, it does not account for the broader European maritime sector's diverse challenges, regulatory environments, or cultural factors that influence recruitment practices.

While the reliance on a single platform may limit the sample diversity, it also underscores the innovative nature of this research. This platform is unique in its integration of pre-vetting processes, machine learning algorithms, and job-matching mechanisms that are tailored to the needs of maritime and industrial sectors in Romania. Other recruitment methods in the region primarily involve traditional practices, such as CV uploads and manual communication. As such, this study provides a novel case study of how digital tools can transform recruitment in skill-intensive sectors.

To enhance the generalizability and robustness of the findings, future research could explore comparative analyses across multiple platforms or datasets from different regions. Such studies could investigate how varying market conditions, platform designs, and user

behaviors impact recruitment outcomes. Additionally, integrating qualitative insights from employers and candidates could provide a richer understanding of the contextual factors influencing digital recruitment success.

By acknowledging these limitations, this study aims to provide a balanced perspective on the findings while emphasizing the groundbreaking potential of digital recruitment platforms in addressing labor shortages in specialized industries.

Building on the findings of this study, several key directions for future research can be identified. Expanding on the current analysis could yield deeper insights and broader applicability to recruitment processes in skill-intensive sectors.

First, future research could focus on determining the average time required to fulfill job vacancies based on detailed job characteristics, such as the salary, duration, location, benefits, technical requirements, and number of available positions. By analyzing these factors, researchers can develop predictive models that not only estimate the time-to-hire but that also identify the specific combinations of characteristics that accelerate or delay the recruitment process.

Second, while the regression analysis in this study identified that the candidates' age, job duration, and job benefits account for 31% of the variance in the ART, the remaining 69% remains unexplored. Future studies could investigate additional factors the influence the ART, such as employer branding, job market conditions, recruitment platform design, and candidate behavioral patterns. Exploring these variables could provide a more comprehensive understanding of the ART and its determinants, enabling more precise optimization strategies.

Finally, real-time predictive analytics could be a promising area for exploration. Future research could focus on integrating real-time ART predictions into digital recruitment platforms to enable dynamic adjustments to job postings, communication strategies, and candidate engagement methods. This would enhance the agility of recruitment strategies, making them more responsive to fluctuating market conditions.

By addressing these research directions, future studies can build on the findings of this work, contributing to the development of more efficient and impactful recruitment technologies that align with the evolving needs of labor markets worldwide.

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