STUDY ON IMPROVEMENT OF PRODUCTIVITY OF INDONESIA SHIPBUILDING WITH THEORY OF CONSTRAINTS

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ABSTRACT

Indonesia is a big country having big population, huge area and huge Exclusive Economic Zone area. For world harmonized growth, it is quite important to realize steady economy growth on Indonesia. Growth of Indonesia's shipbuilding industry specifically is an important part to achieve Indonesia's maritime vision, but by far as for the shipbuilding market, 3 major countries, China, South Korea and Japan have obtained almost 100% share, which means it is quite difficult to increase the world share. In the volatile marine world, fluctuating oil price often affect production capacity, and investment decision is hard to get with TOP management. Indonesia shipbuilding industry has big mission under severe management and environmental condition. We clarify basic dilemma/conflict inhibiting the growth of Indonesia shipbuilding industry under assumption of severe management environmental condition, with Theory of Constraints (TOC). The basic dilemmas are solved by erasing the reason of existence of opposite activity and the Indonesia shipbuilding ever-lasting development logic is proposed with the solution of basic dilemma.

Keywords: TOC, Theory of Constraints, Shipbuilding, Accounting, Productivity Improvement

INTRODUCTION

The Indonesian archipelago straddles a strategic location at the crossroads of two Oceans – the Indian and Pacific Oceans and two continents – the Asian and Australian continents. This geographical advantage added by abundance of natural resources, potential human resources (World no.4 in number of population), huge land area (World no.15) as well as huge Exclusive Economic Zone area (World no.3). At a glance, these features might seem a geostrategic blessing. However, unstable economic condition and slow growth in maritime industries since its independence has complicate Indonesia's strategic calculus (Sandee et.al, 2014).

President Jokowi and his administration have declared a vision to make Indonesia the World's Maritime Axis and outlined an ambitious maritime doctrine to boost economic growth by improving connectivity between the islands of the Indonesian archipelago. This vision has been started by focusing the country's development on building infrastructures to enhance connectivity between main islands in order to reduce the goods price disparities in the regions. As a derivative of this objective, an adequate supply of vessel for goods and passenger transportation is needed, as well as maintaining the quality of the service provided. The milestone for this maritime era under current government administration is by deciding that all government and state-owned companies' vessels procurement have to be built locally. Question arises

whether Indonesian shipbuilding industry are able to answer this challenge. Having more than 250 shipyards located in various regions, mainly in Java islands, does not provide a clear satisfaction that this vision would be easily executed. There are several boundaries that withstand the implementation such as volatile oil price fluctuation, unfavorable fiscal tax on the shipbuilding industry, lack of financial support, limited production capacity of shipyards and outdated ship production technology as well as management (Logam, 2017). That is why, given the geostrategic mentioned above, the production capacity of Indonesian shipbuilding industry is way far below 3 major countries, China, South Korea and Japan which have obtained almost 100% share of the world shipbuilding market.

This paper particularly address this issue by identifying the basic dilemmas/conflicts that stands in the way of achieving Indonesian Maritime Vision especially the one faced Indonesian shipbuilding in general. The theory of constraints (TOC) methodology as one of world of management best practices is applied to the issue to further breakdown the dilemmas and provide a solution to this issue. The Theory of constraints (TOC) has provide concept that the undesirable effects observed in the system should be produced by certain core dilemma/conflict, that views any manageable system as being limited in achieving more of its goals by a very small number of constraints (Goldratt, 2001 & 2002) In that case, core dilemma/conflict is inhibiting the system further development. If the core dilemmas/conflicts of the current system are solved, the system can grow better and significantly in a shorter time than ever. The thinking process of TOC served simple method to find and solve core those dilemmas/ conflicts in particular.

Using the expertise gained from solving similar issue faced by Japanese shipbuilding industries a decade ago, as the first step in our approach, we had found problem similarities with the shipbuilding condition with Indonesia. Fig. 1 shows the trends of completion in major Japanese shipyard that show us core dilemma, "Produce as much as possible" versus "Not produce as much as possible" that existed in both Japan and Indonesian shipbuilding industry. Moving further from the similarities, this paper objective is to propose the ever-lasting growing logic by solving core dilemma with TOC way of thinking that can be applies to Indonesian shipbuilding industry. The solution provided in this paper serves as a general logic that can furtherly expanded with detail clarification of problem found in the operation and management of shipyards.

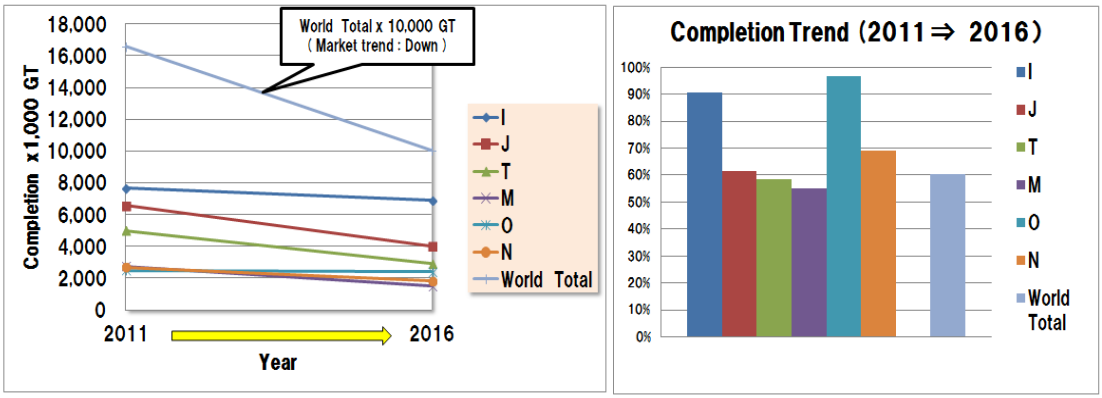

Fig. 1 Completion trends of major Japanese shipyard (2011～2016)

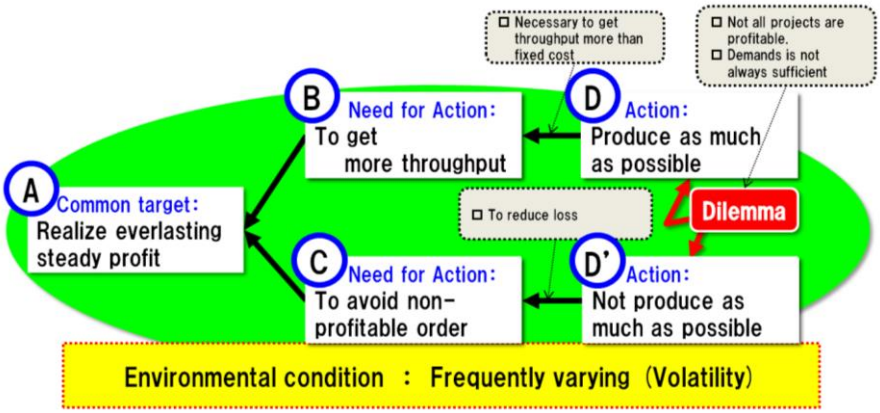

Fig. 2 Core dilemma of Indonesian shipbuilding industry

ANALYSIS OF CORE DILEMMA IN SHIPBUILDING INDUSTRY

Creating Dilemma Structure (CLOUD) in TOC

Conflict is observed at action phase. The same action induced by some different needs is not recognized as conflict / dilemma. Thinking process by TOC uncovers the dilemmas as shown in Fig.2. Dilemma is explained as a state where there are 2 opposite actions to realize their own needs to achieve the common target. This diagram can be produced by the following simple questions and their answers below.

1. Producing process
   To find description box B : What need induce the action D?
   To find description box C : What need induce the action D'?
   To find description box A : What is common target for 2 needs of B & C?
2. Checking process
   After that, review the each linkage by making following sentences.
   Linkage A-B: B is necessary to achieve A.
   Linkage B-D: D is necessary to achieve A.
   Linkage A-C, C-D' similar to above.
3. Assumption process
   Further clarify the reason of linkage by making question as follows.
   Linkage A-B: Why B is necessary to achieve A
   Linkage B-D: Why D is necessary to achieve B
   Linkage A-C, C-D' similar to above.

Solution of Core Dilemma by TOC

Solving core dilemma of shipbuilding is to find action "X" as shown in Fig. 3. In TOC thinking process, answer to these questions needs to be provided.

1. Is there any good way to satisfy both【B】&【C】at same time.
2. Is there any good way to satisfy【C】with doing 【D】
3. Is there any good way to satisfy【B】with doing 【D'】

The answer on above question shall be obtained as follows and serves as the solutions.

1. Profitable evaluation is done with amount of throughput.
2. To raise flow potential / shortening Lead Time (LT)
3. To raise price with improving added value quality.

Although three (3) solutions for core dilemma have been obtained, it is still not practical. So we make more detail explanation on each solution in the next chapter.

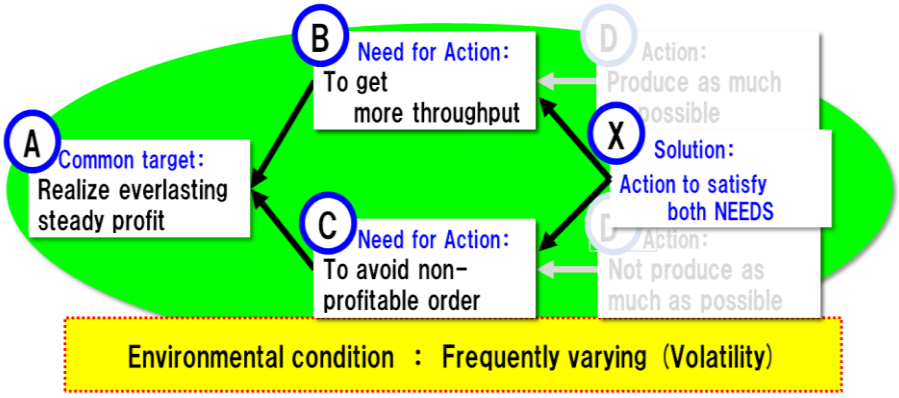

Fig. 3 Image of solution of the core dilemma

REALIZING SOLUTION OF CORE DILEMMA IN SHIPBUILDING INDUSTRY

Solution 1: Profitable Evaluation with Amount of Throughput

The output amount of a production system is determined by bottle neck capacity. For shipbuilding industry, quantity of output is generally determined by building dock period. The throughput, in this case is pre-determined as margin profit is determined by the quantity of output. The profit can be defined by equation (1)

$$P = S - VC - FC \quad \text{and} \quad P = Tp - F \qquad (1)$$

Differentiation of equation (1) in time will result in equation (2).

$$d/dt \cdot P = d/dt \cdot Tp - d/dt \cdot F \qquad (2)$$

Where ,

P = Profit (Surplus money)
S = Sales
VC = Variable Cost
FC = Fixed Cost
Tp = Throughput/Margin profit (=S-VC)

Equation (2) expresses that in order to become profitable the gain velocity of Tp has to be increased more than the consuming velocity of FC. Furthermore, we have to clarify how to define the gain velocity of Tp and the consuming velocity of FC in shipbuilding industry. The total amount Tp is determined by total quantity of output (Sales). The total quantity of output is determined by dock period (Dp). So the gain velocity of Tp is Tp / Dp. Next the total necessary FC & total operating day (total Dp) is determined by TOP management. Then the consuming velocity of FC is obtained with Σ FC / Σ Dp, which is constant value under assumption of keeping same resource.

Profit velocity = Tp / Dp - Constant value (= Σ FC / Σ Dp) (3)

Furthermore, the profitable condition can be obtained with inequality expressed below

Tp / Dp > Constant value (= Σ FC / Σ Dp) (4)

Where Dp means dock period (Assumed to be the bottle neck stage)

From equation (4), we know that the value of Tp/Dp can be increased by decreasing the docking period Dp in which can be fully controlled by shipyard. This means shipyard can change current project more profitable by reducing Dp. We know flow management create significant short of lead time (LT) and Dp reduction can be realized by implementing the flow management. Therefore it is quite important to implement flow management into shipbuilding industry or improving its current status if already applied.

Solution 2: Raising flow potential/shortening project's Lead Time (LT)

In relation to the limited production capacity of most of Indonesian shipyards, the work scheduling and job planning is somewhat important to determine good result in the end. Learning from Toyota Production System, it is quite well known that the TPS implement a strong cash flow management (Ohno, 1988). TOC method proposed in this paper is also developed based on a concept in TPS (Goldratt, 2009). It is said that TOC can be expressed by one word "FOCUS". TOC explains that "to focus" is " to stop unnecessary jobs now". This is quite easily obtained by question of "Which/what is need to do first?", which is a matter of priority in the system. We already know that to do only one task at same time is much faster than doing more than one task at the same time. This concept has been brought into practice by the first author during his time supervising one Indonesia's shipbuilding company in Indonesia, located in Surabaya City of East Java Island. Fig. 4 shows the result of small experiment done in an Indonesia shipbuilding company. This experiment is conducted to verify the above mention concept "to focus" under same quantity of resources and fixed cost (FC). Fig. 4 shows that by focusing the resources at one project before moving to another project when conducting two projects that uses the same block construction has proven to reduce the lead time (LT) of each project and therefore shortened the total production schedule.

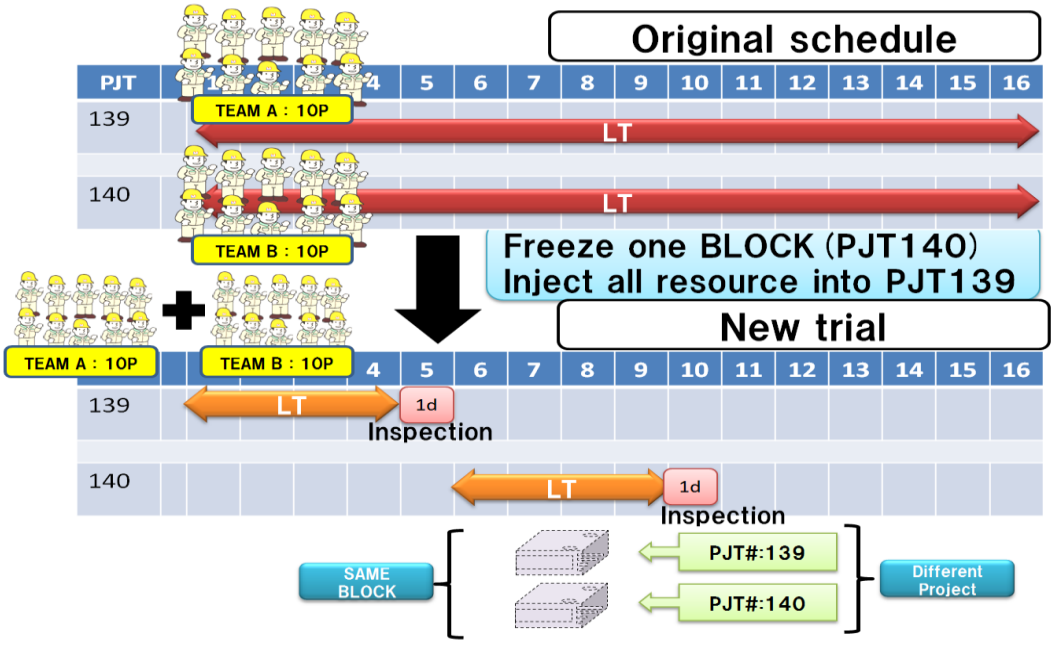

Fig. 4 Result of small experiment with TOC flow management in one of Indonesia's shipbuilding company.

Relation between Demand & Supply	D > S		D < S	
Location of Bottle neck	Market	company	Market	company
	×	○	○	×
Nos of new order Nos of product	Many (Increasing)		Small (Decreasing)	
Evaluation on Economy	Good		Bad	

Fig. 5 Relationship between the economic condition and the location of bottleneck

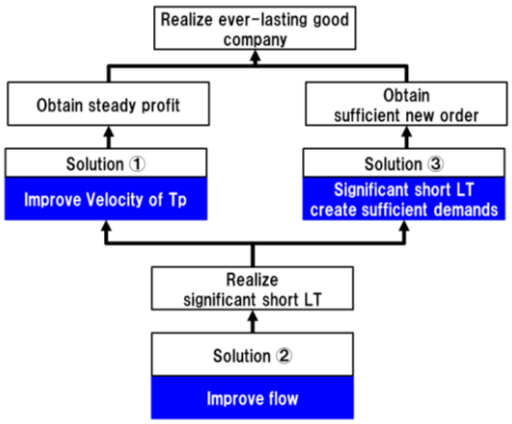

Fig. 6 The improvement way to ever-lasting good company

Solution 3: Raising price with improving added value's quality.

Fig.5 shows relationship between economic condition and the location of bottle neck. The problem for shipbuilding company that the author perceived in Indonesia is to produce profit under bad economy condition (Demand < Supply capacity). If the shipbuilding company get some excellent competitive edge, the shipbuilding company might get the chance to change from (Demand < Supply capacity) condition to (Demand > Supply capacity). Since the price is determined by relationship of Demand and Supply, the prices is going down under Demand < Supply, in this case; the project contract value. So it is quite important to turn things around to condition of Demand > Supply. The second solution mentioned in previous section, assumed can be applied to general situation, shows that TOC shall bring significant improvement on shipbuilding project LT. Adding the assumption that the company can succeed delivering 50% less LT compared with general industry LT level, we may assess how much merit the stake holder of shipbuilding company can get as follows.

1. Client/Investor improve Risk to lose profit due to delay of delivery
2. Client/Investor can invest as late as possible
3. The shipbuilding company can become only one company that can meet the client's inquiry.
4. Financier/Bank can make shorter period of financial loan.

Those merits are quite better for Client / Investor / Financier (Bank) especially under frequent varying management external environment. Therefore, having competitive advantage in ability to deliver shorter project's lead time will be significant to the growth of the company itself. Furthermore, advantage in having significantly short LT might change market condition from (Demand < Supply capacity) to (Demand > Supply capacity), in all management external environment, which bring opportunity to raise price offer compared to competitors for a similar ship product.

All in all, analysis on core dilemma of shipbuilding shows the improving way as a down-top approach shown in Fig. 6. The key point is to make better flow that leads to significantly short project lead time and thus bring profitability and create new demand/market for a shipbuilding company.

CONCLUSION

This paper propose a solution by implementing Theory of Constraints that resulted in finding that an improved process and work flow by reducing concurrent proceeding job in shipbuilding projects has enable a shipbuilding company to realize significant short project lead time (LT) and might bring profitable condition and sufficient demand in the future. This would also bring benefit for Client, Investor and Financier. An improving flow method is already introduced and observed by small experiment in one of Indonesia's shipbuilding company. It is confirmed that there are possibility of this method to be implemented in general way into Indonesia shipbuilding company to induce good effect for Indonesian Maritime Vision under the Indonesia's current government administration.

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