STOWAGE PLANNING FOR CONTAINER SHIPS USING TABU SEARCH ALGORITHM TO MINIMIZE STEVEDORING COST PT XYZ

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Abstrak

Kata Kunci :

Abstract

The competition between ship liner is increasingly tight. The flow of delivering goods by ship in Indonesia is increase. PT XYZ is one of the forefront shipping company in Indonesia. PT XYZ has commitment to improve the performance of the company continuously by efficiency. Stevedoring activity as core activity in shipping, is the critical element to the efficiency of operational. Shifting is one of activity in stevedoring that does not have value added. It is the temporary movement of the containers to another place. There are 128 shifting occurs in PT XYZ from October 2013 to March 2014. The highest number of shifting is on Hilir Mas Ship in March 2014 by 36 shifting. Efficient stowage planning in most case can reduce number of shifting and operating costs. This research use CSP mathematical model from Ambrosino, 2004 with adjustment in constraint of weight stacking and stability to be soft constraint. Violation of these constraints will be given a penalty. Completion of the model is done using a heuristic algorithm to obtain initial solution. Optimization is then performed by using Tabu Search Algorithm with MATLAB R2009a. Optimal value is the smallest value of objective function with the smallest penalty. The result of this study is the number of shifting in proposed stowage planning is 0. Total stevedoring cost reduction for 6 months respect to the proposed stowage planning is 0.56 % or Rp 99,910,875.00.

Keywords : stevedoring, stowage planning, CSP mathematical model, heuristic algorithm, tabu search

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Chapter I Introduction

I.1 Background

The number of containers transported by ships in Indonesia has increased. Containers flow in PT Pelindo increased by 14.78% in the first semester of 2013 (Luthfi, 2013). Another fact is data of goods and containers traffic from PT Pelindo I shows the number of national shipping companies also increased by 6 – 11% each year from 2010 (Sukamto, 2012). The competition between these companies is therefore big.

One of shipping company in Indonesia is PT XYZ. This containerized ship liner began the operations from ship chartered, and then it developed into market leader of domestic containerized shipping company. PT XYZ has 21 ships, which are destined for domestic shipping. The capacity of the ship is 191 – 958 Twenty Feet Equivalent Units (TEUs) with total capacity of 8192 TEUs. PT XYZ offers core service, which is delivering cargo in container by ship and support services, which is loading and discharging containers. Loading containers is the activity of moving the containers into the ship and discharging is moving the container from the ship into container yard or the other place. Loading and discharging is part of stevedoring activities.

PT XYZ has many shipping routes in delivering the containers. One of the fixed shipping route is route from Jakarta to Samarinda and Bitung. This shipping has two ports destination, namely Samarinda and Bitung. Containers loaded from Jakarta will be discharged into Samarinda first, and then Bitung. The revenue, cost, and profit PT XYZ of Jakarta – Samarinda – Bitung from October 2013 to March 2014 is shown on Figure I.1.

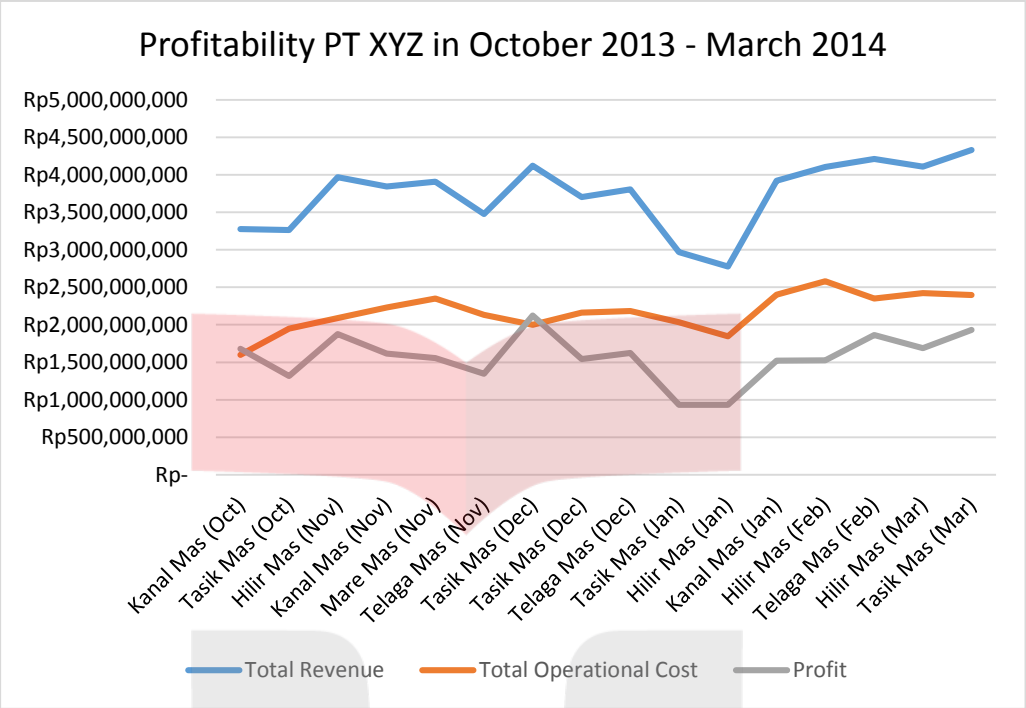

Figure I.1 Profitability PT XYZ
(Source: Profit and Lost Report PT XYZ)

Figure I.1 show the symptom of profitability PT XYZ. The revenue of PT XYZ is not likely experience a significant increase. The revenue up and down within the period with the average around 3.73 billion. On the other hand, the operational cost PT XYZ is increasing slightly each period from Rp 1,598,629,055.00 in Kanal Mas, October 2013 to Rp 2,398,680,445.00 in Tasik Mas, March 2014.

If the revenue of the company is constant but the cost is likely to rise, then the profit of PT XYZ is constant and tend to decline. However, the company expects profits always go up. PT XYZ is looking for the new way to get higher profit still with competitive price in the constant revenue. One way to achieve it is by reducing the operational costs. There are two types of operational cost of shipping, namely operational cost of ship and operational cost of port. Operational cost of ship consists of cost of bunker, maintenance, water, and charter costs. Operational cost of port consists of port services, stevedoring cost, relocation cost, stacking container cost, and other costs.

Total operational cost of port PT XYZ from October 2013 to March 2014 is Rp19,103,495,025 and operation cost of ship PT XYZ in the same period is Rp15,625,529,177. It can be translated that operational cost of port is higher than operational cost of ship with number around 55% of total operation cost. Therefore, the research is focusing on operational cost of port.

Stevedoring cost is the biggest contributor to operational cost of port. Stevedoring is the critical element to the efficiency of operational cost of port (Imai, et al., 2006). The main activities of stevedoring is loading, discharging, hatch cover movement, and shifting. Shifting is temporary removal and replacement (discharging and reloading) of container on to a stack of containers. The common situation of shifting is that containers with further destination place on top of the container with closer destination. Containers on top must be discharged and reloaded in order to access containers below them. Shifting is a detrimental and non – value added activity so that it should be reduced. Number of shifting PT XYZ in October 2013 – March 2014 is depicted on figure I.2.

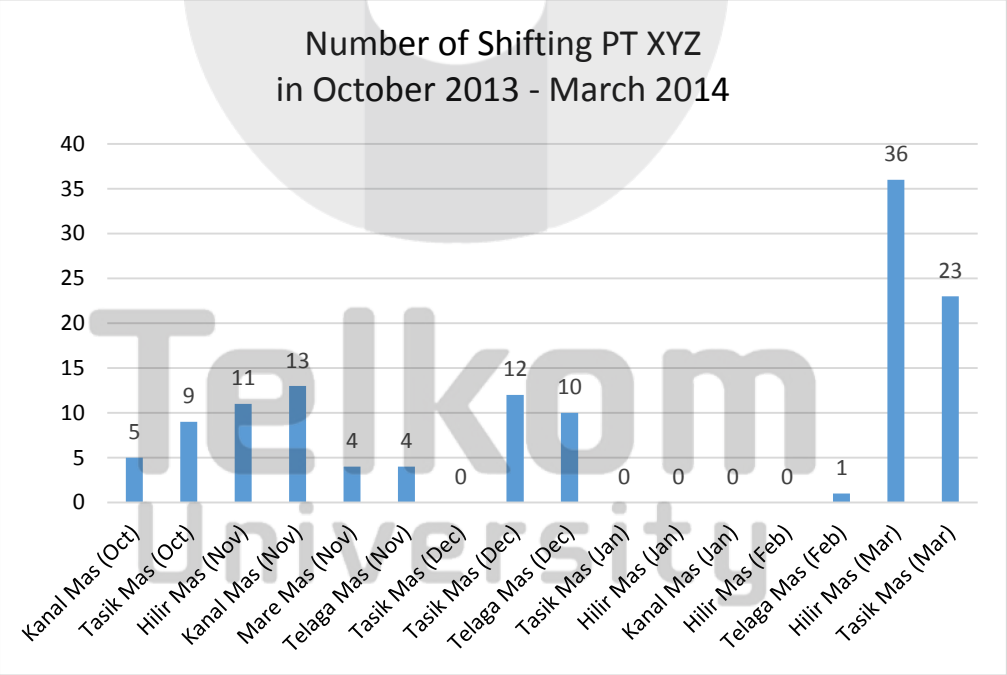

Figure I.2 Number of Shifting PT XYZ in October 2013 - March 2014

(Source: Existing Stowage Planning PT XYZ)

The highest number of shifting occurred in Hilir Mas Ship on March 2014 with 36 shifting. PT XYZ pay shifting calculated per container moved. Efficient stowage planning in most case can reduce number of shifting and operating costs (Imai, et al., 2006). Stowage planning is the task of determining the best container arrangements. This research proposed stowage planning for container ships that can minimize stevedoring cost by reducing number of shifting PT XYZ and considering other factors.

I.2 Problems Formulation

Based on the background of the problems described above, the formulation of the problem in this study is:

How does the stowage planning that minimize stevedoring cost PT XYZ?

I.3 Research Objective

The objective of the research is using model and search algorithm to design stowage planning that minimize stevedoring cost by reducing number of shifting PT XYZ and considering type of container, size of container, weight, and stability.

I.4 Research Boundaries

Problem restrictions are given in an attempt to focus the research on accomplishing its objective and create a scope for the research. The boundaries of this research are:

1. The research solves Container Stowage Problem (CSP) PT XYZ for port of Jakarta – Samarinda - Bitung
2. The research considers two type of size container which is 1 TEUs (20 feet) and 2 TEUs (40 feet)
3. The ship to be stowed is Lo – Lo (Lift on – Lift off), which load and discharge containers from the top (by using crane)
4. There are only three type of container, namely standard container, reefer container, and tank container.
5. Loading containers is only in Jakarta as port or loading.
6. All the container stow in ship will be discharged in Samarinda and Bitung.
7. Shipping term is CY – CY, so PT XYZ is responsible to the container from

CY in port origin to CY in port destination.

8. The research does not consider cost by community issue for calculating operational cost.

I.5 Research Benefits

1. Obtaining recommendations to PT XYZ regarding design stowage planning that minimize operational costs of stevedoring activities PT XYZ.
2. Obtaining recommendation to PT XYZ to use stowage planning as guidance for loading and discharge the containers shipped.

I.6 Research Systematic Writing

This research described the systematic writing as follow:

Chapter I **Introduction**

This chapter covers the background of the research, problem identification, research objectives, research boundaries, research benefits and the writing systematics.

Chapter II **Literature Review**

This chapter contains literature studies relevant to the problems research and theories that support problem solving to prove that the methods employed are fitting, such as method of stowage planning, type of container, ship characteristic, etc. This chapter also covers the results of previous researches.

Chapter III **Research Methodology**

This chapter describes the systematic order of the research in detail: problem identification phase, hypothesis forming, research model development, data collection and processing, data processing analysis, conclusions and recommendations that are to be given to the company.

Chapter IV **Data Collection and Processing**

This chapter goes into the details of data collection, both primary and secondary data, used as input in the research and data processing.

Chapter V **Data Analysis**

This chapter contains an analysis on the result of data processing, which forms the basis for improvement recommendations concerning inventory policy.

Chapter VI **Conclusions and Recommendations**

This chapter contains the conclusions in accordance with the objectives of the research and recommendations for both the company and further research.

Chapter VI Conclusion and Recommendation

VI.1 Conclusion

This research is to generate efficient stowage planning by using model from Ambrosino et al, 2004 with some adjustment in constraint of weight stacking container and stability. To solve the model, heuristic algorithm is used then tabu search is to optimize the solution. From the solution generate, here is the conclusion of this research:

1. Heuristic algorithm forces containers that discharged first are loaded in the highest tier above containers discharged after. It can effectively reduce number of shifting in the proposed stowage planning. Stowage planning proposed reduces number of shifting PT XYZ in voyage October 2013 – March 2014 from 128 shifting to 0 shifting.
2. Tabu Search Algorithm does not react to the number of shifting but it give optimization in stability and weight stacking containers constraint. Tabu search algorithm looks for the best order of stowing the container that give minimum container weight differences in left – right ship and bow – stern ship.
3. Proposed stowage planning minimize stevedoring cost by 0.56% efficiency or Rp99,010,875 in 6 months from October 2013 – March 2014.

VI.2 Recommendation

There are some recommendation related to the future direction of research regarding this topic, including:

1. Considering the stack position in the container yard
2. Considering activity of loading container in the destination port