

Throughput Accounting: A Case Study

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Abstract: The goal of every organization is to make the profit. The throughput accounting help us in selecting proper product mix based on market demand. In this research paper shows that the development of various forms of throughput accounting (TA) inspired by Goldratt's Theory of Constraints. I discussed the potential of TA to change accounting practices, and evidence of change in Indian Power loom textile enterprises. I concluded that transformational (paradigmatic) change is most likely in companies in extreme circumstances: elsewhere TA is more likely to be adopted pragmatically in a portfolio of different accounting techniques.

Keywords: Throughput Accounting, Conventional Costing, Goldratt's Theory, Theory of Constraint

1. Throughput Accounting

Theory of Constraint (TOC) provides a tool for evaluating the result of the process before, during and after it runs (Goldratt; Cox, 1984, 1986) Using intermediate indicators allows for synchronized and conscious manufacturing. The indicators suggested are as follows: value added (VA) or throughput, inventory (I), and operating expenses (OE).

Value added is defined as the speed with which the system generates financial resources through sales. Inventory represents all the financial resources spent on purchasing production inputs that will be transformed into product. Operating expenses are all the financial resources necessary to turn the materials (I) into throughput (VA). Manufacturing management must keep a market oriented approach in mind, because profits come from the value added resulting from sales rather than the size of the inventory or the plant's performance (Wooldrige and Jennings, 1995). Therefore, in order for a manufacturing process to increase its productivity, it needs to reduce inventory levels and make production more flexible, with a more linear flow, and avoiding interruptions to the production process.

TOC, like Cost Accounting, regards firms as a sequence of events. Cost accounting, however, tries to reduce costs in all of a firm's productive segments. On the other hand, TOC, which concentrates on the world of throughput, maintains its focus, concentrating almost exclusively on the firm's critical resources. The theory is based on the premise that every firm has at least one critical constraint that limits its production

capacity. By controlling constraints, manufacturing management controls the contribution margin and the unit production cycle with regard to critical resources (bottlenecks), altering its capacity. According to Goldratt and Cox (2002), there are two types of critical constraints: physical and political.

Likewise, one can say that to generate an increase in production or in profits one must locate the system's Critical Constraint (incentives), in such way that the constraint changes, becoming just another barrier (machine capacity). Now it is no longer convenient to continue to intervene in the initial barrier, because this new obstacle becomes the system's key determinant. In this sense, any effort in a different sequence would be a waste of time and money, since the firm will not achieve its goal.

2. Literature Review

Nowadays, competition has become more complex than ever. This intensive competition has led organizations to accept changes as an undeniable principle, rule, and necessity. A change is not enough. On the other hand, continuous improvement is required. Above all, organizations must change their mentality to encounter this phenomenon. Drucker talks about the necessity of change in management methods. Deming also discusses thorough knowledge that we must learn to manage our organization well. In his book, Senge emphasizes learning and states that we must always question our view toward environment (Corbett, 1998).

Theory of Constraints (TOC) began in 1970s when a

physicist called Eliyahu Goldratt faced with problems resulted from production logistics. He had no previous knowledge of business. Yet, he applied physics problem-solving methods for solving problems concerning production logistics. In the same line, some of his advocates like Corbett consider TOC accounting to be a paradigm shift in management accounting.

Based on TOC, a company is a system. A system, then, is a set of interconnected components. Each is related to the system's general objective and performance as a part of common attempts. One of the most fundamental concepts is to distinguish the important role of "system's constraint or bottleneck. The first step is to distinguish the goal which the system must accomplish. Before discussing the improvement of each part of the system, the whole system's objective and the assessment criteria of the effect of each subset and each trivial decision on the general objective must be defined. System's constraint is also defined as:

"Any factor constraining system performance in the line with its objectives"

In fact, each system includes a few constraints. In a specific time, any system contains at least one constraint (Goldratt, 1990, p4). Otherwise, company's profit would be infinite.

Continuous improvement process and TOC originate from this thinking that all attempts must always be focused on system's objective. This process is the basis of methods used in TOC and management accounting (Corbett, 1998, p26). It includes five stages below:

1. Detecting system's constraint(s).
2. Decision making on how exploit system's constraint, as possible.
3. Obedience of all parts from constraint to further exploit it.
4. Enhancing system's constraint(s) performance level.
5. If constraint is removed in previous stages, go back to the first stage. Yet, resolving system's constraint(s) process should not be stopped by removing a constraint.

TOC is developed based on the presence of at least one constraint. Hence, exploring the nature of this fundamental concept is considerably advantageous. Constraint is a source confining total company's output. The most conventional system's constraint is not tangible or visual. This is the same operational policy or policies. Policy is the rule stating how a system works. For example, rules concerning batch size and resources use guidelines can be implied.

PhD dissertation as "Measuring the Functional Power of TOC-Based Throughput Accounting To Assess Production Companies' Economic Performance", Khan Mohammadi (2011) also stated that: this study examined the relationship between traditional performance assessment criteria (net profit, return on investment, and return on equity), TOC-Based criteria (TOC-Based net profit and return on investment), and value-making criteria (economic value-added and market value-added) with companies' economic performance – as a representative of cash recovery rate.

PhD dissertation as "Planning and Controlling Production

and Cost Accounting Systems: its Effect on Managers' decisions and Institute's Performance", Leen Howard (1999) has examined four cost accounting systems. These systems include: traditional cost system, Activity-Based Costing (ABC), Direct Costing (DC), and TOC-based accounting (TOC). Results indicated that TOC led to making better decisions and also more desirable performance as compared to other systems.

PhD dissertation, Elias Tadeu (2002) also studied and compared Activity-Based Costing (ABC) with TOC-Based Accounting approaches in terms of profitability and management's decisions. He reported interesting results regarding the importance of the type and nature of institute operation using these techniques.

3. Background and Current Situation of the Firm

The company (XYZ), which was established in 1979 in western region of Maharashtra, India, was selected for the case study. The company produces two sizes of towels and having four sections. The section A is having two winding and two weaving machines. The section B is having four weaving machines. The section C is having two warping and two weaving machines. The section D is a stitching section consists of four sewing machines. The company produces two types of towel blended cotton and polyester yarn having 24"×48"(X) and 27"×54" (Y) sizes. The company does outsourcing for polyester yarn. The flow of product X is from winding section A, warping section C and weaving section B. For product Y the flow is from section C to section B then both the products are transported to section D for cutting and stitching. This company manufactures the product based on the demand of domestic market. This power loom industry is having a good domestic market. Generally the agents or wholesale traders purchase the product from the company and sales it in the Indian market. Based on the size of towel the wholesalers give the order to the company on weekly basis. During this case study the market demand for product X was 500 pieces and product Y was 250 pieces. The selling price for X towel is Rs 40/ and Y towel is Rs 52/.

The company operates for 12 hours a day. Total operating time is 96 hours for all sections. Production cycle time for different operations is given in Table 3. The data was collected from the case company which includes market demand, selling price, expenditure, outsourcing, and production data. Interviews were conducted with the owner/manager and supervisor to find out the constraints and reason for low productivity.

4. Research Methodology

Conventionally net profit, efficiency, utilization, ROI and cash flow measures are used for performance measurement. The researcher proposed TOC accounting where throughput, inventory and operating expenses are the measures. Data was

collected through observations of the production process in the related company and interviews with authorized employees.

The following steps are followed.

Firstly the research questions are developed- Is there a bottleneck (constraint) in the production process of the company?

- Does the firm determine product mix in order to increase the profitability in the management's decisions?
- Does the product mix determined by the TOC throughput provide more profitable results than the one determined by the traditional costing methods?

The next step is determining the sub-problems:

- Which resource(s) cause bottlenecks in the production process of the company and how can these be eliminated?
- Why does the firm do/do not determine the product mix? If determined, which method is used? Why?

The third step is what is the unit of analysis? Here the unit of analysis is manufacturing plant and owner/manager and supervisors

The fourth step is determining the sample. In the initial phases of the research, face to face interviews were performed with some managers of the company D. Employee interviews, document studies and direct observation

Because of the research objectives, we conducted interviews with the owner (responsible for accounting and marketing), the supervisor responsible for production.

The fifth step is the data collection process. Here the data is collected by interviewing and document studies.

The sixth step is the analysis of data and interpretation. The data were evaluated on by comparing the effects product mix decisions on profitability based on the throughput accounting, the traditional costing methods.

The seventh step is the findings of the case study. The findings are reported in the "Results" section of the study.

5. Conventional Costing Versus Throughput Accounting

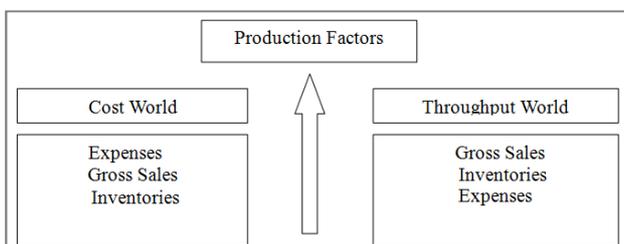


Figure 1. Conventional cost accounting and cost accounting by means of throughput (Goldratt, Cox, 2002).

Figure 1 illustrates the comparison between conventional cost accounting and costs measured by means of throughput accounting. Sobreiro et al., (2014), have mentioned an approach for the throughput per day to help define a product mix was presented. This approach which considers the time used for scheduling.

6. Steps Followed in the Case Study

The first step is determining the system's constraints; "Is there a bottleneck (constraint) in the production process of the firm?" We determine the section B constitutes a constraint in the production process. In order to determine it, the resource loads of the machine calculations were made in Table 4. In these calculations, an attempt was made to determine whether the company has a constraint or not. By setting a capacity usage ratio, we compared the capacity needed for meeting the demand with the existing capacity of the resource.

The second research question of our study was "Does the firm determine a product mix to increase the profitability in the managerial decisions?" According to data collected from the in-depth interviews, the managers did not have any information about the product mix and the firm had not determined a product mix in any way.

As seen in the Table 4, production volume versus capacity, the load and capacity of the section B is limited. The ratio of the usage of the section B is 130 %. The capacity needed from the machine exceeded the present capacity thus, constituting or creating a constraint, while calculating the present capacity of the firm, the number of working days, the number of working hours and the number of minutes in one hour were multiplied which is 23040 minutes.

In step second deciding how to improve the constraints; the limited resource should be improved by producing the product mix that gives the greatest amount of return in the presence of the limited resource. For this reason, the product that has the priority in the production process should be determined by calculating throughput per limited resource. In order to benefit from this limited resource in the most profitable way, the product that should have the priority in production was determined by calculating throughput per limited resource according to the theory of constraints-throughput approach as exhibited in Table 7.

To calculate the throughput of each product, first of all, the direct material cost was subtracted from the sales price of the product as seen in Table 2. Then, the throughput for each product per limited resource was calculated by dividing the throughput of each product to the process duration necessary for that product in the limited resource. The product that has the most throughputs per limited resource will have the priority in production.

The third step is determining the unit of analysis. Here the unit of analysis is manufacturing plant.

The fourth step is determining the sample. In the initial phases of the research, face to face interviews were performed with Manager, supervisor, employees, document studies and direct observation. The sample size was five.

Because of the research objectives, we conducted interviews with the owner (responsible for accounting and marketing), the supervisor responsible for production.

In step five the data was collected on cycle time, production required for the week based on sizes, contribution margin, selling price, expenditure etc.

Sixth step is analysis of data and interpretation. The data were evaluated on by comparing the effects product mix decisions on profitability based on the throughput accounting, the traditional costing methods. The traditional and throughput accounting calculations and profit margin calculations are shown in Table 5 and 7.

The seventh step is concluding the findings of the case study: The findings are reported in the "Results" section of the study.

7. Calculation of the Product Mix and Profitability

Table 1. Manufacturing sections.

Manufacturing Section	A, B, C and D
Weekly hours	96 hours per sector
Winding X(P1, P2 and P3) goes through sections	"A" "C" and "B"
Warping Y(P2 and P3) goes through sections	"C" and "B"
Stitching	Section "D"
Product X	Winding, warping and weaving
Product Y	Warping & weaving

Table 2. Financial figures for product X and Y.

Figures	Product X	Product Y
Selling Price (Rs)	40.00	52.00
Raw Materials Cost (Rs)	5.00	7.00
Contribution Margin (Rs) *	35.00	45.00
Processing Time (minutes)	55	50
Cost/minute of piece (Rs) **	0.636	0.9

Table 2 shows the selling price of product X and product Y and is Rs 40/ and Rs 52/. The raw material cost is Rs 5/ and Rs 7/ respectively. The cost of margin for X and Y product is Rs 35/ and Rs 45/ respectively. The profit margin is Rs0.63 and Rs 0.9 for product X and Y. So, conventionally it is better to produce product Y.

Table 3. Cycle time for operations.

Production Cycle time	Minutes	Section
Winding	30	A
Warping	20	C
Weaving	30	B
Warping	10	C
Stitching	20	D
Winding	20	A
Weaving	30	B
Stitching	10	D

Table 3 shows the cycle time for winding, warping, weaving and stitching in all sections for a week.

Table 4. Production volume versus capacity.

Resource	Time	Process	Use
	Available Time/week (Minutes)	Load/week (Minutes)	Percentage (%)
A	23040	P1 30 × 5 00	A
		P3 20×250	
		Total 20000	
B	23040	P3 30×500	B
		P2 30×250	
		Total 30000	
C	23040	P1 20×500	C
		P2 10×250	
		Total 17500	
D	23040	X 20×500	D
		Y 10×250	
		Total 12500	

According to Table 4, the system constraint is section "B" and one can conclude that it will be impossible to manufacture everything that the market buys, so the firm will have to choose the best product and the optimum quantity to sell. Therefore, the problem is to know which product it will manufacture and in what numbers. Using the conventional approach, we get the result shown in Table 4.

8. Profit Comparison by TOC and Traditional Accounting Method

Table 5. Profit calculations by using conventional approach.

Product Y	
Market	250 pieces/week
Contribution Margin Rs	45
Total time utilized in "B"	15,000 minutes
Amount of time remaining in "B"(for X)	8040 minutes
Gross profit with X (250 x 45) Rs	11200.00
Product X	
Market	500 pieces/week
Contribution Margin Rs	35
Capacity in function of "B" 8040/30	268
Gross profit	9380
Total Gross Profit (X + Y) Rs	20630
Operating expenses Rs	(16,500.00)
Net profit/week Rs	4130

Conventionally it is better to produce the product Y as per market demand and more profit as shown in Table 5. By producing 500 pieces of Y and using the remaining capacity, time to produce product X, then the profit will be Rs 4130/ and is shown in Table 5.

Table 6. Best contribution margin.

Figures	Product X	Product Y
Selling Price (Rs)	40.00	52.00
Raw Materials Cost (Rs)	5.00	7.00
Contribution Margin (Rs)	35.00	45.00
Processing Time (minutes)	15	30
Cost/minute under the constraint (Rs)	2.33	0.5

According to TOC approach, the objective is to maximize

the profit and the constraint is section B. considering this the cost per constraint is calculated for product X and Y as shown in Table 6. The Cost/minute under the constraint (Rs) 2.33 for product X and Rs 0.5 for product Y. So, it will be profitable to produce product X.

Table 7. Maximum profit margin by using TOC.

Product X	
Market	500 pieces/week
Contribution Margin (Rs)	35
Total time utilized in "B"	15,000 minutes
Amount of time remaining in "B" (for Y)	8040 minutes
Gross Profit with P (500×35) Rs	17,500.00
Product Y	
Market	250 pieces/week
Contribution Margin (Rs)	45
Capacity in function of "B" (8040/60)	134 pieces/week
Gross Profit with Y (134 x 45) Rs	6030.00
Total Gross Profit (X + Y) Rs	23530.00
Operating Expense Rs	(16,500.00)
Net profit / week Rs	7030.

The Table 7 shows 500 pieces of X and 134 pieces of Y which gives a net profit of Rs 7030/. The increase in profit is Rs 2900/ by considering the throughput accounting compared to conventional accounting. By making use of throughput accounting the rise in profit is significant which fulfills the market demand by producing 500 pieces of X and 134 pieces of Y.

9. Result of Throughput Accounting Case Study

TOC helps firms focus their attention on their problems. Because it regards bottleneck resources as being worthy of special attention and since, in general, there are few bottlenecks, firms are encouraged not to waste their efforts, but rather to concentrate on solving problems that may jeopardize the performance of these bottleneck resources, which in turn jeopardizes the operating result of the business as a whole. TOC principles offer new insights into old problems. Through a throughput accounting calculation, the Section B was utilized efficiently to demonstrate a new profitable product mix that resulted in increased revenue. The net profit increased to Rs 7030/ from Rs. 4130/- per week.

10. Conclusion

The best product mix can be decided based on market demand and throughput accounting. In this case study net profit is increased by Rs 2900/- per week. Traditional accounting was used by this firm and this case study creates the awareness of throughput accounting. The owner was decided to make use of the same in future.

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