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Assessing Knowledge Gaps about Shipping Emissions: Designing Educational Programs for Sustainable Maritime Logistics for Future Professionals in Albania & Montenegro

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Abstract. This study assesses knowledge gaps among Albanian and Montenegrin maritime professionals regarding EU shipping emissions and their implication on current and future curricula. Survey data revealed educational needs across economic, legislative, and engineering domains. Utilizing IMO model course frameworks and competence-based assessment methodologies, we propose structured educational interventions to facilitate knowledge transfer from established EU member states to the West Balkan countries. The findings contribute to environmental management policy by addressing regional capacity development needs for maritime emissions compliance, technological innovation and best practices.

Keywords: Engineering Education, Questionnaire, West Balkan, Shipping Emissions, Sustainability

1. Introduction

Maritime operations face increasingly stringent environmental regulations to reduce emissions. The International Maritime Organization (IMO) [1] and the European Union (EU) [2] have established ambitious policies to decrease emissions. The transition to a net-zero maritime industry requires both technological innovation and well-trained professionals. These employees need to be proficient with emission regulations as well as technical and operational measures [3]. In countries such as the West Balkan countries Albania and Montenegro (WB), current educational systems may not address emerging skill needs. Thus, a mismatch between industry needs and workforce capabilities might emerge as future maritime professionals must adapt and develop expertise in decarbonization, energy transition, and logistics optimization to effectively implement IMO and EU directives.

Previous research has already addressed the content of future maritime curricula. Jeevan et al. [4] highlighted the importance of integrating maritime sustainability, digitalization, and specialized training into academic programs. This matters as job roles will change due to maritime climate adaption [5]. Similarly, Demirel [6] emphasized the necessity of close collaboration between industry and higher education institutions to identify teaching gaps within the education system. Despite these insights, there remains limited research on specific knowledge gaps and educational needs related to environmental compliance and decarbonization within the WB maritime industry.

This paper is structured as follows: Section 2 details our research methodology, Section 3 presents survey and focus group findings, Section 4 and 5 discuss implications and conclude.

2. Methodology

This study examines sustainable shipping knowledge in the WB maritime industry and identifies the key skills required to implement energy efficiency and decarbonization policies. Our research aims to show current green skill needs of WB maritime organizations, resulting in an academic skill matrix.

To address these questions, we employed a mixed-methods approach combining quantitative surveys and qualitative focus groups. We gathered survey feedback from 45 WB stakeholders exploring their expectations and perceptions regarding future skill needs. Additionally, a focus group has been conducted to complement survey results.

3. Results

The results highlight a critical gap between awareness and implementation of decarbonization and energy efficiency in the WB maritime industry. More than half of the surveyed stakeholders have taken no emission-reduction measures. Over 70% lacked specific strategies meeting EU and IMO targets. Awareness within organizations is largely rated as moderate (56.1%) or low (14.6%), and financial constraints (34.2%), lack of technical expertise (21.1%), and regulatory barriers (15.8%) were cited as the main obstacles. Although most recognize the need to upskill for emission reduction, nearly three-quarters lack training programs. Stakeholders show awareness of climate action and knowledge of emission-reduction strategies. However, practical engagement is limited, underscoring the urgent need for targeted capacity-building to meet EU standards.

4. Implication for West Balkan Universities

Maritime vocational education adheres to the Standards of Training, Certification and Watchkeeping (STCW) convention requirements. Advanced training is provided by accredited institutions in alignment with IMO Model Courses [7]. Responses from WB stakeholders reveal three distinct educational requirements: (1) economic skills, (2) legal knowledge, and (3) engineering competences. Accordingly, a skill matrix has been developed to highlight skill needs to successfully implement the emission reduction strategies (Figure 1). These findings align with the ESCO classification system [8].

5. Summary

The study identifies key knowledge deficiencies regarding EU and IMO emission reduction strategies, targets, and technologies in the WB. Over 70% have neither implemented emission reduction measures nor established training programs. Despite these gaps, most respondents recognize the importance of developing relevant skills. The developed skill matrix categorizes required competencies into three crucial clusters: Engineering; Regulatory Compliance; and Economics.

Our findings highlight the need for closer collaboration between industry and higher education institutions in the WB in preparing the maritime industry for the transition to a net-zero emissions future. Future research needs to verify these results by comparing the content of similar international curricula and assessing the teaching quality of the revised curricula at the WB universities.

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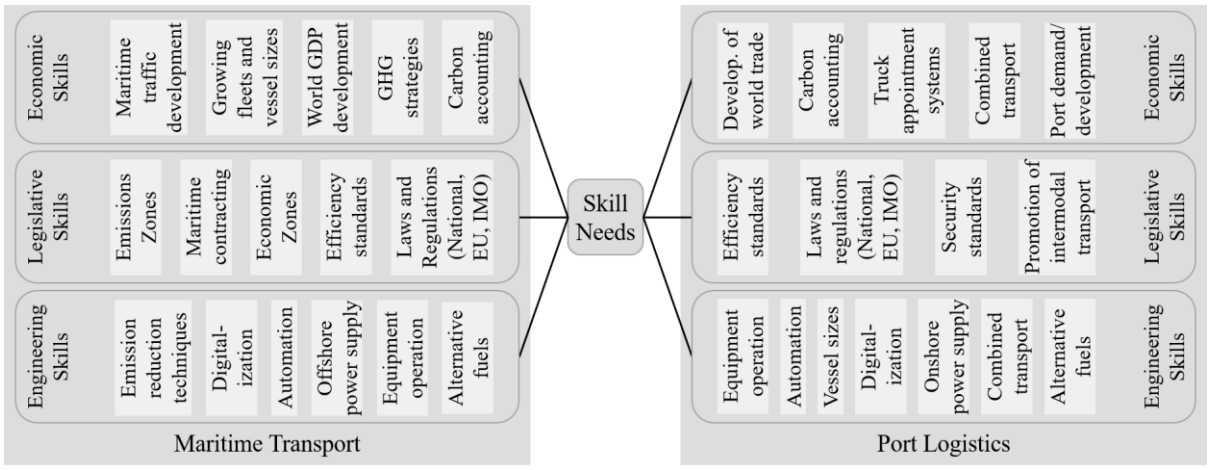

Figure 1. Skill matrix of identified skill needs in maritime transport and port logistics (own figure)

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