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Maritime Sustainability and the Need for Global Performance Indicators in Shipping: An Empirical Investigation Based on the Shipping KPI Standard by BIMCO

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ABSTRACT: This paper aims to cover a gap in maritime literature by analysing the performance of the international fleet through the BIMCO Shipping KPI System databases, and by highlighting the necessity for the adoption of Global Performance Indicators to serve the needs of a sustainable maritime industry. The paper investigates the complex interrelations of the various types of performance in shipping, consisting of 57,622 ships of all commercial types, operated from 26 countries, covering the environmental, health, safety management, HR management, navigational safety, operational, security, and technical performance. Results indicate that countries rank differently with regards to the aggregated performance of their respective shipping companies, signifying different managerial approaches. This paper contributes to the discourse of maritime governance, aiming to be of interest to all maritime stakeholders dealing with marine policies and institutional arrangements for the management and regulation of international shipping.

1 INTRODUCTION

Shipping companies constitute a fundamental element of the international maritime trade, an activity reflecting more than 11.08 billion tons with a growth up to 4.8 percent in 2021, despite the disruptive impact of COVID-19 (United Nations Conference on Trade And Development [UNCTAD], 2020). Within a volatile and constantly changing macroeconomic environment, with various factors occasionally disrupting the global demand and supply, both anthropogenic (i.e. trade wars, sanctions, fuel economics) and not (i.e., the COVID-19 pandemic), shipping companies need to constantly develop their business strategies, deploy resources effectively and efficiently, as well as monitor and improve their performance in order to retain and better their position in the market. Active involvement in a highly cyclical and volatile industry (Stopford, 2009), inevitably led contemporary shipping companies to adopt a corporatist approach regarding various areas of managerial interest, such as their business and financing strategies (Melas, 2019).

However, despite the necessity for the measurement of performance in the broader maritime business context emphatically highlighted in existing research, there exists a significant gap regarding the investigation of several non-financial and non-accounting performance dimensions, able to capture the multi-dimensional nature of business performance in the shipping industry as a whole, or in specific shipping companies with accordingly differentiated strategies.

This paper aims to fill in this research gap by evaluating and analysing long-term performance levels of the shipping industry as a whole, through the use of Key Performance Indicators (KPI). More specifically, it aims to evaluate the environmental, health, safety management, HR management, navigational safety, operational, security, and technical performance of a sample indicative of the global fleet. To address the need for performance measurement in absolute terms and relative to the industry average in a consistent way, allowing both within-country and cross-country comparisons, the research uses a unique international sample provided by the Baltic and International Maritime Council (BIMCO), consisting of performance indicators reflecting a total of 57,622 ships of all commercial types, operated from 26 countries, and providing a truly international coverage of the above mentioned performance types in the maritime industry. The research aims to be useful to wide and narrow shipping stakeholders, primarily maritime corporate managers, and directors, as well as policy makers at international, regional, and national level.

The remaining of the paper is organised as follows: Section 2 presents the theoretical framework and the specifics of Shipping KPI system; Section 3 presents the Empirical Investigation of international shipping performance based on the Shipping KPI System databases and Section 4 provides a discussion of the main findings. Finally, Section 5 discusses the necessity of a Global Performance Indicator system for the maritime industry and Section 6 concludes the paper.

2 THEORETICAL FRAMEWORK

2.1 *Performance Management*

Performance measurement is a crucial management function, allowing for efficient management and materialization of key business strategies. Traditionally, the performance measurement has been mostly focused on financial and accounting measures such as Return on Assets (ROA), Return on Investment (ROI), Return on Capital (ROC), Return on Sales (ROS), Return on Equity (ROE), Return on Capital Employed (ROCE), and Return on Invested Capital (ROIC) (Panayides, Gong and Lambertides, 2010). The sole evaluation of performance based on financial and accounting data is nowadays considered insufficient and much attention is shed upon multi-dimensional performance indicators. There is considerable evidence that in order to achieve a representative reflection of its overall performance, an organization should supplement financial with non-financial performance evaluation methods, both quantitatively and qualitatively (Narkunienė & Ulbinaitė, 2018).

In the shipping industry, this need for non-financial performance measurement has also been highlighted in past research (Chou and Liang, 2001; Lagoudis, Lalwani and Naim, 2006; Panayides, Gong and Lambertides, 2010). This paper aims to fill in this gap in the literature, by presenting an international, cross-country and cross-sector analysis of overall shipping performance through the use of a suitable standardised measurement system covering all the non-financial and non-accounting types of shipping business performance indicators covered by the Shipping KPI System by BIMCO.

2.2 *Key Performance Indicators (KPIs) in Shipping*

According to Barr (2015, 2019), KPIs serve three purposes: (a) the monitoring of important findings, (b) the interpretation of the results, and (c) the undertaking of action, if deemed necessary, and past research provides evidence of their use in various industries. In the shipping industry, the use of Key Performance Indicators (KPIs) essentially represents a byproduct of the required continuous improvement processes. The latter are both due to mandatory standards of quality, such as the International Safety Management (ISM) code, and voluntary, such as the ISO 9001 and ISO 14001, although self-regulatory practices such as the Tanker Management Self-Assessment (TMSA), derived from the Oil Companies International Maritime Forum (OCIMF). Interestingly, however, the existing literature on KPIs in the shipping industry is relatively limited. Indicatively, Konsta and Plomaritou (2012) have identified the limited use of KPIs by Greek tanker companies, despite them recognizing their value for performance evaluation, while Banda et al. (2016) highlighted the potential of KPIs to develop, monitor, control and improve the safety of shipping operations, whereas Nesheim and Fjørtoft (2019) used the Shipping KPI System to PI Database to identify costs and benefits of e-navigation solutions. Finally, Darousos et al. (2019) identified the potential of a tailored KPI system as a facilitator for good maritime governance, as a common 'language' between regulating authorities and market practitioners.

2.3 *The emerging role of KPI for sustainability*

The deployment of an efficient sustainability and environmental, social and governance (ESG) strategy, appropriately and organically integrated into the core business strategy of a ship management company, should begin by clearly demonstrating the way that it permeates the corporate entity. The identification of suitable KPIs, directly relevant to the respective sustainability strategy, should be set after a thorough identification of the material sustainability issues which are relevant to both wide and narrow stakeholders. Recent literature has focused on the importance of KPI to address and measure various dimensions of ESG performance, in a diverse range of industrial segments. Indicatively, Yip and Yu (2023) explored the ESG disclosure quality through KPIs in a sample consisting of small and medium-sized companies listed in the Hong Kong Stock Exchange, interestingly identifying environment-related KPI as the more underperforming. A study by Dragomir, Parsons & Choi (2018) focused on the use of KPI as a measurement tool for the evaluation of the economic efficiency of shipping companies employing multigender crews and implementing gendering policies, suggesting a specific set of KPI and also approaching social, financial, health & safety, and training issues. An emerging wave of literature explores the widespread impact of new technologies and sustainability-ESG concerns upon the international supply chain, and the necessity for the development of suitable KPIs, able to measure this impact and allow for performance information exchange industry-wide (Patidar et al., 2022).

2.4 *The Shipping KPI System by BIMCO*

The Shipping KPI System is a tool comprised by shipping performance indexes (SPIs), Key Performance Indicators (KPIs), and Performance Indicators (PIs). Starting in 2011, the Shipping KPI System – administered by InterManager since 2003 – was superintended by the independent KPI Association Ltd. In 2015, Denmark-based BIMCO acquired the Shipping KPI System and along with the IT support of SOFTImpact, a specialised maritime IT service provider based in Cyprus, has been operating and further developing it ever since. The System is a benchmarking tool, meant to ameliorate the overall non-financial performance of ship management companies, as well as to provide efficient communication regarding the ship operation to the internal and external stakeholders (BIMCO, 2018).

The SPIs (high level indices) constitute the aggregated expression of the various types of performance and are calculated by the KPIs (mid-level indices), which are in turn calculated via the PIs (lowest level), as seen in Figure 1. The PI data are directly measured and reported by the ship or the ship management company. Then, a normalization process takes place leading to the KPIs which are scaled between 0-100, in a range between unacceptable (0) and outstanding performance (100). Thus, according to BIMCO, it is possible to compare the performance of ships with different characteristics or amount of data.

The SPIs are expressed as a weighted average of relevant KPI ratings on a scale between 0 and 100. Their objective is to allow the communication of shipping performance information to external stakeholders. Given that there is currently lack of a commonly used, standardised system of communication regarding the maritime industry, such initiatives may actually serve the purposes of sector-wide stakeholders by providing information on the overall operation performance of the international fleet. The types of performance expressed through the SPIs are: (i) Environmental Performance; (ii) Health and Safety Performance; (iii) HR Management Performance; (iv) Navigational Safety Performance; (v) Operational Performance; (vi) Security Performance; (vii) Technical Performance; and (viii) Port State Control Performance.

According to BIMCO, the characteristics of the performance indicators considered in the Shipping KPI System need to be observable and quantifiable, valid indicators of performance, robust against manipulation, sensitive to change, transparent and easy to understand, and compatible (BIMCO, 2018). They all signify a useful tool for communication among the crews and the companies, but also among the shipping companies and the external stakeholders, such as the international, regional, and national formal and informal authorities.

Based on the above KPI system, the following research objectives are set:

1. To identify the overall performance ranking of ship management companies on a different national basis;
2. To examine the relationship between aggregated high SPI-level of performance on a different national basis;
3. To examine the relationship between aggregated mid KPI-level of performance on a different national basis.

To obtain a representative set of data regarding shipping performance related to the human element, the sample was obtained from the BIMCO Shipping KPI System databases.

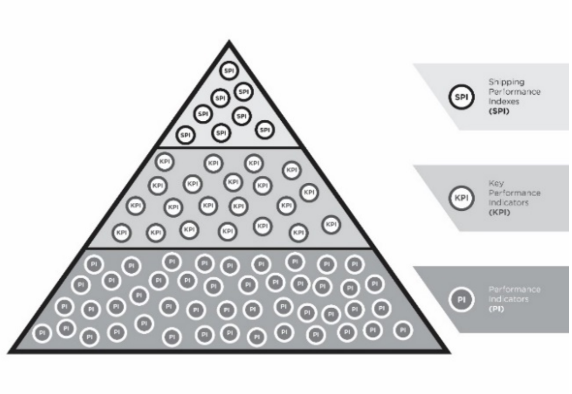

Figure 1. The BIMCO Shipping KPI System (Darousos et al., 2019; derived from BIMCO, 2018)

As discussed, BIMCO produces a variety of information on various types of shipping performance. Namely, the SPIs used in this paper, including their constituent KPIs, and according to the Shipping KPI System Version 3.0, are: (i) Environmental Performance (SPI001); (ii) Health and Safety Performance (SPI002); and (iii) HR Management Performance (SPI003), (iv) Navigational Safety Performance (SPI004), (v) Operational Performance (SPI005), (vi) Security Performance (SPI006), (vii) Technical Performance (SPI007), and (viii) Port State Control Performance (SPI009). Table 1 below presents the Version 3.0 of the system, which constitutes the basis of this analysis:

Table 1. Overview of Shipping KPI Version of BIMCO Version 3.0

SPI	KPI	PI
SPI001 Environmental Performance	KPI028: Releases of substances	Number of releases of substances to the environment
		Number of oil spills
	KPI001: Ballast water management violations	Number of ballast water management violations
	KPI007: Contained spills	Number of contained spills of liquid
	KPI011: Environmental deficiencies	Number of environmental related deficiencies
		Number of recorded external inspections
	KPI005: CO2 efficiency	Emitted mass of CO2
		Transport work
	KPI021: NOx efficiency	Emitted mass of NOx
		Transport work
	KPI030: SOx efficiency	Emitted mass of SOx
		Transport work
SPI002: Health and Safety Performance	KPI013: Fire and Explosions	Number of fire incidents
		Number of explosion incidents
	KPI017: Lost Time Injury Frequency	Number of fatalities due to work injuries
		Number of lost workday cases
		Number of permanent total disabilities (PTD)
		Number of permanent partial disabilities

		Total exposure hours
	KPI015: Health and Safety deficiencies	Number of health and safety related deficiencies Number of recorded external inspections
	KPI018: Lost Time Sickness Frequency	Number of cases where a crew member is sick for more than 24 hours Number of fatalities due to sickness Total exposure hours
	KPI025: Passenger Injury Ratio	Number of passengers injured Passenger exposure hours
SPI003: HR Management Performance	KPI008: Crew disciplinary frequency	Number of absconded crew Number of charges of criminal offences Number of cases where drugs or alcohol is abused Number of dismissals Number of logged warnings Total exposure hours
	KPI009: Crew planning	Number of seafarers not relieved on time Number of violation of rest hours
	KPI016: HR deficiencies	Number of HR related deficiencies Number of recorded external inspections
	KPI003: Cadets per ship	Number of cadets under training with the DOC holder Number of ships operated under the DOC holder
	KPI022: Officer retention rate	Number of officer terminations from whatever cause Number of unavoidable officer terminations Number of beneficial officer terminations Number of officers employed
	KPI023: Officers experience rate	Number of officer experience points Number of officers onboard
	KPI031: Training days per officer	Number of officer trainee man days Number of officer days onboard all ships with the DOC holder
SPI004: Navigational Safety Performance	KPI019: Navigational deficiencies	Number of navigational related deficiencies Number of recorded external inspections
	KPI020: Navigational incidents	Number of collisions Number of allisions Number of groundings
SPI005: Operational Performance	KPI002: Budget performance	Last year's running cost budget Last year's actual running costs and accruals Last year's AAE (Additional Authorized Expenses)
	KPI010: Drydocking planning performance	Agreed drydocking duration Actual drydocking duration Agreed drydocking budget Actual drydocking costs
	KPI004: Cargo related incidents	Number of cargo related incidents
	KPI024: Operational deficiencies	Number of operational related deficiencies Number of recorded external inspections
	KPI032: Ship availability	Actual unavailability Planned unavailability
	KPI033: Vetting deficiencies	Number of observations during commercial inspections Number of commercial inspections
SPI006: Security Performance	KPI029: Security deficiencies	Number of security related deficiencies Number of recorded external inspections
SPI007: Technical Performance	KPI006: Condition of class	Number of conditions of class
	KPI012: Failure of critical equipment and systems	Number of failures of critical equipment and systems
SPI009: Port State Control Performance	KPI027: Port state control detention	Number of PSC detentions Number of PSC inspections
	KPI026: Port state control deficiency ratio	Number of PSC deficiencies Number of PSC inspections
	KPI014: Port state control performance	Number of PSC inspections resulting in zero deficiencies Number of PSC inspections

Source: Own elaboration, derived from BIMCO, 2018

Table 1, presents the performance indicators from a total of 57,622 ships of all commercial types, operated from 26 countries, shipping accounts, providing an overview of the different performance types of the maritime industry. It has to be noted that the number of countries used as sample is smaller than the actual total of countries with shipping accounts registered in the Shipping KPI System, due to the confidentiality policy of BIMCO.

Table 2. Overview of the research sample (countries, number of registered ships per country, number of corresponding registered accounts)

Country	Number of Registered Ships	Number of Registered Accounts
Singapore	7975	27
Hong Kong	7885	9
Philippines	6737	6
Germany	4655	24
Greece	4262	43
Cyprus	4223	9
Japan	2986	14
United Kingdom	2521	14
Monaco	2078	4
China	1855	4
India	1750	10
Denmark	1567	11
Italy	1398	9
Netherlands	1177	11
Korea, Republic Of	1174	7
Norway	1060	14
Turkey	864	13
France	820	3
Belgium	777	3
United Arab Emirates	634	9
Sweden	252	3
Canada	244	4
Spain	239	3
Viet Nam	212	4
South Africa	192	4
Taiwan, Province Of China	85	3

Source: Own elaboration

3 EMPIRICAL INVESTIGATION OF GLOBAL SHIPPING PERFORMANCE BASED ON THE SHIPPING KPI SYSTEM DATABASES

Table 3 presents a liner regression analysis of the aggregated SPI database. At this stage, the dependent variable is the variance between the SPI indicators for each country and the independent variable is the mean of the SPI indicators for each country. The coefficient of determination R2 is approximately 0.50, so 50% of the variance in the values of the dependent variable can be explained by the model and the use of the explanatory variables. The crucial point is the statistical significance of the estimated coefficients of the variables; indeed, the coefficients are statistically significant for $P<0.05$; and the values are negative. This signifies that when the mean of all SPI indicators increases by one point, the variance between the indicators decreases by 16,35. This is an indication that countries which achieve a higher mean value for all SPI indices also have a lower variance in the SPI indices. In other words, higher average performance across all indices, for each country, is also associated with smaller dispersion of the indices. This is the first important result of this study, signifying that achieving high-level non-financial and non-accounting performance as expressed through SPIs is reflected upon all relevant types. Furthermore, that higher standards of management, as expressed through fleet performance, can be associated on a specific national basis perhaps signifying a combination of collective expertise and a well-implemented regulatory framework.

Additionally, a dummy variable was used: D=1 for each EU-27 country, and D=0 for all other countries of the database, in order to investigate whether any substantial differentiations can be observed regarding the shipping performance of Europe-based companies through the overall performance of their respective fleets. This further supports the first conclusion, as the fact that the coefficient of the dummy variable is negative (-48.79) means that, irrespective of average values, EU-27 countries present smaller variations between SPI indicators compared to other countries.

The model is econometrically supported by the fact that there is no issue related to heteroskedasticity in these stratified data, as we can see from the Durbin-Watson value of close to 2 (approximately 2.08). In any case, the coefficients would be unbiased as White heteroskedasticity-consistent standard errors & covariance were used for the purposes of the below analysis:

Table 3. The relationship between variance and mean value of SPI per country

Variable	Coefficient of variables	Std. Error	t-Statistic	Prob.
Constant	1562.376	405.0675	3.857076	0.0008
Average SPI per country	-16.35594	4.457369	-3.669416	0.0013
European Union	-48.79891	19.76451	-2.469017	0.0214
R-squared	0.505063	Mean dependent var	108.7169	
Adjusted R-squared	0.462025	S.D. dependent var	72.57239	
S.E. of regression	53.22949	Akaike info criterion	10.89527	
Sum squared resid	65167.71	Schwarz criterion	11.04043	
Log likelihood	-138.6385	Hannan-Quinn criter.	10.93707	
F-statistic	11.73530	Durbin-Watson stat	2.089811	
Prob (F-statistic)	0.000307			

In the next part of the analysis, the variance for each SPI was analysed separately based on country performance for each indicator (dependent variable), followed by the analysis of the average performance (explanatory variable) for each indicator separately from country performance.

The coefficient is negative (-3.56) and statistically significant, meaning that when the average performance expressed through a SPI indicator increases (based on all/among countries' performance), the variance for that indicator also decreases. That is, if all countries show good average performance on a selective performance type, meaning that the average value of the indicator (average performance) is high, then their variance is also lower as the differences in performance between countries for that indicator are relatively smaller.

For this testing, no dummy variable for the EU-27 countries was used because the average value of each SPI indicator is formulated by the performance of all countries of the database. This is also the case for the variances in each performance category, which are due to the differences in the according SPI's of all countries.

Table 4. White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	350.5086	46.41695	7.551307	0.0003
AVERAGE_INDEXES_SPI	-3.562008	0.442299	-8.053392	0.0002
R-squared	0.681725	Mean dependent var	38.42636	
Adjusted R-squared	0.628679	S.D. dependent var	37.47137	
S.E. of regression	22.83360	Akaike info criterion	9.306661	
Sum squared resid	3128.239	Schwarz criterion	9.326522	
Log likelihood	-35.22664	Hannan-Quinn criter.	9.172711	
F-statistic	12.85161	Durbin-Watson stat	1.614223	
Prob (F-statistic)	0.011574			

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Prob (F-statistic)	0.011574			

Due to the relatively smaller number of observations, a dummy variable was not set for each SPI indicator. Such a dummy variable would be set as D-1, reflecting the number of SPI indicators minus 1 dummy variable; thus, the regression constant would incorporate the variance of the last dummy variable. Therefore, the coefficients of the other dummy variables would reflect the variation of the variance of the other SPI indicators, irrespective of the average value of each indicator achieved by countries. However, due to the larger number of observations, the KPI analysis following below also incorporated the corresponding dummy variables.

Table 6. KPI White heteroskedasticity-consistent standard errors & covariance analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	589.1517	150.8509	3.905522	0.0005
AVERAGE_ INDEXES_ KPI	-5.516156	1.606399	-3.433865	0.0017
R-squared	0.440598	Mean dependent var	127.1210	
Adjusted R-squared	0.422553	S.D. dependent var	180.9519	
S.E. of regression	137.5053	Akaike info criterion	12.74389	
Sum squared resid	586138.7	Schwarz criterion	12.83459	
Log likelihood	-208.2742	Hannan-Quinn criter.	12.77441	
F-statistic	24.41631	Durbin-Watson stat	1.774169	
Prob (F-statistic)	0.000025			

In the subsequent regression analysis of the KPIs which addressed the variance between all KPIs for each country as the dependent variable and the mean between all KPIs for each country as the independent variable, the results reconfirmed the previous findings. Indeed, countries which collectively achieve higher average performance across all KPIs, present substantially smaller inter-indicator performance variations. This leads to the conclusion that in comparison, the differences in performance, measured by each KPI, decrease as the average performance across all KPIs for each country increases.

As for the EU-27 dummy variable, European states present smaller variation across all KPIs when compared to non-European countries, irrespective of the average value of all KPIs. This result is highlighted by the statistically significant coefficient of 0.1 p-value.

Table 6. KPI Regression analysis with EU-27 Variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5177.207	494.9564	10.45993	0.0000
AVERAGE_ COUNTRIES_ KPI	-54.48752	5.904463	-9.228192	0.0000
DUMMYEU	-58.03503	33.99452	-1.707188	0.0998
R-squared	0.779940	Mean dependent var	576.3351	
Adjusted R-squared	0.760804	S.D. dependent var	185.2358	
S.E. of regression	90.59453	Akaike info criterion	11.95883	
Sum squared resid	188769.5	Schwarz criterion	12.10400	
Log likelihood	-152.4648	Hannan-Quinn criter.	12.00063	
F-statistic	40.75837	Durbin-Watson stat	2.035745	
Prob (F-statistic)	0.000000			

Regarding the regression analysis of the variance for each KPI as it is formed by the respective performance of all countries for each indicator (dependent variable) against the average performance achieved by the countries in each KPI (explanatory variable), the coefficient is also negative and statistically significant ($P<0.01$ or 1%). This is a final confirmation that when the average performance increases (from the performance of all countries in each KPI) the variance is smaller (i.e. the differences in performance between countries for that indicator).

Table 7. White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	385.2174	129.2635	2.980094	0.0065
AVERAGE_ INDEXES_ KPI	-4.330393	1.532568	-2.825579	0.0094
DUMMYSPI001	56.26377	29.80685	1.887612	0.0712
DUMMYSPI002	96.94605	37.84314	2.561787	0.0171
DUMMYSPI003	254.6813	70.68217	3.603190	0.0014
DUMMYSPI004	41.18462	30.81005	1.336727	0.1938
DUMMYSPI005	95.68496	73.44351	1.302838	0.2050
DUMMYSPI006	44.81663	32.51158	1.378482	0.1808
DUMMYSPI007	44.83244	25.00463	1.792966	0.0856
R-squared	0.636292	Mean dependent var	127.1210	
Adjusted R-squared	0.515056	S.D. dependent var	180.9519	
S.E. of regression	126.0111	Akaike info criterion	12.73762	
Sum squared resid	381091.1	Schwarz criterion	13.14576	
Log likelihood	-201.1707	Hannan-Quinn criter.	12.87494	
F-statistic	5.248382	Durbin-Watson stat	1.675846	
Prob (F-statistic)	0.000718			

The final regression analysis, presented in Table 7 below, was also performed using dummy variables, keeping the same explanatory variable of average performance between all countries in the database, per KPI. That is, a value of 1 was set for each KPI constituting a specific SPI. We observe that the indicators with the largest variance, regardless of the average performance of all countries on the specific KPIs, and based on the statistical significance of the coefficients, are SPI001 (Environmental Performance), SPI002 (Health and Safety Performance), SPI003 (HR Management Performance) and SPI007 (Technical Performance). SPI003 in particular shows a large variation, as performance varies significantly across countries on this indicator.

4 DISCUSSION

The above analysis of the BIMCO databases revealed some useful results regarding the management of the international fleet and its multidimensional performance at aggregated level. The analysis of SPIs and KPIs provided strong evidence that efficient management of the fleet and the potential cultivation of good managerial practices can be reflected in all types of non-financial and non-accounting performance in the shipping industry. Furthermore, it leaves room for reasonable extension of this conclusion at national and even regional level. The fact that data from Europe-based shipping companies points towards a collectively robust shipping performance with no particular variance between the various performance metrics can be attributed to the extensive regulatory framework of the EU, which in close step (and often supplementing) the international IMO framework, sets the pace for more efficient and holistic shipping management. Furthermore, the close link between the ship-owning and ship management functions, which have been historically inseparable until the late 20th century (Stopford, 2009) and which is still strong in the case of european coastal nations as a result of their socioeconomical, geographical, and historical characteristics, may be one of the factors behind this.

Equally interesting is the established variance SPI001 (Environmental Performance), SPI002 (Health and Safety Performance), SPI003 (HR Management Performance) and SPI007 (Technical Performance), overarched by the large variation of the HR Management performance. The latter, considering issues relevant to the health and safety of the crews, is particularly important as relevant occupational problems may potentially influence and situational awareness of the crew ultimately leading to maritime accidents. As Theotokas (2018) argues, in the greatly intensified working conditions of contemporary maritime industry, where crews are substantially confined in the social environment of ships -their working and living environment being absolute synonymous, for the duration of their engagement- for longer periods of time, shipping companies need to meaningfully intervene. Be it through a strategy based on CSR or other means, shipping companies should try surpassing the minimum regulatory requirements and tend to the needs of the crews, in order to ameliorate their everyday life, thus reducing the possibility for a failure due to the onboard human element.

Regarding the use of KPIs either as a means of inter-industrial communication tool, the results of this research highlighted the potential of an appropriate KPI system to serve as a foundation towards the establishment of a shipping Global Performance Indicator (GPI) system.

As has been argued before, "…in every situation requiring cross-sectional cooperation, the need for a common system of reference, a common "language", is required by institutional and market stakeholders." (Darousos, Mejia and Visvikis, 2019). In a recent collective work, entitled "The Power of Global Performance Indicators" (GPI), Kelley and Simmons explore the role of GPI which they define as "…a named collection of rank-ordered data that purports to represent the past or projected performance of different units", highlighting the importance of various numerical indices for the ranking of state performance, focusing on standards with the following characteristics:

– Public and easily available.
– Regular and published on a predictable schedule.
– Purposive, explicitly normative, policy focused
– Deployed to influence state-level outcomes.
– Comparative of the performance of multiple states within a region or more broadly. (Kelley and Simmons, 2019).

Various existing indicators, including the United Nation's Human Development Index and the UN Gender Equality Index, the World Bank's Ease of Doing Business (EDB) Index, the Millennium Development Goals (MDG), the Financial Action Task Force (FATF) database, and the Aid Transparency (AT) Index, serve as examples of what could successfully constitute a successful GRI. The importance of GRI not only as a way of international performance communication, but as a means of transferring social knowledge and applying social pressure within emerging forms of influence and governance, has been therefore established in previous studies. (Kelley and Simmons, 2019).

The need for similar initiatives for the needs of the broader maritime industry are obvious and already expressed through existing databases, such as the Paris MoU database publishing the port state control results and the according detention lists, leading to "White, Grey and Black (WGB) list", presentung a wide range from flags of high to poor performance. Similar databases exist, emphasizing on environmental performance, such as the Environmental Shipping Index (ESI), measuring air emissions of NOx and SOx with the aim of reducing them.

Considering the characteristics of GPI and their social and self-regulatory dynamics far exceeding simple benchmarking purposes, but rather constituting a pathway towards wide and narrow stakeholder cooperation, transparency, participation, all important aspects of good governance, the need for a similar multidimensional instrument for the maritime industry seems to be of paramount importance. The Fourth Industrial Revolution (4IR) with its various advances in Big Data, automation and digital interconnection already alters the global transportation sector (World Maritime University, 2019) and reshape the industry.

The continuously expanding and evolving maritime regulatory framework, mostly driven by the International Maritime Organization (IMO) and the International Labour Organization (ILO), already includes an environment allowing for the nurturing of sustainable development in the sector. From the Agenda 21 (UNCED, 1992) highlighting the major role of the ocean, sea, and coastal areas to support human life to addressing sustainability in the maritime industry as part of the UN Agenda 2030, multiple efforts at all levels of the international power structure underline the effort for protecting the fundamental pylons of sustainability, present in the first conceptualization of this concept through the Brundtland Report (1987): Economy, Society, Environment. Issues relevant to the environment, safety and security of the vessel and the cargos, as well as the human element, its working and living conditions, health, safety, welfare and appropriate training and certifications, are already regulated primarily through various conventions, i.e. the International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974); the International Convention for the Prevention of Pollution from Ships (1973), as modified by the Protocol of 1978 relating thereto and by the Protocol of 1997 (MARPOL) (IMO, 2011), the Maritime Labour Convention (MLC), (ILO, 2006) and the International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) (1978).

However, despite most elements of shipping business -crucial for the sustainability of the wider sector- being thoroughly regulated as described above, there is almost complete lack of a standardized and internationally, industry-wide applied system for benchmarking (and thus, comparing) the performance of market actors and member states, wide and narrow stakeholders, a multi-dimensional GPI tailored for the needs of the maritime industry.

A maritime GPI not only addressing environmental and technical dimensions, such as already existing initiatives, but also aspects relevant to the human element for example, would support the exercise of good maritime governance as an indispensable element of sustainability. Enabling the homogeneous measurement and comparison of performance internationally could possibly lead to targeted sectoral improvements within an environment of cooperation and participation between regulators and authorities, as well as market practitioners, bridging two often opposing forces. Effective maritime governance should be addressed as a problem of collective action, with a set of policies able to reduce conflicts between individual interests and global efficiency (Ostrom, 2009). For example, maritime environmental policy has been "…informed by a command-and-control approach to regulation" (Furger, 1997), with the self-interested stakeholders seeking competitive advantage at the expense of the public interest (Sugden, 1991; Roe, 2013). Several past studies recognise that the overall issues and problems in the maritime policy implementation is generated by lack of effective governance, and not by the regulations themselves. Bloor et al. (2006) argue that at the root of the problem lie several governance issues rather than regulatory failings. Gekara (2010) provides evidence about lacking jurisdictional and governance integrity in the maritime sector, while Benett (2000) states that the problems related to maritime governance and shipping companies are due to lack of responsibility and enforcement.

A holistic approach would greatly facilitate the development of a comprehensive and inclusive maritime policy, but not one imposed by hierarchical leading authorities in a top-bottom linear approach and process. Good governance is not only synonymous with efficiency in achieving goals but, far more than that, by interactions from the top of the governance model to the bottom. A more open and democratic approach is calling for, and being characterised by, the decentralization of power; that is, according to Sørensen and Torfing (2005), a gradual, yet ongoing, process of debating how political institutions exercise their power by governing top-down through enforceable laws and bureaucratic regulations. The establishment of a shipping GPI allowing for the homogeneous exchange of performance information between all maritime stakeholders could be the next step in this evolutionary process.

5 CONCLUSION

The objectives of this paper were to (i) explore, for the first time, the overall performance of the international fleet based on market-generated data through the Shipping KPI System of BIMCO and (b) investigate the potential of a suitable KPI standard to bridge, for the first time, a research gap in the non-financial and non-accounting performance measurement in the maritime industry towards the adoption of a Global Performance Indicator initiative.

To reach its first objective, the research focused on potential empirical correlations between the various types of maritime performance. The analysis showed that indeed, different sub-types of performance seem to correlate through the scope of shipping management companies. Overall high scores in mid and high-level performance can be associated, signifying that managerial efforts and a robust regulatory framework can lead to an overall. As a result, countries can rank regards to the performance of their respective shipping companies as evidence suggests correlation between health and safety performance, and navigational, environmental, and safety performance of the international fleet.

In this paper by using the unique sample of BIMCO Shipping KPI System, the authors focused on the correlation between several categories of performance, for the first time, and attempted an according ranking based on the aggregated performance of national business clusters since 2011. According to BIMCO, the KPIs need to be observable and quantifiable; valid indicators of performance; robust against manipulation; sensitive to change; transparent. and easy to understand (BIMCO, 2018). Those elements are directly relevant to some of the prerequisites for the development of a GRI; which in turn allows for the suggestion, given its potential, of a similar, suitable KPI standard, aiming for the expression of non-accounting and non-financial performance score of the global fleet.

By attempting an analytical overview of shipping performance globally, and by identifying structural relationships between several of its multidimensional constituting elements, a primary indication is demonstrated that highlights the reality that market-generated appliances, such as benchmarking tools, may serve far greater purposes in the case of industry-wide adoption.

As potential future research, the connection between health and safety, and navigational safety performance, should be further investigated. Focused investigation of performance indicators of selective shipping companies at micro-level would be suggested, in order to conduct a deeper investigation of the conditions influencing their human element performance. Furthermore, the examination of instruments similar to the Shipping KPI System, would be suggested regarding their potential for cross-industry standardized exchange of information.

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