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DESIGN OF PERFORMANCE MANAGEMENT SYSTEMS FOR MARINE TRANSPORTATION SYSTEM IN COMPANY X

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Abstract

A company with multiple roles as a profit generator and public service provider has special characteristics. Considering that the numbers of Performance Management Systems (PMS) for managing this context are limited, this research aims to design a PMS that is appropriate with such unique characteristics. This research utilised the PMS framework developed by Irfani *et al.*as this framework is specifically designed for multiple-role companies. The framework was applied in a case company namely Company X. The development of the PMS consists of several steps, including analysing the suitability of the existing PMS, selecting the key performance indicators using statistical methods, and analysing the relationship among performance indicators using Decision Making Trial and Evaluation Laboratory Model (DEMATEL).

The research results indicated that the framework developed by Irfani *et al.* could be used to develop a PMS that is appropriate for multiple-role companies. Firstly, the framework could reveal that the existing PMS in Company X was not fully aligned with the organisation's strategy. The alignment analysis results showed that the existing PMS in Company X had not emphasised the infrastructure aspects of the marine transportation system, although the reliability aspect was emphasised in the organisational strategy. Besides, the framework could be used to identify that there were still several gaps and false alarms in the existing PMS. In addition, the framework was successfully used to select relevant key performance indicators in Company X. Lastly, the framework was used to model the relationships between several dimensions and performance measures in Company X.

The value of this study is that it provides stakeholders of multiple-role companies with a direction for assessing and designing the appropriate PMS that suits the characteristics of such companies. In addition, this study fills the theoretical gap by proposing the causal relationships between performance dimensions and measures in a marine transportation system. Such relationships have helped decision-makers in Company X to comprehensively analyse how the marine transportation system at Company X performs. However, this study only uses a single case study. To find out the generalizability of the PMS that has been proposed, this research can be replicated and furthered by applying the proposed PMS to other contexts.

Keywords: Performance Management System, Marine Transportation Performance, Multiple-Role Company.

1. Introduction

Companies with multiple roles need to seek solutions for balancing their financial and social performances. Role as a profit generator requires such companies to optimize cost and asset efficiency aspects. On the other hand, the role of a public service provider requires decision makers in multiple-role companies to prioritize the reliability, responsiveness, and flexibility aspect in the marine transportation system. In this case, such companies may benefit from the use of contextual Performance Management Systems (PMS). According to Jayaram et al. (2000), performance management helps companies to manage resources to achieve company objectives. Similarly, Lockamy et al. (2000) suggest that firms must have a comprehensive set of measures to assess progress towards achieving companywide goals, improving core business processes and aligning the firm with the needs of the market.

The conflicting objectives of multiple-role companies demand specific performance management systems. Although there have been many types of research in the field of performance measurements, however, very few studies focus on examining marine transportation performance in companies with multiple roles. In this case, further research is needed to investigate the suitability of the existing PMS framework to be applied in multiple-role companies. Besides, it is required to understand the key indicators that are relevant to be used in measuring the performance of multiple-role companies. Lastly, the relationships among indicators in multiple-role companies are needed to be examined as such relationships may provide a better picture for decision makers in such companies to comprehensively manage their performances.

2. Literature Review

Based on a review of the literature on performance measurement framework development, it is known that many researchers have made efforts to make performance measurement more effective and efficient. Kaplan and Norton (1992) introduce BSC which proved to be complementary to financial measures by bringing operational and strategic measures of performance. Neely et al. (2001) developed a new PMS framework named Performance Prism, which integrates stakeholder perspective under five facets, namely stakeholder satisfaction, stakeholder contribution, strategies, capabilities and processes. Wibisono (2003) proposes an improved methodology for the design of a realistic PMS to balance short-term and long-term measures, internal and external measures, and financial and operational measures. Sureshchandar and Leisten (2005) extend BSC perspectives by integrating intellectual capital perspective, employee perspective, and social perspective. Thakkar et al (2006) propose an integrated qualitative and quantitative approach to the development of a BSC by using a mixed approach of cause and effect diagram, Interpretive Structural Modeling (ISM) and Analytic Network Process (ANP). Barnabe (2011) utilized system dynamics methodology to develop BSC and realized that feedback loop learning, dynamic strategy maps and management simulators help to provide better support for decision-makers facing complex and dynamic domains.

However, although the aforementioned frameworks have been widely implemented to manage logistics performance, the results of the review process indicate that none of those frameworks is fully suitable for a Company that has multiple roles (Irfani et al., 2019; Fein & Rasul, 2010). According to the findings that the existing PMS frameworks are not fully suited with the characteristics of multiple-role companies, Irfani et al (2019) developed a performance management framework specifically for measuring performance in multiple-role companies. The framework developed by Irfani et al. consists of several steps that are dedicated to managing the objective conflict that is commonly found in multiple-role companies.

3. Methodology

This research employed literature review and case study methods to build a new PMS for the marine transportation system in a multiple-role company namely Company X. The literature review covered articles about the PMS framework developed by Irfani et al. (2019), logistics performance indicators, and DEMATEL approach. The framework developed by Irfani et al. (2019) was chosen because it was specifically designed for managing the performance system multiple-role companies like Company X. In this research, part of the framework was combined with performance dimensions and indicators collected from the literature relevant to the context of marine transportation systems.

The step-by-step development process of PMS in Company X is shown in Figure 1

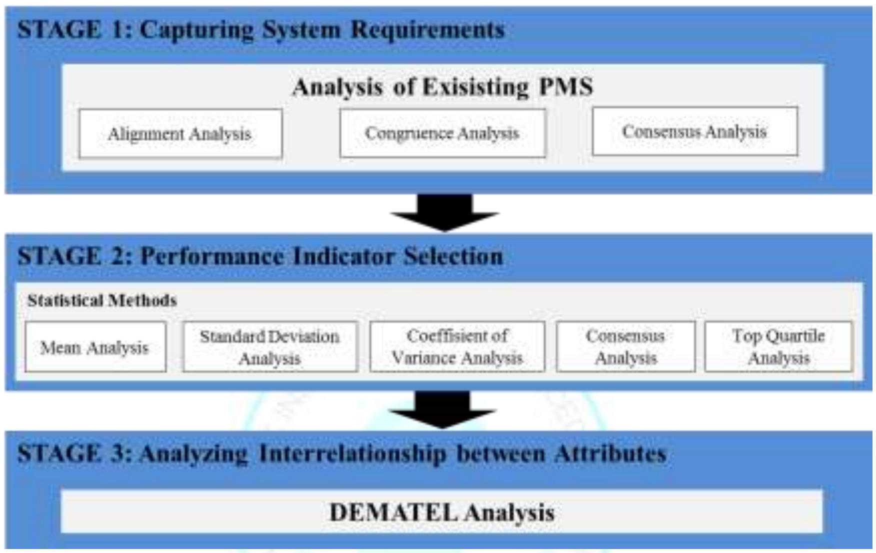

Figure 1: The Stages of the Irfani Framework

The framework developed by Irfani et al. (2019) uses the modified Performance Management Questionnaire (PMQ) as originally proposed by Dixon et al. (1990). In this research, the modified PMQ was used to analyse the suitability of the existing PMS in Company X. The modified PMQ uses a questionnaire tool to collect the data. In this case, questionnaires were distributed to the 250 respondents from ten divisions and several job positions related to marine transportation systems in Company X. The then divisions, in this case, are Integrated Supply Chain, Supply and Distribution, Vessel Operation, Tonnage Analysis, Vessel procurement, Refinery, Marine, Performance Evaluation, Marketing, and Finance. The job positions cover analyst, assistant manager, manager, and vice president positions. Among 250 respondents, 143 respondents returned the questionnaires so the response rate is 57%

Three types of analyses were used to examine the suitability of the implemented PMS in Company X, including alignment analysis, congruence analysis, and consensus analysis. Alignment analysis was intended to find out the extent to which the organization's strategies, performance measures, and actions line up with each other. Meanwhile, congruence analysis was performed to find out how well the Performance Management System supports the organization's actions and strategies. Lastly, consensus analysis was intended to identify the existence of poor communications both in relationships that were vertical and horizontal.

After the suitability of the existing PMS has been examined, the next step is selecting the key performance indicator that is relevant to the context of Company X. In this research, key performance indicators were selected by using statistical methods, including mean analysis, standard deviation, coefficient of variance, consensus analysis and top quartile analysis.

After key performance indicators have been selected, the last step is to analyze the relationships between performance attributes using DEMATEL analysis. This study uses Decision Making Trial and Evaluation Laboratory Model(DEMATEL)approach with the steps as follows:

1. Identify elements related to the problem and degree of influence between elements.
2. Construct a direct-relation matrix
   In the initial stage, the initial direct relation that contains ($n \times n$) matrix A is created. In the matrix, a_{ij} represents the degree to which criterion i affects criterion j.
3. Normalizing the direct-relation matrix
   Based on matrix A's initial direct relation, the normalized direct-relation matrix can be constructed by dividing each element in the matrix with the largest row sum or the largest column sum as found in equation 1.

$$s = Min\left(\frac{1}{\max_{1\le i\le n}\sum_{j=1}^{n}|a_{ij}|}, \frac{1}{\max_{1\le j\le n}\sum_{i=1}^{n}|a_{ij}|}\right)$$

$$i, j \in \{1,2,3,\ldots..n\} \qquad (1)$$

   Furthermore, s used to calculate the normalized direct relation matrix with X after Equation 2.

$$X = s \times A \qquad (2)$$

4. Obtaining total relationship matrix by using Equation 3.

$$T = \lim_{k\to\infty}(I + X + X^2 + \ldots\ldots + X^k) \qquad (3)$$

   The sum of the values in each column and each row is calculated in the total relation matrix. D_i shows the sum of the i-th row and R_j shows the sum of the j-th column.

$$D_i = \sum_{j=1}^{n} t_{ij} (i = 1, 2, \ldots, n) \qquad (4)$$

$$R_i = \sum_{i=1}^{n} t_{ij} (j = 1, 2, \ldots, n) \qquad (5)$$

5. Compute the cause and effect group

   Horizontal axis (D + R) is made summing R and D, the vertical axis (D − R) is made subtracting R from D. Several performance attributes that have positive values of D−R are called cause groups. Meanwhile, some performance attributes that have negative D-R values are called effect groups.
6. Build the cause and effect diagram

   The next step is plotting each performance attribute into the causal diagram. The horizontal axis is a representation of the D + R value. Meanwhile, the vertical axis is a representation of D-R which explains the position as a cause or effect of a performance attribute.

7. Calculate the total influence/dependence matrix

   In this step, the sum of each column in the total-relation matrix is equal to 1 by the normalization method, and then the dependence matrix can be acquired

8. Calculate the threshold value (α)

   Threshold value (α) = (Sum of elements of total impact matrix) / Number of elements of total impact matrix

To collect the data regarding the causal relationships between performance indicators, this study uses the interview method. Five decision makers in Company X who represent the department of vessel operations, tonnage analysis, and performance evaluations were selected. Evaluators, in this case, have varying ages, ranging from 40 to 53 years. Evaluators have been working in from 15 - 30 years. The age background and the work experience indicate that the chosen evaluators were quite competent and experienced with the logistics system.

4. Results and Discussion

This section covers explanation about the results of PMS design conducted in Company X.

Step 1: Analysis of Existing PMS

The analysis results of the existing PMS conducted by using the modified PMS are as follows:

1. Alignment Analysis
   The existing marine transportation system strategy in Company X is directed at improving customer service quality and cost leadership. Meanwhile, the survey results show that the area that is perceived to be the most need to be improved in Company X at present is related to capability building, especially in terms of infrastructure marine transportation system. This indicates that currently the strategy of the marine transportation system in Company X is not well aligned with the actions taken in the company. Table 1 shows the top and bottom quartile of improvement factors as perceived by the respondents.

Table 1: Alignment Analysis of Improvement Factor

Top Quartile	Bottom Quartile
Storage Capacity	Vessel Plotting
Port Draft Capacity	Storage Utilization
Port Capacity	Bunkering Operation
Port Reliability	Vessel Routing
Port Utilization	Vessel Scheduling
Vessel Reliability	Labour Utilization
Vessel Utilization	Standardization

2. Congruence Analysis
   The purpose of congruence analysis is to find out how well the Performance Management System supports the organization's actions and strategies. Based on Table 2, it is known that several improvement areas such as Storage Capacity, Port Draft Capacity, Port Capacity, Port Reliability, Port Utilization, Vessel Reliability, and Value Utilization are perceived by respondents as important factors. However, such factors are not emphasized in Company X. This finding shows that there are currently gaps related to improvement area.

Table 2: Congruence Analysis of Improvement Factor

Gaps (Top Quartile)	False Alarm (Bottom)
Storage Capacity	Vessel Scheduling
Port Draft Capacity	Vessel Plotting
Port Capacity	Ship Management
Port Reliability	Vessel Capacity
Port Utilization	Vessel Procurement
Vessel Reliability	Bunkering Operation
Vessel Utilization	Vessel Routing

3. Consensus Analysis
The consensus analysis was conducted to identify the existence of poor communications both in relationships that were vertical and horizontal. Based on Table 4 and Figure 3, it is known that each department in the marine transportation system in Company X has different perceptions regarding the factor that needs to be improved. This finding suggests that there are still SILO thinking between departments in Company X.

Table 5: Functional Consensus Analysis of Improvement Area

Factor	Department										p-value
	1	2	3	4	5	6	7	8	9	10	
Tonnage Planning	6.64	6.27	5.09	5.77	6.72	6.14	6.22	6.42	6.13	6.60	0.000
Port Capacity	5.60	5.90	4.83	5.33	5.03	4.90	5.00	4.42	5.20	4.92	0.020
Storage Capacity	5.40	6.00	5.18	5.22	5.14	4.63	4.66	5.28	4.70	4.96	0.042
Vessel Utilization	6.20	6.71	5.54	5.77	6.25	6.63	6.53	6.38	6.50	6.60	0.007
Vessel Reliability	6.85	6.27	5.72	6.11	6.68	6.45	6.46	6.40	6.50	6.60	0.39

Nomenclature:

1: Integrated Supply Chain 4: Vessel Procurement 7: Performance Evaluation 10: Supply and Distribution

2: Shipping Operation 5: Refinery 8: Finance

3: Tonnage Analysis 6: Marine 9: Marketing

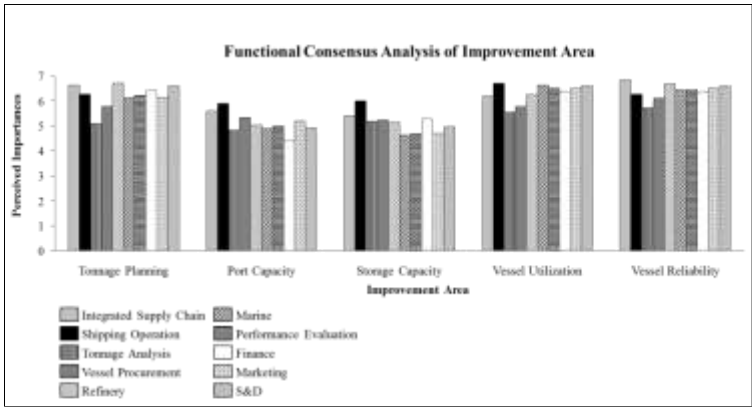

Figure 4: Improvement Area Functional Consensus Analysis

Step 2: Performance Indicator Selection

In this study, key indicators were selected by using a statistically based method. Mean value analysis, analysis of variance, and reliability analysis with Cronbach's Alpha were used to identify perceived key indicators. Analysis of the mean value of each indicator is carried out to determine the perceived importance level of each performance measure. Meanwhile, the coefficient of variation was employed to judge whether respondents have consensus to a certain extent. In general, respondents are said to reach a consensus on a performance indicator if the coefficients of variation of the respondent's answers are less than 0.15 (Lin, 2003).

Several potential performance measures collected from the literature and pilot studies were evaluated by using the question "how important is this performance factor?". In this case, key performance indicators were selected by using these following criteria:

1. Has a level of importance above 3.5 (middle value of Likert scale 1 to 7)
2. Has a coefficient of variance that is higher than 0.15 (Lin, 2003).

Based on the analysis result, there are 59 key performance indicators selected from a total of 75 potential performance indicators which cover organizational output, transport logistics performance, and performance driver dimensions. Those indicators have a level of importance above 3.5 (middle value of likert scale 1 to 7) and coefficient of variance that is higher than 0.15 (Lin, 2003).

Step 3: Analyzing Interrelationship between Attributes

After key indicators have been selected, the next step is to examine the causal relationships among such indicators. In this research, the dependencies between indicators are mapped using the DEMATEL method. Due to the limited space, this paper will only cover the explanation about the DEMATEL implementation for examining the inner dependence between performance dimensions.

1. The initial direct relation matrix is made by decision makers who are influential among performance dimensions.

   Perceptions about the relationships between some dimensions with other dimensions are collected through interviews. For example, the effect of Responsiveness (RL) on Reliability (RL) is asked to the decision makers through the question item "What level the Responsiveness influences Reliability?" The average answer to this question is "low influence". Hence, the influence scale "1" is placed in the relevant cell. The initial direct relation matrix for organizational performance is presented in Table 11.

Table 11: Initial Direct-Relation Matrix for Performance Dimension (Matrix A)

Performance Dimensions		FP	SP	RP	RL	AU	LC	VP	IN	DS	CP	IS	MS
Financial Performance	(FP)	0	1	0	0	0	0	0	0	0	0	0	0
Social Performance	(SP)	1	0	0	0	0	0	0	0	0	0	0	0
Responsiveness	(RP)	1	4	0	4	0	3	0	0	0	0	0	0
Reliability	(RL)	1	4	0	0	0	0	0	0	0	0	0	0
Asset Utilization	(AU)	3	0	0	0	0	4	0	0	0	0	0	0
Logistics Cost	(LC)	4	0	0	0	0	0	0	0	0	0	0	0
Vessel Performance	(VP)	1	2	4	3	1	2	0	0	0	0	0	0
Infrastructure Support	(IN)	2	3	4	4	4	3	0	0	0	0	0	0
Discipline	(DS)	2	3	4	4	4	3	0	0	0	0	0	0
Capability	(CP)	2	3	4	4	4	3	0	0	0	0	0	0
Information Sharing	(IS)	2	3	4	4	4	3	0	0	0	0	0	0
Management Support	(MS)	2	3	4	4	4	3	0	0	0	0	0	0

2. The normalized direct relation matrix X

Table 12: The Normalized Initial Direct-Relation Matrix for Performance Dimension

Performance Dimensions		FP	SP	RP	RL	AU	LC	VP	IN	DS	CP	IS	MS
Financial Performance	(FP)	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Social Performance	(SP)	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Responsiveness	(RP)	0.07	0.17	0.00	0.15	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Reliability	(RL)	0.04	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Asset Utilization	(AU)	0.13	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Logistics Cost	(LC)	0.15	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vessel Performance	(VP)	0.07	0.12	0.15	0.13	0.04	0.10	0.00	0.00	0.00	0.00	0.00	0.00
Infrastructure Support	(IN)	0.13	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Discipline	(DS)	0.13	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Capability	(CP)	0.13	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Information Sharing	(IS)	0.13	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Management Support	(MS)	0.13	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00

2. The Total Relations Matrix

The Total Relations Matrix in this case is calculated by multiplying the Normalized Initial Direct Relations Matrix as found in Table 13.

Table 13: Total Relationship Matrix

Performance Dimensions		FP	SP	RP	RL	AU	LC	VP	IN	DS	CP	IS	MS
Financial Performance	(FP)	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Social Performance	(SP)	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Responsiveness	(RP)	0.06	0.17	0.00	0.15	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Reliability	(RL)	0.01	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Asset Utilization	(AU)	0.13	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Logistics Cost	(LC)	0.15	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vessel Performance	(VP)	0.07	0.12	0.15	0.13	0.04	0.10	0.00	0.00	0.00	0.00	0.00	0.00
Infrastructure Support	(IN)	0.12	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Discipline	(DS)	0.12	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Capability	(CP)	0.12	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Information Sharing	(IS)	0.12	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00
Management Support	(MS)	0.12	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00

3. The calculation results for some of variables

After the values of D and R for each performance dimension are known, the next value is calculated D + R and D-R.

Table 14: Dominance (D) and Reciprocal (R)

Performance Dimensions		FP	SP	RP	RL	AU	LC	VP	IN	DS	CP	IS	MS	D	D + R	D - R
Financial Performance	(FP)	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	1.19	-1.11
Social Performance	(SP)	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	1.34	-1.27
Responsiveness	(RP)	0.07	0.17	0.00	0.15	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.50	1.39	-0.39
Reliability	(RL)	0.04	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	1.32	-0.94
Asset Utilization	(AU)	0.13	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.29	1.06	-0.49
Logistics Cost	(LC)	0.15	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	1.26	-0.95
Vessel Performance	(VP)	0.07	0.12	0.15	0.13	0.04	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.60	0.60
Infrastructure Support	(IN)	0.13	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.91	0.91
Discipline	(DS)	0.13	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.91	0.91
Capability	(CP)	0.13	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.91	0.91
Information Sharing	(IS)	0.13	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.91	0.91
Management Support	(MS)	0.13	0.16	0.15	0.17	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.91	0.91
R		1.15	1.30	0.89	1.13	0.78	1.10	0.00	0.00	0.00	0.00	0.00	0.00			

4. Inner dependence matrix

Innerdepence matrix can be built from a total relationship matrix by dividing the value of each component in the total relationship matrix by summing the values according to the column of the component.

Table 15: Inner Dependence of Performance Dimensions

Performance Dimensions		FP	SP	RP	RL	AU	LC	VP	IN	DS	CP	IS	MS
Financial Performance	(FP)	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Social Performance	(SP)	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Responsiveness	(RP)	0.06	0.16	0.00	0.14	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
Reliability	(RL)	0.01	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Asset Utilization	(AU)	0.12	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Logistics Cost	(LC)	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vessel Performance	(VP)	0.06	0.11	0.14	0.12	0.03	0.09	0.00	0.00	0.00	0.00	0.00	0.00
Infrastructure Support	(IN)	0.12	0.15	0.14	0.16	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Discipline	(DS)	0.12	0.15	0.14	0.16	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Capability	(CP)	0.12	0.15	0.14	0.16	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Information Sharing	(IS)	0.12	0.15	0.14	0.16	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Management Support	(MS)	0.12	0.15	0.14	0.16	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00

5. The total dependence matrix

The total dependence matrix that has been cut with the threshold value can be seen in Table 16.

Table 16: Inner Dependence of Performance Dimensions

Performance Dimensions		FP	SP	RP	RL	AU	LC	VP	IN	DS	CP	IS	MS
Financial Performance	(FP)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Social Performance	(SP)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Responsiveness	(RP)	0.06	0.16	0.00	0.14	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
Reliability	(RL)	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Asset Utilization	(AU)	0.12	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Logistics Cost	(LC)	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vessel Performance	(VP)	0.06	0.11	0.14	0.12	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00
Infrastructure Support	(IN)	0.12	0.15	0.14	0.16	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Discipline	(DS)	0.12	0.15	0.14	0.16	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Capability	(CP)	0.12	0.15	0.14	0.16	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Information Sharing	(IS)	0.12	0.15	0.14	0.16	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Management Support	(MS)	0.12	0.15	0.14	0.16	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00

6. Cause and effect diagram

   Based on the series of steps that have been taken, the cause and effect diagram compiled based on the DEMATEL method can be seen in Figure 6.

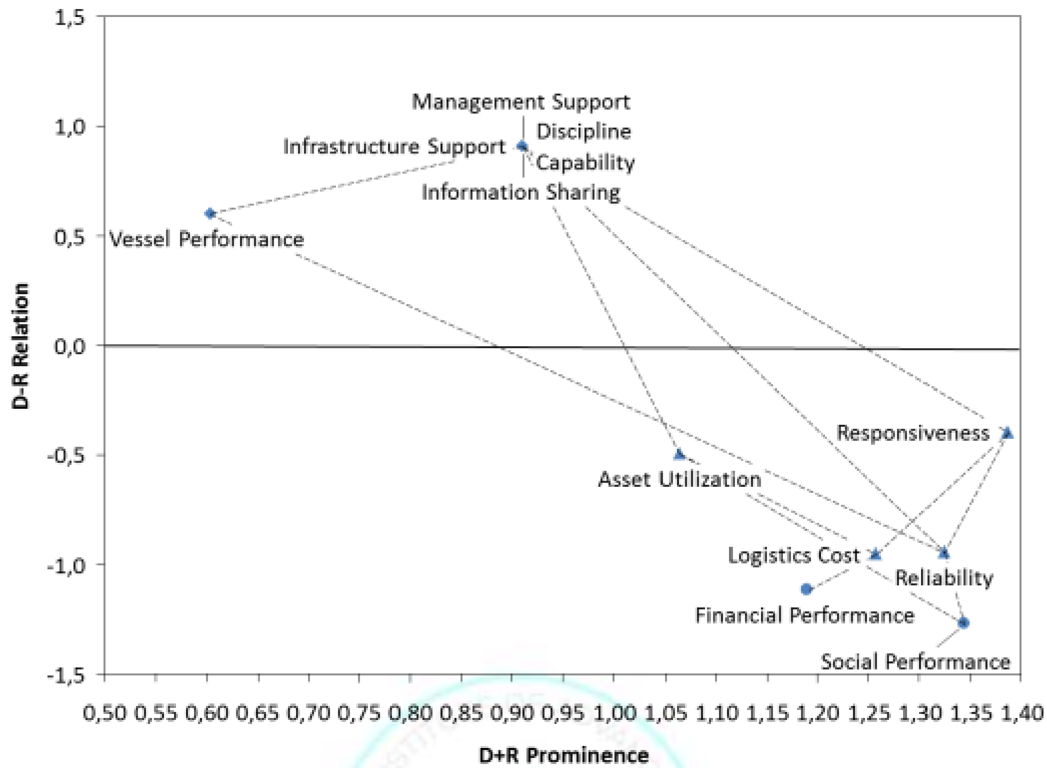

Figure 6: Cause and Effect Diagram for Performance Dimension

Based on Impact Diagram in Figure 6, it can be seen that Vessel Performance, Infrastructure Support, Management Support, Discipline, Capability, and Information Sharing are dispatchers. Meanwhile, Asset Utilization, Responsiveness, Logistics Cost, Reliability, Financial Performance, and Social Performances) are dimensions in the receiver category or effect group. The step-by-step DEMATEL implementation processes were repeated to examine the causal relationships between performance dimensions and measures. The complete results of DEMATEL implementation are presented in Figure 7. Based on Figure 7, it is known that all of the key indicators in the organizational output category are influenced by key indicators in the logistic transport category. For example, financial performance indicators are influenced by logistic cost, responsiveness, and asset utilization. From the DEMATEL analysis, it is known that the lower the logistic cost, the better the financial performance. In addition, DEMATEL analysis also suggests that the more responsiveness the logistics system, the better the financial performance of the organization will be.

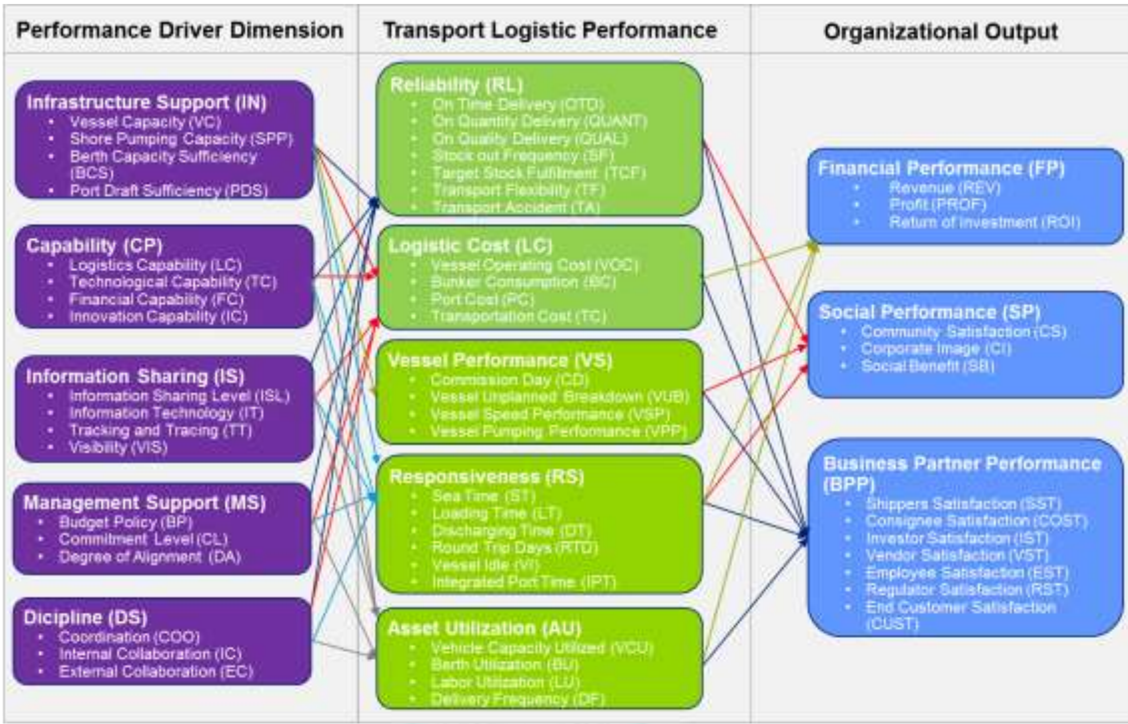

Figure 7: Relationship between Performance Indicators

The causal relationships among performance indicators as shown in Figure 7 have helped decision-makers in Company X to comprehensively analyse how the marine transportation system at Company X performs.

4. Conclusion and Suggestions for Future Work

Several conclusions that can be formulated based on the steps listed and have been carried out in this research are as follows:

1. Multiple-role companies indeed have unique characteristics that demand contextual performance management systems. The examination of the existing PMS implemented in Company X revealed that PMS developed by using generic PMS frameworks result in unaligned performances. The alignment analysis results showed that the existing PMS in Company X had not emphasised the infrastructure aspects of the marine transportation system, although the reliability aspect was emphasised in the organisational strategy. Besides, the framework could be used to identify that there were still several gaps and false alarms in the existing PMS.

2. Companies that perform multiple roles as profit generators and public service providers require balanced performance indicators. The survey conducted in Company X suggests that Company X's organizational performance must cover both financial and social performance dimensions. In addition, Company X's marine transportation performance must include both the financial and quality of service aspects. Financial aspects are represented by transportation cost and asset utilization dimensions, while the quality of service is represented with reliability, responsiveness, and vessel performance dimensions.

3. The provision of causal relationships among performance indicators has helped decision-makers to analyse how the marine transportation system performs

comprehensively. This, in turn, helps involved parties in the marine transportation system to avoid silo thinking and foster a shared view within the system.

This research makes an initial effort to identify the unique characteristics of performance management in companies with multiple roles. Since it only uses a single case study in the marine transportation system in Company X, this research can be replicated and furthered by applying the suggested framework in other contexts such as that of the land transportation system, air transportation system, and so forth, to determine its generalizability.

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