APPLYING THEORY OF CONSTRAINTS FOR IMPROVING BUSINESS RESULTS IN A NPD PROCESS

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Abstract- The best way to achieve a goal is to identify limiting constraint and to improve that constraint so that it is no longer limiting. Theory of Constraints (TOC) methodology provides an approach to improve business results by improving the weakest link in the chain of activities. Today, business environment has become very dynamic with more demanding customers and intense market competition. To meet this, firms are creating new products, solutions and services that provide a radically better experience for the consumers. Still, many companies mess up their product innovation and development process which leads to failure of their new products/ solutions in the market place. Theory of Constraints (TOC) is one of the continuous improvement concepts that were developed to improve competitive advantage in the areas like price/cost, product quality and delivery reliability. It helps to identify core organizational problems and developing solutions that address these core problems. This paper presents the application of TOC Thinking Process (TOC TP) to FEI & NPD process to bring out system constraints and their root causes. A typical NPD process of a consumer durable firm has been taken as case study to demonstrate the useful of this methodology. This methodology was found to be more effective in analyzing problems and conflicts by laying out transition from an undesirable present to a desirable future.

Keywords- Theory of Constraints, TOC, TOC Thinking Process, New Product Development, Front end of Innovation.

I. INTRODUCTION

Most of the organizations are structured, measured, and managed in parts, rather than as a whole. This results in lower overall performance, difficulties in securing or maintaining a strategic advantage in the marketplace, financial hardships, seemingly constant firefighting, the constraint constantly shifting from one place to another, and chronic conflicts between people representing different parts of the organization. Once the barriers that block those parts from working together as an integrated system are removed, significant and sustainable improvement in each and every problem mentioned above is the result. The organizations that produce excellence are those that continuously improve. It is based on the fundamental concept that whatever the company's success in the past, it has to continuously improve for the future. TOC process seeks to identify the constraint and restructure the rest of the organization around it,

II. PHILOSOPHIES OF TOC

TOC is one of continuous improvement philosophies developed by Goldratt and Cox (1986). The concept is focused on two aspects.

1. Every system must have at least one bottleneck or constraint (which limits the system from achieving high performance)
2. The presence of constraint represents the opportunities available for improvement. Thus TOC sees various constraints as positive opportunities.

TOC uses a systematic approach called five-step TOC implementation (Zhang Lin (2009)). The descriptions of steps are given below and also refer Figure 1.

Step 1: Identify the system's constraint(s)
The constraint may be physical such as material, machines, peoples etc. or managerial. However, it is important to identify constraints impacting on goal.

Step 2: Exploit the system's constraint(s)
In TOC, the constraint represents the weakest link and hence it has to be exploited to the maximum extent.

Step 3: Subordinate the system's constraint(s)
This means the other components (non-constraints) of the system has to be adjusted to support and increase the effectiveness of the constraint.

Step 4: Elevate the system's constraint(s)
After exploiting and subordination, if the constraint is still the most critical one in the system then improvement effort should be applied to improve the constraint.

As the performance of the constraint improves, eventually the system will encounter a new constraint.

Step 5: If the constraint has been broken then go back to Step 1, but do not let inertia to cause the system's constraint.

As discussed in the steps, the first three steps are focused on analyzing and correcting the system. The step 4 and 5 are continuous improvement steps that maintain system capability (Kasemset (2011)).

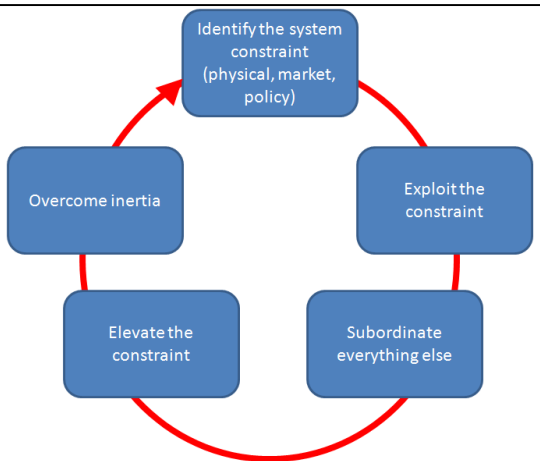


Figure 1. TOC steps

III. TOC TP

Goldratt (1990) developed a generic approach called Thinking Process (TP) to address the policy constraints and create breakthrough solutions using intuitive knowledge, logic and common sense. He has suggested three generic decisions have to be made by the managers to deal with the constraints. They are:

1. Decide what to change
2. Decide what to change to
3. Decide how to cause the change.

The TP prescribes a set of five tools in the form of cause-and-effect diagram to address those questions. The logic tools are; Current Reality Tree (CRT), Conflict Resolution Diagram (CRD), Future Reality Tree (FRT), Prerequisite Tree (PRT) and Transition Tree (TT).

Current Reality Tree (CRT):
It is the logical structure designed to depict the reality of the existing system. The diagram shall be built in the form of cause-and-effect relationships between the undesirable effects (UDEs) and their immediate causes. From this, root causes are identified. Root causes are those causes that contribute 70% of UDEs. The root causes must be in the span of control and sphere of influence.

Span of control is the area where one can enjoy complete authority to change anything. Sphere of influence is a region of the environment where one can influence things to varying degree but don't have direct control (Xiaoming Zhang et. al. (2011)).

Conflict Resolution Diagram (CRD):
It is also called a Evaporating Cloud (EC) since it has the capacity to evaporate conflicts. It is used to identify hidden conflicts and underlying assumptions behind UDEs. The diagram involves system objectives, the necessary requirements that lead to it, the conflicting prerequisites that satisfy them and injections. An injection is the change initiative (actions) to break the conflict or solve the problem. It helps to begin to answer "what to change to".

Future Reality Tree (FRT):
It is a strategic tool used to plan major changes (Dettmer (1997)). This logic structure designed to reveal how changes to the status-quo would produce desired effects (DEs). This model enables effective testing of new ideas before committing resources for implementation.

Prerequisite Tree (PRT):
It is logical structure designed to identify all obstacles and the responses needed to overcome them in realizing an objective.

Transition Tree (TT):
It is a cause-and-effect logic tree designed to provide a detailed step by step implementation of solution.

IV. APPLYING TOC TC TO IMPROVE NEW PRODUCT DEVELOPMENT PROCESS

This section of the paper presents the application of the TOC TP tools in a case study involving a typical company manufacturing home appliances. As everybody understands, the home appliances market is crowded with many manufacturers and the success of the firm depends on their innovative products and competitive products. Many established firms undergo difficulties while facing these realities. They constantly look inwards to improve their processes in order to sustain their business. This section illustrates how the TOC TP tools are used in identifying UDEs, core conflicts, understanding system problems and developing solutions that address these core problems, while dealing with layers of resistance in the change management process.

As discussed the improvement process focuses on three questions: What to change? What to change to and How to cause change? These three questions must be answered in sequence to make the improvement process effective.

4.1 What to Change – Indentify the weakest link
CRT is used to identify the core problem by revealing the relationship among the undesirable effects that are dysfunctional symptoms or behaviours. For our study, nearly 13 UDEs are identified which are provided in the Table 1. The survey method, personal interviews, telephone interviews are the methods used in order to generate UDEs and CRT. All the UDEs are connected using the if-then logic and are traced to a few causes. List of UDEs are linked and their CRT is provided in the Figure 2. From the CRT, five major root causes such as lack of customer and market understanding, lack of awareness on overall cost, lack of structured FEI and NPI process, poor execution of FEI and NPI and leadership and cultural issues are

identified. The core problem identified is risk of business survival. Based on discussion and subsequent deliberations within the critical group of process owners revealed that more than 70% of the issues are related to causes such as lack of market understanding, lack of awareness on overall cost, lack of structured FEI and NPI process.

4.2. What to Change to? – Design a Stronger Link
Next step in the improvement process is to determine what to change to. CRD (also called as EC) is tool that helps the decision makers search for the solution. The objectives of the CRDs are taken as business survival ensured, good understanding on costing and control and FEI & NPD process.

In order to meet the objectives requirements and prerequisites are identified. These details are provided in the Figure 3. FRT is drawn to show how stated changes solve the problem without becoming the source of future problems (Figure 4). Let us understand the CC of FEI and NPD process. As per CC, the requirements are given as "put FEI process in place" and "reduce process lead time by adopting rapid NPI". From this it is evident that the company lacks FEI process (could be the reason why many innovative products are not coming to market) as well as the current NPI process is lengthy.

By analyzing CC, the team has recognized that managing incremental innovation is different from managing radical innovations. There is an urgent need of rapid NPI process to take care of incremental innovation and to reduce the project lead time. In the FRT, 4 injections are provided viz. hire external consultant (invest as little as possible), involve employee in customer and market study, train the sourcing team and develop new FEI and rapid NPI process. These injections are actions needed to eliminate bottlenecks and to reach objective.

4.3. How to Cause Change? – Operationalize this stronger link into the chain
The last step in the TOC improvement process is the implementation of the solution. The action plan is embedded in the Transition Tree (Figure 5).

Some of the action items generated using TT are making alliance with some customers, using best-in-class companies system as reference (to have to good understanding on customer and market), identify employee for customer engagement, develop training calendar for sourcing people's training and benchmark other companies for the best FEI and rapid NPI process.

How these action items helps in achieving objective are depicted as arrows in Figure 5. If the organization implements these action items then their weakest link in achieving the desired effect will be eliminated and hence it will be in better position to meet competitive situations.

CONCLUSION

Improving new product development performance stills needs lots of hardworking. This paper made an initial attempt to improve efficiency and effectiveness of the process so as ensure the organizational survivals. TCP TP methodology has been used to identify system constraints, finding root causes and solutions to eliminate system constraints.

Thus TOC TP tools provide promise as a strategy for management teams struggling with difficult organizational issues and policy issues and working towards resolution of issues including managerial and organizational dynamics.

Table 1. List of undesirable effects (UDEs)

#	UDEs
1	Risk of business survival
2	Loosing competitive advantage
3	Hampered growth
4	Low profit margin
5	Less flow of innovations
6	Missing product launch
7	Not meeting sales target
8	Loosing market leadership
9	Poor organizational culture
10	Loosing market share
11	Several field issues
12	Customer dissatisfied with the products
13	Not a perceived as a innovative product
14	Declining share price
15	Sustainability issues

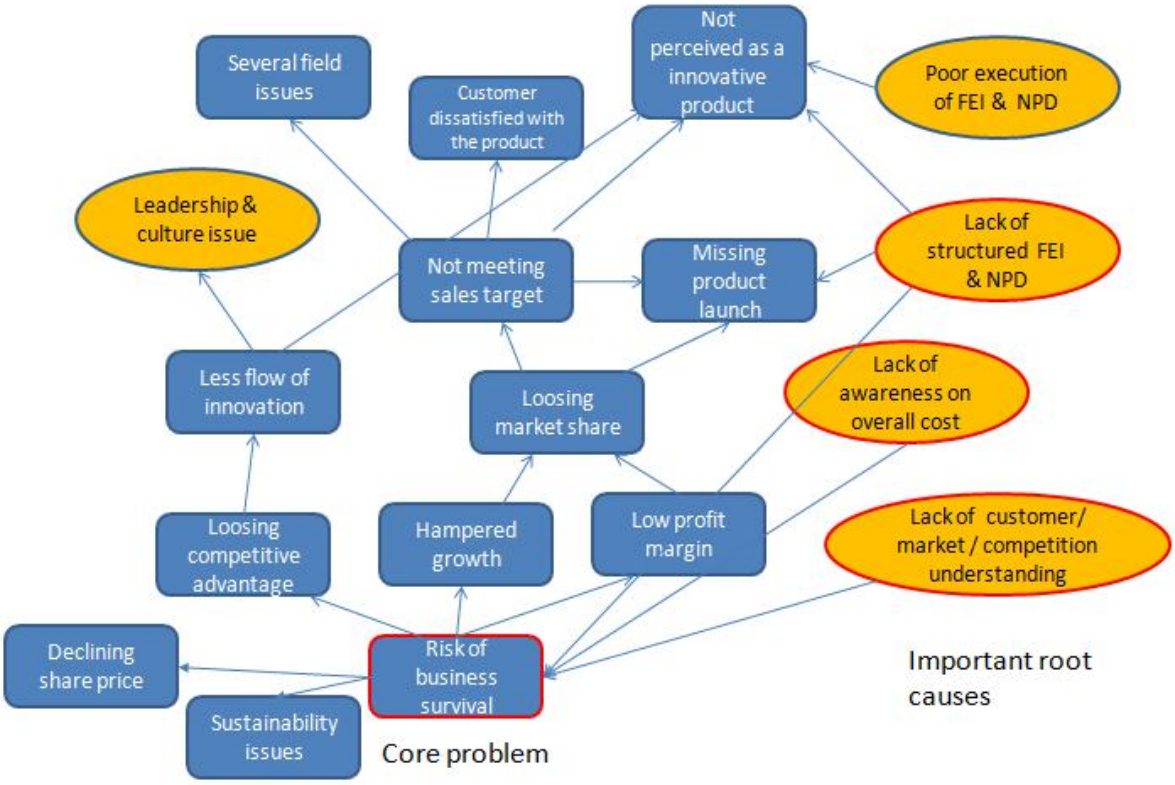


Figure 2. Current Reality Tree

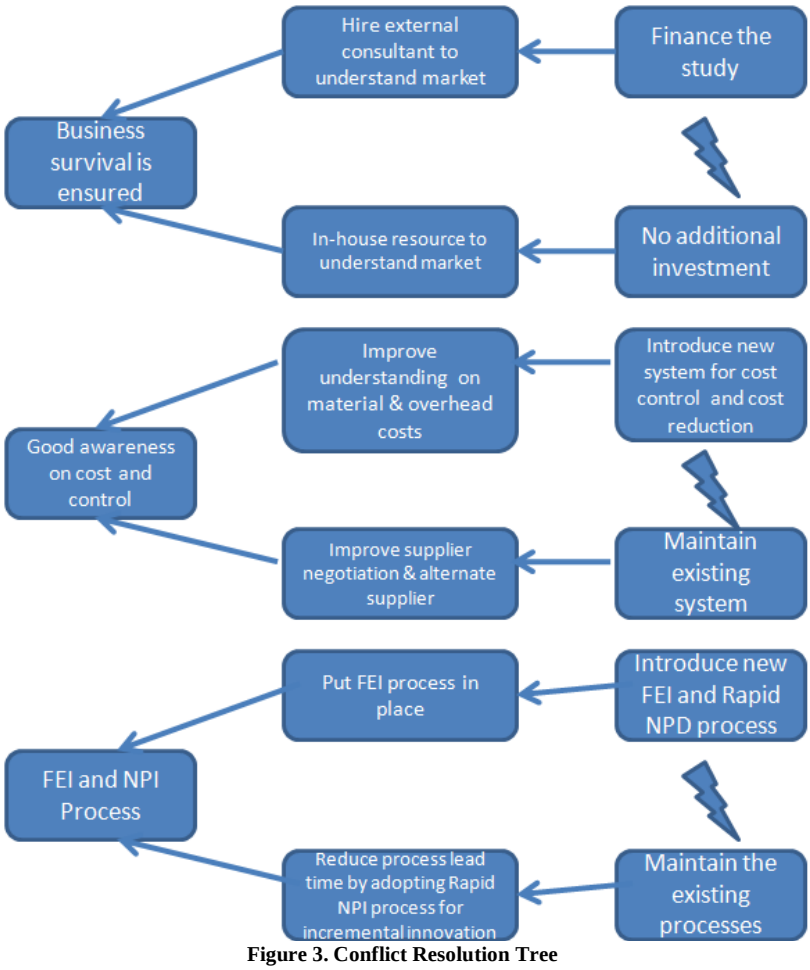


Figure 3. Conflict Resolution Tree

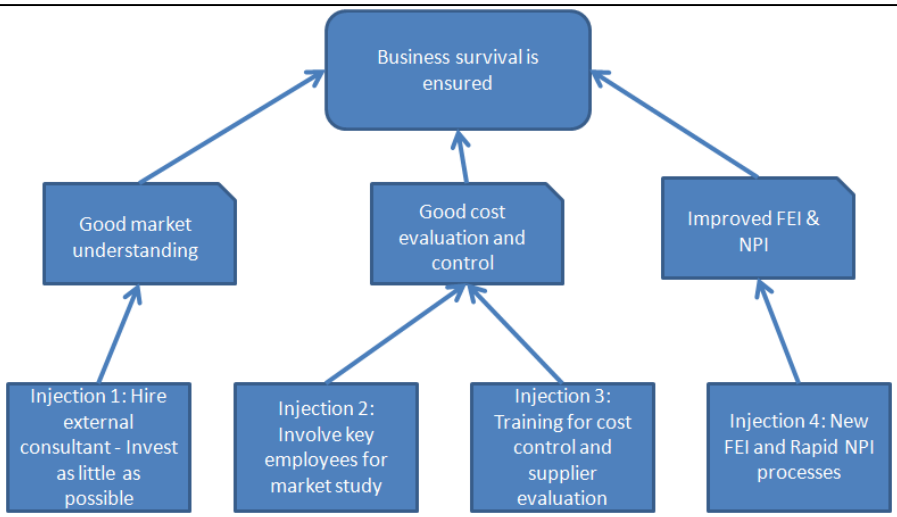


Figure 4. Future Reality Tree

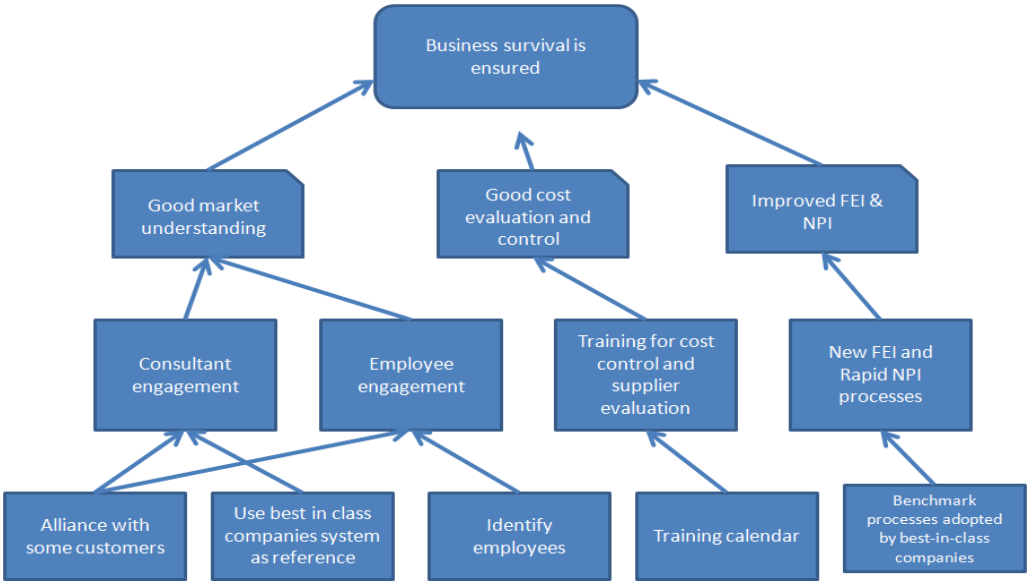


Figure 5. Transition Tree

REFERENCES

[1] AGI Goldratt Institute, The Theory of Constraints and Thinking Process: A brief introduction to TOC, 2009.

[2] W. H. Dettmer, Goldratt's theory of constraints – a systems approach to continuous improvement, ASQ Press, Wisconsin, 1997.

[3] E.M. Goldratt, Theory of Constraints, North River Press, New York, pp. 89-100, 1990.

[4] E.M. Goldratt and J. Cox, The Goal: The process of ongoing improvement, Revised edition, North River Press, 1986.

[5] C. Kasemset, A review on quality improvement and Theory of Constraints (TOC), Proceedings of the 2011 IEEE ICQR, pp. 327-330, 2011.

[6] Kwangseek Choe and Susan Herman, Using theory of constraints tools to manage organizational change: A case study of Euripa Labs., International journal of Management and organizational behavious, vol. 8, no. 6, pp. 540-558, 2004.

[7] Richard A. Reid and James A. Cormier, Applying the TCP TP: A case study in the service sector, Managing Service Quality, vol. 13, no. 5, pp. 349-369, 2003.

[8] Seonmin Kim, Victoria Jane Mabin and John Davies, The theory of constraints thinking processes: retrospect and prospect, International Journal of Operations and Production Management, vol. 28, no. 2, pp.155-184, 2008.

[9] Xiaoming Zhang, Yi Wan, Tengchi Yang and Hui Ding, Improving Efficiency of Emergency Management Based on TOC Thinking Process, 2011 2nd IEEE International Conference on Emergency Management and Management Sciences (ICEMMS), pp. 903-906, August, 2011.

[10] Zhang Lin, Using TOC Thinking Process Tools to Improve Safety Performance, World Congress on Software Engineering, pp. 13-17, 2009.

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