Application of Theory of Constraints in Quantity Surveying Firm

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Abstract

As the construction projects grow in size and complexity, the roles of Quantity Surveying (QS) firms which provide QS services getting more significant. Theory of Constraints (TOC) views every process in a system are linked and constraint needs to be identified and dealt with so that to achieve continuous improvement in the whole operation. Removing constraints are the most effective way to improve the overall system performance. As QS firm did not involve inventory, the TOC application and its impacts might be different. This research focused on how TOC approach could be applied in solving the critical constraint appeared in the QS firm. This study adopted questionnaire surveys and semi-structured interviews with QS practitioners in Kuala Lumpur, which directly involved in the management of the QS firm. Descriptive and content analysis were adopted to analyse the identified constraint. The TOC methodology used to deal with the constraint, as well as the impacts of TOC to the QS firms. It could be concluded that the most common constraint in the QS firms was the delay of project participants and substandard QS practices. Meanwhile, the concept of TOC could be applied as one of the tools in decision-making process for QS firm, especially when to dealt with constraint of the delay of project participants and providing better quality of QS services.

Keywords: Theory of Constraints, Quantity Surveying Firm, Performance

Article history:
Submitted: 12/11/2019; Revised: 15/04/2020; Accepted: 24/04/2020; Online: 01/05/2020

INTRODUCTION

A constraint is defined as anything that limits an organization or an entity from moving toward to achieving its goal (Goldratt, 1990). There are constraints in every working environment including QS organisations, which will slow down the overall operation. TOC have been discussed in many management literature. However, there is little study emphasise on constraints in QS organisation working environment. Identifying and removing constraints from main activities could help in reducing uncertainties in construction processes, which in turn increases the transparency of management (Chua, Shen, and Bok, 2003). It could be argued that better performance can be assured if constraints are better understood at the outset.

Nowadays, organisations including in the construction sectors struggle to survive in a global competition. Every organisation tries to find the best philosophy which is suitable with their strategy to gain advantage among their rivals such as total quality management (TQM), just-in-time (JIT), or lean manufacturing (LM), theory of constraints (TOC), and etc. In Malaysia, construction industry plays an important role in generating wealth to the country and also contributing in the development of economic, buildings and social infrastructures. As the construction projects grow in size and complexity, therefore QS have diversified roles in providing project management services. It is important for a QS organisation to have a well management system that leads to more efficient management of time and resources.

An organisation is a system of connected department working together to deliver goods and services to the customers to generate profit. In real world, the business variables are highly interdependent. An action that changes one variable could impact another variable in the chain and eventually boomeranging back to the original action. For example, the decision to increase sales can lead to growing inventory levels, which in turn increase working capital levels to increase supplier credits that causing material delays. This eventually cause production delays, which give negative impact to the sales. Moreover, this creates conflicts within departments and remedial measures need to be taken on the foremost action.

Managing short-term conflicts might slowing down the company's ability to deal with external opportunities and threats. Management capacity is exhausted but the outcomes might not as substantial as what were expected. In this non-linear world of causal loops and relationships, the linear mathematical

equation is not applicable. A big action can result in no outcome at all or a small action can result in a big outcome. We need a system approach to manage a complex organisation where deep understanding of causal relationships between parts are essential. These interconnected systems look complex but are easy to manage as they always have one influence point for intervention. To manage a complex organisation such as a QS firm, it is important to find this leverage point for a focused intervention. TOC is viewed as "an overall theory for running an organisation" (Goldratt, 1988). TOC has a broad range of implementation scale. It can be applied in production, logistics, supply chain, project management, land transportation system, service sector banking and so forth (Chawla and Kant, 2017). The TOC can also be applied to not-for-profit organizations to improve performance towards non-financial goals and to ensure financial survival. However, to date, there is no research carried out on application of TOC in QS organisations. Therefore, TOC comes into play as it emphasises on the weakest point on the chain and fix it.

Generally, a QS organisation specialised in carrying out QS practices within the construction industry such as construction cost estimating, contract administration, procurement and tendering. As the construction projects grow in size and complexity, the roles of QS organisations which provide QS services getting more significant. The management of the QS organisations should be efficient so that better QS services can be provided. This resulting in better quality construction project. TOC is believed to aid the management team in the QS firms to deal with the constraints, which impede the operation of the firms to provide excellent QS services.

THE THEORY OF CONSTRAINT

The theory of constraints (TOC) developed by Goldratt is a process meant to identify and remove constraints within the organizational operation that are obstructing the way of organizational goals (Goldratt, 1990). Its rationale forms major portions of the organization's philosophy of continuous improvement. It is used to figure out the limiting factors of an organization from accomplishing its goals, establish a solution to the problem, and getting the individuals in the process to create the necessary changes for themselves.

Goldratt, (1990) defined constraint as anything that limits an organization or an entity from moving toward to achieving its goal There are constraints in every working environment including QS firms which will slow down the overall operation. However, there can be situations where we are unaware of the presence of the constraints, or, we are more likely emphasise more on the project goals. Even though constraints have been discussed in a lot of the management literature, there is little detailed study on constraints in QS firm working environment. Identifying and removing constraints from activities help to reduce uncertainties in construction processes and increases the transparency of management (Chua, Shen, and Bok, 2003). Therefore, avoidance measures can be taken if the cause of conflicts and disputes is understood (Yate and Hardcastle, 2002). This can help to reduce unnecessary wastage and loss of money and time because of inadequate planning. If constraints are better understood at the outset, it is believed that better performance can be assured.

Removing constraints from are the most effective means of improving overall system performance (Chua et al., 2003; Goldratt, 1990). Studies reporting subjective evidence from early adopters proposed that TOC techniques could result in increased output while decreasing both inventory and cycle time (Aggarwal, 1985; Johnson, 1986; Koziol, 1988). Rigorous academic testing has validated those early findings revealing that manufacturing systems employing TOC techniques exceed the performance of those using Manufacturing Resource Planning (MRP), Lean Manufacturing, Agile Manufacturing, and Just-in- Time (JIT) (Cook, 1994; Fogarty et al., 1991; Ramsay, 1990). The results of these studies indicate that TOC systems produce greater levels of output while reducing inventory, manufacturing lead time, and the standard deviation of cycle time (Watson, Blackstone, and Gardiner, 2007). As QS firms are service type organization, which unlike the manufacturing companies, they do not have inventoried, their outcome cannot be determine by reduced inventory and cycle time. Therefore, the TOC application and its impacts might be different.

In addition, the rate of growth of a firm depends on the rate of absorption of new management determined by the quality of existing management (Penrose, 2009). Cannon and Hillebrandt (1990) identifies management (and not fixed capital) as the most significant factors of the capacity and capability in the firms. He suggested that construction industry is management intensive as many decisions require to be made from day to day operation as well as within the organization. The TOC is a spontaneous framework for managing organisations. It implied the ambition of a company or organisation to

continuously improve their performance, through a process of continuing improvement. This concept is based on the assumption that the available resources for the managers within the organization are limited and should be directed towards a clearly defined goal. According to the TOC, the goal of a company should be the ability to generate profit in short term and long term instead of defining it in terms of technology utilisation, market share, and performance of human resource (Chawla and Kant, 2017). According to Goldratt (1988), every system must have at least one constraint. If there is no, then it is a "real" system. For example, if a profit-making organisation is in real system situation, then it would be making unlimited profit.

The presence of constraints represents the opportunities for improvement which is opposing to conventional thinking. TOC views constraints as positive. As constraints determine the performance of a system, therefore, an increase of the system's constraints will improve its performance. TOC views every process in the operation as they are rings of the same chain instead of thinking they are independent from each other. Simultaneously, TOC emphasises on the weakest points which are bottlenecks for the whole company and attempt to determine the relationship of these bottlenecks (Şimşit et al., 2014). Umble and Spoede (1991) used the analogy of a steel chain. In order to strengthen the chain, one must strengthen the weakest link first. If a link beside the weakest is strengthened, the strength of the whole chain is not increased. Little effort exerted on the weakest link will simply break the chain. The concept of a chain can be used to represent processes in any organization.

Moreover, Serigar (2019) apply the TOC to eliminate constraints on bottleneck work stations to facilitate the overall production flow in manufacturing sector. The author discovered that after setting the optimal master production schedule, applying the principle of TOC and using linear programming methods, it was found that the mixing and cooking stations become non-bottleneck work stations anymore. The bottleneck problem has resulted in a significant decreased in product sales and consumer demand every month.

In the construction industry, Talib and Kashkol (2019) mentioned that project works could achieve a certain achievement in a project after defining the constraints, types and impact. This provides a comprehensive framework for the project works, as it helps to identify and treat the obstacles experienced by the projects and work to identify appropriate solutions and through a set of logical thinking throughput. These solutions are examined and the future results of each solution are identified and useful in addressing the specific problem and the extent of the future impact of its application.

In short, TOC is an overall management philosophy emphasises that identification and management of constraints are the keys to utilising limited time and resources to generate maximum potential returns. Therefore, this combined management philosophy changes the way of thinking of managers and become an important tool to solve root problems.

RESEARCH METHODOLOGY

Mixed mode research design was adopted as a method of data collection where it combines both qualitative and quantitative methods in the research. In this research, mixed modes were adopted to collect data to exploit the strengths and counterbalance the weaknesses of each data collection method, therefore, widen the scope of the research. The instruments used to collect data are through questionnaire surveys and interviews. The questionnaire is conducted via telephone calls and electronic software. Telephone calls used to contact the respondents to obtain useful information related whereas, online questionnaire is conducted through Google Doc and were emailed to the respondents. The data collected from questionnaire and interviews were quantitative and qualitative form respectively. Besides, the secondary data was collected using desk study approach where the data obtained through reviewing literature from previous research publications. The sample size for this research activity was determined by using Krejcie and Morgan (1970) Table. A total population of 102 Consultant Quantity Surveyors Practitioner (CQSP) located in Kuala Lumpur based on list by the Board of Quantity Surveyors Malaysia (BQSM) involved in this study. The sample size determined by the Sampling Table was 80. Off those 80 replied respondents, 5 were involved in faced-to-faced semi-structured interview for validation purposes. The interview was ended when achieved the saturation point. Descriptive and content analyses were adopted to figure out the ways how TOC be applied in the QS firms.

Result and Discussion

For the first question, it consists of four sub questions, it reflects the familiarity of TOC among the respondents i.e. do they heard about TOC before or aware that TOC is actually practiced by other

companies in their operation, do they realised that every system must have constraint, TOC can actually enhance continuous improvement, and whether they will practice TOC in the future. The respondents are required to give score regarding their understanding of the statements.

Table 1: Understanding and Familiarity of TOC

	Mean	Median	Mode	Standard Deviation
I am aware that many companies from other industries are practising Theory of Constraints (TOC) in their operation	3.19	3.00	3	1.030
I am aware that according to Theory of Constraints (TOC), every system must have at least one bottleneck	4.43	4.00	4	.507
I am aware that Theory of Constraints (TOC) is important for continuous improvement of a company	3.29	3.00	3	1.056
I am willing to adopt Theory of Constraints (TOC) in the company operation in the near future.	4.19	4.00	4	.750

Table 1 shows that among the respondents, most of them have an average understanding regarding TOC. The mean scores lie around 3.00, which shows the moderate answer in the questionnaire. In this case, the respondents aware that there was at least one bottleneck in every system and they were willing to adopt TOC in their firm's operation in the future. This gave the mean score of 4.43 and 4.19 respectively. The result subsequently showed awareness about TOC was important for continuous improvement of a company, which gives the mean score of 3.29. Lastly, most respondents did not realise that other firms from other industries are practicing TOC in their operation, which indicate mean score of 3.19. The values for standard deviation for this set of data are all greater than 0.5 which means the results obtained have slightly high variation.

Generally, the constraints are classified into six categories based on the literature review. The constraints are: (1) Competition among QS firms, (2) changes in procurement routes, (3) delay of other project participants, (4) changes in technology used, (5) substandard QS practices, and (6) financial Constraints. The respondents are required to give the score to the constraints indicating how big the magnitude of impact of the following constraints hinders the operation of the firm.

Table 2: Constraint Encountered in QS Firms' Operation

Core Constraint	Mean	Median	Standard Deviation	Rank
Competition among QS firms	1.33	1.00	.483	6
Changes in procurement routes	1.81	2.00	.512	5
Delay of other project participants	***4.57***	***5.00***	***.507***	***1***
Changes in technology used	3.24	3.00	.768	4
Substandard QS practices	***4.43***	***4.00***	***.507***	***2***
Financial Constraints	3.67	4.00	*.483*	3

Table 2 shows that most respondents agreed that delay of other project participants cause the most trouble to the QS firms where it gives the highest mean score of 4.57. This followed by the Substandard QS Practices and Financial Constraint with the mean score of 4.43. and 3.67 respectively.

The remaining three constraints did not cause much impact to the QS firms. For changes in technology, the mean score obtained was 3.24. The subsequent constraint, which was changes in procurement route, obtained a mean score of 1.81. There is a quite distance of the mean score from the previous constraint. Lastly, competition among QS firms provide little impact to the QS firms by referring to the lowest mean score, which was 1.33. The values for standard deviation for this set of data were around 0.5, which indicated the results obtained have least variation.

The semi-structured interview shows that the interviewees have the general concept regarding TOC which are the existence of constraint and TOC enhanced towards continuous improvement. The

concept of TOC states that every system must have at least one constraint and the presence of constraints represents the opportunities for improvement. As the respondents involved in management for several years, with business knowledge acquired, therefore, they have some ideas on generally what TOC is all about.

The TOC methodology start with identification of constraint and from the interviews, the main bottleneck constraints were delays of other project participants and substandard QS practices as shown. As in a typical construction process, QS works span almost the whole construction process but most of the works are dependent on other project participants such as the client, architect, and contractor. When the client delay in stating his project requirements or suddenly changes the requirement, the architect and engineer would subsequently delay in preparing the construction drawing. Therefore, the QS have lesser time to prepare the estimates based on the drawings issued by the architect and engineer if following the stipulated period of executing his services. If there is such delay, the Quantity Surveyors have to accelerate their works to meet the deadline, cause physically and mentally pressure.

Regarding substandard QS practices, it was due to lack of Professional Quantity Surveyors (PQS) in the industry. In Malaysia, QS job is demanding. Many construction companies were hiring Quantity Surveyors and offer a good salary scheme. As in consulting firm, it was merely a place to temporary stop by and for accumulating several years of experience so that to earn the professional title. Therefore, most employees in the QS firms were freshly graduates with have not acquired much experience. Therefore, they are not able to easily adapt to the different environment.

The interview also agreed that for the constraint delay of other project participants, there was nothing could be done. This is because according to the hierarchy of the construction team, the client is the superior of the team. Every project participant is under the client and with the same level of authority unless the client specially delegate any authority to any party. It is supposed all the project participants work together to make the project comes into reality. One of the approach TOC methodology is subordinate of other element especially workers from elsewhere such as the support services to deal with the constraint faced. It also involves scheduling the works so that the works are carried out in sequence. Therefore, the only way to deal with this constraint is to improve the working speed and capability. When the working capability increases, no matter how much delay happens, the QS works could be completed rapidly within the stipulated time.

As for the substandard of QS practices, it was suggested that to eliminate this constraint, the employer or the human resource department shall provide training for the freshly graduated candidates. The employees are the most important asset especially for service organisation i.e. QS firms. The employer has the responsibility to provide training to the employees so that the employees can adapt to the working environment as soon as possible unless the employee itself does not have the willingness to learn and with bad attitudes. If the employees are well-trained, the employees can produce a higher quality of works so that it can achieve higher performance level with less mistakes and hence increase the profit. Furthermore, the company can carry out QS practices by using software such as BIM. The 5-dimensional (5D) BIM enables the estimating job of the Quantity Surveyor become simpler and more straightforward compared to traditional paper drawings and manually take off quantity. Therefore, to increase the speed and capability of QS services, it is a good idea to promote usage of BIM in the QS services

CONCLUSION

From the findings, analysis and result obtained, the most common bottleneck constraint faced in the QS firm is delay of other project participants such as the client, architect, engineer, and contractor, followed by substandard QS practices. The findings also indicated that, by applying TOC in their organization operation, it could help to increase profit by eliminating constraint and improve overall service quality of QS organisations. This is similar with the one being discussed in the literature. Moreover, there was another benefit pointed out, which TOC approach also helps to enhance relationship among the company employees. To eliminate the constraint, the most agreeable options were training to newly QS graduate and implement technology such as software in QS services.

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