



The impact of process innovations on maritime transport services in Bulgaria

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Abstract: The aim of this study is to analyse the impact of four key process innovations on maritime transport services provided by leading companies in Bulgaria. Specifically, the process innovations studied are: improved provision of the service; specification of services targeting new market segments; creation of better conditions for the realisation of the services offered; introduction of a new organisational innovation. In this study, a method is applied to identify the Factor Effect (screening) design, resulting from the numerical values of the indicator scores given by experts to managers of leading organisations in the Bulgarian maritime sector. The results of the overall study indicate that the introduction of process innovations in each of the four areas would be beneficial for the development of maritime organisations in Bulgaria. Furthermore, the synergistic effect of the innovations would be beneficial for the development of human resources and new management technologies of the maritime industry in Bulgaria.

Keywords: maritime transport services, innovations, entrepreneurship

1. Introduction

The COVID-19 pandemic caused significant disturbances in the maritime transport system despite the efforts made, including through the different nature of incentives for the commercial sector, which has made it difficult to secure the loading and unloading activities and transportation (Sohrabi et al., 2020). Undoubtedly, one of the greatest challenges that need to be overcome are the unprecedented procedures related to the replacement of freight vessel crews (Dimitrakieva, Kostadinov, & Atanasova, 2021; Kersan-Škabić, 2022; Margherita & Heikkilä, 2021). These difficulties gave rise to the risk that the imposed restrictions may create conditions for permanent reduction in the number of people employed in maritime transport and, respectively, for reduction of their income, while creating uncertainty among those employed with respect to the duration of the individual contracts due to the lack of possibility for replacement of the crew. The pandemic also had a negative effect on the preparation of the future senior staff who are expected to be involved in the management of the maritime transport system (Belev & Stoyanov, 2020; Stoyanov, 2021a, 2021b). It has been concluded that faster adaptation to the changed conditions and subsequent recovery of the entire transport system (Ozdemir, Sharma, Dhir, & Daim, 2022) need to be provided in order to avoid the risk of any threats to food security. The way toward the recovery of international trade is closely associated with the return to the normal course of development of maritime logistics services after the partial relaxation of the measures. This requires addressing the shortage of port infrastructure (Fratila, Gavril, Nita, & Hrebenciuc, 2021; Lin, Chang, & Hung, 2022) as a result of the sharp increase in the trade of products and the delayed deliveries caused by the more burdensome procedures for access before starting the loading and unloading operations. The pandemic, on the other hand, has made it possible to pinpoint the vulnerability of transport logistics activities more accurately and clearly, and, at the same time, has drawn the experts' attention to the need to search for new strategic opportunities to create greater flexibility and sustainability.

These factors have also had an adverse impact on maritime logistics services in Bulgaria. In search of strategic alternatives for development, logistics companies have taken into account the already existing factors that influence the development of maritime transport services, which are related to the country's crucial location, the existing transport infrastructure and its connections to the rail network (Bakalova, 2014; Mednikarov,

Dimitrov, & Vasilev, 2018; Ministry of Transport, Information Technology and Communications, 2010, 2017; Narleva, 2019). The favourable factors are creating conditions for introducing new systemic innovations in the management of these services to allow faster adaptation to the new market restrictions.

The objective of this study is to analyse the impact of four key process innovations on maritime transport services provided by leading companies in Bulgaria. In particular, the process innovations studied are: improved provision of services on the existing markets; improvements in the service specifications targeting new market segments; creating better conditions for the delivery of the services offered; introduction of new organisational innovations.

2. Methodology of the study

This study applies the method of Factor Effect (screening) design derived from the numerical values of each indicator determined by experts working as managers in leading organisations in the Bulgarian maritime sector. The method allows to identify the impact of the four key process innovations and to identify the variations among the different results. Based on this, the research approach adopted provides us with the opportunity to conduct a comparative analysis of the expert evaluations and ensures reliability and validity of the results.

2.1 Methods for data collection from the logistics experts involved in the survey

Discussions in focus groups have been conducted in the course of the survey in order to better identify the attitudes of the logistics managers and experts involved in the survey toward the impact of different innovations on the more rapid recovery and development of maritime transport services. The participants in the focus groups for analysing the impact were selected based on their long-term experience (more than 10 years) and expertise in the field of logistics. The potential participants in the survey were familiarised with its objectives and methodology and only 3 out of 55 companies refused to participate. Two of the experts did not join the actual survey despite their confirmation of participation. All logistics experts that participated in the survey provided a confirmation of informed consent and knowledge of the methods of discussion in the focus groups and the methods of analysis for presenting the results of the survey. The survey was conducted between October 2021 and January 2022. Participants were given a questionnaire examining the impact of a combination of the four factors to be analysed and the experts had to provide a score on a scale from one to five, which was for evaluation of the input factors (where a score of 1 means that the factor has no impact, and a score of 5 means that the factor has a very strong impact) The scores were summarised and used to establish the relationship between input and output data when combining the impact of multiple factors. The combination of factors for building the model and identifying the scores is shown in Table 2 and is as follows: no impact of the factor (A1, B1, C1, D1) or very strong impact of the factor (A2, B2, C2, D2).

Table 1. Variable information.

Improved provision of services	Introduction of new organisational innovations	Specification of services targeting new market segments	Creating better conditions for realisation of the services offered	Sum of the scores given by the experts
A2	B2	C1	D2	
A1	B2	C1	D1	
A1	B1	C2	D2	
A2	B1	C1	D1	
A2	B2	C2	D1	

The participants' responses were organised and summarised and the data obtained were used for further analyses.

2.2. Data analysis methods

Factor effect (screening) design (Cotter, 1979) allows to calculate the impact of the effect of the four factors studied, where the factor given the highest score in the different combinations will undoubtedly be the one with the strongest impact. The summarised data were analysed with XLSTAT Design of Experiments, Analysis of a screening design, Microsoft Excel (Addinsoft, 2021).

3. Results from the study

The comparative results (including the uncertainty of measurement) do not show any significant variations in the experts' scores on the impact of the different innovations on maritime industry. Furthermore, the results show that the most significant factor for maritime transport organisations is the introduction of organisational innovations (rationalising the processing of quotes and reducing the time for implementation), followed by innovations related to the development of new specific services targeting new market segments in the sector. The results also show the priorities of the sector and the problematic areas challenging its future development. The scores given by the experts, which were used to build the model, are shown on figure 2 (Experimental design) and vary from 200 to 250.

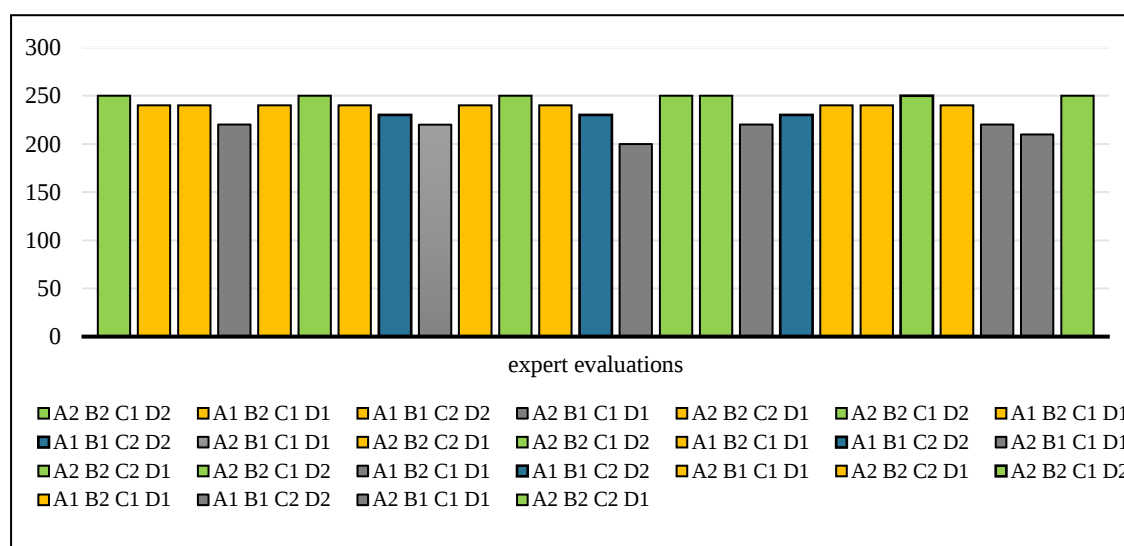


Figure 2. Experimental design

3.1. Organisational innovations in maritime transport services in Bulgaria

As shown on figure 1, the highest scores were given to the combination of factors where organisational innovations have received the highest score (B2). This is largely the result of the changed market conditions, which require using primarily internet commerce in a highly competitive environment as a mechanism for being awarded contracts in the maritime sectors. This sector could recover more rapidly if these electronic tenders for contracting services are not only based on the "lowest price" criterion, but also on organisational advantages related to the quality of implementation after signing the contract for the transport service. It has been recognised a long time ago that the shipping industry is rather conservative and it is difficult to introduce new technologies for process management or innovative methods for organisation based on the existing resources. The majority of experts that participated in the study shared that there is a rather one-sided view with respect to organisational innovations and that the projects or innovations introduced are primarily related to the port infrastructure or the shipping information technologies. The underestimation of the positive impact of organisational innovations covering both systems at the same time hinder the sustainable introduction of projects in the field of ecology. The introduction of innovative models of service or organisation of maritime transport services in the participating logistics companies over the past few years focus on two themes: one of them is improvements related to a specific problem that required and optimised solution in the work organisation (rationalisation of the processing of quotes and reducing the time for implementation) and the other one is related to projects for optimisation, where the final expected effect is the application of innovations in different parts of the two systems.

3.2. Creating better conditions for realisation of the maritime transport services offered

The overall international policy followed over the past few years supports projects for replacing road transport with maritime transport. Many regulatory reforms and coordination policies for investment in port infrastructure projects have been implemented. The changes in the market conditions during the pandemic deepened the increasing need to include maritime transportation in the transport services. This necessitates the implementation of realistic projects stimulating the complementarity between the different types of transport and the introduction of proper organisational management for their better compatibility. Most experts maintain

that the strict restrictive measures for land transport introduced and overcoming the strict border control can streamline the efforts of logistics operators toward the unlimited capacity of maritime transport, which, among other things, does not require a lot of investment for the creation of maritime waterways. The higher scores were observed for combinations of factors where this factor has a strong impact (D2). The new market conditions created and the adaptation to the new “normality” require that efforts are focused on investment in innovations for the creation of better conditions for the implementation of the transport services. Investment in innovative concepts for shipping trade need to align with the coordination between all stakeholders in the “door-to-door” delivery in order to overcome the currently existing problems within the entire transportation chain related to the multimodal and intermodal transport systems. The use of ship transport for short distances could also result in the fulfilment of the environmental objectives to reduce the number of transport vehicles on the international roads for transportation and could help reduce traffic jams. The experts that participated in the study shared that the introduction of environmental standards related to the overall quality management could contribute to the more seamless introduction of innovations and opening of new business opportunities, which could compensate for the investment in this initiative in the long-term. These innovations require very close coordination between maritime, railway and road transport and thus, the development of a higher number of specialised terminals for the introduction of the transport services is a prerequisite, the lack of which would make investment in such innovations worthless.

3.3. Specification of services targeting new market segments

The results from the study show that the introduction of new technologies designed for new market segments lag behind as compared to the other novelties and that companies would rather rely on technologies that have already been adopted and welcomed in other market segments. The introduction and use of digital technologies is primarily related to the digitalisation in maritime transport, particularly in navigation systems. The study confirms that there are few innovations focusing on new market initiatives and development of new transport services and therefore the scoring of this factor is less significant (scores of C1 and C2 were given). The submission and processing of information in sea ports plays the key role in the provision of maritime logistics services that meet the clients’ requirements. Therefore, innovations in this field would contribute to the development, however, innovations at present are primarily related to plans and programmes for paperless and automated procedures in the sea ports.

3.4. Improved provision of services

According to the experts that took part in the study, the lack of flexibility resulting from the uncertainty in the context of the crisis in maritime transport services has several dimensions related to the inaccuracy of the information, the rapidly changing conditions for closing the ports, the delay of information and the lack of possibility to meet the contractual terms caused by the inaccuracy of information. This situation requires to seek rapid solutions for improving the method of provision of transport services that corresponds to the uncertainty with respect to the exact time of the ships’ calling at the ports. The main drawbacks of using innovations for improving the services provided (A1 and A2) is that they are often related to an increase in the costs as a result of the indirect transfer of cargo during the integration of this type of transport in the transport system to the end user. The lack of harmonisation in procedures, such as in the requirements or the processing of documents which are essentially different for the different types of transport makes the introduction of innovations difficult to implement, which is the reason why the experts have given the lowest score to this factor.

3.5. Analysing the impact of the four groups of innovations

Over the past few years maritime transport services have been significantly affected by the sharp changes in the conditions of the environment, the introduction of new (not only in the field of ecology) policies, regulations and laws of different nature and natural disasters. These services ensure food security and therefore any interruption in this chain could lead to significant consequences. To overcome these factors and the increasing competition, maritime logistics operators should continuously improve their capability to provide services in order to achieve a competitive advantage. The strategies to mitigate the consequences of these negative aspects are closely related to the introduction of innovations for improving the quality of services. Standardised coefficients have been examined in the study to analyse the impact of the four possible groups of innovations. The results are illustrated on Figure 3.

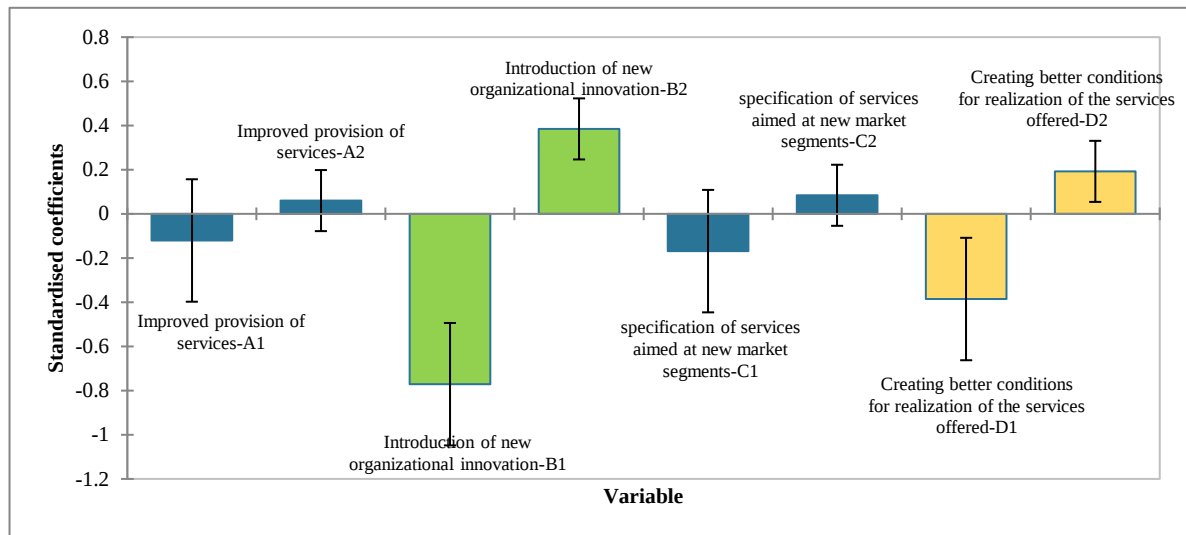


Figure 3. Standardised coefficients (95% conf. interval)

The results presented on figure 3 show the impact of each of the studied innovations for improving maritime logistics services, where the innovation with the highest variation has the greatest effect. After making repetitive studies for each combination of factors, the mean confidence intervals have been calculated. As a summary of the analysis a Pareto diagram has also been drawn (Figure 4), which clearly shows that the innovation related to the organisation of processes and their optimisation is the factor with the most significant impact, followed by the creation of better conditions for realisation of the maritime transport services offered.

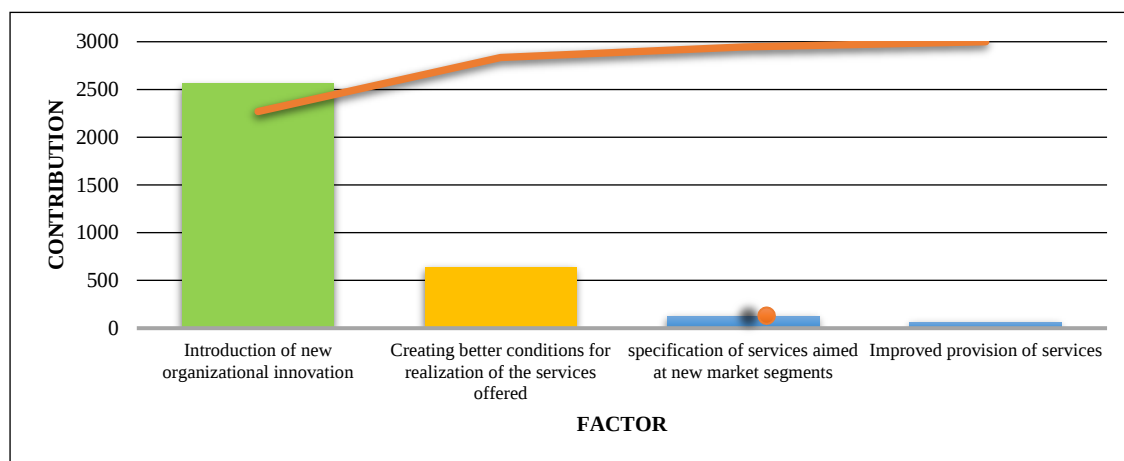


Figure 4. Contribution of the variables: Pareto charts

The other two innovations have a lower impact and should be used in combination with the impact of the others in order to have a significant effect. The combined effects of the innovations are presented (Figure 1) together with the scores given by the experts involved in the study.

4. Conclusion

The results from the overall study show that the introduction of process innovations in each of the four areas would be beneficial for the development of maritime organisations in Bulgaria. Maritime transport services include a lot of processes where innovations could be introduced and these are not just in the activities related to the conclusion of contractual agreements, loading and unloading operations and warehousing operations and the relevant accompanying documentation that could become fully digitalised, but also in many other areas, such as quality control, packaging, repackaging and environmental aspects. The changes in the market conditions related to the consequences of the pandemic and the fuel price increase create a greater uncertainty that needs to be overcome. Therefore, the synergistic effect of the introduced innovations with a combined impact should be sought, which could benefit the development of human resources and new technologies for management of the maritime industry in Bulgaria.

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