

## **Managing CO<sub>2</sub> emissions within sustainable supply chain**

### **Abstract**

The pursuit of implementing distribution transport processes in line with the principles of sustainable development encourages enterprises to take the environmental perspective into account in the decision-making process. As a result of the conducted research, it was found that incorporating appropriate emission management in distribution transport processes has a positive impact on cost reduction, improvement of qualitative and quantitative parameters, while simultaneously mitigating the carbon footprint in a supply chain.

The doctoral research identified the limited scope of existing managerial methods that enable the measurement of emissions from distribution transport while simultaneously incorporating environmental parameters into the management process. In response to this gap, a new model for managing emissions from distribution transport in sustainable supply chains was developed, which constitutes the main scientific aim of the thesis. Alongside the formulation of a clear managerial logic, a utilitarian aim was also achieved. This was realised through the creation of a dedicated computational model supporting the evaluation of emissions generated by transport processes and enabling the integration of results into decision-making. In this way, enterprise-level decisions concerning the organisation of transport can be based on the selection of the most advantageous scenario, taking into account environmental and cost parameters.

Chapter One examines the implementation of transport processes within sustainable supply chains. It defines the concept of sustainable development and outlines the boundary conditions for transport operations within this framework, identifying the main motivations for measuring and managing distribution transport from this perspective.

Chapter Two analyses existing approaches to measuring and managing the carbon footprint of transport in a sustainable supply chain. It reviews key legal acts, norms and standards, and considers the potential for integrating emission management into existing managerial methods.

Chapter Three identifies the key parameters of transport processes that affect emission levels. Based on a literature review, a classification of these parameters was proposed. Empirical research with experts made it possible to assess the significance of selected factors. The study also verified the influence of vehicle characteristics, the choice of load units and reusable packaging, as well as the potential of multi-criteria analysis in transport management in a sustainable supply chain.

Chapter Four presents the logic of the newly developed model for assessing the carbon footprint of transport processes. Given differences in the quality of available enterprise data, two evaluation variants were proposed – a detailed and a simplified one. The chapter also discusses the use and role of multi-criteria analysis in emissions management in a sustainable supply chain.

Chapter Five is devoted to the validation of the proposed solution, following the logic defined in the new model. The usefulness of the solution was confirmed, and its practical applicability in enterprises carrying out distribution transport processes was clearly demonstrated.

The literature review and empirical research enabled the formulation of conclusions, which are presented in Chapter Six. The research questions were answered, the limitations of the solution identified, and the current implementation pathways of the model were outlined, together with directions for future development.

The research and validation confirmed practical value of the proposed solution and can be successfully implemented in existing enterprises. The developed model provides significant support for companies in improving the efficiency of their transport processes by including emission level perspective into the decision-making process in a sustainable supply chain.

**Keywords:** carbon footprint, transport processes, sustainable supply chain, sustainable development, CF management