

THEORY OF CONSTRAINTS IN CONSTRUCTION PROJECTS

Surbhi Rithe¹, Maithilee Thakare²

^{1,2}MBA Final Year Student of Management, Department of Project and Construction Management, MIT College of Management, MIT Art, Design and Technology University, Pune Maharashtra, India.

Abstract - The aim and scope of this paper is to identify the constraints in construction project working environment and apply the theory of constraints (TOC), which provides practical steps for making organizational decisions in situations in which constraints exist, classifying and eliminating constraints from obstruction activities will help to decrease the suspicions in construction procedures and will escalate the limpidity of project management.

The goal of TOC is to maximize the efficiency, profitability, quality of work. This paper includes basic theoretical information about TOC. It basically helps in problem solving & implementing the solution for the same. TOC is majorly applied in manufacturing sector, including distribution, marketing, project management, and accounting. In short, any situation involving change to a system TOC is applied.

Key Words: constraints, construction, theory of constraints (TOC), Project management

1. INTRODUCTION

There are constraints in every working environment. However, there can be situations that we are unaware of the existence of the constraints, or, we tend to put more emphasis on the project goals. Although constraints have been discussed in much of the management literature, there is little detailed study on constraints in construction working environment.

In current construction situation, it is vital to grow with the new technology & concepts. The ultimate goal is nonstop improvement. Essentially in India, where the appropriate system of work is not followed, TOC will not only help in controlling the limiting factors but also help in continuously approaching the new techniques to overcome delay and cost overrun.

Theory of Constraints (TOC) presented by Dr. Goldratt in his book titled **The Goal**. It is an overall management philosophy. Constraint is point where the project or task fails to perform at it is predicted.

“Anything that bounds an organization or individual from moving toward or achieving its goal” is known as a constraint. Constraints exists in all working environments. Though, there can be situations that we are not aware of the existence of the constraints, we tend to put more

importance on the project goals. Even though constraints have been discussed in much of the management works, there is little detailed study on constraints in construction projects.

The construction working environment involves multi-party participation. Needs and constraints in a multi-party working situation bring complications in project management. These can further develop into conflicts and disputes, which bring cost consequences, direct and indirect, to clients and contractors (Yates, 2002). The project team members have to meet client’s needs on one hand and to overcome constraints on the other hand. With the limited literature for the constraints in the construction working environment, it is important to identify the potential constraints in the construction project, which will help to decrease the unnecessary wastage and loss of both money and time because of inadequate planning. Controlling the constraints is thus a pre-condition for high performance of the project.

THE FIVE FOCUSING STEPS

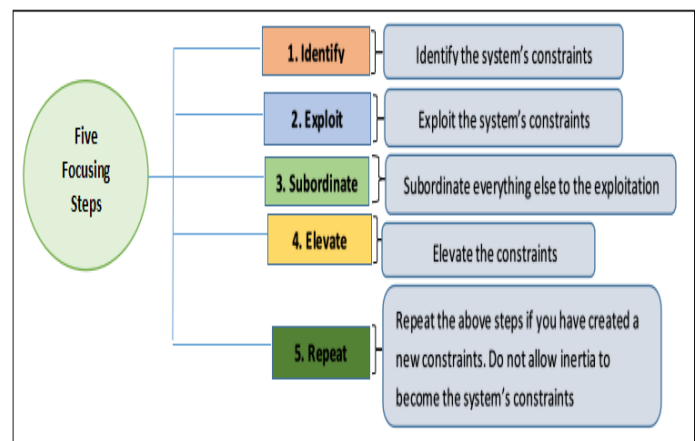


Figure 1: Five Focusing Steps

The objective of this study was to explore the following aspects:

1. To successfully diminish the constraints to overcome delay, cost overrun and poor quality work.
2. To study the reasons behind the occurrence these kind of constraints and find out the ways to reduce and ultimately eliminate them.

3. To show the importance of identifying and reducing the constraints in the current construction industry and its effects.
4. To improve quality.

2. LITERATURE REVIEW

Theory of Constraints (TOC)

The Theory of Constraints is a concept describing methodology for identifying the most important limiting factor (i.e. Constraint) that stands in the way of achieving a goal and then systematically improving the constraint until it is no longer the limiting factor (Lau & Kong, 2006). Dr. Eliyahu Goldratt conceived the Theory of Constraint (TOC) and introduced it to a wide audience through his bestselling 1984 Novel, "The Goal". Since then, TOC has continued to evolve and develop and today it is a significant factor within the world of management best practices. One of the appealing characteristics of the Theory of Constraints is that it inherently prioritizes improvement activities. The top priority is always the current constraints. In environments where there is an urgent need to improve, TOC offers a highly focused methodology for creating rapid improvement. The core concept of the Theory of Constraints is that; every process has a single constraint and that total process throughput can only be improved (Jacob & William, 2003). A very important corollary to this is that spending time optimizing non-constraints will not provide significant benefits; only improvements to the constraint will further the goal (achieving more profit). Thus, TOC seeks to provide precise and sustained focus on improving the current constraint until it no longer limits throughput, at which point the focus moves to the next constraint.

The underlying power of TOC flows from its ability to generate a tremendously strong focus towards a single goal (profit) and to removing the principal impediment (The Constraint) to achieving more of that goal. In fact, Goldratt considers focus to be the essence of TOC. TOC is a common-sense way to enhance system improvement. Any system usually at least has a constraint like that weakest part of the system. The system only becomes stronger until it can improve the strength of the weakest part.

It has been suggested that TOC can be applied to project management. Construction projects are intricate, time-consuming undertakings. The construction projects need a good management to achieve the satisfied result including functional satisfaction, aesthetic satisfaction, completion on time, and completion within budget, value for money and health and safety. (Walker, 1989) defines the construction management as "The planning, control and coordination of a project from conception to completion (including commissioning) on behalf of a client. It is concerned with identification of the clients' objectives in

terms of utility, function, quality, time and cost, and the establishment of relationships between resources. The integrating, monitoring and control of contributors to the project and their output and the evaluation and selection of alternatives in pursuit of the clients' satisfaction are the fundamental aspects of construction project management.

The project definition process is significant if it offers the opportunity for the clients and the teams to identify the constraints and project constraints have to be considered when formulating the project strategy (Chua et. al, 2003). Quantifying the assessment of the actual constraining effect on project objectives and the procurement process, Theory of Constraints will be adopted in the construction context because project development in this respect resembles a production process in which productivity is affected by various constraints. Goldratt propose a five-step process to achieve continual improvement and to get the most of overcome.

In our study, we firstly classified the constraints into five categories based on literature review. They are:

- (1) Economic constraints
- (2) Legal constraints
- (3) Environmental constraints
- (4) Technical constraints
- (5) Social constraints.

2.1. The Five Focusing Steps

The Theory of Constraints provides a specific methodology for identifying and eliminating constraints, referred to as five focusing steps (Vorne_Industry, 2011).

- **Identify:** Identify the current constraint (The single part of the process that limits the rate at which the goal is achieved).
- **Exploit:** Make quick improvements to the throughput of the constraint using existing resources (i.e. make the most of what you have)
- **Subordinate:** Review all other activities in the process to ensure that they are aligned with and truly support the needs of constraints.
- **Elevate:** If constraint still exists (i.e. it has not moved), consider what further actions can be taken to eliminate it from being the constraint. Normally actions are continued at this step until the constraint has been "broken" (until it has moved somewhere else). In some cases, capital investment may be required.

- **Repeat:** The five focusing steps are a continuous improvement cycle, therefore; once a constraint should immediately be addressed. This step is a reminder to never become complacent-aggressively improve the current constraint and then immediately move on to the next constraint.

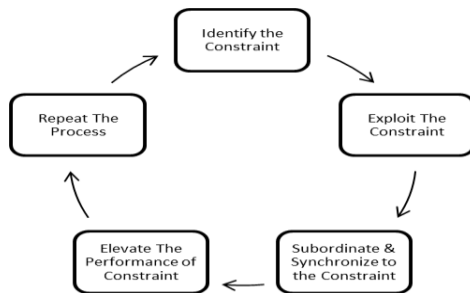


Figure 2: TOC-Five Focusing Steps

3. APPLICATIONS

The processes defined in Goldratt’s Theory of constraints have been applied to the areas of manufacturing, distribution, marketing, sales and finance, and project management (Jackson & Gelhorn, 1994). Here are some lists of examples of applications and solution related to this theory.

Manufacturing: Within manufacturing operations management, the solution seeks to pull materials through the system, rather than push them into the system. This prevents bottle necking while resource exploitation.

Project Management: This is sometimes called Critical Chain Project Management (CCPM), which is a method of planning and managing projects that puts more emphasis on the resources used to execute project tasks. The solution will tend to keep resources levelly loaded but will require them to be flexible in their scheduling.

Distribution: The solution for supply chain constraints is to move a replenishment model, rather than a forecast model. The replenishment model would represent at inventory that is able to meet customer demand while being regularly replenished by some manufacturing facility or other source.

Marketing and sales: While originally focused on manufacturing and logistics Goldratt’s Theory of Constraints (TOC) has expanded into areas of marketing, sales and finance. The application here is surprisingly similar to that of manufacturing and is sometimes called customer manufacturing. The solution is to avoid market bottle-necking while ensuring maximized sales and marketing resources.

Finance: The solution for finance and accounting is to apply holistic thinking to the finance application. This has

also been “Throughput accounting” and suggests that one examine the impact of investments and operational changes in terms of the impact on the throughput of the business.

Planning is the most important aspect of any project & this paper shows how TOC can be applicable to the construction sector to eliminate the delay, identify its cause and solution to it.

Example- for Bar bending, If there are 4 nos. of bar benders, then also delay is causing due to on time assembling of reinforcement bar then we have to identify the weakest or slowest person in this procedure. After that, instead of incorporating extra recourse one shall see the solution to strengthen the existing bar bender by training or single task procedure or allocating him the bars at first stage.

TOC mainly focuses on such small links in a chain as small delay can result into the overall delay of project. To avoid such delays, the schedule shall be made not only for the overall project but also for weekly purpose. Then the observations are to be made. Regular meetings, approaching the vendors can help in fast delivery of project.

3.1. ASSUMPTIONS

TOC methodology operates on several assumptions:

- For any system, Speed and volume are the main determinants.
- Current processes are essential to produce the desired output.
- The product or service design is stable.

4. RESEARCH METHODOLOGY

The Research Methodology follows below procedure-

1. **Applied research:** gathering the knowledge for practical application focusing on solutions for specific problems.
2. **Qualitative approach:** Approximation between theory and factors, by means of analysis of subjectiveness and practical approach.
3. **Explorative research:** Bibliographic survey, interviews with people, analyzes the causes & effects.
4. **Case study:** direct observation of the reality with the use of logic; deeply analysis of the object

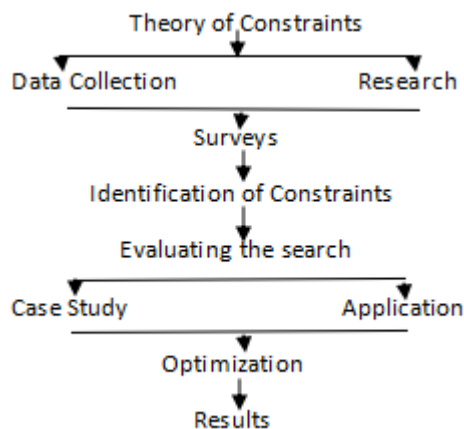


Figure 3: Flow Chart of Research

Observations on site & causes of delay

Before starting of any project, a lot of documentation is to be done.

It involves environmental clearance certificate from MPCB, NOC's from different departments, approvals from MSRDC, MIDC, etc. These approvals takes time hence it's a time consuming activity.

After discussing with client (If any), these approvals are made. Simultaneously drawings are to be prepared. Now, the drawings are primary requirements without which one can't start the work of approval process. Once the preliminary drawings are prepared & approvals are made excavation process is started.

In Ampco, after getting approval, trial pits were excavated. Then it was noticed that Hugh amount of black cotton soil is there at site. So, Geological survey was made, which caused 10 days delay in consulting & further excavating the whole WBC at about 3 to 5m depth took a lot of time. This type of ignorance of not doing Geological survey by trial pit method is regularly in practice in India.

If TOC would have been applied in this area, one should have done the pit excavation prior to approval or at the same time documentation was made. Resulting in saving time, cost & delay wouldn't have occurred.

Another example is of using appropriate excavating tool. For removing such a big amount of WBC, JCB is more suitable as pokland is to be used for hard rock plus it costs more. Averagely, 15-20 m3 of material can be removed by a JCB in one working day

5. CONCLUSION

To have a good understanding of the identified constraints at the planning stages, the documentation plays a very important role. Based on experience & assumptions, one

can list out the probable causes of delay & identify the root for the same. At the implementation stage, the management should keep track of the progress and be aware of the constraints they encounter initially. The management should ensure that enough resources like money, facilities, staff and equipment's are allocated to decrease the limitations from the constraints encountered.

After studying the basic concept of TOC, the application of it can be done by simple Linear programming method. So far this paper has focused on maximizing throughput as the end goal. Actual Process is to elaborate start to finish length of the project, the overall delays occurred and reasons so as for the next project same mistakes shall not happen. However, short cycle times results in high. In short, for maximum profit, the bottleneck tool should always run at full capacity. That's one reason why *Just in Time* isn't really compatible with mass customization and mass construction processes. Goldratt's approach *should* be flexible enough to work even in a low cycle time environment, simply by redefining the constraints.

6. FUTURE SCOPE OF WORK

This paper describes the theoretical and practical knowledge about Theory of constraints. Consequently, this article pointed to the possible problems and barriers at Ampco during application. Results from this research give an impulse for next Working out about continues process improvement at Ampco. At present, goal is to identify the way to Incorporate TOC by identifying the scope, cost estimation, project management, proper planning and scheduling.

Another advantage of this is we can identify the future constraints and plan to overcome them well in advance. It can also be helpful to overcome the barriers not only on Ampco but also to other sites too. Such barriers could be material procurement, resource allocation, etc.

Identifying the probable constraints prior to the work helps in planning the tasks as per the analysis and saving money. Well in this case, Ampco has the following probable future constraints-

1. **PEB design-** PEB drawings, certification and approval from authority shall be done on prior basis as

RCC design is totally dependent on it. Even though the design is ready, it takes time for the certification and approval. Also, after getting the approval, it takes 20-30 days for a manufacturer to cast and transport the material at site. So, one should take this thing in mind and order according to that so as the delay shall not occur.

2. **Material allocation, its procurement, availability in market-** material management is one of the most important tasks in any project. Its inventory control,

testing, procurement, availability, etc things shall be taken care of.

3. **Finishing works**- as finishing works takes a lot of time, finishing works like flooring, painting shall be done on priority basis and for that proper resource management is required.

4. **Fire NOC**- Fire NOC form PMRDA or MIDC need to be taken for industrial works. It included casting of fire tanks, fire hydrants, etc. all the drawings should be prepared and approval shall be made.

5. **MEP Design**- Electrical and plumbing layout is prepared and approval shall be made from respective authorities.

REFERENCES

[1] The goal: a process of ongoing improvement By Goldratt, Eliyahu.

[2]
http://en.wikipedia.org/wiki/Theory_of_Constraints

[3] Applying the theory of constraints in the course of process improvement by Michal MARTON, Iveta PAULOVÁ

[4] Brazilian Journal of Operations & Production Management (Volume 7, Number 2, 2010, pp. 81-100)

[5] A Review of Goldratt's Theory of Constraints (TOC) – lessons from the international literature (Steven J. Balderstone and Victoria J. Mabin School of Business and Public Management Victoria University of Wellington New Zealand)

[6] Critical chain: the theory of constraints applied to project management by Graham K. Rand (Department of Management Science, The Management School, Lancaster University, Lancaster LA1 4YX, UK International Journal of Project Management 18 (2000) 173±177)

[7] Goldratt EM. Critical chain. Great Barrington, MA: The North River Press, 1997.

[8] Applying the Theory of Constraints to Supply Chain Collaboration by Togar M. Simatupang Institute of Information Sciences & Technology Massey University Private Bag 11222 Palmerston North New Zealand

BIOGRAPHIES



Ms. Surbhi Rithe, Student of MIT college of Management , MIT ADT University, Pune



Ms. Maithilee Thakare ,Student of MIT college of Management , MIT ADT University, Pune