



ADVANCING PORT OPERATIONS THROUGH INTEGRATED SERVICE MANAGEMENT: QUALITY, SAFETY, AND SECURITY PERSPECTIVES

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Abstract

This research aims to advance port operations through the application of an integrated service management model that combines quality, safety, and security perspectives. The subject of the study is focused on maritime and port services, emphasizing the internal and external benefits of implementing integrated management systems in line with international standards and best practices. By analyzing the operational, organizational, and security dimensions of port activities, the research seeks to demonstrate how integrated approaches enhance efficiency, resilience, and stakeholder confidence. The ultimate goal is to provide recommendations for practical training in real port environments, ensuring that personnel are equipped to manage integrated systems that safeguard the quality of services, the safety of operations, and the security of vessels and port facilities.

Key words: *Improvement, BSC model, KPI, Business performance management, Key performance indicators.*

Introduction

The subject of the research is maritime services, with a particular focus on port services, examined from the perspective of internal and external advantages arising from the introduction of integrated management systems and the management of port services in terms of quality, safety, and security. The research aspects relate to:

- Challenges of integrating different management systems within the existing business strategy;
- Key processes for which the Integrated Management System (IMS) metrics have been developed;
- Sustainability of ports and port services in a turbulent business environment, viewed through the application of the IMS strategy.

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Application of the BSC Concept in measuring performance and implementing strategy in maritime shipping and ports

The Balanced Scorecard (BSC) model is one of the modern concepts for performance measurement systems. Although relatively new, developed in the last decade of the twentieth century, this model has become a leading concept for measuring company performance. The essence of the model lies in the fact that, in addition to measuring financial parameters, it also encompasses non-financial but highly significant parameters. The Balanced Scorecard (BSC), as a management tool, has evolved through three generations. The first generation of BSC included reports on achieved goals, enabling executive management to gain insight into the organization's state. Second generation established a connection between strategic management and performance measurement by introducing a strategic map based on four perspectives. The cause-and-effect relationship between perspectives flows from the bottom up. The third generation places strategy at the center of the organization (Kaplan & Norton, 2001, 2006), enabling integration with the Total Quality Management (TQM) approach and the concept of business intelligence.

The essence of the Balanced Scorecard concept is that it represents a managerial-control system that motivates and initiates significant improvements in critical business areas, such as port services, internal processes, service users, and the development of the maritime market. As a system of strategic management and performance measurement, the concept is based on a balanced scorecard that demonstrates how modern maritime companies plan the conversion of various resources into desired outcomes.

According to Kaplan and Norton (1996), the BSC model involves monitoring and measuring company performance across four key perspectives:

- Financial (ownership) perspective,
- Internal processes perspective,
- Learning and growth perspective,
- Stakeholder perspective.

Managing a company in a country undergoing transition, especially in the context of intense competition in the maritime market, is a complex process that requires multilayered knowledge from various fields. Only in this way can an environment be created in which a company can develop and steer toward success.

The Balanced Scorecard enables management to balance quantitative indicators while simultaneously monitoring both "leading" (non-financial) and "lagging" (financial) performance indicators (Jovanović, 2016). Measures defined in each of the aforementioned perspectives are derived from key performance indicators and strategic goals. These provide insight into the degree of achievement of defined goals and serve as a basis for efficient management and further improvement of the organization's operations.



Creating a vision – operational activity for quality improvement

Maritime companies in Montenegro lack established cause-and-effect relationships for their strategic goals across all perspectives, as there is no practical understanding of the significance and thematic relevance of each perspective. Linking performance measurement with strategic planning and management is essential for such a system to adequately serve in the process of strategic control.

Creating a vision as an operational activity is used for so-called policy-based management, meaning that strategic elements (vision, mission, etc.) are transformed into tactical and operational projects for quality improvement (Hutchins, 2008).

Phases are presented in Figure 1. Phases 1 (Strategy) and 2 (Vision) were taken as input parameters from the software - based BSC Designer approach, for phases 3-7. Phase 8 relates to the application of business intelligence, typically involving the use of benchmarking tables.

Corporate balanced scorecard

In maritime practice, we encounter various situations in the maritime market, diverse port service strategies, and different competitive environments. The enhancement of the balanced scorecard, with appropriate measurement and monitoring of key quantitative and qualitative performance metrics, is illustrated through the example of "Port of Kotor" AD (Figure1).

The diverse requirements placed on maritime companies necessitate the integration of performance measurement and strategic planning to ensure such a system can adequately serve in the process of strategic control. The BSC concept is not merely a measurement tool but also a management system for maritime companies that enables their business systems to define their strategy and, most importantly, implement it. The complexity of the BSC management system and its implementation process highlights the need to select and use software packages to make implementation as straightforward as possible for all employees in maritime companies.

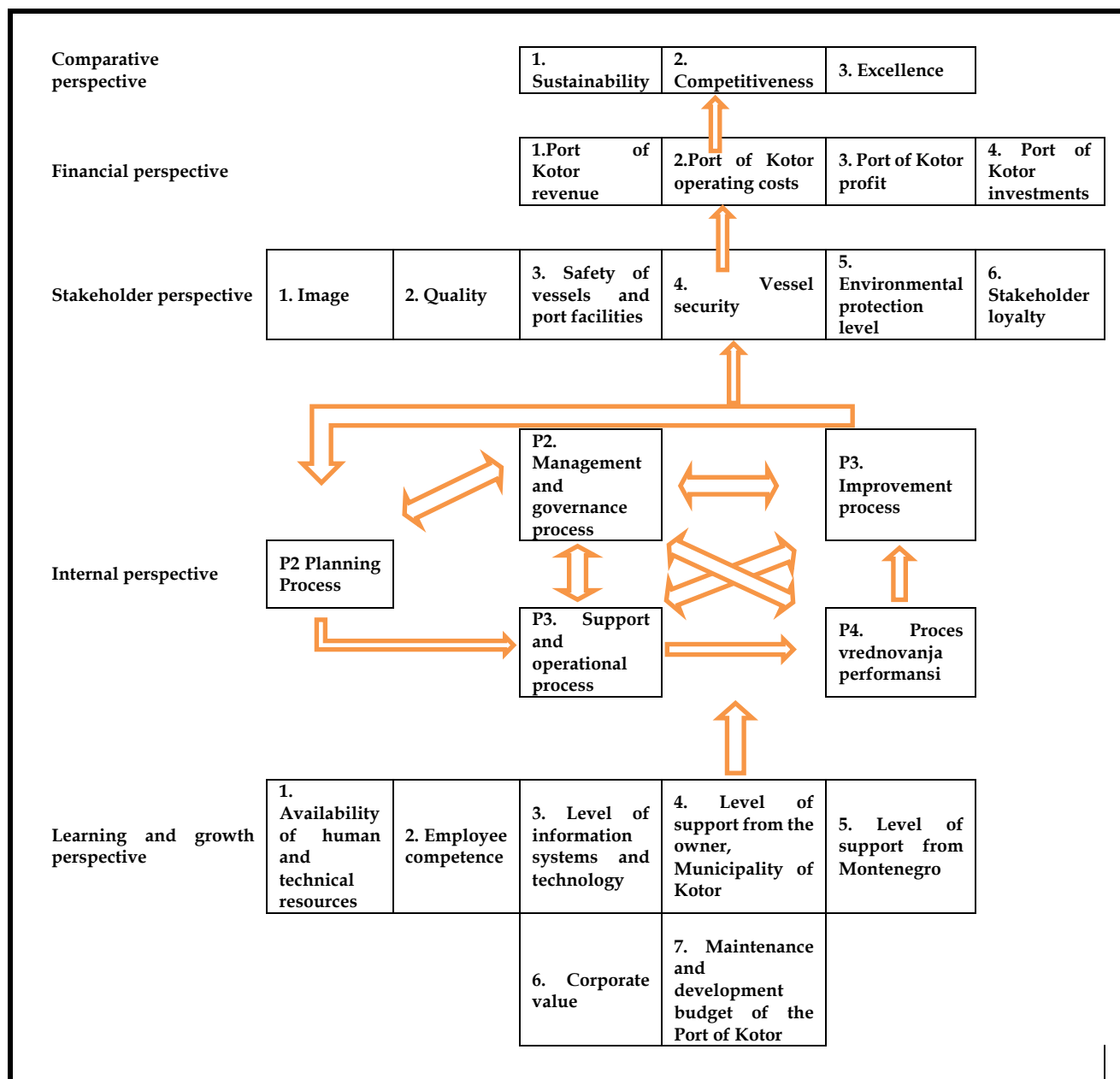


Figure 1. Phase 3 - Base Model (4) Corporate Balanced Scorecard –BSC
Souce: Popović, 2018.

Key performance indicators (KPIs)

The most significant perspectives of internal processes in ports consist of port service competitiveness, process management, safety, security, and environmental protection, as presented in Table 1.

The elements examined when analyzing user satisfaction with port services within the Port of Kotor are shown in Table 2, as well as in Figures 2 and 3.



Table 1. Internal processes perspective at the Port of Kotor

Performance	Measure of goal achievement
Management and Leadership Process - Measures of economic success (basic principles of reproduction) - Principle of productivity - Principle of efficiency - Principle of profitability	Maximum results of service operations per unit of labor employed. Maximized individual work performance within the Company; SPecified port service with minimal input of resources. Efficient use of resources for port operations; Maximization of income (as the difference between revenues and costs).
Planning process Level of availability of human and technical resources	The ISO 9001 and ISO 14001 standards require that an organization ensures the availability of resources necessary to support the execution and monitoring of the identified processes.
Support and operational processes - Safety of vessels and port facility - Security of vessels in the port basin - Environmental protection	Establishment of conditions for the extension of validity of the Port Facility Security Plan (Statement of Compliance of a Port Facility) Compliance with all legal regulations in the field of navigation safety Possession of ISO 14001 certificate Compliance with all legal regulations in the field of environmental protection (EMAS certificate)
Improvement process	Assessment of the effectiveness of the implemented IMS Achievement of IMS objectives in relation to the plan Effectiveness of IMS design in terms of time and costs Improvement of corporate climate and culture
Performance evaluation process	Monitoring of process performance Determination of target values Execution and monitoring of the Vessel Reception and Departure process Reporting on performance achievements Analysis and implementation of measures

Table 2. Stakeholder relationship management perspective

Year	KP %	Stakeholder perspective (port service users) %				
2022/23	Indicator $\geq 3,5$	Competence Responsibility for processes Overall Average score Coefficient	KP % Indicator Increase by 10 % 2023/24	Number of passenger arrivals from ships in 2024: 586,258	KP % Indicator Decrease by 10 % 2023/24	Number of service user complaints (6) Reduction by (25%)



		(3,54)		Increase by 16.07% compared to 2023 (505076)		
2021/22	Indicator ≥ 3,5	Competence Responsibility for processes Overall Average rating Coefficient (3,52)	KP % Indicator Increase by 10 % 2022/23	Number of passenger arrivals from ships (505076) Increase by (20,78%)	KP % Indicator Decrease by 10% 2022/23	Number of service user complaints (6) Increase by (16,67%)
2023/24	Indicator Increase by 10 %	Number of ship arrivals: 473 Increase by (9,22%)	KP % Indicator Increase by 10% 2023/24	Number of yacht passenger arrivals: 1,004 Reduction by (- 7,55%)	KP % Indicator Decrease by 10% 2023/24	Number of service user complaints Procedures and instru- ctions (5) Increase by (25%)
2022/23	Indicator Increase by 10 %	Number of ship arrivals: 434 Same number (- %)	KP % Indicator Increase by 10% 2022/23	Number of yacht passenger arrivals: 434 Increase (36,09%)	KP % Indicator Decrease by 10% 2022/23	Number of service user complaints Procedures and instruc- tions (4) Increase by (30%)

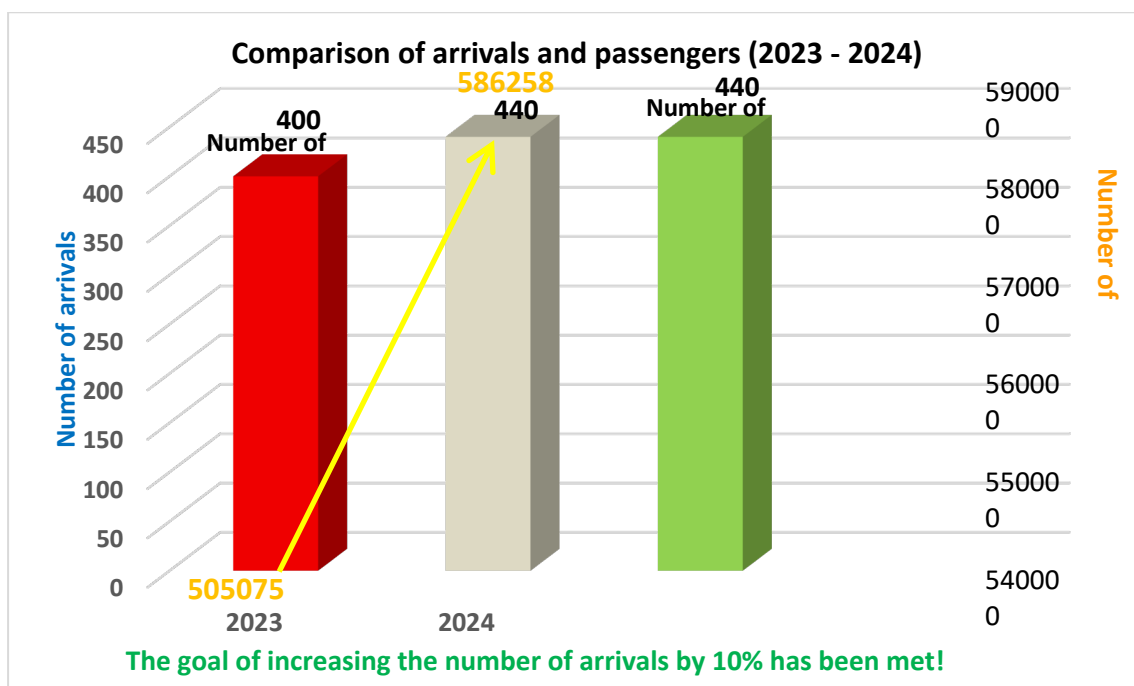




Figure 2. Customer perspective: Evaluation of port service quality

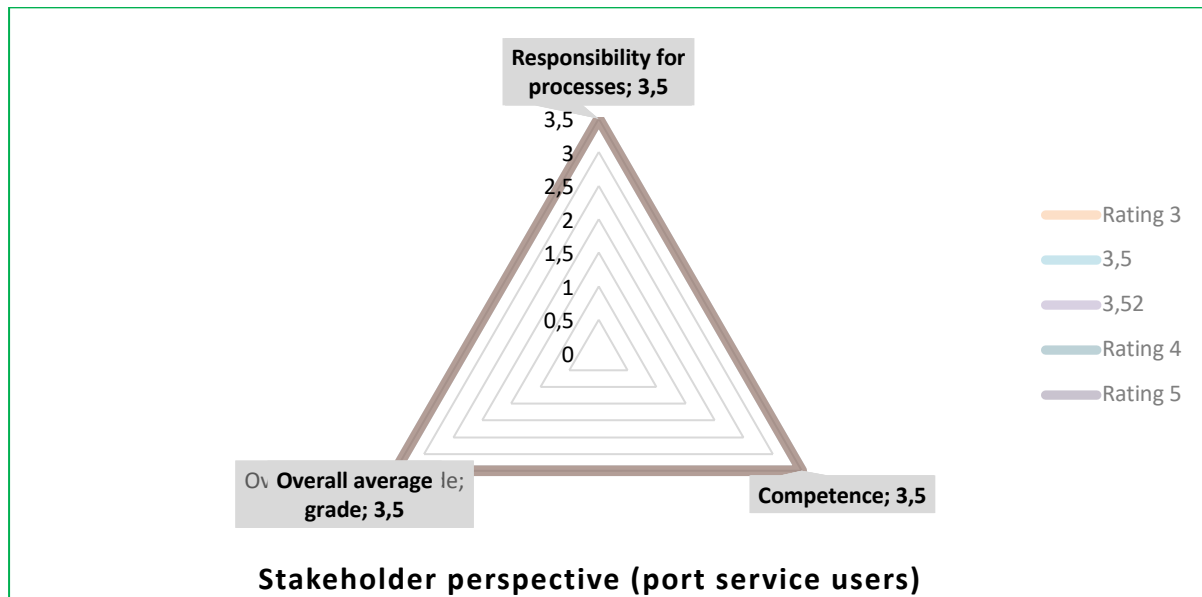


Figure 3. Responsibility in process management at the Port of Kotor

Although the purpose of the BSC is to balance all perspectives, it should be emphasized that the financial perspective remains at the top of the base model of the corporate balanced scorecard and requires a cause-and-effect relationship between financial indicators and the company's strategy (Table 3 and Figure 4).

Table 3. Financial perspective: indicators and performance results

Year	KP %	Financial perspective %				
2022/23	Indicator $\geq 0,10$	ROA- Return on assets – Net / Total assets Coefficient (0,16)	KP % Indicator ≥ 1	Overall business efficiency – Total revenue / Total expense Coefficient (1,61)	KP % Indicator ≥ 1	Financial stability – Capital / Long- term liabilities Coefficient (0,71)
2021/22	Indicator $\geq 0,10$	ROA- Return on assets – Net / Total assets Coefficient (0,14)	KP % Indicator ≥ 1	Overall business efficiency – Total revenue / Total expenses Coefficient (1,53)	KP % Indicator ≥ 1	Financial stability – Capital / Long- term liabilities Coefficient (0,87)



2022/23	Indicator ≥ 0,10	ROA- Return on assets – Net / Total assets Coefficient (0,26)	KP % Indicator ≥ 1	Current liquidity – Cash / Short-term liabilities Coefficient (2,86)	KP % Indicator ≥ 1	Debt factor – Total liabilities / (Profit + Depreciation) Coefficient (1,67)
2021/22	Indicator ≥ 0,10	ROA- Return on assets – Net / Total assets Coefficient (0,24)	KP % Indicator ≥ 1	Current liquidity – Cash / Short-term liabilities Coefficient (1,86)	KP % Indicator ≥ 1	Debt factor – Total liabilities / (Profit + Depreciation) Coefficient (0,98)

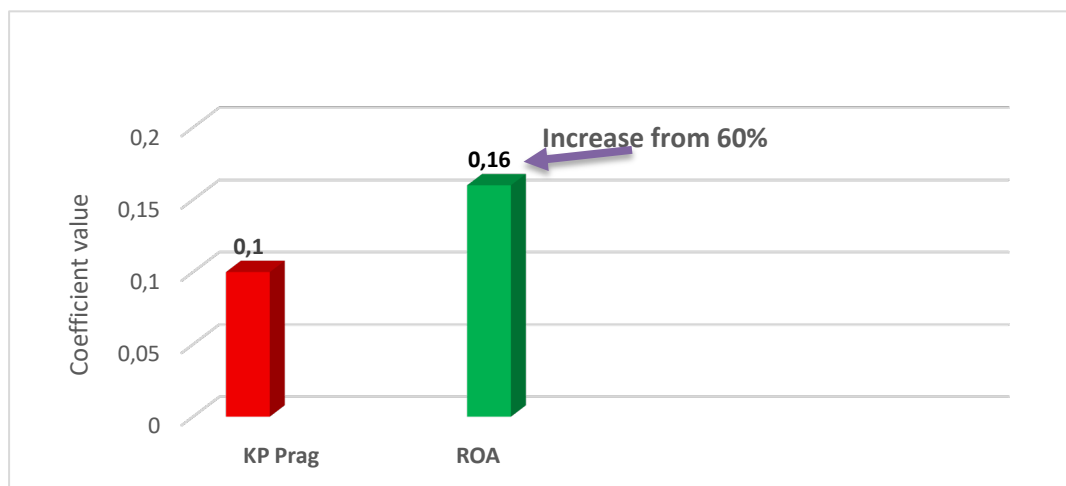


Figure 4. Display of ROA growth relative to the KPI indicator value (≥0,10)

When measuring the learning and growth perspective at the Port of Kotor, one of the fundamental tasks was to measure the intangible value of the port, whose value is multiple times greater than its tangible value. The most significant performances of the learning and growth perspective in the company are provided in Tables 4 and 5.

Table 4. Learning and growth perspective

Performance	Measure of objective achievement
1.Availability of personnel and technical resources	Level of implementation of ISO 9001 and ISO 14001 requirements to ensure adequate working conditions for personnel, influencing both service quality and service availability.
2.Communication of legal employment obligations	Level of staff competence – satisfaction with the outcomes of internal and external assessments (audits).



3. Level of information systems and technologies	Degree of business process functionality coverage with real-time information availability
4. Level of State support as the owner of the Company	Ensuring effective mechanisms for a stronger institutional response to demands under global crisis conditions
5. Corporate values	Work motivation level Level of employee satisfaction Number of process improvement suggestions submitted
6. Port of Kotor maintenance and development budget	Achievement level of objectives versus budget Degree of modern technology integration (smart port initiatives) Improvement of environmental management capabilities

Table 5. Results of balanced performance measures: employee competencies

Year	KP %	Learning and Growth Perspective %				
2023/ 2024	KP % Indicator ≥ 3.5 Decrease by (- 2,86%)	Competence Process responsibility Security Department Overall Average score Coefficient (3,48)	KP % Indicator ≥ 3.5 Same grade (- %)	Competence Responsibility for processes Maintenance and Security Department Overall Average grade Coefficient (4)	KP % Indicator ≥ 3.5 Increase (0,57%)	Competence Responsibility for processes Overall Average grade Coefficient (3,54)
2022/ 2023	KP % Indica- tor ≥ 3.5 Decre- ase by (- 4,32%)	Competence Responsibility for processes Security Department Overall Average grade Coefficient (3,54)	KP % Indicator ≥ 3.5 Same grade (- %)	Competence Responsibility for processes Maintenance and Security Department Overall Average grade Coefficient (4)	KP % Indicator ≥ 3.5 Decrease by (- 7,37%)	Competence Responsibility for processes Overall Average grade Coefficient (3,52)

„Pilot“ research of balanced performance measures at the Port of Kotor

To obtain a preliminary result of balanced performance measures for Montenegrin passenger ports and to demonstrate how the analysis system functions, a



„pilot“ research was conducted at the level of one passenger port. The Port of Kotor was selected as the sample for conducting the „pilot“ research.

In the continuation of the analysis, the BSC Designer software was used to confirm the impact of changes in performance (KPIs) across the five BSC perspectives on the company's overall performance, as well as the relationship between process management and the quality performance of the Port of Kotor. Using the BSC Designer software (<http://www.bscdesigner.com/>) and based on survey questionnaires [Lko 05], the key indicators of balanced performance measures for the Port of Kotor's operations in 2023 and 2024 were determined. The survey method was used to collect quantitative data. The survey questionnaires were designed as described in the SWOT analysis of the Port of Kotor IMS (point 24, Management Review). The first survey questionnaire is completed by the vessel's crew and pertains to the evaluation of the company's processes from the perspective of safety, security, and environmental protection. The second survey questionnaire is completed by passengers on the vessel, aiming to capture a wide range of factors significant for evaluating the company's offerings and measuring the level of user satisfaction with port services. Responses from the survey questionnaires were used to calculate KPIs related to resource efficiency at the Port of Kotor.

The collected data were processed quantitatively and qualitatively. In the quantitative analysis, descriptive statistics methods were used, while the qualitative processing of data was conducted through content analysis of responses from port service users to open-ended questions, primarily by analyzing their comments, objections, and suggestions. This is the first research on passenger ports in Montenegro's maritime economy concerning the determination of key indicators of balanced performance measures.

Defining key performance indicators in the strategic map of the Port of Kotor

The determination of these KPIs is based on the monitoring and measurement of processes (Popović et al., 2015), as exemplified in the research on the learning and growth perspective. The quality management system in the company provides a broad understanding of the „influence“ of its own human resource strengths and weaknesses at the process level, so the company's board regularly receives information on what needs improvement but lacks insight into which strategic priorities should be pursued and where investments should be made. In the maritime practice of companies, the joint implementation of BSC and IMS significantly contributes to improving organizational performance.

The Deming Cycle forms the basis of both, but BSC focuses much more on results, while QMS leaves some room for doubt regarding whether the right strategy has been Implemented (Jovanović & Krivokapić, 2011, p. 64). As the best solution in the process of translating the mission, vision, and strategy of the Port of Kotor, BSC represents a clear system for measuring performance, as illustrated by the Top-Down path in Figure 5. The strategy was translated into goals for each analyzed perspective, and then indicators (measures), target values (limits), and activities to achieve those goals were defined for each perspective. The significant role of BSC is also reflected in the

Bottom-Up path, where activities directed toward the target values of measurable indicators evaluate the degree of fulfillment of set goals and determine the company's effectiveness in implementing the strategy. In this way, continuous action within the company is encouraged toward constant improvements through the PDCA cycle, as it is impossible in the highly volatile maritime market to define a strategy once and apply it indefinitely without review and improvement.

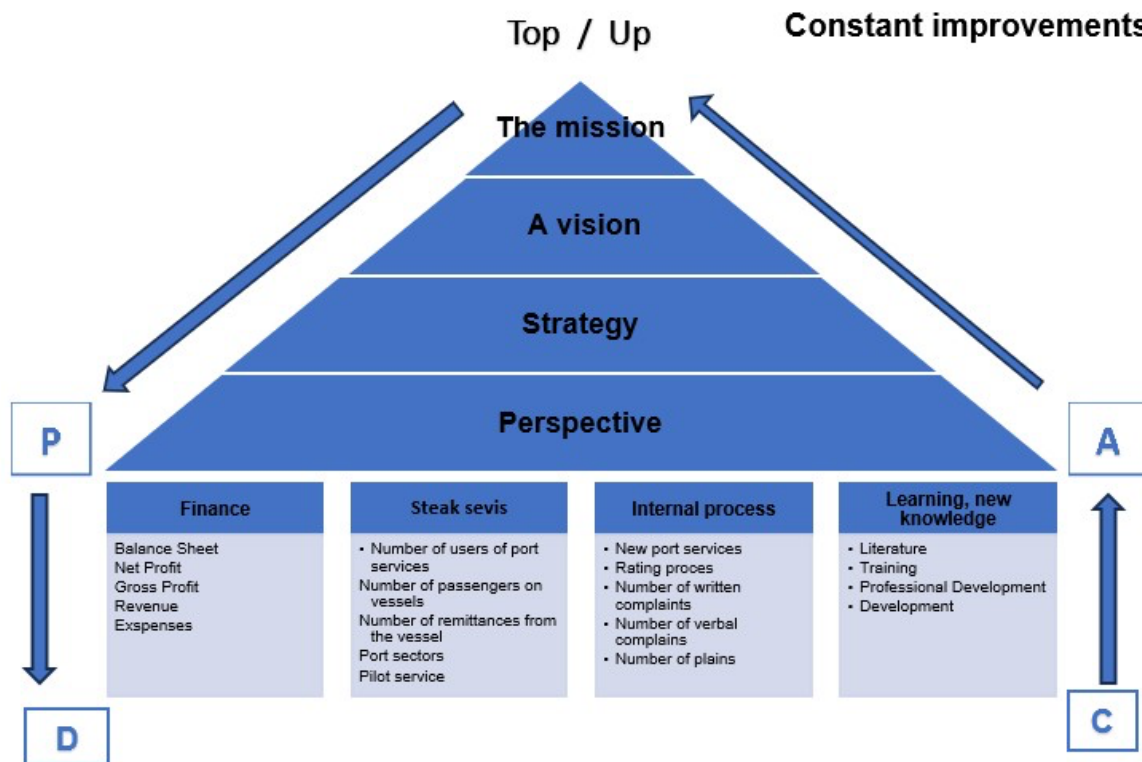


Figure 5. Translation of mission, vision and strategy using the BSC Model

Source: Popović, 2018.

Continuous improvement can be achieved by introducing Business Intelligence (BI) systems (e.g., Tableau, Power BI). By applying these systems, maritime companies can assist in visualizing performance data and tracking changes in real-time, enabling faster responses to unexpected market situations.

Analysis of improvement flows for the period 2019 - 2024

The basic premises of the BSC model, using the example of the Port of Kotor, are based on the following facts:

1. The developed model accumulates data from the company's annual reports.
2. Of the three basic data series, we used the target data series.

The business analysis provided indicators that enable the monitoring of improvements in the management of port services, thereby achieving an improvement in the overall performance of the Port of Kotor. The analysis showed



which performances are most responsible for successful operations. Since each KPI has its own value, their input was performed, along with the input of additional values (max, min, target). The final result was a simulation that allows us to identify which critical success factors of the company need attention, which need improvement, and how to manage success. Designer PRO Dnam enables a simulation that confirmed the importance of process improvement for enhancing the company's performance. The simulation confirmed that process quality significantly impacts the company's performance. An improvement was achieved by increasing the productivity of port service processes, which led to an improvement in the performance of the entire system at the Port of Kotor. The Port of Kotor uses a large number of diverse forms to collect data for the needs and requirements of stakeholders. For the research, forms were available that do not ensure systematic and complete data collection on the issues monitored and analyzed. Knowing that this is common in practice, quality monitoring cards and statistical reports were used. The research utilized basic quality tools aimed at data collection (form Lko 05 for data collection) for processing predominantly numerical data.

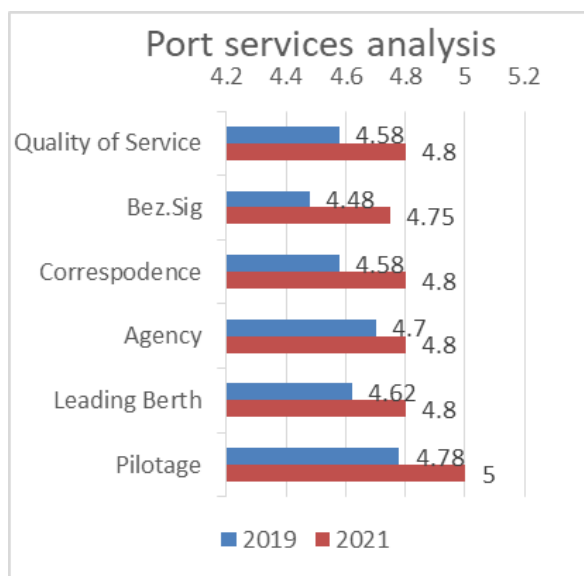


Figure 6. Analysis of Survey Questionnaires

Source: Vessels, 2019-2021

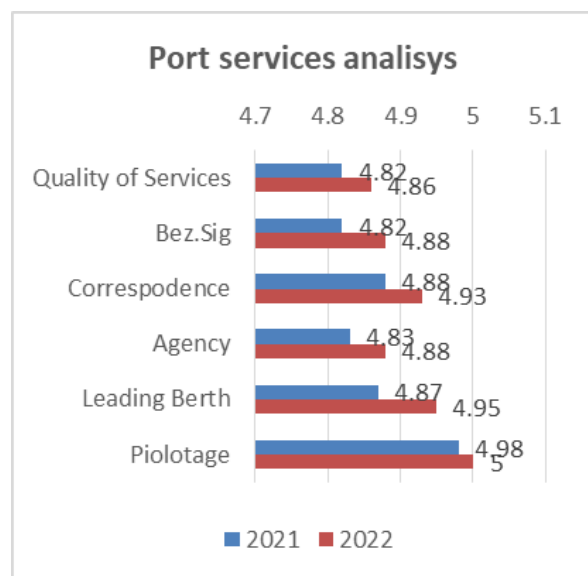


Figure 7. Analysis of Survey Questionnaires

Source: Vessels, 2021-2022

The data were divided into two groups:

- Numerical data: measurable data (port service evaluation).
- Attribute data: counting nonconformities from survey questionnaires.

The trend was analyzed in percentages (%) for the observed years from 2019 to 2024.



Table 6. Analysis of survey questionnaires

2022													
Table No.	Assessment Elements	Score 1	%	Score 2	%	Score 3	%	Score 4	%	Score 5	%	ukupno	Arithmetic Mean
1	Pilotage	0	0,00	0	0,00	0	0,00	2	2,04	96	97,96	98	4,98
2	Ship Berth in the Port	0	0,00	0	0,00	0	0,00	4	4,71	81	95,29	85	4,95
3	Maritime Agency	0	0,00	1	1,05	1	1,05	11	11,58	82	86,32	95	4,83
4	Port–Ship Correspondence and Issue Resolution	0	0,00	0	0,00	1	1,01	10	10,10	88	88,89	99	4,88
5	Safety and Security	0	0,00	0	0,00	0	0,00	12	12,12	87	87,88	99	4,88
6	Service Quality – Other	0	0,00	0	0,00	0	0,00	13	13,40	84	86,60	97	4,87

2023													
Table No.	Assessment Elements	Score 1	%	Score 2	%	Score 3	%	Score 4	%	Score 5	%	ukupno	Arithmetic Mean
1	Pilotage	0	0,00	0	0,00	0	0,00	2	1,32	150	98,68	152	4,99
2	Ship Berth in the Port	0	0,00	0	0,00	0	0,00	4	3,13	124	96,88	128	4,97
3	Maritime Agency	0	0,00	1	0,65	1	0,65	13	8,44	139	90,26	154	4,88
4	Port–Ship Correspondence and Issue Resolution	0	0,00	0	0,00	1	0,66	14	9,27	136	90,07	151	4,89
5	Safety and Security	0	0,00	0	0,00	0	0,00	10	6,54	143	93,46	153	4,93
6	Service Quality – Other	0	0,00	0	0,00	0	0,00	8	6,84	109	93,16	117	4,93

Source: Vessels, 2022 2023.

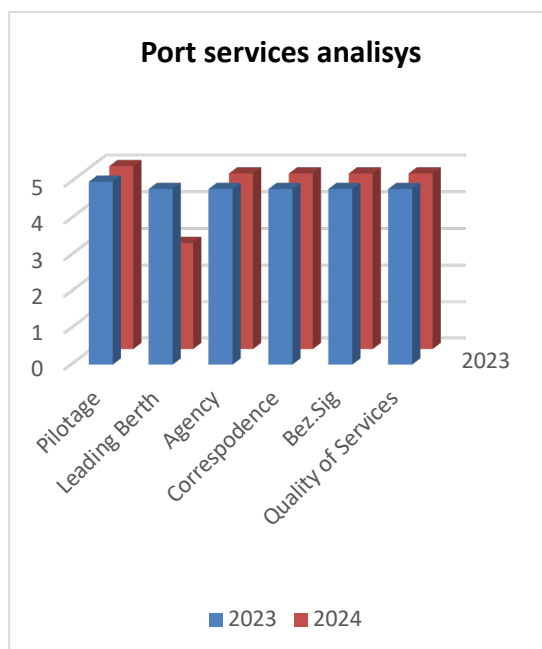


Figure 8. Analysis of survey questionnaires

Source: Vessels, 2023 2024.

From the data analysis, it is clear that the greatest impact on non-conformities comes from the operations of the port agency and port processes, particularly in the areas of

safety and security. Based on the presented analysis, significant attention will be devoted to safety and security factors that need improvement at the Port of Kotor. Additionally, this factor is directly correlated with the increase in cruise ship traffic at the Port of Kotor, and consequently, with the increase in the number of arriving passengers. The use of stratification is necessary at the Port of Kotor, as it allows the discovery of real facts that may be obscured in standard analyses. Since the origin (source) of most data is unknown, the collected data were analyzed as a homogeneous set that did not provide sufficient information. The analysis adhered to the basic principles of stratification.

Conclusion: Creating a vision as a key operational measure in the process of quality improvement

Within the conducted research at the Port of Kotor company, the application of the „policy - based quality management“ method proved to be an effective strategy. This approach enables the transformation of strategic elements such as vision, mission, and strategic goals into concrete tactical and operational projects aimed at quality improvement. The research results indicate that such a management structure contributes to better strategy implementation at all levels of the company. This process and its effects are illustrated by the graphical representation in Figure 9 (Hutchins, 2008), which further confirms the importance of this approach in the context of quality improvement.

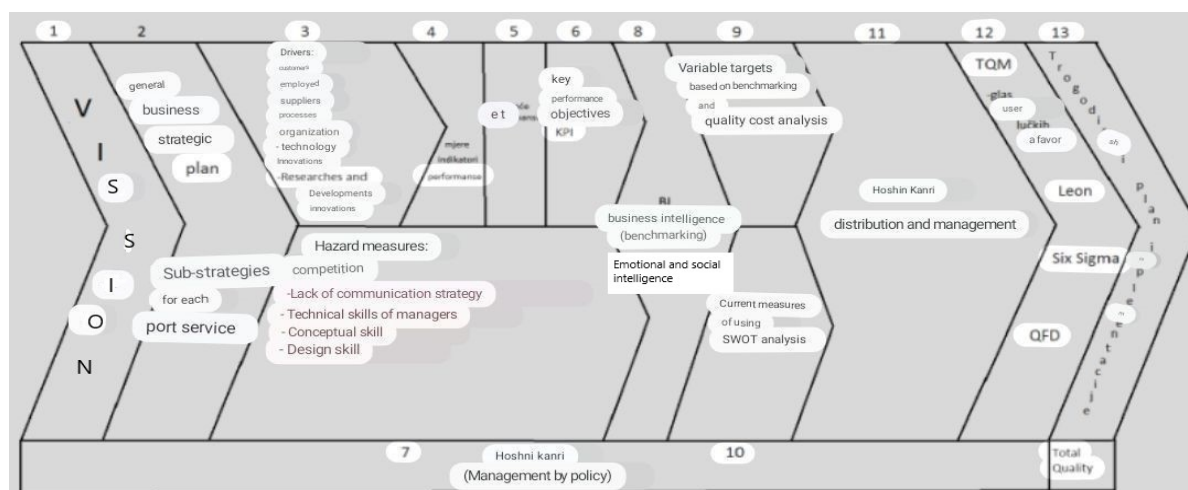


Figure 9. Innovative model of transforming vision into operational activities - quality improvements at the Port of Kotor AD

Source: Popović, 2018, p. 124.

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