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Application of Theory of Constraints in Service Type Organization

Sumit Chawla*, Radha Kant
Department of Mechanical and Automation, Delhi Technical Campus(IP University), Greater Noida (UP), India

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Abstract
Theory of constraints is widely used in manufacturing industries to identify and remove the constraint/ bottleneck due to which the industry in unable to achieve its goal and enough productivity and profitability which is implemented by different tools like DBR, SDBR.
The constraint can be identified by collecting the production data or rejection data within the process flow by making different bar charts, scatter charts etc.
TOC approach is applied for manufacturing sector and applied this approach in service organization and to find out the different benefits by implementing TOC in service type organization. In this paper a study on health care clinic and identify the restrictions in organization's stability and provide better treatment and better throughput.

1. Introduction

Theory of constraints (TOC) developed by Dr. Eliyahu Goldratt (1984) is widely used in manufacturing industries to identify and remove the bottleneck and it can also be applied in service organization that in present case study and it is sometimes called DBR because it is implemented by different tools like,DBR,SDBR,etc. For identification of constraints, first collect the production data or rejection data within the process flow and plot it on different bar charts, scatter charts etc for the analysis of constraints, e,.g. there is one process grinding of inner races of bearing where it was found that material is collected very much for rejection and re-machining during step quality inspection and material flow is obstructed and affects on productivity and profitability of the company. So it is one of constraint here.

1.1 Theory of Constraints (TOC) is based on two premises

1. The Goal of a business is to make more money in the present and in the future.
2. A system's constraint(s) determine its output

The theory of constraints (TOC), total quality management (TQM) philosophy and just-in-time (JIT) can be used effectively to assist managers of service organizations in identifying their organization goals, the constraints to improved performance, and the most effective solutions.
The TOC can also be applied to not-for-profit organizations to improve performance towards non-financial goals and to assure financial survival.

1.2 Objective of Reasearch

Following are the main objective of this dissertation
1. To check the entire process for the bottleneck or constraint.
2. To find the root cause of the constraint.
3. Set a methodology for solving the constraint according the theory of constraint.

1.3 Types of Constraints

1.3.1 Physical Constraints

Physical,tangible, easy to recognize as constraint, Machine capacity, material availability, space availability etc.

1.3.2 Market Constraints

Demand for company's products and services are less than capacity of organization, or not in desired proportion.

1.3.3 Policy Constraints

Not physical in nature, Includes entire system of measures, methods and even mindset that governs the strategic and tactical decisions of the company. Goldratt states that 99 per cent of an organization's constraints are policy constraints.

1.4 Types of Policy Constraints

1.4.1 Mindset Constraints

A constraint if thought process or culture of the organization blocks design & implementation of measures & methods required to achieve goals.

***Corresponding Author**
E-mail address: chawlasumit4@gmail.com

1.4.2 Measures Constraints

A constraint if they drive behaviors that is incongruous with organizational goals.

1.4.3 Methods Constraints

A constraint when procedures and techniques used result in actions incompatible with goals.

2. Literature Review

The TOC is an intuitive framework, developed by Goldratt, for managing organizations. Implicit in the TOC framework is the desire to improve performance of organizations continually, through a process of ongoing improvement. This concept is based on the assumption that resources available for managers and organizations are limited, and should therefore be directed towards a well defined and focused goal. According to the TOC, the goal of a corporation should not be defined using terms such as technology, share of market, automation, quality or human resource development, but as the ability to generate profits in the present and in the future. When applying the TOC to a manufacturing organization, for example, Gardener and Blackstone defined the primary goal of such an organization as the maximization of long-run profit. In order to maximize the efficiency of resources used in the organization, the TOC requires that after clearly defining the goal, the organization establish specific measurements that will enable management to determine the impact of any action on the goal.
Umble and Spoede (1991) using the analogy of a steel chain. In order to strengthen the chain, one must strengthen the weakest link. If a link other than the weakest is strengthened, the strength of the whole chain is not increased. The concept of a chain can be used to represent processes in any organization. The framework of the TOC rests on the fact that an organization must always have constraints that limit the organization from achieving higher performance in terms of its goal. Constraints must exist, or else performance would be unlimited. As defined by Umble and Spoede (1991), "TOC is an overall management philosophy which emphasizes constraints identification and management as the keys to focusing limited time and resources on areas where potential returns are greatest." According to Goldratt (1990a), TOC initially recognizes that every organization must be understood as a system with a goal; hence, every action taken by any part of the system must be judged by its impact on that goal. It is imperative to define measures that allow for the evaluation of the impact of any subsystem, and of any local action in this subsystem. A system constraint must be defined as anything that significantly prevents a system from improving its performance towards that goal. Every system must present at least one constraint. In addition, there will always be very few constraints, since there is always a single weaker link in a chain (Goldratt, 1990b).
The constraint may be physical, such as a machine with limited capacity, a policy or a behavior constraint. Policy constraints often arise when the company environment changes while its policies remain unchanged. Most significantly, policy constraints are usually under the control of the organization's management (Mabin and Balderstone, 2003).
Goldratt (2004) asserts that the goal of a capitalist enterprise is to make money in both the present and the future, and that this must be

evaluated in terms of its net profits (NP) and return on investment (ROI). Alexandre Linhares (2009) proposes that, when production is bounded by a single bottleneck, the best product mix heuristic is to select products based on their ratio of throughput per constraint use. This, however, is not true for cases when production is limited to integer quantities of final products.

The application of TOC in the field of supply chain management is composed of three correlated areas: logistics, performance measurement and logical thinking . Firstly, TOC applies drum-buffer-rope scheduling, buffer management and VAT analysis methods to the area of logistics. Secondly, performance measurement is adopted to decide whether the system accomplishes its preset targets, which includes operation measurements, such as throughput, inventory operating expense; and local performance measurements, such as throughput-dollars-days, inventory-dollars-days. Lastly, logical thinking includes a five-step-focusing thinking process to assist the decision maker to solve the problems of system constraint. Previous TOC study only focused on the supply chain problem of a single company. Recently, supply chain collaboration gradually became a new research direction . Supply chain collaboration adopts the technique of buffer management to control the buffer size adjustment. Basically improvement actions are taken to increase or decrease the target inventory level when needed. The buffer size reflects the pattern of the stock consumption level; suppliers must pay attention to the buffer consumption level to decide the timing of production or replenishment at all time. In general, the buffer size is divided into 3 partitions, labeled as green zone, yellow zone and red zone respectively as shown in figure 1.

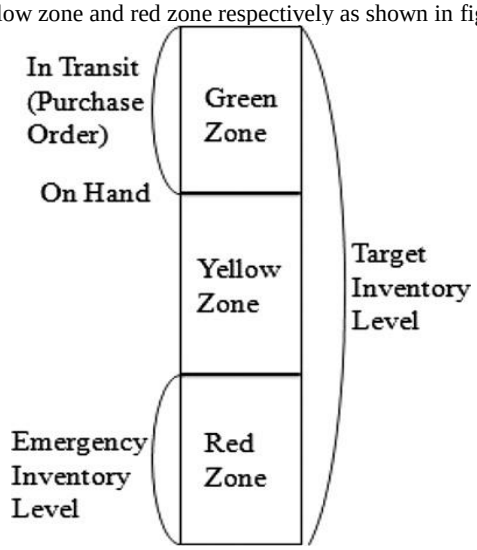

Fig.1: Basic framework of TOC buffer management

The green zone indicates the upper limit of inventory buffer which is set by the replenishment policy; the red zone indicates the serious consumption of the buffer, it needs carrying out replenishment immediately, otherwise it will lose sales opportunity due to shortage of stock. When the inventory level falls in the green zone, there is no need to proceed with replenishment. As the inventory level falls into yellow zone, it needs to pay more attention to watching the buffer consumption because the market demand will change at any time, and it needs to proceed with the replenishment plan to increase the inventory level to the top of the buffer. When the inventory level has penetrated into the red zone, it needs to speed up the replenishment action to increase the inventory level to the top of the green zone. Fig. 1 also shows the framework of inventory buffer management, target inventory level is the presetting level of the stock, stock in transit is the scheduled received stock to be filled into the buffer, on hand is the current buffer level, and emergency inventory level is the buffer penetrated stock level.

TOC techniques have been applied at a number of Fortune 500 companies; 3M, Amazon, Boeing, Delta Airlines, Ford Motor Company, General Electric, General Motors, and Lucent Technologies have publicly disclosed significant improvements achieved through deployment of TOC solutions. Additionally, a number of adopting companies state an unwillingness to disclose improvements for competitive reasons.

Application of TOC is not limited to for-profit companies; not-for-profit organizations and government agencies such as Habitat for Humanity, Pretoria Academic Hospital, British National Health Service, United Nations, NASA, United States Department of Defense (Air Force, Marine Corps, and Navy), and the Israeli Air Force all have successfully employed TOC solutions.

To clearly focus on the development of principal TOC concepts and segmented the evolution of TOC into five eras, as shown in figure 2:

1. The Optimized Production Technology Era – the secret algorithm.
2. The Goal Era – articulating drum-buffer-rope scheduling
3. The Haystack Syndrome Era – articulating the TOC measures.
4. The It's Not Luck Era – thinking processes applied to various topics.
5. The Critical Chain Era – TOC project management.

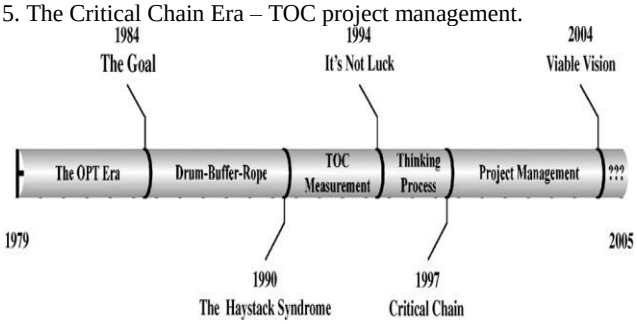

Fig.2. Timeline of major eras in the development of TOC.

3. TOC Methodology

3.1 Steps in Toc Methodology

Following are the five focusing steps:

1. Identify the constraint.
2. Exploit the constraint.
3. Subordinate other activities to the constraint.
4. Elevate the constraint.
5. After change made, go to step one

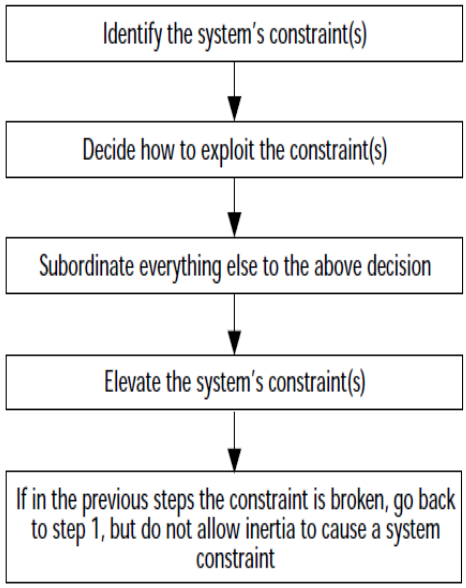

Fig. 3: Five steps for achieving ongoing improvement (North River Press (1990))

(a) Constraint identification: Identification of the constraint is main thing which hits the production of the industry. It may be in the production process flow or may be with the management strategy.

(b) Constraint exploitation: one has to think all around that how to eliminate this constraint from the process flow and how can increases the production time so that industry may have more production after this constraint finish.

(c) Constraint should be coordinated with other process activities: See how other process station is giving better production and this

weak station can be compared with those so that some fruitful solution can be achieved.

(d) Highlighting constraint: If one doesn't find the solution in existing conditions than the constraint may be supported by additional employees and modern tools and m/c's etc.

(e) Step (a) to review: Even if all above four methods are unable to detect the solution of the problem than again look towards the first step to exactly identify the bottleneck or constraints.

3.2 Ongoing Improvement Using TOC

In order to facilitate ongoing improvements it is important to assure adherence of the entire organization to the ultimate global goals. As numerous researchers have shown, the process of organizational change is one of the most difficult to achieve.

In order to synchronize the initiation, creation and response to these essential changes the TOC proposes the following Socratic thinking process for dealing with change:

(a) What to change? – Assessment of what are the constraints to improved performance.

Applying the TOC to the "What to change" question often leads to the identification of an organizational constraint

(b) What to change to? – Devising simple, practical changes to the core problem/constraint identified. The TOC emphasizes that only simple solutions have a real chance of working in a real organization.

(c) How to create change? – Developing strategies and actions to break undesired constraints and manage constraints in desired areas.

In order to determine the impact of actions on the organization, Goldratt and Fox's TOC, identifies three basic measurements.

3.3 Measures of TOC

(a) Throughput: The rate at which the system produces outputs which are conforming to the organization's goal. For a typical manufacturing organization, this would be the rate at which the company generates money through sales of products.

(b) Inventory: The amount of assets involved in the process. Again, for the typical manufacturing organization this would be all the money the company invested in purchasing things that it intends to process and sell.

(c) Operating expenses: All the money that the company spends in the process of turning inventory into throughput

The TOC sets different priorities and believes that throughput should be at the top of the list, inventory next and operating expense last. To improve, an organization should first make an effort to increase throughput, then decrease inventory and decrease operating expenses. Whenever possible, the first line of action should be to improve throughput.

3.4 Advantages of Theory of constraint application

1. Increase in productivity
2. Non-constraint areas are also awakened when constraint is being monitored and improved.
3. Simple to manage
4. Enhances team work.
5. No need to additional staff or space.

TOC is sometimes known as Drum buffer rope which is applied only to the manufacturing industries making the lesser inventory in the process flow.

DRUM: It is the minimum producing station and all other stations are to cope up with it to have constant flow as per TOC Theory. It is the constraint station.

BUFFER: It is the stock of material by the constraint Station and the representation of time to allow keeping in together the entire flow. If it's before the finish goods than it represents constraint in the process and if it is in the finish goods station then it represents constraint in market demand.

ROPE: It is the communication system which makes arrangement of equal material at buffer and other places in the process.

It has two types applicable for manufacturing:

Traditional manufacturing

DBR manufacturing (Synchronous manufacturing)

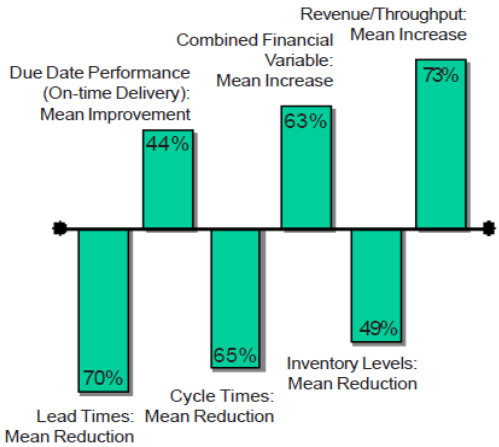

Fig. 4: Advantages of TOC Application (Lucie press, 1999)

3.4.1 Traditional manufacturing

In fig. of traditional manufacturing simple five works in process are shown from Raw material to finish goods. These are done through different operation and machines. Normally in traditional manufacturing inventory is very much at all the station which losses the production.

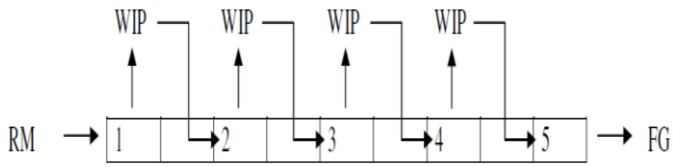

Fig.5: Traditional manufacturing

3.5 Simplified Drum Buffer Rope technique

Figure 6 presents two DBR Models one is Traditional DBR Model and another is standard or simplified DBR model in the traditional model that material release schedule gives material to the station where capacity is 1200 units /day and then after it goes to the second station which gives 800 units/day and then to 1000 units/day, then it goes to shipping schedule as per the market demand but due to system constraints the material store and stops at this station which is known as constraints buffer. Whereas station of capacity 1200 units /day known as non constraints.

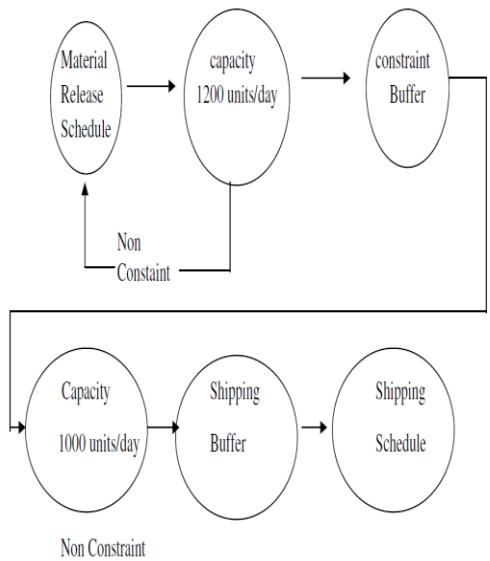

Fig.6: The Traditional DBR Model

3.5.1 Traditional DBR Model

In the DBR system material shall be released according to the requirement at constraints area. If it produces less than market demand than it's the bottleneck and if it produces and is sufficient for market than market demand shall be bottle neck. The production rate of this constraint is known as DRUM. Stock at any where is known as BUFFER and communication technique is known as the ROPE. The standard or simplified DBR Model is utilized through special software programme. It is beneficial where "material planning" is utilized.

3.5.2 S-DBR Model

In standard DBR model the drum is based on confirmed orders from the market. These are further based or accepted as per the followship of producing minimum at the constraints station of DBR model. Also material release is dependent on the orders of the customer. S-DBR model material schedule is tied up with the shipping schedule along with the DRUM which is based on confirm orders.

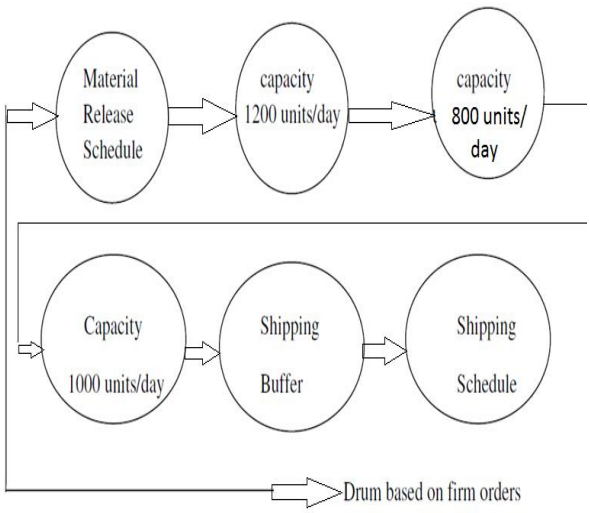

Fig.7: The SDBR Model

4 Advantage of S-DBR Technique

The SDB are model has following advantages:-

1. This will have buffer at one place only either at the start or at the shipping area
2. This is based on customer demand and therefore customers are in direct touch.

4.1 TOC approach to service organizations

The theory has already been implemented successfully in several manufacturing organizations and some techniques such as the Drum-Buffer-Rope method have been developed to support implementation of scheduling and decision making on the shopfloor.

A question arises whether the TOC is applicable only to manufacturing organizations or whether it encompasses service-type organizations as well. Other modern management philosophies such as TQM have been found very applicable and have been successfully implemented already in service organizations. Can service organizations benefit from implementation of the TOC?

Coming from the manufacturing viewpoint, tend to identify constraints as physical – not enough machining capacity, limited floor-space, lack of materials and other things.

The TOC holds that only improving the weakest link in the chain will create the desired effect on the organization's bottom line. To measure the effect of actions, firstly concentrate on defining the organization's goal. In manufacturing, identified the ultimate goal as making profit. How would measure goals in service type organizations?

For most of the service industry, one can continue to define profit as the organization's goal. Dealing with daily measurements, however, becomes a more difficult issue. Throughput, for example, is ordinarily considered to be a manufacturing term which has to do with the flow of products along a production line. Service organizations do not manufacture products. They do not carry limited capacity machinery. Some not-for-profit organizations are not even interested in making money.

By trying to present a basic service organization as a system. A system is basically a process or a series of processes, in which inputs are turned into desired outputs. The TOC defines two basic inputs as inventory and operating expenses, and the output as throughput. It may be easier to analyse the application for a specific example – an organization providing medical services. A system representation of a surgical clinic is provided in Figure 5.

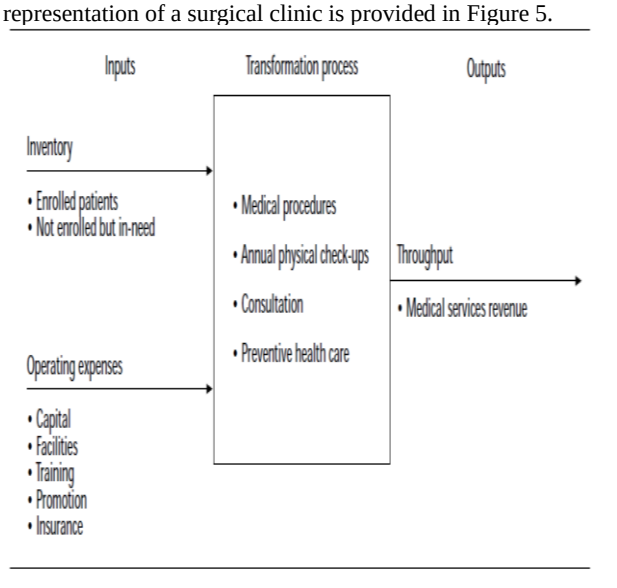

Fig.8: System Representation of Health Care Clinic

Throughput can be defined as revenues from selling medical services. Revenue is directly related to the number of patients treated by the clinic at any given period. Operating expenses are composed of numerous costs and are relatively easy to identify. But what about inventory?

Then refer to the common manufacturing terms of raw material supplies, working process or finished goods as they apply to the medical organization. The inventory is composed of all those who are in need of medical care but do not use the clinic because, for example, it does not offer the type of service they need. Those patients who are engaged in pre-treatment activities may infact be considered as work-in-process. Now, basically established an economical model of the organization which shows the relationship between throughput, inventory and operating expenses.

Throughput is the rate at which the organization receives healthcare payments in return for a patient's wellbeing, minus any totally variable costs directly related to these inputs. Operating expense is clearly the rate at which money is spent to deliver the product wellbeing.

Inventory, therefore, is represented by any potential patient outside the system who could be turned into throughput.

Costs are visible, measurable, and significantly more controllable than externals like health-care revenues. But in fact, focusing on cutting the wrong expenses (such as training or advanced equipment) may actually reduce the level of treatment provided, and discourage patients from enrolling to the services of the clinic. Then lose through put revenue. Thus, may decide to increase prices, but the net effect would be that less people would be able to afford the services.

5. Conclusions

Taking the TOC approach and by looking at ways to increase health-care signup (reduce inventory, increase throughput). Through the process of Socratic questions trying to identify what is restricting the organization'stability to enroll more patients, provide better treatment, and increase throughput. It is important to identify the weakest link in the chain, since so many internal and external factors can affect enrolment and they cannot all be changed. The clinic is lacking some advanced medical techniques or equipment and is, therefore, losing patients. Certain procedures previously

performed by the doctor may have matured and can now be performed by the nurses, freeing the doctor to care for other patients. The conclusion is that if the bottom line performance of this service organization is to be improved, it needs to provide more timely products to its customers. Interestingly, this is exactly what manufacturing businesses try to do.

References

1. Kim, S., Mabin, V.J. and Davies, J. (2008), ‘‘the theory of constraints thinking processes: retrospect and prospect’’, International Journal of Operations & Production Management, Vol. 28 No. 2, pp. 55-84.
2. Alexandre Linhares, International Journal of Production Economics, Volume 121, Issue 1, September 2009, Pages 121-129
3. Gardener, S.C. and Blackstone, J.H., “The ‘TOC’ and the make-or-buy decision”, International Journal of Purchasing and Material Management, Summer 1991, pp. 38-43.
4. Umble, M.M. and Spoede, C.W., “Making sense of management’s alphabet soup”, Baylor Business Review, Fall 1991, pp. 26-37.
5. Mabin, V.J. and Balderstone, S.J. (2003), ‘‘The performance of the theory of constraints methodology: analysis and discussion of successful TOC applications’’, International Journal of Operations & Production Management, Vol. 23 No. 6, pp. 68-95.
6. Reimer, G., “Material requirement planning and TOC: can they coexist? A case study”, Production and Inventory Journal, fourth quarter, 1991, pp. 48-52.
7. Ramsey, M.L., Brown, S. and Tabibzadeh, K., “Push, pull and squeeze shop floor control with computer simulation”, Industrial Engineering, February 1990, pp. 39-45.
8. Schragenheim, E. and Ronen, B., “Drum-buffer-rope shop floor control”, Production and Inventory Management Journal, third quarter, pp. 18-23.
9. Goldratt, E.M., “Computerized shop floor scheduling”, International Journal of Production Research, Vol. 26 No. 3, pp. 42-62.
10. Reimer, G., “Material requirement planning and TOC: can they coexist? A case study”, Production and Inventory Journal, fourth quarter, 1991, pp. 48-52.
11. Schragenheim, E. and Burkhard, R. (2007), ‘‘Drum-buffer-rope and buffer management in a make-to-stock environment’’, available at: www.inherentsimplicity.com/.

12. Schragenheim, E. and Ronen, B., “Drum-buffer-rope shopfloor control”, Production and Inventory Management Journal, third quarter, 1990, pp. 18-23.