INTERNATIONAL JOURNAL OF MARITIME TECHNOLOGY

IJMT Vol.15/ Winter 2021 (1-9)

Available online at: www. ijmt.ir

Evaluation of the main factors effective on loading and unloading of dry bulk cargo with a focus on reduced rate of loading and unloading in the Imam Khomeini port - Iran

Homayoun Yousefi

Associate Professor, Faculty of Economics and management, Khorramshahr University of Marine Science and Technology, Khorramshahr - Iran. Email: homayounyousefi@yahoo.com

ARTICLE INFO

Article History:
Received: 13 Nov. 2020
Accepted: 24 Feb. 2021

Keywords:
Port performance
Bulk Terminal
Ship equipment
Delay in separation

ABSTRACT

This article aims to determine the main factors affecting the fast and reliable loading and unloading of the dry bulk terminal in the Imam Khomeini Port with an emphasis on reduced rate of loading and unloading in order to improve the performance of the port. In this study, the actual loading and discharging statistics data related to the port used previously as validated databases. A linear regression method used for calculating and final analysis in order to analyze the data and obtain the results by using the econometric method. The overall results of this study indicate that in the first model-independent variables of a technical defect of ship equipment, delay in separation, and displacement of cooling equipment affect the dependent rate of loading variable and this effect is indirect. In the second model, independent quarantine variables, technical defects of ship equipment, and the displacement of the cooling equipment influenced by the rate of unloading the dependent variable and these effects are indirect.

1. Introduction

Ports in all countries are gateways to world trade. Due to the phenomenon of globalization and the increasing development of distribution chain systems, the ports of each country play an important role in the economic competitiveness of industries and economic growth of that country. Owners of goods want to speed up the passage of their goods through ports and reduce tariffs and freight rates; the efficiency of ports has an effective role in achieving these factors. Ports with a high level of efficiency provide fast and reliable services to their customers, which leads to customer satisfaction, attraction, increase revenue, and the ability to provide cheaper services (Noramin et al., 2011). As a result, optimization of unloading and loading operations in ports in order to reduce the time of transfer of goods from producer to the consumer being considered an important issue. Given this approach and the growing need of countries for economic development, the need to examine the performance of ports as the main bases for exports and imports of goods, to improve performance is more necessary (Umang, et al, 2011).

The existential philosophy of ports makes sense with the function of unloading and loading goods with the quality and speed of unloading and loading operations incessant in order to grow to the development level. This means that in addition to continuous quality improvement, optimal use of time and efforts to eliminate disruptive and harassing factors in port performance is the key to success, even fourth and third generation ports do not need unloading and loading operations (Van Vianen, et al, 2014). In other words, the main subject of a port is the fast loading and unloading of cargo, so, the other activities are ancillary; it means that the factors that act as barriers should be removed in order to improve the rate of dry bulk cargo handling at the port.

By considering the effective factors such as fast and reliable services, the reduction time of handover of cargo from shipper to consumer, and high efficiency of Imam Khomeini port will cause to improve the quality and speed of loading and unloading operations nonstop at the port.

2. Theoretical Foundations and Scientific Background of the Subject

In maritime transport, loading and unloading is a field of activity in the interior of the port area to the ship's warehouse. From the UNCTAD point of view, the loading and unloading activities divided into three categories: 1). Ship operations: This type of activity is carried out between ships' holds and the wharf. In fact, this activity includes items that move goods from ships' holds to the Berth. 2). Wharf operation: This stage starts immediately after the end of the previous stage and ends until the goods to be placed in the warehouse. At this stage, port equipment has the highest volume of activity. 3). Warehouse operation: This stage begins with the arrival of goods at the warehouse. According to a regular schedule and based on safety principles, all goods to be positioned in a specific and appropriate place inside the yard and warehouses (UNCTAD, 1993).

Wadua (2009) has planned the operation of bulk goods loading terminals by simulation. Their purpose is to present the application of port simulation models to make decisions regarding the improvement of port operations and the expansion of port capacity. In addition, port capacity has been estimated as a function of port performance by establishing a relationship between port performance and operational indicators for bulk goods loading terminals.

Tunzen (2009) states that the high level of port efficiency due to its ability to provide reliable and fast services is one of the factors that make them attractive to freight forwarders. He also states that the efficiency of ports can have a significant impact on the time of shipwreck at the port, which reducing the time of delivery of goods and freight received by shipping companies. Bogarik and Petrovik (2007) intend to seek the development of dry bulk terminal capacity with the help of a simulation model. The modeling results strongly show that the work of "unloading mechanization" with a short strategy reduces the time required to unload the ship and thus increases the unloading capacity of the system.

In a paper using a simulation model, Wienen et al. (2014) seek to determine the range required for storage of dry bulk terminals, which is used to increase the capacity of dry bulk terminals in that period. Short-term and long-term planning. The analytical method can be used to determine the parameters that affect the required storage size. The results show that these parameters include ship service time, ship sizes, and bulk material storage area in the bulk terminal, which ultimately increases the storage capacity.

In their study, Amang et al. (2011) identified the key issues and sources of disruption at the port in question by examining the largest bulk port in the Middle East, the Port of Mina SAQR in the United Arab Emirates. Finally, a mixed linear optimization model for the Quay allocation problem for the dry bulk cargo terminal is presented. Nooramin et al. (2011) aimed to determine the main causes of delays in the operation of loading and unloading of bulk dry goods in the port of Imam Khomeini that was done by risk assessment and calculation of risk priority numbers. Based on the values of risk priority numbers, four factors of unpreparedness of goods owners, pass and quarantine procedures, administrative and financial issues, and truck shortages were identified as important factors in delaying the loading and unloading of dry bulk cargoes in the Imam Khomeini Port.

According to the above statements, a simulation model is a valuable tool for assessing the port operational performance results; so, the focus has also turned to the financial results of the port in order to evaluate the items in the model. Therefore, the simulation model with a high degree of accuracy may reduce the time required to discharge dry bulk cargos in the Imam Khomeini Port.

3. Method of Research and Data Collection

The research outcomes are useful to improve the prosperity of Imam Khomeini port in order to increase the port performance by growing the loading and unloading efficiency of dry bulk cargo at the terminal; the present study is considered as applied research in terms of purpose and in terms of dimension. Once a retrospective study, based on how the data is collected, this research is descriptive and correlation. Library method and documentary studies are used to identify and collect information related to the factors affecting the loading and unloading performance of the port.

Since this study deals with the actual data reflected in the loading and unloading statistics of Imam Khomeini port, in order to provide information from the statistics and the informatics section for the rate of loading and unloading of the dry bulk terminal. The data of Imam Khomeini Port are used for the period 1390 to 1396, including 60 observations, to perform calculations and final analysis in order to investigate the data and obtain the results from the regression method using Stata14 software. Regression analysis or analysis of variance is a statistical technique for examining and modeling the relationship between variables. Regression analysis is one of the most widely used methods among statistical techniques. In the research, regression analysis is used; the goal is usually to predict one or more criterion variables from one or more predictor variables. One of the most widely used statistical methods in various sciences is the implementation of various regression methods to determine the relationship between a dependent variable and one or more independent variables. Dependent variables, responses, and independent variables are called explanatory variables. Execution of a regression model is possible by defining a regression model. The simple regression model with the dependent variable Y and p-1, the independent variable X1, X2,…, XP-1 is defined as a relation (1) (Neter et al, 1996):

$$Y_I = \beta_0 + \beta_1 X_I + \beta_2 X_2 + \cdots + \beta_{p-1} X_{p-1} + \varepsilon_i \quad (1)$$

The regression equation is defined as relation (2) by defining the matrix of explanatory variables and the variables of response variables, model parameters and error sentences (Neter et al, 1996):

$$Y_{n*1} = X_{n*p}\beta_{p*1} + \mathcal{E}_{n*1} \quad (2)$$

Using the least-squares method, the values of the vector β_ (p * 1) can be obtained by halving Equation (3) (Neter et al, 1996):

$$Q = \sum\nolimits_{I=1}^{n} \left(Y_I - \beta_0 - \beta_1 X_n - \cdots - \beta_{p-1} X_{i*p-1}\right)^2$$

(3)

The estimation of the vector β_ (p * 1) is shown as b_ (p * 1) and according to the matrix form defined in Equation (3), it is calculated as Equation (4) (Neter et al, 1996):

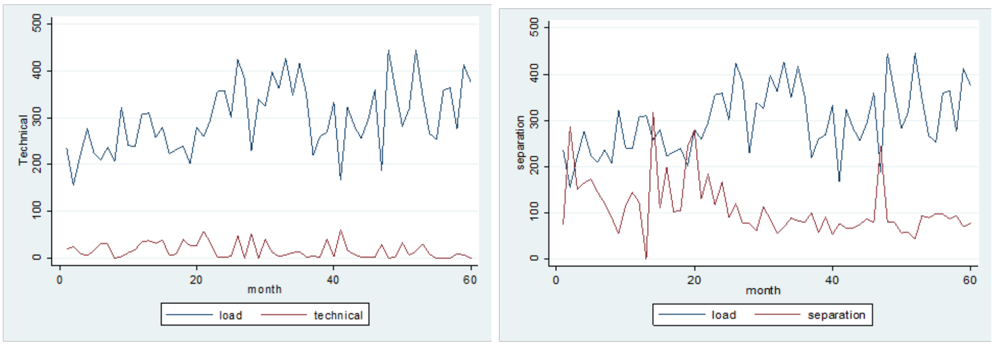
$$b_{p*1} = (\acute{X}X)^{-1}(\acute{X}X)Y \quad (4)$$

The coefficient of determination (R2) in the regression shows that the percentage of the changes of the dependent variable is explained by the independent variable. In other words, the coefficient of determination indicates how much of the changes in the dependent variable are affected by the relevant independent variable and the rest of the changes in the dependent variable are related to other factors. It's better to calculate by using Equation (5) (Neter et al, 1996):

$$R^2 = \frac{(SST-SSE)}{SST} = \frac{SSR}{SST} = 1 - \frac{SSE}{SST} \ (5)$$

4. Analysis and Interpretation

In order to investigate the fluctuations model of loading and unloading rates, among the factors affecting the loading and unloading performance, we have analyzed the structure of the following four factors, technical defects of ship equipment, delays in separation, relocation of cooling equipment and quarantine. The time series has been extracted and plotted by using Stata software.

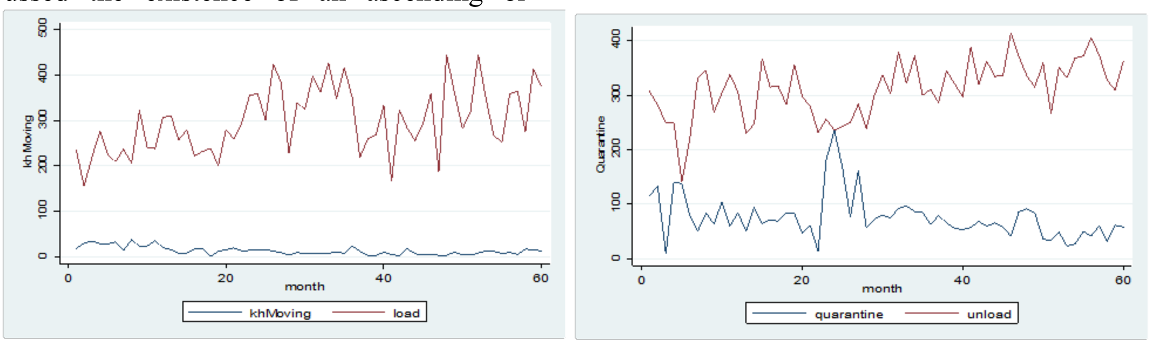


(a) (b)

Figure 1: (a): Variable time series trend of technical equipment of ship equipment

(b): Time series variable trend of separation delay

Figures 1 and 2 show the values of delay in separation were more than the values of technical defects of ship equipment in addition; the maximum values of these two variables are equal to 60 and 318.25, respectively. They discussed the existence of an ascending or descending the trend in them, but the variable of delay in separation in the period from the twentieth month to the fiftieth month, which is equal to 244, almost goes through a downward trend.



(a) (b)

Figure 2. (a): Novel series trend of cooling equipment displacement variable

(b): Quarantine variable time series trend

Figures 3 and 4 show the changes in the displacement of refrigeration and quarantine equipment do not follow a fixed trend and have many stresses over a period of 60 months, but it can be said that the variability of displacement of refrigeration equipment from 16th and 17th months after the trend. It is declining compared to the first 15 months and the quarantine variable from 21 to 28 months is following an increasing trend. In addition, the values of the quarantine variable are more than the displacement of cooling equipment and have more stress; the maximum values of these two variables are 35 and 236, respectively. Before performing econometric tests, it is necessary to check the meaning of the variables. Research has always assumed that the time series is mana, and if the time series variables are not mana, a problem called false regression may occur. A time-series variable is when the mean, variance and its correlation coefficient remain constant over time (Bazargan Lari, 2012). Statistical tests, specifically the single root test, are used for this purpose. In this study, we use Stata software to perform a single root test.

Table 1: Manai-Dickey - Fuller test results in Stata software

Variable	Test statistics	Critical values at 1%	Critical values at 5%	Critical values at 10%	Critical values at Z MacKinnon
Soft drain	-4.302	-3.567	-2.923	-2.596	0.0004
Soft download	-5.404	-3.567	-2.923	-2.596	0.0000
Quarantine	-5.245	-3.567	-2.923	-2.596	0.0000
The unpreparedness of the owners of the goods	-5.586	-3.567	-2.923	-2.596	0.0000
Lack of depot space (evacuation place)	-4.220	-3.567	-2.923	-2.596	0.0006
Cargo not ready	-7.081	-3.567	-2.923	-2.596	0.0000
Draft survey	-6.385	-3.567	-2.923	-2.596	0.0000
Shortage or early departure of the truck	-6.218	-3.567	-2.923	-2.596	0.0000
Technical defect of ship equipment	-7.322	-3.567	-2.923	-2.596	0.0000
Delay in separation	-6.422	-3.567	-2.923	-2.596	0.0000
Ship security inspection	-5.126	-3.567	-2.923	-2.596	0.0000
Strategic equipment failure	-4.115	-3.567	-2.923	-2.596	0.0009
Gang going fast	-3.336	-3.567	-2.923	-2.596	0.0134
Gang equipment failure	6.941	-3.570	-2.924	-2.597	0.0000

Lack of gang equipment	-5.917	-3.567	-2.923	-2.596	0.0000
Replacement of gang equipment	-3.775	-3.567	-2.923	-2.596	0.0032
Gang food delay	-7.412	-3.567	-2.923	-2.596	0.0000
weather condition	-5.499	-3.567	-2.923	-2.596	0.0000

Here we can assume that the p-value of all variables is greater than 0.05 (0.0000, 0.0009, 0.0004, 0.0006, 0.0134, 0.0032) of the null hypothesis (there is a single root and the variable in question is anonymous) in all variables Reject dependent and independent research. As a result, all variables are meaningful or stable and there is no single root in them, and we can enter the research model and prevent a false regression. Linear regression makes for 15 independent variables and 2 dependent variables in two stages for the first model (load dependent variable and all other independent variables), and the second model (discharge dependent variable and all other independent variables). The results of this estimation show, due to that for all independent variables the t-statistic is not greater than 2, in addition, the absolute value of the t-statistic is not less than 0.05, so we must look for a model in which none of the independent variables have a significant relationship with the dependent variable. The coefficients are not statistically meaningless and equal to zero and should remain in the model. The following model can be considered as the main model because R2 is related to the dependent variable of discharge softness equal to 0.3257, loading softness is 0.3329 and also t is greater than 2 and in addition, the absolute value of t is less than 0.05.

$$\text{First model regression:} \qquad \text{Load} = f\,(\text{technical, separation, KHmove}) \qquad (1)$$

Table 2: Results of linear regression estimation of selected independent variables and load-dependent variable

Source	Addition of squares of errors	Df (degree of freedom)	Average square
Model	33772.2423	3	131316.727
Component error	۳۶۲۵/۷۰۱۲۵	56	203039.27
Total	۵۱۵۸/۵۷۶۲۳	59	304355.997

Number of observations = 60
Statistics = F(3.56) = 9.31
Probability F = 0.000
The correlation coefficient = 0.3329
Adjusted correlation coefficient = 0.2972
The root of the mean square error = 60.214

Loading	Coefficient	The standard deviation	T test statistics	Probability of absolute value of T statistic	Coefficients in the 95% confidence interval	
Technical defect of ship equipment (KHmove)	- 1.2518	0.4962	- 2.52	0.015	- 2.2459	- 0.2576
Delay in separation	- 0.3509	0.137	- 2.55	0.014	- 0.6266	- 0.0753
Replacement of gang equipment	- 2.2732	0.9192	- 2.47	0.016	- 4.1146	- 0.4317

Width of origin (the regression coefficient)	390.4827	19.1545	20.39	0.000	352.1114	428.854

Second model regression: Unload = f (Quarantine, technical, KHmove) (2)

Table 3: Results of linear regression estimation of selected independent variables and discharge dependent variable

Source	Addition of squares of errors	Df (degree of freedom)	Average square	
Model	52950.912	3	17650.304	Number of observations = 60 Statistics = F(3.56) = 9.02 Probability F = 0.0001
Component error	109639.329	56	1957.84516	The correlation coefficient = 0.3257 Adjusted correlation coefficient = 0.2895 The root of the mean square error = 44.248
Total	162590.241	59	2755.76679	

Unloading (discharging)	Coefficient	The standard deviation	T test statistics	Probability of absolute value of T statistic	Coefficients in the 95% confidence interval	
Quarantine	- 0.4940	0.1465	- 3.37	0٠01	- 0.7875	- 2005
Technical defect of ship equipment	- 0.8743	0.3562	-2.46	0.017	- 1.5876	- 0.1610
Replacement of gang equipment (KHmove)	- 2.0158	0.6485	-3.11	٠/٠٠3	- 33150	- 0.7167
Width of origin (the regression coefficient)	391.3212	16.6164	23.55	0.000	358.0344	424.608

By considering the stability of other factors in the first model, a unit increase in the independent variable of a technical defect of ship equipment causes 1.2518 decrease in the dependent variable and a unit increase in the independent variable delay in separation causes 0.3509 decrease in the dependent variable plus one. The unit of increase in the independent variable of cooling equipment displacement causes 2.2732 decrease in the dependent variable of loading. In addition, in the second model, assuming the stability of other factors, a unit increase in the quarantine independent variable causes 0.4940 decrease in the unloading dependent variable. A unit increases in the independent variable of a technical defect of the ship equipment causes 0.8743 decrease in the unloading dependent variable plus a unit increase in the displacement independent variable. Cooling equipment causes a 2.0158 reduction in the dependent discharge variable. As a result, the equations of the first and second models are as follows.

Model.1: Loading = 390.4827 + (-1.2518 technical) + (-0.3509 separation) +(-2.2732. KHmove)

Model.2: Unloading = 391.3212 + (-0.4940 Quarantine) + (-0.8732 technical) +(-2. 0158. KHmove)

Auxiliary or specific regression method, also known as vif[1] test, which is used to find out the alignment problem. We run the alignment test for the discharge dependent variable. The software output is presented in Table 4.

Table 4: vif test results for independent variables and discharge dependent variable

Variable	vif	1/vif
Quarantine	1.07	0.9377
Technical defect of ship equipment	1.05	0.9558
Replacement of gang equipment	1.03	0.9693
Average vif	1.05	

Column 1/ vif represents the share of the independent variable that other independent variables could not explain. Table 4 shows that 93% of the quarantine variable, 95% of the shipbuilding equipment technical defect variable and 96% of the cooling equipment displacement variable are not explained by other variables. In fact, the smaller of 1/vif value, may cause have a higher probability of alignment. As you can see in Table 4, all variables have a high 1/vif, so there will be no alignment problem in the regression of the first model. Next, we run the alignment test for the dependent variable. The software output shows in Table 5.

Table 5: vif test results for independent variables and load dependent variable

Variable	vif	1/vif
Technical defect of ship equipment	1.18	0.8461
Delay in separation	1.12	0.8634
Replacement of gang equipment	1.10	0.9111
Average vif	1.13	

[1] Variance inflation factor

According to Table 5, 84% of the premature variable of technical defect of ship equipment, 86% of the variable of delay in separation and 91% of the variable of displacement of cooling equipment by other variables are not explained by other variables. It should be noted that there would be no alignment problem in the regression of the second model.

If we have a correlation problem and use the simple regression method to estimate the coefficients, the estimated coefficients in this case will remain unstable and consistent, but will lose their efficiency (Bazargan Lari, 2012). In this study, the camera-Watson statistic test was used for both self-correlation and soft-load models to perform self-correlation testing. The results obtained from performing the camera-Watson statistic correlation test for the soft discharge dependent variable are as follows:

"Durbin-Watson d-statistic (4, 60) = 2.063006"

Meanwhile, the obtained statistic is 2.06 and this value is between 1.5 and 2.5 and is close to 2, we have no correlation in our model. To perform the camera-Watson statistic correlation test for the soft load dependent variable, the result is as follows:

"Durbin-Watson d-statistic (4, 60) = 1.432618"

Although our statistic is below 1.5, therefore, we have a positive correlation, and one way to fix the correlation is to enter the dependent variable interrupt into the model and use the camera etch test or generalized camera. To do this, once again regression applied the results of the camera etch statistics test can be obtained as shown in table 6.

Table 6: Generalized camera test results

Prob > Chi^2	df	Chi^2	lags(p)
0.2206	1	1.500	1

Since Prob is greater than 0.05, hypothesis H_0 is accepted, in which H_0 hypothesis is non-correlated. By entering the interrupt of the dependent variable as an independent variable in the model, the problem of self-dependence is solved. A cryptographic test is used in order to know what variables are necessary in our regression, or to remove redundant variables from the regression model. The results of this test for the first and second models of this research are as follows:

The model has no removable variables = H_0

The model has removable variables = H_1

"For the unloading dependent variable: F(3.53) = 0.16, Prob > F= 0.9237"

"For the loading dependent variable: F(3.53) = 0.21, Prob > F = 0.8897"

Because of the prob value that in both regression is greater than 0.05, therefore the H_0 hypothesis is accepted, and the model with the variable cannot be removed.

The main factors are as follows: 1). quarantine, 2). the unpreparedness of cargoes owners, 3). lack of storage space (unloading place), 4). unprepared cargo, 5). draft survey, 6). shortage or truck failure, 7).technical defect of ship equipment, 8).delay in separation, 9).ship security assessment, 10).failure of strategic equipment, 11). dull speed, 12). failure of cooling equipment, 13). lack of cooling equipment, 14). relocation of cooling equipment, 15). delay in cooling food and weather conditions.

Before performing the econometric tests, it was necessary to check the significance of the variables, because if the time series variables are not constant, there may be a problem called false regression. After performing the mana test, since the p-value of all variables was greater than 0.05, then we reject the null hypothesis (there is a single root and the variable in question is anonymous). All research variables, dependent and independent, are mana and stable, there is no single root in them and we can enter in the research model.

Considering the stability of other factors in the first model, a unit increases in the independent variable of a technical defect of ship equipment causes 1.2518 decreases in the dependent variable. A unit increases in the independent variable delay in separation causes 0.3509 decreases in the dependent variable plus a unit of increase in the independent variable of cooling equipment displacement causes 2.2732 decreases in the dependent variable of loading. In addition, in the second model, assuming the stability of other factors, a unit increases in the quarantine independent variable causes 0.4940 decrease in the unloading dependent variable and a unit increases in the independent variable of technical equipment of the ship equipment causes 0.8743 decreases in the unloading dependent variable plus a unit increases in the displacement independent variable. Cooling equipment reduces 2.0158 in the discharge dependent variable.

5. Conclusion

Based on the previous internal and external research and studies, fifteen main factors affecting the reduction of loading and unloading performance are extracted by the researcher.

By observing the graph of changes of independent and dependent variables in a period of 60 months, it can be concluded that the changes of independent and dependent variables in a specified period has a lot of stress, which means that they do not have a significant downward or upward trend. Nevertheless, by examining the graph of changes of independent variables relative to dependent variables, an inverse relationship between independent variables and the rate of loading and unloading variables can be seen.

Therefore, it can be concluded that the first model shows independent variables of a technical defect of ship equipment, delay in separation, and displacement of cooling equipment effect the dependent rate of loading variable and this effect is indirect. Furthermore, in the second model, independent quarantine variables, technical defects of ship equipment, and the displacement of the cooling equipment influenced by the rate of unloading of the dependent variable and these effects are indirect.

According to the results of the vif test, there will be no alignment problem in our regression. Furthermore, to perform the self-correlation test, the two camera-Watson statistic tests and the free brochure test have been used for both soft-discharge and soft-load models, so there is no self-correlation in the regression. In order to remove redundant variables from the regression model, we have used a cryptographic test which refers to the test results of the model with a variable that could not be removed. According to the results of the present study, three factors of technical defects of ship equipment, delay in separation and displacement of cooling equipment compared to soft loading and three factors of quarantine, technical defects of ship equipment and displacement of cooling equipment compared to soft unloading have an indirect effect.

6. Resources

1- Bazargan, A. (2012) *'Practical statistics'*, first publication, Shiraz University Publication, pp 48-62.

2- Farhanianzadeh, S. and Yousefi, H. (2014) *'Investigation and ranking of factors affecting the optimal unloading and loading of bulk goods in the port'* MSc. thesis, Khorramshahr University of Marine Science and Technology.

3- Nooramin, S. and Sayareh, J. (2012) *'Finding the causes of delays in the operation of unloading and loading dry bulk goods in the port of Imam Khomeini using the method of error analysis and its effects'*, Journal of Oceanography, year 2, issue 6, summer, pp 49-55.

4- Bugaric, U. and Petrovic, D. (2007) *'Increasing the capacity of terminal for bulk cargo unloading.'* Simulation Modelling Practice and Theory 15(10): 1366-1381.

5- Tongzon, J. L. (1995) *'Determinants of port performance and efficiency'*, Transportation Research Part A, vol. 29A, no.3, pp.245-252

6- Van Vianen, T. et al. (2014) 'Simulation-based determination of the required stockyard size for dry bulk terminals.' Simulation Modelling Practice and Theory 42: 119-128.

7- Vianen, T. A., Mooijman, D. L., Ottjes, J. A., and Lodewijks, G. (2012) *'Simulation based operation control of dry bulk terminal in proceedings of the (2012)'*, International Conference on Networking Sensing and Control (ICNSC 2012) , Beijing - China, 35: 73-78.

8- Neter, J., Kutner, M. H., Nachtsheim, C. J., and Wasserman, W. (1996) *'Applied linear statistical models'*, vol. 4, p. 318. Chicago - Irwin.

9- U. Bugaric, D. Petrovic (2007) *'Increasing the capacity of terminal for bulk cargo unloading'*. Simulation Modelling Practice and Theory 1366–1381

10- UNCTAD. (1993) *'Strategic planning for port authorities'*, United Nations, Geneva.

11- Umang, N. et al. (2011) *'The berth allocation problem in bulk ports'*. 11th Swiss Transport Research Conference.

12- Waldhwa, L. C. (1992) *'Planning operations of bulk loading terminals by simulation'*, Journal of Waterway, Port, Coastal and Ocean Engineering, vol. 118, no. 3, pp. 300-315