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Information System Analysis on Cargo Supply Chain Shipment for Decision Making in Bahrain Logistics Zone

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Abstract: Transitional country's economy vastly relies on the port logistics service industry. In Bahrain, the Khalifa Bin Salman Port made a significant contribution across the commercial zone, where information systems were heavily involved in logistics. The performance of port logistic management in the supply chain is highly dependent on the decision-making process, which is equipped with transshipment data. The improvement and relevant actions within the logistic region are borne by analytic port transshipment data. The aim of this research finding the decision-making process and how information system are involved for further direction with the port logistic in supply chain approach. This study uses statistical observation methods to examine port logistic activities to make decisions, while information system entirely supports for comparison. Analytical research contributes to logistic performance when the decision-making process becomes crucial important at port logistic activities that flow as vehicle comparison in the Bahrain Port Logistic Zone. Implication of the research also influences logistic performance in terms of cost, time, and reliability by sorting out the appropriate decision-making. As a consequence, generated result of decision making highly contribute to the short- and long-term collaboration agreements among companies from its previous transshipment dataset.

Keywords: Port Logistic, Supply Chain, Decision Making, Information System, Bahrain Logistic Zone

1. INTRODUCTION

Information system (IS) in logistic operation is combinational of hardware and software that methodically store for data performance, graph chart to display the logistic operation or continuity as a functional approach to immense on it. Indeed, the rapid advancement of information and communication technology-driven by industrial logistic growth [1]. It is strategically managing the direction of information that usually bear the adaption, collection, transformation, and presentation of information for the users. All these four variables influence decision-making for logistics operation, whereas the company used to optimize for successful operations based on various aspects. Khalifa Bin Salman Port (KBSP) in Bahrain geographically suitable to located positioning for maritime transshipment, which contributes immensely to the largest economic region. Based on port logistics, this study mainly focuses on four operational variables for precious decision making (DM) that present the usable and essential information from its functional aspects. Four categorical industrial data are classifying for smoothing operation for DM that define from tangible and intangible platforms for the critical change throughout the current information, giving the direction in terms of minimizing the cost or upgrading existing tools. There has been little research on these topics in the context of the Bahrain logistic zone (BLZ), particularly for logistic service quality (LSQ) with information system (IS). This research explores the information system in terms of quality services and cargo shipment, including several pilot indexes whether IS detects the influential observations from the experimental transshipment data.

2. LITERATURE REVIEW

Strategically situated middle of the Arabian gulf links to the mainland (Saudi Arabia & Qatar) adjacent to the Bahrain logistics zone (BLZ) in the Salman industrial

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city that known as an ultramodern gateway which running immensely market opportunities (USD 1.5 trillion) with the Gulf Cooperation Council (GCC) countries. BLZ equipped with modern facilities, KBSP one of the busiest bubs for trade and commerce efficiency in the Gulf region. The lift system and advanced digital solution enabling the online port booking and cargo containers services which emerged the port efficiency as new level with regards by providing speed and conveniences for any environmental challenges and make sustainable operations. Maritime industrial sectors BLZ also responsible for administration, promotions, and procedures. Applicable information system (IS) in logistic activities diverts to various opportunities that mostly gain through GCC market and northern gulf countries where BLZ rapidly accessible through transportation system from the kingdom's prime air, sea, and land transport hubs tenants. The range of the BLZ transportations and its awareness occupies more priority through product demand, stocks, and transport costs with its distribution channels. Several types of vessels operating in Khalifa Bin Salman Port (KBSP). E.g., combine transport (CT) vessels, general cargo (GC) vessels, a Cruise ship that drives 6 MW [2]. Bahrain APM terminal converted into a public company on 9th Dec'2018 and started to be providing commercial opportunities. It is listed as Bahrain's boss index that holds more than 800 shareholders which also offers easy access, benefit, and it has 85% success story from total local shareholders.

Seaport cargo transhipment dependence on the port management system's key advantages with digitalization facilities, efficient competition, and global economic [3][4][27]. Subject-based ancillary information is necessary for decision making where Electronic Data Interchange (EDI) aggregate based on a maritime environment that emerged from container tracking, inland navigation, or between partners in the supply chain [5][6]. Global logistics require different skills with a new approach as its part of IS management and future developments that mostly depend on electronic data exchange that impact on international trade. Without the role of information technology (IT), it is impossible to monitor performance, area improvement, and quality services in logistic management as integrated supply chain system [7][8]. It is also defined that IT facilities are required to boost performance and productivity. In such a case, BLZ provided the most advanced IT facilities in logistic port activities to monitor the performance. Hence, there is a need to examine the IS processing on cargo system shipment as it is integrated into various fields [24] [25]. E.g., guiding vehicles, safe handling, control system, system management, warehousing, etc [29].

However, EDI in modern port facilities is inevitable as utilized in BLZ. Creating a reliable logistic performance in competitive sectors always demanded as necessary to improve overall [9]. This research may bring reliable logistic performance in decision making (DM) which influenced by IS and the level of pertinent that usually come from the statistical impact of information processing.

A. Decision-making process in IS

The organization's operations are entirely dependent on DM in terms of policymaking or further constitutional rules. The rapid development of information technology gives the strengthened role to make any kind of decision. Moreover, optimizing decision-making applies to the global business model rolling by third-party logistics services and returning the high competitiveness to the market [10]. The study's research has focused on decision-making that derived from the information system of strategic analysis in a sense of long-term or short-term period that may impact on BLZ. In this regard, selected decision-making strategies may implement upon analysis of the data. Since BLZ data related to structure-based real-time analysis. So, the appropriate decision could be generated from operational strategy as applicable. The inspection result and analysis produce the result of how information could be processed to support the decision making for various management functions. Various DM operates on different organizations from different perspectives to get closer to citizens [11] [28]. Several categorial operations and decisions could be selected for ideal result as part of the organizational governing body as details below in table 1.

TABLE I. VARIOUS DECISIONS AND IMPLICATION

Name	Description	Example
Strategic Decisions	Impact as long-term to give the direction as forecasts of market condition.	Business could be turnover by strategic decisions.
Tactical Decisions	Also known as a managerial decision that implementing strategical operational via middle management.	Operation hours or business time management.
Operational Decisions	Routine based decision as taken by the junior manager. Typical decisions are dependent on stock and sales data.	Operational decision operates to business for making a profit.
Structure Decision	Accepted method is used to apply for structure decision via computing formula that reorders quantity.	Inventory management system running with structure decision.
Unstructured Decision	There is no agreed-upon unstructured decision-making process.	This decision applies to the forecast on the stock market and future economy.

The analytical research discusses about the appropriate decision-making model that could suggests the

significant support for logistic operations in BLZ. The significance test from the statistical analysis and the decision-making process that usually depends on various DM operations or vice versa.

B. Decision-making process with supply chain

Logistic operational activities involved as the efficient flow of various traffic of goods and handling cargo shipment data. In this case, supply chain management in the commercial sector flow with goods and services that involving storage materials or products movement in port logistic activities. The supply chain system may focus on the core of port logistic activities for decision making because the entire delivery system or service depends on the beginning stage of the source or supply of raw materials for the final stage as the destination. In this case, the information system plays a vital role in dealing with the fulfillment of customer orders or faster product cycle. So, it observed that supply chain management as connected in port logistic operation that also depends on Information System (IS) either directly or indirectly. Proper decision making with the IS bring the value and gain a competitive advantage within BLZ operations.

C. Logistic Operational on IS

Information System (IS) prompts the industrial operation in terms of data streaming. IS as defined the components of combinational hardware and software that works together to disseminate information which supports to decision making, control, coordination, analysis, and visualization [9][12]. It also optimizing the business process and maximizing the utilization resources as the target approach may rolling on the logistic management model. In such a case, information may process on the homogenous organizations with the same logistic zone. An appropriate information system in the logistic chain carries the company development strategic plan where the intangible components like ICT implement a more reliable logistic operation. Since the business hub is recognized, BLZ is operating the logistic chain. So, information system constitutes as liveware as this research rolling with the country national economy. It basically among suppliers, outsourcers, distributors, and transporters that sequentially rely on four variables as adaption, collection, transformation, and presentation of information.

D. Aim of the Study

The key objective of this research is information processing. In contrast, logistic services involved with the port area's geographical location and service quality throughout business strategy may be applicable based on improving modern port facilities. Performance depends on the ability to deliver goods, services quantity, and time in corresponding with customer's demands in BLZ. Logistic division varies dependent on the information system due to information processing from previous service perspectives. As this study aims to rely on three major independent variables, whereas filtering techniques identify this research's dependent-target variables. Those variables from the dataset able to decide as required from a different company in BLZ. E.g., services price, quality improvement of company satisfaction level in terms of relationship and upgrading the modern port facilities that enhance services quality. The Port operating company APM terminal in Bahrain at KBSP supported by graph and statistical analysis as illustrated by the annual result. From this report, the study defines the analytical approach of IS in which each term of making the decision for port operation based on the statistical analysis and in this case, IS uses the filtering techniques. All transshipment data is used for decision-making to make a more sustainable operation.

E. Role of IS in decision-making process

BLZ has offered the lowest cost for running and establishing business across the entire GCC region. The ability to make product portfolio and customer awareness flow on the growing demand is important to analyze as seen from optimal data dissemination. This also used the same information system in tactical, operational, and strategic management levels to connect between functional and procurement. BLZ provided world-class operational services to its tenants within its range. So, the decision-making process can generate the functional or conditional process as part of the logistic activities, whereas BLZ requires some strategies that help optimize the seaport operation for further exploiting its resources efficiently [13]. This investigation also focused on capabilities that define the information system in decision-making and alleviate any coincidental problem as part of the port logistic operations. The information system's role is integrated with port logistic operations where the port authorities define the feasible solutions from the current seaport facilities. Typical further decisions also help them to improve the quality of port activities.

F. Issue Behind the Topic and Research Gap

The information system must be matched with business function and logistic process. Despite the growing demand for product portfolio and customer awareness, the study of this logistic research investigates the KBSP performance, which is important for geographical distribution and cost reduction among tenants within a zone. IS also analyzes controlling the output classified information that prevents the risk of leaks [14][15]. The relationship among the companies and suppliers is growing from structural information that enables the capabilities of information system improvement, transactions procedures, inventory control system,

product cycle time [16]. Logistic integrated with IS could be operate for its desired result due to ultimate approach for decision making in terms of preventing information leaks that may bear the crucial factor for an individual company. So, the main issue behind the topic pursuing decision-making is based on its past influential performance that gives future direction for port improvement and innovation. Most business performances depended on the quality of services, especially the port logistic activities for customer satisfaction [8]. Such cases could be handled by information processing of port logistic activities that depend on positive or negative aspects from customer satisfactions. Technological advantages are able to identify more preciously of satisfaction level that influences on industrial productivity. Information processing varies on data import ability for decision making model. So, DM much dependent on the tremendous amount of data. Hence, the transshipment number of containers are imported in the last few years, which generated from BLZ and generalized decision-making as consider to be independent data. Information processing facing sometime confronts the issue of decision making from its import quantities which also improves the quality of port-logistic services. Logistic factors are also significant for the industrial process that dependent on appropriate transportation mode and find several types of transportation mode that usually defined on past transactions dataset. Specially container transportation of large volume defines as an intermodal transport system throughout inland navigation that bear the alternative picture of this research [11]. Comparing with national, international transactions are more complicated on IS in terms of transport regulations, tariffs, exchange of documentation, and so on. Such complexation could be simplified for IS throughout proper method.

3. RESEARCH METHODOLOGY

The research methodology is the systematic approach of collecting data for research projects; it could be either theoretical or practical research which represents the design and size of sampling data for the experiment [10][11][12][26]. BLZ continue operating the regional, local, and international companies that offer as free of customs-bounded area. As part of the concerning data of logistic activities preserved in the web-source of the ministry of transportation and telecommunications in Bahrain. Transport operational data are gaining through port operations as various vessels engaged in the shipping process. Regression in statistical analysis as an observation method used to approach this quantitative research can define different expectations and impacts on operational behaviors. Series of independent variables attempt to determine from the characteristics of logistic shipping data, whereas dependent variables will be evaluated throughout the information system's processing. Among the various decision-making processes, data analysis from this research identifies which decision-making is the most compactable with IS. Shipping lines from different companies are obeyed for their continuous success based on global economic perspectives that rolling on information systems. For this reason, this study suggests the method of evaluation observing by measuring the alignment between the information processing and increasing the success rate of previous years of BLZ. Statistical analysis precisely finds the context of shipping, transport operations on maritime-logistics-chain-related businesses to identify the information processing that find the significance different throughout the ANOVA test. Procedures of statistical models of estimation are used to analyze among the group means of a sample. In this case, existing transshipment data of the last nine years evaluated for the overall statistical test. ANOVA test defines the result of P-value, which brings the significance result for decision making.

4. HYPOTHESIS FORMULATION

Null Hypothesis (H_0): There is no difference between the three groups of transshipment data. There is no relationship between risk factors as data being observed or studied. To rejecting this hypothesis, sometimes need enough correct evidence. However, the alternative hypothesis (H_1): There is a difference among the three transshipment data groups. That means there is a relationship between risk factors involved among those three consequence groups of data by years. If this hypothesis is not proved or rejected, then groups of data accept the null hypothesis. The following two hypotheses as formulated and proposed based on multiple variables.

H_0 : $\beta = 0$, IS not dependent on strategical data & fail to DM.

H_1: $\beta \neq 0$, IS dependent on strategic data while a single variable proved significant for DM.

Regarding two hypotheses applicable, three independent variables are selected for analysis that bears the value of IS on DM. The statistical approach defines the hypothesis test for a specific analysis of decision making.

A. IS select DM

IS processing the alternative hypothesis if it is accepted. The implication projected to this research as it could be suitable for further investigation to make a decision. Indeed, rejecting the null hypothesis indicates accepting the alternative hypothesis that bears the significance value from this transshipment data—list of decision-making from previous table-I, pointing to the perfect decision

after the data analysis. Information processing plays a vital role for decision making based on hypothesis testing.

B. Data Analaysis

Selected data is aggregated from statistics of the Ministry of Transportation and Telecommunication. Analysis rolling on transshipment data from last nine years. Multiple regression tests had been done on this data. Overall data analysis test first tries to identify the significance of the P-value and whether the decision-making process is analyzed through IS. The following table - II, carry the entire dataset as its sample type of container throughput. From last 9 years various type of substances had been imported including container. In this research, selected container throughput category is being analyzed to find more significance of P-value which also known as prediction value. Dataset holds three independent variables (CT Vessels, GC Vessels and Cruise Vessels) and one dependent variable which is container throughput. These selected variables are main as collected data sample for the analysis. This well-prepared dataset from the table-II, as simplified from complex datasets from same web source that documented individually within the range of four quarters (Q1, Q2, Q3, Q4) for each year as quipped.

TABLE II. AGGREGATES TRANSSHIPMENT DATA

Yearly	Quarter	Container Throughput	CT Vessels	GC Vessels	Cruise Vessels
2011	Q1	94396	136	121	20
2011	Q2	91529	130	104	0
2011	Q3	100,769	128	131	0
2011	Q4	88,129	114	125	3
2012	Q1	104892	124	131	5
2012	Q2	113726	109	123	2
2012	Q3	130,684	103	121	0
2012	Q4	176000	114	143	16
2013	Q1	95828	123	148	22
2013	Q2	120114	112	137	0
2013	Q3	122,768	122	155	0
2013	Q4	91133	104	151	7
2014	Q1	93093	106	171	11
2014	Q2	109355	108	209	2
2014	Q3	114402	101	213	0
2014	Q4	116091	106	215	12
2015	Q1	111353	105	177	23
2015	Q2	226900	191	349	23
2015	Q3	329804	264	529	23
2015	Q4	424602	87	182	9
2016	Q1	95618	95	171	19
2016	Q2	193974	184	346	23
2016	Q3	288060	252	481	23
2016	Q4	379817	311	618	36
2017	Q1	93879	61	160	20
2017	Q2	197665	128	322	20
2017	Q3	109159	69	154	0
2017	Q4	95801	73	182	13
2018	Q1	110296	74	182	21
2018	Q2	110683	77	129	5
2018	Q3	107407	67	112	0
2018	Q4	104046	68	117	13
2019	Q1	99527	67	114	31
2019	Q2	104188	67	114	31

C. Statistical Test and Analysis

The statistical method of multiple regression is applied to this dataset. As stated, one dependent and three independent variables dataset analyzed are performing to the test. The interpreted result defines the final implication of this research. In contrast, applicable regression is multiple in this statistical model that generates an ***R Square*** value of 0.59, which means the variance of all types of vessels usually operating on this port is predicted as derived from independent variables. Means that 59% of variation come from independent variable as given to container throughput. So, the relationship between independent and dependent variables is moderate for prediction, as seen below in the figure 2.

Regression Statistics	
Multiple R	0.765435338
R Square	0.585891256
Adjusted R Square	0.544480382
Standard Error	58205.69457
Observations	34

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	1.43799E+11	47932884893	14.14824645	6.3249E-06
Residual	30	1.01637E+11	3387902880		
Total	33	2.45436E+11			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	41955.61161	24823.32098	1.690169161	0.101362484	-8740.373109	92651.59633
CT Vessels	-27.13798293	398.8944115	-0.068032999	0.946210791	-841.7890524	787.5130866
GC Vessels	552.1852832	199.1941426	2.772095987	0.009476946	145.3765724	958.993994
Cruise Vessels	-335.728881	1117.323437	-0.300476004	0.765886575	-2617.607761	1946.149998

Figure 2. Overall Statistical Analysis Result.

Since, the model bears significance so the relationship is negative value 6.3249E-06, and the p-value is well below ($P<0.05$), which is very significant overall. This overall significance bears the value of individual significance known as P-value or prediction value for each vessel. Since coefficients of CT vessels and cruise vessels are negatively correlated with the dependent variable that bear the low significance, it decreases the number of container throughput of each year within the last nine years. Oppositely, the more significant is GC vessels as generate the higher value of positive number compared to both CT and cruise vessels that increase every year as expected of container throughput. This could be one of the regions of collaboration within the companies, whereas GC vessels bring more quantitative products accordingly port management. But decrease number of containers through CT and cruise vessels is not statistically significant

because the individual p-value is greater than (P>0.05) that not useful to generating a prediction. In this case, IS alternatively elaborate all the variables and find the regions of decreasing. So, necessity of IS declared that decision might depend on a statistics analysis of how level of significance bears on it that also comes from IS's elaboration due to crucial matter to make a decision [21]. Regression formula moderating as stated below in equation number (i).

$$Y = a_0 + a_1 CT + a_2 GC + a_3 \quad \ldots\ldots\ldots (i)$$

The above equation (i) is sorting the three independent values *(CT, GC, Cruse)* for *Y* prediction, whether CT & Cruse generates the non-significance value. That's why only GC is acceptable, and the other two are rejected for prediction result as calculated. Additional plotting charts also represent the significance level of GC vessels.

D. Plotting Analaysis

A constructed relationship defines the plotting where the three categorical vessels determine the particular plot that may not be quite random. However, due to the heteroskedasticity problem that happens only for GC vessels, as seen orange color that predicted value as appeared of this region is significant. The other two values appeared as homoscedasticity on the same plot (color blue & gray), which statistically non-significance. Y-direction refers to the predicted value and x-direction refers to residuals value as stated below in the plotting figure 3 where three vessels visually determine the number of significances of the prediction level.

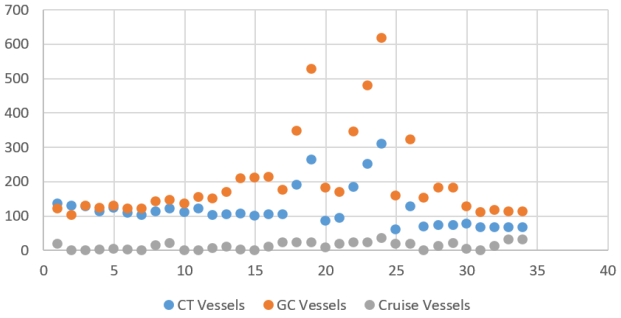

Figure 3. Data plotting of categorical vessels

E. Hypothesis Test

Conventional level of significant influence over the null hypothesis and alternative hypothesis. Since the significance level is less than 0.05, an alternative hypothesis will be selected as found in the statistical analysis. The coefficients of GC vessels are not equal to zero as value is 552.18, suggesting or selecting the alternative hypothesis and rejecting the null hypothesis. The hypothesis test proved that IS dependent on DS, whereas the significance level of the interval of both CT and Cruise vessels not less than the p-value. So, the prediction value is to be defined only by Y-intercept, and the observation result is failed to do so. However, only the GC vessels must be determined to construct the IS concerning the transshipments data that bears the enormous significance value.

5. Result Analysis and Significances

The significance value carries via GC vessels as stated on hypothetical test, which can be constructed by structured decision making, as it is stated that quantity analysis could be reordered via computing formulation. As the result stated that p-value in Y-pred only GC vessels as accepted for its. The result generates the direction from the observational method in the heteroskedastic statistical analysis that only find the high number of significance vessels as found in GC. Heteroskedastic mean unequal scatter. In this case, other elements vectors on scatter plot like CT and Cruse quantified by the variance in statistical dispersion. For this reason, IS necessary to apply on target margin whereas the supply chain formulation may generate the required number of quantities. It also varies on dependent variables that how much support comes from the competitive analysis. This quantified result with IS significantly operates in decision-making process for market profitability, full-fill the target value, overcome the lost or bring the sustainable profit. In this regard, number of GC vessels are highly significant as the prediction value is indicated. CT and Cruise vessels do not bear any significant value. In this case, number of CT and Cruise vessels help analyse how GC vessels become more significance for the supply chain operation. It can follow two different terms as short term and long term for decision making as stated here.

A. Short Term

Short-term collaboration agreement in this structure of decision-making able to brings a positive impact on logistic performance, which contributes with the flexibility and business logistic performance that derived by partnerships among companies. So, peer to peer companies as collaborate from decision making process.

B. Long Term

A long-term shipping collaboration agreement also engage with the further decision making that impacts on practical implication, strengthening company capability which increases competitiveness at the international level. In this case, manufacturers and suppliers are co-operated to transfer containers for the long-term agreements, since DM depends on IS for logistic management system [16].

From this hypothetical test, select a structural decision-making process with IS, operating the long or short-term decision as applied previously on maritime logistics research [17]. As seen from the result of the significance bear two approaches where short and long

terms carry out the result of decision-making from its past influential performance which able to lead future direction for port operations. Indeed, this statistical observation method significance on port logistic decision-making process for further policy making [23].

6. DISCUSSION

IS revolutionized in various sectors. This research has focused on DM since the operational logistic management system is dependent on information processing. The overall statistical analysis suggests that one out of three independent variables dependent on IS for its significance level. IS of any organizational level is designed to process, collect or distribute the information. In this regard, structure decision makes it more comprehensive with computational methods that could handle based on a prediction, whether reordering or manipulate the number of container quantities. BLZ terminal APM company uses this structure decision for its operational case. Since structure decision is formulated, so applicable long- and short-term decisions could be finalized based on the independent variables that are significant and able to give the prediction.

7. CONCLUSION AND FUTURE SCOPE

Information system is exceedingly essential for decision making whereas categorical decisions are pending for operational case and in this research evaluate the transshipment data in supply chain as analysis to prove that how appropriate decision could be selected based on its categories. Analytical data sorted out from some data sampling in terms of depth analysis for DS that depend on IS [21][22]. Further study may discover the logistic approach within the supply chain in port management system for qualitative analysis.

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