

THE IMPACTS OF HIGHER EDUCATION INSTITUTIONS ON SUSTAINABLE SOFTWARE DEVELOPMENT

Chkoniya, Valentina¹; Martins Batista, Maria Manuela²; Cruz Gonçalves, Fernando¹

¹GOVCOPP, ISCA-UA, University of Aveiro, Aveiro, Portugal

²Escola Superior Náutica Infante D. Henrique, ENIDH, Paço de Arcos, Portugal

ABSTRACT

The world is constantly becoming more aware of the importance of sustainability in every aspect of our activity, and due to the omnipresence of ICT in a digitalized society software development is no exception. (Leong *et al.*, 2023). The International Maritime Organization (IMO) has set strategic goals to reduce total annual greenhouse gas emissions by 50% by 2050 compared to 2008 levels (Gucma *et al.*, 2023). And the ICT sector is potentially responsible for 14% of the global carbon footprint by 2040, revealing that sustainability in tech is a pressing issue that needs to be addressed (Raisian *et al.*, 2022). Shipping Software Development (SSD) is at the juncture of these two realities, continually challenged by rapidly evolving concepts, technologies, and demands. Since the UN Conference in 1972, Higher Education Institutions (HEIs) have increasingly undertaken active measures to contribute to sustainable development (Findler *et al.*, 2019). Driven by a mission to create sustainable social, economic, and environmental impact at scale HEIs have to actively support SSD (Reyes Nieto *et al.*, 2018). ESG (Environmental, social, and governance) became a key factor in the Poseidon Principles and a framework for measuring how well a company is doing in terms of sustainability, and its introduction significantly affected the shipping industry. On the other hand, OntoSuSD facilitates knowledge, awareness, implementation and proposes a description of relationships generated around lean, agile, and green approaches in sustainable software development (Zada *et al.*, 2023). This paper provides a systematic literature review of peer-reviewed journal articles published between 2018 and 2023. Inductive content analysis was applied to identify major themes addressed in the literature to develop a conceptual framework detailing the relationship between HEIs' activities and their direct and indirect impacts on SSD by using the eShip case study. An overview of the ESG aspects and how they are relevant to the shipping industry includes the impacts of HEIs on sustainable SSD, complementing previous literature reviews by broadening the perspective from what HEIs do in pursuit of sustainability to how these activities impact environment, society, and economy. Holistic perspective on sustainable SSD design includes an environmentally conscious approach and tangible benefits to the user (Fiore *et al.*, 2020). For example, optimizing code to reduce energy consumption, using more efficient hardware, opting for energy-efficient data centers, providing fast access to data and easy search, intelligent cargo, and vessel matching, forecasting vessel route and decreasing port

congestion, predicting an estimated time of arrival and Increasing fuel efficiency, improving overall performance, lower application ownership costs, increasing cargo owner and shipowners agility and competitive edge, etc. (Cacho *et al.*, 2021; Kyas *et al.*, 2021; Gonçalves and Chkoniya, 2022). The need for a more sustainable world is gaining momentum and involves every industry, including software development. The paper identifies seven principles of sustainable SSD with indirect impacts of HEIs and how they can be applied to build next-generation digital products with a positive impact on the shipping industry.

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