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Performance-based classification of container ports using fuzzy clustering and analysis of organizational climate dimensions

Gonul Kaya Ozbag[1]
Sefik Kahve[2]
Aysen Simsek Kandemir[3]

(✉ Corresponding Author)

[1]*Department of Maritime Business Management, Maritime Faculty, Kocaeli University, Turkey.*
[1]*Email: gonul.kaya@kocaeli.edu.tr*
[2]*Kocaeli University, Turkey.*
[2]*Email: sfkkhv@gmail.com*
[3]*Hereke Vocational School, Kocaeli University, Hereke 41800, Turkey.*
[3]*Email: aysens@kocaeli.edu.tr*

Abstract

This study aims to classify container ports in Turkey according to their operational performance levels and to analyze differences in organizational climate perceptions among employees across distinct performance groups. Key performance criteria were identified through a literature review. Hierarchical cluster analysis and fuzzy C-means clustering were applied to 18 Turkish container ports, yielding two distinct performance groups. A survey using the nine-dimension Organizational Climate Measure (OCM) was administered to employees at four ports, and independent samples t-tests were conducted to compare climate perceptions between performance groups. The clustering analysis revealed two distinct port performance groups. Employees in the high-performance group reported significantly more positive organizational climate perceptions across eight of nine dimensions, participation, communication, emphasis on training, interdepartmental integration, supervisory support, employee welfare, job motivation, and reward systems, compared to those in the standard-performance group. Autonomy did not differ significantly between groups. Organizational climate plays a decisive role in port performance. While autonomy alone does not directly influence performance outcomes in this sector, participative management, effective communication, training investment, interdepartmental collaboration, supervisory support, employee welfare, job motivation, and reward systems collectively serve as robust predictors of operational performance. Port managers should adopt integrated human resource strategies to sustain competitive advantage. Port managers seeking to improve organizational performance should prioritize cultivating a supportive and participatory work environment. Strengthening communication channels, encouraging employee involvement in decision-making, enhancing supervisory support, and implementing equitable reward mechanisms are critical factors that distinguish high-performing ports. Targeted interventions addressing specific climate dimensions will yield more meaningful and lasting operational improvements than uniform management approaches.

Keywords: Container ports, Fuzzy clustering analysis, Organizational climate, Performance criteria, Port management.

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Contents

Contribution of this paper to the literature

This study is the first to integrate fuzzy clustering-based performance classification of Turkish container ports with a multidimensional organizational climate assessment using the validated OCM framework. It uniquely links port-level operational outcomes with employee perceptions across nine climate dimensions, providing original empirical evidence from a substantially underexplored domain in maritime management literature.

1. Introduction

Maritime transport remains the cornerstone of global trade, moving over 80% of goods by volume and underpinning international economic integration and supply chain connectivity (UNCTAD, 2025). According to the UNCTAD Review of Maritime Transport 2025, global seaborne trade volume reached approximately 12.72 billion tons in 2024. While this 2.2% growth reflects positive momentum compared to the 2013–2023 average, it remains below the longer-term historical average of 2.9%, indicating a persistent deceleration in global volume expansion. Against this backdrop of long-term deceleration and heightened geopolitical uncertainty, maintaining a competitive edge and enhancing operational efficiency requires a holistic management paradigm.

In this context, modern port management must continue to prioritize investments in physical infrastructure, which are essential for achieving green performance and long-term environmental sustainability. However, technological and infrastructural improvements alone are insufficient to secure sustained operational excellence. To ensure resilience in a volatile environment, these developments need to be complemented by a strong organizational climate and strategic human capital management. Ultimately, the synergy between advanced physical assets and a supportive organizational environment serves as the primary driver of sustainable performance.

In the Turkish context, maritime trade performance has also demonstrated notable progress. In 2025, total cargo throughput across Turkish ports surpassed 553 million tons, marking a 4 % year-on-year increase and setting a new historical record; containerized cargo throughput similarly experienced growth, reaching roughly 14 million TEUs, a 3.5 % increase over the previous year (General Directorate of Maritime Affairs, 2026). Turkish ports have further strengthened their global maritime positioning, with multiple facilities securing places among the world's busiest container terminals, indicating an expanding role for Türkiye in international trade networks (Invest in Turkey, 2025). However, these record-breaking figures and expanding trade volumes represent only the physical and operational dimension of success. Sustaining such high-level performance in an increasingly complex and competitive environment necessitates more than just infrastructure; it fundamentally depends on the efficiency of the human and organizational systems driving these operations. Consequently, traditional performance indicators like cargo volume must be evaluated in tandem with organizational factors, as the long-term resilience and competitiveness of container ports are increasingly shaped by the prevailing organizational climate.

Current advancements in organizational sciences highlight that organizational climate, defined as employees' shared perceptions of workplace practices, leadership styles, and environmental support, acts as a fundamental determinant of both individual and collective performance (Ehrhart & Raver, 2014; Quan, Choi, & Tan, 2023). Extensive research suggests that a positive organizational climate is inherently linked to higher job satisfaction, enhanced employee engagement, and streamlined communication (Ostroff, Kinicki, & Tamkins, 2003; Patterson et al., 2005). These elements collectively foster an elevated adaptive capacity, which in turn drives superior operational performance and long-term institutional sustainability (Schneider, Ehrhart, & Macey, 2013). Furthermore, a strategically aligned climate acts as a catalyst for organizational effectiveness, ensuring that human capital becomes a source of competitive advantage (Bakker & Demerouti, 2017).

Despite this, maritime and port literature exhibits a relative scarcity of studies integrating organizational climate dimensions with port performance outcomes, especially in empirical settings such as Turkish container terminals. Addressing this gap, the present study aims to classify Turkish container ports based on performance levels using fuzzy clustering analysis and to investigate whether significant differences exist in organizational climate perceptions among employees across distinct performance groups. The organizational climate was operationalized using nine specific dimensions adapted from the Organizational Climate Measure (OCM) developed by Patterson et al. (2005): autonomy, participation, communication, emphasis on training, interdepartmental integration, supervisory support, welfare, job motivation, and rewarding. By linking performance clustering with these validated climate dimensions, this research contributes to both the theoretical discourse on maritime logistics and provides practical, human-centered management insights for enhancing operational resilience in port facilities.

2. Conceptual Framework and Research Model

Ports are complex operational systems where performance is shaped not only by physical infrastructure and technical capacity but also by underlying organizational conditions. Traditional performance indicators such as throughput, berth utilization, and turnaround time remain essential for evaluating port efficiency. However, these metrics alone are insufficient to explain performance differentials across ports, as they largely overlook the organizational mechanisms through which available resources are translated into operational outcomes. Addressing this limitation, prior research emphasizes the role of latent organizational dynamics that bridge the gap between resource capacity and realized performance (Bichou, 2004; Notteboom* & Rodrigue, 2005).

At the center of these dynamics lies organizational climate, which extends beyond formal structures to capture employees' shared perceptions of workplace practices and processes. Rather than reflecting how work is formally prescribed, organizational climate represents how it is collectively experienced and interpreted in practice (Schneider et al., 2013). In the context of port operations, where time pressure, coordination intensity, and operational uncertainty are particularly high, these shared perceptions function as cognitive frames that shape how employees interpret situations, respond to disruptions, and align their behaviors with operational demands.

Within port settings, organizational climate should therefore be understood not as a static or uniform construct but as a dynamic and multidimensional system emerging from ongoing interactions and operational processes. To render this complexity analytically tractable and empirically measurable, the present study adopts the OCM framework (Patterson et al., 2005). Compared to alternative approaches, OCM offers a comprehensive and operationally relevant taxonomy, making it particularly suitable for complex service environments such as ports. Building on its strong psychometric foundation, the study focuses on nine dimensions that define the organizational climate of port operations. Autonomy, participation, communication, training emphasis, interdepartmental integration, supervisory support, employee welfare, motivation, and reward systems. These dimensions capture critical aspects of how work is structured, coordinated, and supported. For example, autonomy facilitates rapid decision-making in time-sensitive operations, while interdepartmental integration ensures coordination between planning and execution units. Similarly, training emphasis and reward systems reflect the organization's investment in skill development and performance reinforcement, both of which are essential in sustaining operational reliability.

Despite its collective nature, organizational climate is not perceived uniformly across employees; rather, it is interpreted through individual-level cognitive and social filters. Drawing on Social Identity Theory as well as person–environment fit perspectives, individuals tend to evaluate organizational practices in light of their identity affiliations, career stages, and role expectations. In this sense, demographic characteristics such as gender, age, education, tenure, and job position shape how employees make sense of workplace experiences and organizational signals. Prior research consistently demonstrates that variations in these characteristics lead to differentiated climate perceptions, as employees develop distinct evaluative frameworks regarding managerial practices and work conditions (Ehrhart, Schneider, & Macey, 2014; Parker et al., 2003). More recent evidence further suggests that such differences may manifest in specific dimensions of organizational climate, particularly in relation to fairness, support, and participation mechanisms (Wziątek-Staśko, Krawczyk-Antoniuk, & Gracjasz, 2024). Accordingly, this study proposes that organizational climate perceptions differ significantly according to employees' demographic characteristics (H1), specifically across gender (H1a), age (H1b), marital status (H1c), education (H1d), tenure (H1e), and job position (H1f).

Beyond individual-level differences, the broader organizational context, particularly the performance level of the port, constitutes a critical structural condition influencing climate formation. High-performing ports are more likely to institutionalize structured human resource practices, effective communication channels, and coordinated workflows, which in turn foster more positive and coherent climate perceptions among employees. In contrast, lower-performing ports may exhibit fragmentation, weaker coordination, and less consistent managerial practices. To capture this distinction, the present study employs hierarchical cluster analysis to classify ports into two groups: high-performing and lower-performing ports based on operational indicators. This categorization enables an examination of whether organizational success is reflected in employees' perceived work environment. Accordingly, it is hypothesized that organizational climate perceptions differ significantly between these two groups (H2), across all nine dimensions.

The proposed conceptual model is presented in Figure 1. The model conceptualizes organizational climate as a multidimensional construct shaped by two complementary pathways: individual-level demographic filters (H1) and organizational-level performance conditions (H2). By integrating these two levels of analysis, the study moves beyond purely descriptive comparisons and provides a more nuanced understanding of how specific climate dimensions, such as interdepartmental integration or reward systems, vary across different organizational and individual contexts. This approach enables the identification of particular climate mechanisms that distinguish higher-performing port environments from their lower-performing counterparts.

2.1. Research Model

The research model presented in Figure 1 conceptualizes organizational climate as a multidimensional construct shaped by two complementary pathways: individual-level demographic filters (H1) and organizational-level performance conditions (H2). Hypothesis 1 (H1) proposes that employees' demographic characteristics, including gender, age, marital status, education, tenure, and job position, are associated with significant differences in organizational climate perceptions. Hypothesis 2 (H2) posits that employees working in high-performing ports report significantly more positive organizational climate perceptions than those in standard-performing ports, across all nine OCM dimensions. By integrating both levels of analysis, the model enables a nuanced examination of how specific climate dimensions vary as a function of both individual and organizational context.

Figure 1. Proposed framework linking demographic variables, organizational climate dimensions, and port performance levels.

3. Research Design and Scope

This study employs a quantitative multi-stage research design aimed at classifying container ports in Turkey based on operational performance metrics and identifying organizational climate profiles within these clusters. The research population includes major container-intensive ports across the Turkish maritime landscape. While the initial scope covered 18 container ports with accessible data, the final selection was based on rigorous criteria, including operational density, data granularity, and accessibility for primary data collection.

3.1. Data Collection and Performance Indicators

In determining the framework for classifying container-oriented ports in Türkiye, several critical factors, particularly data accessibility and practical applicability, were prioritized. To ensure a comprehensive classification, the following primary sources were analyzed.

The Turkish Port Operators Association (TÜRKLİM): Port Industry Report (2022).

Industry Assessment Reports and relevant Academic Literature.

Ministry of Transport and Infrastructure (UAB): Statistical datasets.

Official Port Websites (Institutional web pages).

World Bank Group: Container Port Performance Index (CPPI) data.

S&P Global Market Intelligence Database.

Based on the preliminary data analysis and literature review, a wide array of potential performance indicators was identified. These included total workforce, administrative personnel, quay length, terminal area, maximum draft, theoretical handling capacity, number of quay cranes and yard equipment, internal transfer vehicles, TEU throughput, crane moves per hour, vessel productivity, ship call frequency, commissioning year, number of service areas, and CPPI scores.

3.2. Selected Criteria and Scope of Study

To ensure consistency and data availability across all subjects, the following criteria were selected for the evaluation framework:

Infrastructure & Equipment: Number of container cranes, water depth, and container quay length.

Capacity & Space: Container storage (stacking) area and total handling capacity.

Operational output: annual throughput (TEU) and the total number of vessel calls.

Human Resources: Total personnel count (categorized as permanent operational staff, other permanent staff, and subcontracted labor).

Global Benchmarking: CPPI scores.

The dataset compiled based on these criteria is presented in Table 1. The scope of this research encompasses the following major Turkish ports: Mersin (MIP), Asyaport, Marport, Kumport, Gemport, DP World Yarımca, Evyapport, Yılport, Nemport, İzmir, Ege Gübre (TCEEGE), Limak İskenderun, SOCAR, Assan Port, Borusan, QTerminals Antalya, Samsunport, and Rodaport.

To maintain scientific objectivity and eliminate potential bias, the names of these ports have been anonymized and replaced with numerical identifiers throughout the analysis. Following the completion of the data collection phase, the specific research methodologies for data processing and classification were determined.

Table 1. Statistical data for Turkish container ports, 2021.

Port	Number of container cranes	Water Depth (Draft)	Quay Length	Storage Area	Handling Capacity	Throughput	Permanent Operational Staff	Administrative And Technical Staff	Subcontracted Labor	Total	Number of vessel calls	Container Port Performance Index (Cppi)	
1	12	-15.8	1.175	550.000	2.600.000	2.097.349	1.582	448	935	2.965	3.796	34	28
2	11	-18.0	1.000	400.000	2.500.000	1.802.517	180	229	526	935	1.163	-	-
3	15	-17.0	1.937	447.431	2.300.000	1.503.254	624	254	554	1.432	1.418	-	-
4	15	-16.5	2.200	450.000	2.100.000	1.211.515	813	0	313	1.126	2.798	-	-
5	8	-36.0	1.000	300.000	2.000.000	682.064	384	237	385	1.006	1.427	113	105
6	8	-16.0	922	400.000	1.300.000	666.174	307	96	47	450	440	-	30
7	4	-18.5	455	265.000	855.000	599.566	343	130	164	637	1.151	-	-
8	8	-30.0	850	310.000	1.000.000	566.447	276	212	279	767	810	-	-
9	7	-21.5	1.080	160.000	750.000	544.568	181	113	209	503	571	-	-
10	7	-11.0	1.050	400.000	1.000.000	529.131	-	-	-	855	2.767	253	246
11	3	-28.0	734	200.000	1.000.000	488.507	228	72	50	291	1.079	-	-
12	4	-15.5	550	500.000	1.000.000	476.627	272	190	630	1.092	1.132	-	-
13	3	-16.0	700	420.000	1.500.000	357.314	217	80	162	459	530	-	-
14	4	-14.8	682	225.000	250.000	214.484	128	36	164	328	218	70	72
15	4	-14.5	600	60.000	450.000	138.491	239	103	202	544	1.438	148	-
16	6	-9.5	450	80.000	350.000	116.786	149	30	205	384	445	-	-
17	3	-12.0	450	80.000	300.000	102.155	252	25	41	318	1.422	248	253
18	3	-14.5	450	50.000	200.000	92.408	140	125	12	277	712		

Source: https://www.turklim.org/sektor-istatistikleri (Accessed: May 5, 2023).

3.3. Classification Strategy: Clustering Analysis

To categorize the ports into distinct performance tiers, the study utilizes a dual-method clustering approach. Hierarchical Cluster Analysis and Fuzzy C-Means Clustering are employed to ensure the robustness of the classification. This methodological triangulation allows for a more nuanced grouping of ports, accounting for the inherent complexities and overlapping characteristics often found in large-scale logistics hubs.

3.4. Organizational Climate Assessment and Sampling

Following the classification, an extensive field survey was conducted to evaluate employee perceptions of the organizational climate within the identified port clusters. The research instrument adopted the Organizational Climate Measure (OCM) developed by Patterson et al. (2005), utilizing a five-point Likert scale. To uphold ethical standards and enhance response rates, data were collected via an anonymous online interface, ensuring participant confidentiality and ease of access.

The minimum required sample size for each port was determined using Cochran's (1977) formula, accounting for a specific margin of error and confidence level relative to the total workforce of each terminal. Although seven container-intensive ports were initially targeted for the survey, the final analysis was restricted to four major ports that successfully met the rigorous sample volume requirements for statistically significant inference.

3.5. Statistical Analysis and Validation

All statistical computations were performed using IBM SPSS software. To ensure the psychometric integrity of the data, a series of validation tests was executed.

Construct Validity: Verified through Exploratory Factor Analysis (EFA), supported by the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity.

Reliability: Assessed via Cronbach's Alpha coefficients to ensure internal consistency across the OCM dimensions.

Inferential Statistics: Independent sample t-tests and One-Way Analysis of variance (ANOVA, were conducted to identify significant variances in organizational climate dimensions across performance clusters and demographic cohorts.

4. Findings

4.1. Performance-Based Classification of Turkish Container Ports

In this study, a total of 18 predominantly container-oriented ports operating in Türkiye were classified using the Hierarchical Cluster Analysis (HCA) method based on predetermined performance criteria. Geographically, the sample includes nine ports in the Marmara Region, four in the Aegean, four in the Mediterranean, and one on the Black Sea coast. Among the nine performance criteria utilized in the analysis, container throughput (TEU) and the number of cranes exhibited dominant effects on the clustering process.

Based on the hierarchical clustering results and the evaluation of graphical break points, a two-cluster structure was identified as the most appropriate model. Consequently, the ports were categorized into two distinct performance groups accordingly (Table 2).

Table 2. Clustered port data.

Port	Cluster	Number of container cranes	Water Depth (Draft)	Quay Length	Storage Area	Handling Capacity	Throughput	Staff	Number of vessel calls	Cppi	
										Administrative	Statistical
1, 2, 3, 4, 5, 10	1	11	-19	1.394	424.572	2.083.333	1.304.305	1.387	2.228	133	126
6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18	2	5	-18	660	229.167	746.250	363.627	504	829	155	118

To determine the optimal number of clusters, the Agglomeration Schedule (Table 3) was analyzed. This table shows the numerical stages of merging 18 ports. A significant numerical jump (spike) in the Coefficients column was observed between Stage 16 and Stage 17. This sudden increase in distance indicates that a two-cluster solution is the most statistically stable model for this dataset.

Table 3. Agglomeration schedule of the hierarchical clustering process.

Stage	Cluster Combined Cluster 1	Cluster Combined Cluster 2	Coefficients	Stage Cluster 1 First Appears	Stage Cluster 2 First Appears
1	15	17	0.706	0	0
2	18	C1	1.046	0	1
3	14	16	1.451	0	0
4	6	13	1.499	0	0

Stage	Cluster Combined Cluster 1	Cluster Combined Cluster 2	Coefficients	Stage Cluster 1 First Appears	Stage Cluster 2 First Appears
5	8	11	1.727	0	0
6	7	12	1.761	0	0
7	3	4	1.772	0	0
8	9	C5	1.799	0	5
9	C2	C3	1.875	2	3
10	C4	C6	1.972	4	6
11	5	C8	2.914	0	8
12	10	C10	3.196	0	10
13	2	C7	3.341	0	7
14	C11	C12	4.908	11	12
15	1	C13	4.970	0	13
16	C9	C14	6.362	9	14
17	C15	C16	11.961	15	16

Note: Ward's linkage method applied to z-score normalized performance data (n = 18 ports). Columns "Stage Cluster First Appears" indicate the prior stage at which the merged cluster was formed; 0 indicates a singleton (individual port). The spike between Stage 16 (6.362) and Stage 17 (11.961) confirms the two-cluster solution. C = merged cluster from the indicated stage.

The dendrogram illustrates the hierarchical structure of the classification. According to Figure 2, the 18 ports converge through 10 distinct stages to form two primary clusters. While most ports show high similarity within their groups, certain units (Ports 6, 8, 9, and 13) exhibited non-homogeneous characteristics, indicating some membership uncertainty.

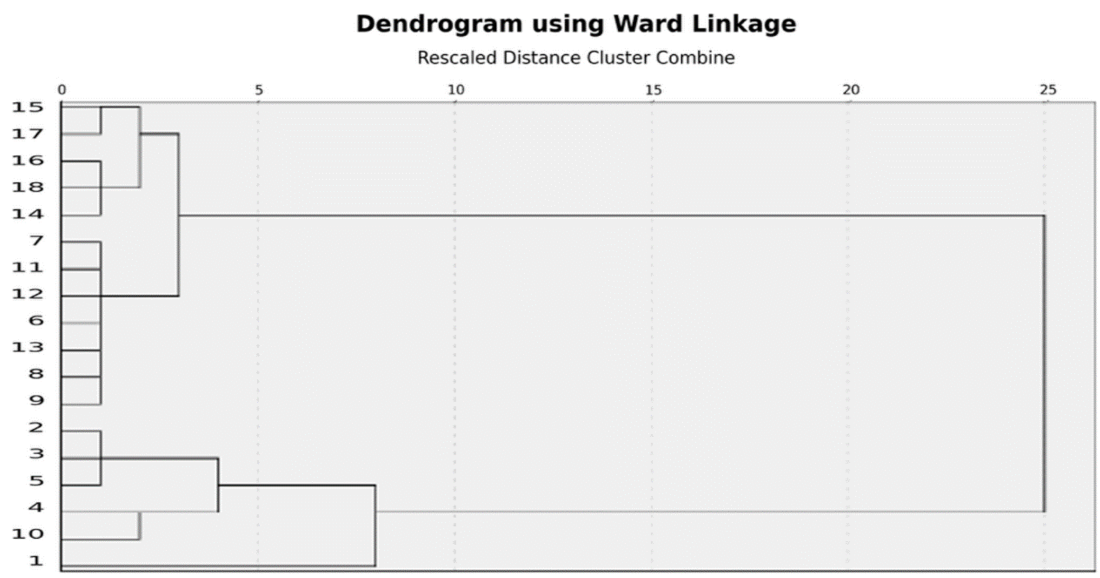

Figure 2. Dendrogram of Turkish container ports using Ward's method.

To enhance the reliability of the classification and address the 'uncertain' status of Ports 6, 8, 9, and 13, fuzzy clustering analysis was applied using both Euclidean and Manhattan distance metrics. These tables display the membership probabilities of each port. By analyzing the likelihood of a port belonging to an alternative cluster, the final classification was clarified, ensuring a more robust and objective result.

Table 4 presents the fuzzy clustering membership probabilities for all 18 Turkish container ports calculated using the Euclidean distance metric, indicating the degree to which each port belongs to Cluster 1 (high-performing) or Cluster 2 (standard-performing).

Table 4. Fuzzy clustering results based on Euclidean distance metric.

Port	Cluster 1 Membership (High-Performance)	Cluster 2 Membership (Standard-Performance)	Cluster Assignment
1	0.8001	0.1999	1
2	0.8131	0.1869	1
3	0.9291	0.0709	1
4	0.8895	0.1105	1
5	0.4925	0.5075	1
6	0.5841	0.4159	1
7	0.0319	0.9681	2
8	0.2532	0.7468	2
9	0.5430	0.4570	1
10	0.4309	0.5691	2
11	0.1196	0.8804	2
12	0.5321	0.4679	1
13	0.1365	0.8635	2
14	0.0491	0.9509	2
15	0.0703	0.9297	2
16	0.0989	0.9011	2
17	0.0859	0.9141	2
18	0.0767	0.9233	2

Note: Membership values indicate the degree to which each port belongs to Cluster 1 (high-performance) or Cluster 2 (standard-performance). Values range from 0 to 1; higher values indicate stronger cluster membership. Fuzzification parameter m = 2.0.

Table 5 presents the fuzzy clustering membership probabilities for all 18 Turkish container ports calculated using the Manhattan distance metric, complementing the Euclidean results in Table 4 and providing the basis for identifying four ports (Ports 6, 8, 9, and 13) with inter-cluster transitional membership.

Table 5. Fuzzy clustering results based on Manhattan distance metric.

Port	Cluster 1 Membership (High-Performance)	Cluster 2 Membership (Standard-Performance)	Cluster Assignment
1	0.8459	0.1541	1
2	0.7559	0.2441	1
3	0.9611	0.0389	1
4	0.9194	0.0806	1
5	0.5631	0.4369	1
6	0.5802	0.4198	1
7	0.5240	0.4760	1
8	0.1351	0.8649	2
9	0.5952	0.4048	1
10	0.3460	0.6540	2
11	0.0527	0.9473	2
12	0.1365	0.8635	2
13	0.0885	0.9115	2
14	0.0356	0.9644	2
15	0.0545	0.9455	2
16	0.0805	0.9195	2
17	0.0856	0.9144	2
18	0.0708	0.9292	2

Note: Membership values indicate the degree to which each port belongs to Cluster 1 (high-performance) or Cluster 2 (standard-performance). Values range from 0 to 1; higher values indicate stronger cluster membership. Fuzzification parameter m = 2.0. Ports 6, 8, 9, and 13 exhibited inter-cluster transitional membership; final cluster assignments were determined by evaluating Euclidean and Manhattan results jointly (see Table 6).

However, it was observed that certain ports did not exhibit homogeneous characteristics within their assigned clusters. To enhance the reliability of the classification, Fuzzy Clustering Analysis based on Manhattan and Euclidean distance metrics was additionally applied. This analysis revealed that specific ports (specifically Ports 6, 8, 9, and 13) demonstrated inter-cluster transitionality (membership overlap). The final classification, presented in Table 6, was established by evaluating the results of both methods in conjunction.

Table 6. Final performance classification of Turkish container ports.

Port Name	Hierarchical	Fuzzy Manhattan	Fuzzy Euclidean	Final Status
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	1	1	1	1
6	1	1	1	1
7	2	1	2	2
8	2	2	2	2
9	2	1	1	1
10	2	2	2	2
11	2	2	2	2
12	2	2	1	2
13	2	2	2	2
14	2	2	2	2
15	2	2	2	2
16	2	2	2	2
17	2	2	2	2
18	2	2	2	2

As a result of this analysis, four ports with sufficient survey responses for the second research stage, organizational climate evaluations, were included. Two ports belong to the first group (high performance), and two to the second group (standard performance).

Following the final classification, a survey was conducted to compare employees' perceptions of organizational climate at ports in both performance groups. Valid data from four ports were analyzed, and perception levels regarding organizational climate variables were compared. The findings related to the survey results are presented below.

4.2. Participant Profile

A total of 87 employees working at container ports in Turkey participated in the study. The majority of participants are male (69%) and married (57.5%). Regarding age distribution, the highest proportion belongs to the 26-35 age group at 40.2%. In terms of educational attainment, Bachelor's degree holders (24.1%) and Associate degree holders (18.4%) are the most prominent groups.

Approximately one-third of the participants (34.5%) have been employed at their current institution for 1–3 years, while those with 4–6 years and over 10 years of tenure account for 21.8% and 14.9%, respectively. In terms of job positions, the largest groups consist of those serving as "supervisors" (25.3%) and in "other" (27.6%) staff roles. This distribution indicates that data were obtained from various hierarchical levels within organizations.

4.3. Impact of Demographic Variables on Organizational Climate Perception

To determine variations in perceptions of organizational climate, hypothesis testing was conducted based on the conceptual framework and demographic variables. Out of 87 participants, data from 78 were included in the final analysis. The exclusion (n=9) was due to incomplete responses and data cleaning procedures to ensure statistical validity.

H1a (Gender): Organizational climate perception did not differ significantly by gender ($t(76) = -1.33$, $p > .05$), indicating that male and female employees reported comparable levels of perceived organizational climate.

H1b (Marital Status): No statistically significant difference was found in organizational climate perception based on marital status ($t(76) = 0.79$, $p > .05$), suggesting similar perceptions between married and single employees.

H1c (Age): Organizational climate perception varied significantly across age groups ($F(4,73) = 3.68$, $p < .01$). Post hoc comparisons revealed that employees aged 26–35 reported significantly more positive perceptions compared to those in the 46–55 age group.

H1d (Education): A statistically significant difference was observed in organizational climate perception across education levels ($F(4,73) = 7.55$, $p < .05$). Results from both Scheffé and Tukey HSD post hoc tests indicated that associate degree graduates differed significantly from those holding master's or doctoral degrees.

H1e (Tenure): Organizational climate perception differed significantly according to tenure ($F(4,73) = 3.93$, $p < .05$). Specifically, a significant difference was identified between employees with 1–3 years of service and those with more than 10 years of tenure.

H1f (Position): A statistically significant difference was found in organizational climate perception based on job position ($F(4,73) = 2.54$, $p < .05$). In particular, employees in "Department Manager/Assistant" roles differed significantly from those categorized under "Other" positions.

To sum up, variables such as age, education level, tenure, and job position create significant differences in organizational climate perception. Conversely, gender and marital status do not have a statistically significant impact. These findings indicate that organizational climate is partially correlated with employee demographics.

Table 7. Hypothesis testing.

Hypothesis	Variable	F/t Value	p-Value	Result
H2a	Autonomy	0.19 / 1.68	0.667	Rejected
H2b	Participation	8.60 / 4.71	0.000	Accepted
H2c	Communication	15.86 / 5.67	0.000	Accepted
H2d	Emphasis on training	94.82 / 6.50	0.000	Accepted
H2e	Interdepartmental integration	76.25 / 4.58	0.000	Accepted
H2f	Supervisory support	10.33 / 6.43	0.005	Accepted
H2g	Employee welfare	45.38 / 4.88	0.000	Accepted
H2h	Job motivation	28.50 / 2.92	0.000	Accepted
H2i	Reward systems	4.90 / 4.13	0.000	Accepted

The study's findings offer a nuanced view of the relationships between various organizational practices and performance (Table 7). The hypothesis regarding autonomy (H2a), which predicted a positive link with performance, was not supported ($F/t = 0.19$ / 1.68, $p = 0.667$). This diverges from prior literature, such as Deci and Ryan (1985), suggesting that autonomy enhances motivation and performance. However, the autonomy-performance relationship appears complex and context-dependent, with some studies indicating indirect or contingent effects.

Conversely, hypotheses concerning participation (H2b), communication (H2c), emphasis on training (H2d), interdepartmental integration (H2e), supervisory support (H2f), employee welfare (H2g), job motivation (H2h), and reward systems (H2i) were supported, indicating significant positive relationships with organizational performance (all $p < 0.01$). Specifically:

- The positive effect of participation aligns with findings highlighting that participatory management enhances performance (Cansız & Soysal, 2019; Çolak & Kuzey, 2020; Eren & Erat, 2013; Şahin, 2016; Sürücü & Yeşiltaş, 2019).
- Communication was also confirmed as a key predictor, consistent with prior research demonstrating that effective organizational communication improves productivity, employee satisfaction, and overall performance (Clampitt & Downs, 1993; Erdil & Acar, 2010; Gözübüyük & Ergin, 2014; Raman & Naik, 2010; Serinkan & Yıldırım, 2011; Welch, Jackson, & Roper, 2006).
- Emphasis on training showed strong positive effects, supporting studies emphasizing the role of employee development in organizational performance (Altınkurt & Acar, 2014; Aydın & Ersoy, 2012; Lai & Lin, 2014; Yıldırım, 2008).
- The positive influence of interdepartmental integration is consistent with literature on cross-functional collaboration and performance outcomes (Acar, 2016; Chen & Xie, 2008; Erdoğmuş & Eren, 2012; Hitt, Keats, & DeMarie, 1998; Nishii, Lepak, & Schneider, 2008).
- Supervisory support was validated as an important antecedent of performance (Keskin & Demirel, 2019; Kılıç & Güngör, 2016; Özmen & Kılıçoğlu, 2018).
- The results for employee welfare confirm its positive contribution to performance (Akyüz & Çelik, 2020; Bakker & Demerouti, 2007; Bayraktaroğlu & Soyer, 2017; Wright & Cropanzano, 2004; Yıldız & Duru, 2018).
- Job motivation exhibited a significant positive relationship, supporting motivation-based explanations of performance (Aydın, 2015; Grant, 2008; Latham & Pinder, 2005).
- Finally, reward systems were positively associated with performance (Gerhart & Milkovich, 1990; Lawler III & Worley, 2006).

5. Conclusion and Implications

In summary, the findings suggest that while autonomy alone may not directly influence performance in this context, participative practices, effective communication, training investment, interdepartmental collaboration, supervisory support, employee welfare, motivation, and reward systems are robust predictors of organizational performance. These results underscore the importance of an integrated approach to human resource and organizational practices to enhance overall performance outcomes.

This study contributes to the literature by examining organizational climate through its specific dimensions, namely communication, participation, supervisory support, employee well-being, motivation, reward, and autonomy, rather than relying on generalized or aggregated constructs. By adopting this multidimensional perspective, the study provides a more nuanced understanding of how different aspects of organizational climate relate to port performance. It extends prior research by demonstrating that not all dimensions of organizational climate exert uniform effects and that certain dimensions (e.g., communication, motivation, and supervisory support) are more strongly associated with higher-performing port clusters.

From a theoretical standpoint, the findings reinforce the view that organizational climate is not a monolithic construct but a composite of interrelated yet distinct dimensions that may vary in their influence depending on sectoral and organizational contexts. The absence of a significant difference in autonomy, for instance, suggests that structural and operational characteristics of port operations may constrain variability in this dimension, highlighting the importance of contextualizing climate research within industry-specific dynamics. Furthermore, the study supports existing literature emphasizing the link between supportive organizational environments and enhanced organizational outcomes, while also offering evidence from the relatively underexplored context of container ports.

In terms of managerial implications, the findings suggest that port managers aiming to improve organizational performance should prioritize fostering a supportive and participatory work environment. Enhancing communication channels, encouraging employee involvement in decision-making, strengthening supervisory support, and implementing fair and motivating reward systems appear to be critical factors distinguishing higher-performing ports. Rather than focusing solely on operational or infrastructural improvements, management practices that directly influence employees' perceptions of the work environment may play a key role in sustaining a competitive advantage. The results also indicate that uniform management approaches may not be equally effective across all climate dimensions, and therefore, targeted interventions addressing specific climate factors may yield more meaningful improvements.

Despite its contributions, this study is subject to several limitations. First, the limited number of ports included in the survey analysis and their uneven distribution restrict the generalizability of the findings. Second, the use of online data collection methods may have constrained the depth and richness of responses, potentially limiting the ability to capture more nuanced employee perceptions. Third, the lack of access to comprehensive longitudinal performance data across ports posed challenges in conducting more detailed and time-sensitive performance assessments.

Future research could address these limitations by employing larger and more geographically balanced samples, as well as incorporating mixed-method approaches that combine quantitative surveys with qualitative interviews. Expanding the scope of analysis to include additional organizational or contextual variables may also provide a more comprehensive understanding of the relationship between organizational climate and performance. Moreover, integrating non-financial performance indicators and longitudinal data could help better capture the dynamic nature of this relationship over time.

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