
Theory of Constraints Based Approach to Effective Change Management

Ajay Gupta¹, Arvind Bhardwaj¹, Arun Kanda², Anish Sachdeva^{1*}

Department of Industrial & Production Engineering, NIT Jalandhar, India

Department of Mechanical Engineering, Indian Institute of Technology, Delhi (India)

*Corresponding author e-mail: asachdeva@nitj.ac.in

Abstract

The business organizations are operating in an ever-increasing competitive environment. To succeed in such an environment now as well as in the future, these organizations have to continuously adapt themselves to the changing reality of the business world. Bringing about a successful change is a difficult process. Many researchers have suggested many methods, based on their areas of research, to bring about a successful change. Theory of constraints (TOC) is a method to improve the performance of an organization by identifying and eliminating the core problem which is preventing an organization from achieving higher level of success. To improve, a system has to be changed from its current unacceptable state to a desired future state. So, Developers of TOC like Goldratt have developed a method to successfully implement change in an organization. The paper describes the TOC based approach of the layers of resistance to change and the method to peel those layers in succession so as to get the needed buy in and bringing about the necessary change successfully.

Key words: Change management, Theory of Constraints

1. Introduction

Theory of constraints (TOC) suggests a three steps process to identify what needs to be changed and bringing about the change successfully. This three-step process of improvement can be compared to the three steps, i.e. Diagnosis, design of a treatment plan and execution of treatment plan used by doctors to improve the health of their patients. TOC also explains the reason behind people's resistance to change and suggests a method to overcome this resistance. TOC has developed certain tools like current reality tree, future reality tree, conflict resolution diagram etc. that are useful in these three steps of change process. The following paragraphs explain these concepts and tools of TOC.

2. Three steps improvements process: - The process of improvements is to be inspired by the following three simple questions.

- a. **What to change:** - Every organization in a real environment is overwhelmed with problems and/or opportunities, which needs the manager's attention and/or

corrective actions. However, limited time, energy and resources make it difficult to act on all such problems or opportunities. Hence, the manager has to find what should be changed (the core problem) to effectively improve the performance [R. Verma, 1997]

- b. **What to change to:** - Once the core problems have been identified, the next step is to find the solution. If sincere efforts are not directed towards finding solutions to the core problems, chaos and panic will result. [R. Verma, 1997]
- c. **How to cause the change:** - Perhaps the most difficult of the three questions is to find out how to cause the change in a system? In addition to time, efforts and capital required, the managers often face the problem of emotional resistance from the people in the organization who perceive change as a threat to their security. If “To what to change to” is identified, but it is not possible to cause that change, then the solution is not of much use. [R. Verma, 1997]. So, it is necessary to gain the required buy-in and approvals to implement the developed solution. Finally, a detailed action plan has to be prepared using project management technique to successfully implement the solution. The plan should mention in detail the actions to be taken, the person responsible for each action and the time schedule for each action.

Thinking process tools of TOC can be used for the above process. Current Reality Tree can be used to answer the first question, while Evaporating Cloud and Future Reality Tree can be used to answer the second question and Prerequisite Tree and Transition Tree can be used to answer the third question. These tools are explained in the sections given below. The current reality, the future reality tree and the transition tree are sufficiency based logic diagrams. They consist of a collection of simple declarative statements that are linked with cause and effect relationships. A sufficiency-based diagram is one that identifies all the conditions that are necessary and sufficient to cause a particular effect. On the other hand, the evaporation cloud (conflict resolution diagram) and pre-requisite tree are necessity based logic diagrams. A necessity based logic diagram is one that identifies the conditions that are merely necessary for a particular effect to exist. However, these conditions are not sufficient to cause the effect e.g. for survival, it is necessary that a person ingests food but the mere fact that someone is ingesting food is not sufficient to ensure the survival of the person. The cause and effect relationships between the statements in logic diagrams are established by connecting them with and/if logical connectors.

3. TOC thinking process

The thinking processes are a set of tools and techniques which allow an individual or a group to solve a problem and/or develop an integrated strategy using the rigor and logic of cause and effect, beginning with the symptoms and ending with a detailed action plan that co-ordinates the activities of all those involved in implementing the

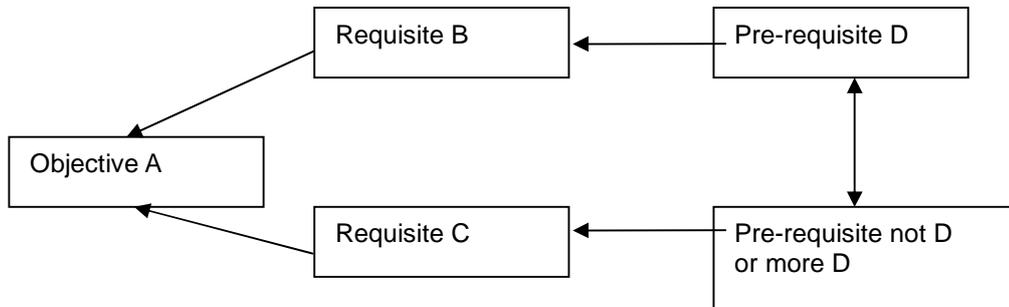
solution. It provides a theoretical framework and tools for continuous identification and removal of system constraints [Mishra, Parkash & Tiwari, 2005]. These tools are:

- a. **Current reality tree:** - Current reality tree is used to identify the core problem in a system by listing and linking all the undesirable effects together. It is found that the various undesirable effects can be linked with one another through successive layers of cause and effect relationships [Goldratt, 1994] and ultimately one core problem can be found in most of the situations. If this core problem is solved, most of the undesirable effects disappear. The effectiveness of the current reality tree depends on the experience and intuition of the individuals involved in preparing it.
- b. **Evaporating cloud (Conflict resolution diagram):** - It is used to find the solution of the core problem identified with CRT (Current reality tree). It is not always easy to solve the core problem because it is probably the problem that has existed for a long time. Most of the employees and probably everyone in the organization knows about that problem. But they do not know that it is the cause of most of their headaches. So, why this problem has not been solved? The reason is conflict. Within the organization, there are interests that would be jeopardized by the solution of the core problem. Thus the problem persists. The organizations learn to live with these problems rather than attempting to solve them. Behind most of the conflicts are certain assumptions, if some of these assumptions are found to be invalid or can be made invalid by our actions; the conflict evaporates like a cloud, i.e. how the name of this technique is evaporating cloud.

In the situation of conflict, people generally develop compromise-based solutions. Compromise based solutions do not eliminate the problem. They just make the conflicting parties to exist together with some disadvantage to both let us first examine the meaning of a problem? A problem is defined as something that prevents us from achieving an objective. So, to solve the problem by evaporating cloud method, first step is to clearly verbalize the desired objective. It is the common objective that both the conflicting parties are trying to achieve by their actions that are in conflict with each other. Once the objective has been defined, in the situations involving compromise solutions, there will be at least two requirements that must be satisfied in order to reach the objective and to satisfy these requirements there will be some pre-requisites. These pre-requisites may require sharing of the same resource that is available only in limited quantity or these prerequisites may be contradictory to each other. Diagrammatically, it can be explained as below

Let the objective be A and the requirements to meet the objective are B and C. The prerequisites for the requirements B and C are D and Not D or D and some more amount of D respectively as shown below:

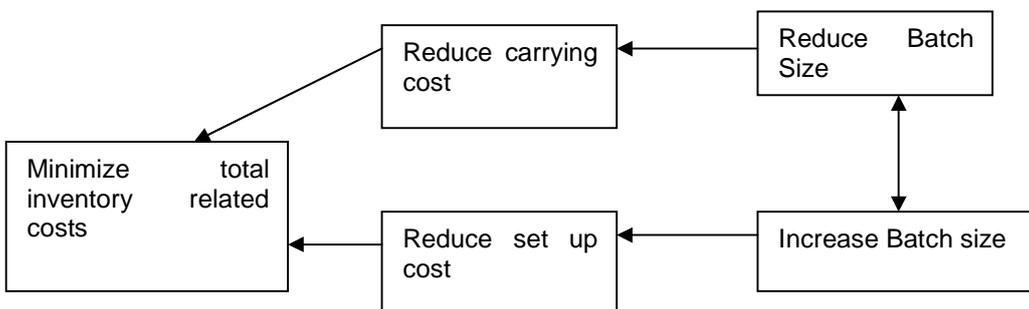
Figure1 Basic conflict faced by managers



These requirements and prerequisites are always based upon certain assumptions. If we carefully analyze and challenge these assumptions, we will find that some of these assumptions are invalid or can be invalidated. Once this is done the requirements can be satisfied simultaneously and the conflict is resolved without any compromise. Goldratt [1990] explained it by taking the example of compromise based approach conventionally used in determining economic batch quantity

Here the objective is to minimize the total inventory related costs. For this purpose there are two requirements. One, reduce the setup cost. For this purpose the number of setups should be small and the batch size should be large. The second requirement is to reduce the inventory carrying cost. For this purpose, the prerequisite is that the batch size should be as small as possible. This conflict is shown in the following diagram:-

Figure2 Basic conflict in determining Economic Batch Quantity



Conventional solution method is to find the solution where the sum of these two costs is minimum. What we do in this solution is that we compromise a bit on carrying cost and a bit on ordering cost. Then we carry out the sensitivity analysis to state that the total cost is not badly affected by small deviations (either positive or

negative) from economic batch quantity. The assumption that we use in calculating the total ordering cost is that the setup cost per set up is fixed. JIT challenged this assumption and showed that the setup time and cost can be reduced substantially and thus we can move to smaller batch size. TOC challenges setup cost by questioning whether setups cost us anything at all by using the concept of operating expenses. It questions whether an additional setup increases our operating expense at all. On bottlenecks, it does. Not by increasing operating expenses rather by decreasing our throughput. On non-bottlenecks, since we have spare capacity and with additional setups, we will be using that capacity only. Thus, the operating expenses do not increase. Thus the conflict can be resolved without compromise at least on the non-bottleneck operations. Similarly, the conflict between the larger batch size and the smaller batch size can be resolved by using larger process batch (it will reduce the number of setup changes) and smaller transfer batches (It will make the material quickly pass through the production system and the carrying cost will be less). This, again, is a solution without any compromise.

According to sensitivity analysis, equal deviation above or below economic batch size has same impact on the total inventory related costs and hence any one of these can be chosen. Let us change it a bit and see the impact. We know that the profit is equal to selling price minus cost. If we assume that the selling price per unit is constant then as the cost per unit goes up the profit per unit will go down. We replace cost per unit with profit per unit on y-axis. Similarly, we take investment on x-axis in place of total cost. Now, if we choose smaller quantity, we will require lesser cash but if we choose larger quantity with the same per unit profit, it will require more cash and may mean liquidity problem. So, the impact of larger and smaller batch will not be same on the working of the organization as seen from the global point of view of having sufficient cash in hand to meet the impending liabilities.

- c. **Future reality tree:** - It tries to portray the future situation that will prevail if the solution identified in the previous step is implemented. This will help in judging the suitability of the solution before spending time, money and energy in implementing it. Since future reality tree is a sufficiency-based diagram, it points out the deficiencies in the solution, if any. Similarly, it points out the negative effects of the proposed solution so that the solution can be suitably modified before implementation.
- d. **Pre requisite tree:** - This tree helps to surface and eliminate the obstacles in the implementation process of a chosen solution. To overcome the obstacles; the intermediate steps/ objectives are defined. To build the prerequisite tree, we begin by listing all the obstacles that stand between the organization and its stated objective. Then for each obstacle we identify a condition that overcomes the obstacle. This identified condition becomes the intermediate objective.

- e. **Transition tree:** - This tree is generally plotted when the people implementing a solution are not the same as the one who developed it. This tree highlights the steps needed to take the organization from current problem situation to the desired future. To build the transition tree, we identify those actions that we need to take, given our current environment, to achieve the intermediate objectives that we identified in pre-requisite tree and the final objective to transition the organization from its current desired state to the desired future state.

First, CRT should be used to identify the core problem, and then this problem should be analyzed and solved by using the evaporation cloud. To prove the effectiveness of solution, FRT is drawn. It presents the future that will exist, once the solution is implemented. FRT is presented to the employees of the organization to get their criticism about the solution (negative branch reservations). To plug these negative holes pre-requisite tree is plotted. Finally transition tree is plotted, which shows the complete steps to take an organization from the current state to the desired future state.

4. Resistance to change

Any significant improvement requires change in the behavior and method of working of the people. Change induces stress because people fear change. People fear that the said objective is too difficult to achieve or they lack sufficient resources or they will have to leave their current situation/loved ones behind. It is important to drive out these fears from the minds of the people only then the change can be effectively implemented. We need to take care of the following three points to persuade others to implement any significant change:

- a. We need to show them that the change can be successfully implemented and once implemented will improve their situation significantly.
- b. We need to show them how to make a change happen in a way that will not cause them any harm
- c. We need to ensure that they can keep what they know and love about their current situation.

By taking care of the above three points, we can reduce the fear of the people and can hope to implement the change successfully.

People generally ask one or more of the following questions to gauge the suitability of change being proposed.

- a. Has the right problem (mine) been identified?
- b. Is the solution leading us to the right direction?
- c. Will the solution really solve the problem?
- d. What could go wrong with the solution? Are there any negative side effects?
- e. Is this solution implementable?

- f. Are we really committed to implement it?

All these questions are to be answered one-by-one and to the satisfaction of the person asking these questions. Only then, we can expect their co-operation in implementing the change.

Goldratt from his experience of successful implementation of improvement techniques in the factories has suggested that we have to overcome the following five layers of resistance to change

- a. **The first layer of resistance:** raising problems having one thing in common- its out of our hands i.e. either the problem is not caused by us or the solution of the problem is not in our hands and the problem is due to some factors outside our area of control e.g. vendors do not always deliver, clients change their mind at the last minute, workers are not properly trained, corporate forces it on us etc. In most of the situations, these are the undesirable effects of the core problem and the core problem is something, which is very much in the work domain of the people stating these reasons. CRT along with simulation can be used to pinpoint the core problem and to peel this layer of resistance.
- b. **The second layer of resistance:** arguing that the proposed solution cannot possibly yield the desired outcome. FRT along with if-then logic can be used to explain how the proposed solution can lead to desired outcome.
- c. **The third layer of resistance:** “Yes, but...” Arguing that the proposed solution will lead to negative effects. Generally, the developers of the solution may miss some of these potential negative effects. When the people raise these objections, do not discard them as trivial. Develop pre-requisite tree stating the intermediate objectives to overcome these negative side effects of the proposed solution and to reach the final objective.
- d. **The fourth layer of resistance:** raising obstacles that will prevent the implementation. Again PRT can be used to address these obstacles.
- e. **The fifth layer of resistance:** raising doubts about the collaboration of the others (or worse, not raising their doubts). If everyone, who will be affected by the solution or will be implementing the solution, is involved right from the beginning, they will take the pride of ownership of that solution and will be committed to implement the same.

Goldratt states that it is not easy to overcome resistance to change. But, it is possible. Peeling, in sequence, all these layers turns resistance to change into the enthusiasm of an inventor. It requires about one week of sincere efforts to peel these layers of resistance.

5. How to overcome the resistance to change

Goldratt states that any improvement is a change and any change is a perceived threat to security and threat to security leads to emotional resistance. The emotional resistance cannot be overcome by logic or reasoning. It can be overcome by a stronger emotion only. Two types of emotions can be used for this purpose. First, the emotion of fear or threat to security. But this is not very effective method. The other person starts treating these threats as meaningless and stop responding due to fear. Other method that is very effective is to induce the person to develop the solution by himself. If someone develops a solution to a problem, he or she takes the pride of ownership of that solution. The feeling of ownership is a very strong emotion and the one who develops a solution sees all the positive aspects in the solution and tries his level best to get it implemented. Therefore, even if a manager knows the solution of a problem, he should not present the solution rather he should induce his subordinates to logically derive that solution themselves. Socratic Method of questioning is very effective technique for this purpose. But before using Socratic Method, it is very important to make people realize that the problem in hand is their problem, it is an important problem and not a trivial one. Even if the subordinates know intuitively that he is not the first one to develop this solution, his pride of ownership does not diminish. So, it is an effective method to get the change implemented. Goldratt states that whenever a change is being implemented in the organization, either an employee will be in favor of it or will resist the change. Therefore, to avoid getting resistance to change, efforts should be made to induce the people to work in favor of it.

6. Conclusion and directions for future research

The practicing managers often find it hard to identify what needs to be changed and how to bring about that change without getting resistance from the people working under them. This paper discusses the TOC based approach to bring about change. It is a complete approach that helps in identifying the core problem and provides an effective methodology to convert people's resistance to change into enthusiasm of an inventor who will try his level best to get the solution implemented. The technique has been successfully applied in many companies in America and Europe. Further research needs to be carried out to test its applicability in Indian context and other parts of the world.

References

- 1 Chakravorty Satya S (2001) "An evaluation of DBR control mechanism in a job shop environment," *Omega*, Vol. 29, pp. 335- 342.

- 2 Chakravorty Satya S, Atwater J Brian (2005), "The impact of free goods on the performance of drum-buffer-rope scheduling systems," *International Journal of Production Economics*, Vol. 95, pp. 347-357.
- 3 Daniel V, Guide R Jr. (1997,) "Scheduling with the priority dispatching rules and drum-buffer-rope in a recoverable manufacturing system," *International Journal of Production Economics*, Vol. 53, pp. 101-116.
- 4 Duclos Leslie K, Spencer Michael S (1995), "The impact of a constraint buffer in a flow shop," *International Journal of Production Economics*, Vol. 42, pp. 175- 185.
- 5 E.M Goldratt & R. E. Fox, "The Race," North river press, 1986.
- 6 E.M Goldratt, "It's not luck," North river press, 1994.
- 7 E.M Goldratt, "Production the TOC way," North river press, 2003.
- 8 E.M Goldratt, "Theory of Constraints," North river press, 1990.
- 9 E.M. Goldratt, "The Goal: A Process of Ongoing Improvements," North river press, 1984.
- 10 Gerhard Plenert (1999), "Focusing Material Requirement Planning (MRP) towards performance," *European Journal of Operations Research*, Vol. 119, pp. 91-99.
- 11 Michael Umble, Elisabeth J Umble (2006), "Utilizing buffer Management to improve the performance in a health care environment," *European Journal of Operations Research*, Vol. 174, pp. 1060-1075.
- 12 Mishra Nihikant, Parkash, Tiwari M K, Shankar R, Felix T S Chan (2005) "Hybrid Tabu- Simulated Annealing Based Approach to Solve Multi-Constraint Product-Mix Decision Problem," *Expert systems with applications*, Volume 29, pp. 446-454.
- 13 Radovilsky Zinoverly D (1998), "A Quantitative Approach to Estimate the Size of Time Buffer in the Theory of Constraints," *International Journal of Production Economics*, Volume 55, pp. 113-119.
- 14 Ribeiro M A, Silveira J L & Qassim R Y (2007), "Joint Optimization of Maintenance and Buffer Size in a Manufacturing System," *European Journal of Operations Research*, Vol. 176, pp. 405-413.
- 15 Wahlers James L, Cox James F (1994) "Competitive Factors and Performance Measurement: Applying Theory of Constraints to Meet Customer Needs," *International Journal of Production Economics*, Vol. 37, pp. 229-240.