

THEORY OF CONSTRAINT THROUGHPUT ACCOUNTING

How to achieve better, faster decisions at all levels of management

By Dr Alan Barnard

One of the key requirements of adopting a Systems Approach to continuous improvement and auditing is the ability to judge the impact of decisions on the system as a whole – especially the impact of financial decisions. For most managers in organizations, the idea of trying to evaluate the impact of their local decisions or proposed investments on the “system as a whole” is a daunting, lengthy and frequently frustrating experience (especially if they need to make a decision quickly). Throughput Accounting (TA) was invented by Dr. Eli Goldratt (Goldratt, 1990) to meet this challenge as an alternative to cost accounting.

Throughput Accounting (according to the IMA Statement 4HH on Theory of Constraints) differs from traditional Cost Accounting firstly in its recognition of the impact of constraints on the financial status of an organization (i.e. if a decision impacts the constraint, the system’s Throughput will be impacted and vice versa) and secondly in that it separates Totally Variable Cost from Operating Expenses (all costs that are not totally variable with increased /decreased production) to assist with faster and better decisions. This definition removes the need to allocate all costs to products and services, which frequently results in sub-optimum decisions when managers erroneously assume that once Operating Expenses were allocated they become variable (Smith 2000).

Throughput Accounting improves profit performance (even for not-for-profit organizations) with better and faster management decisions (Corbett, 1995), by using measurements that more closely reflect the effect of decisions on three critical monetary variables – Throughput, Investment/Inventory, and Operating Expenses (defined below). Goldratt's alternative begins with the idea that each organization has a goal and that better decisions increase its value. The goal for a profit maximizing firm is easily stated - to increase profit now and in the future. Throughput Accounting applies to not-for-profit organizations too, but they have to develop a goal that makes sense in their individual cases. Organizations that wish to increase their attainment of their goal should therefore require managers to test proposed decisions against three questions:

Will the proposed change:

1. Increase or Reduce Throughput (Sales – Total Variable Cost)? If yes, by how much?

2. Reduce or Increase Investment (Inventory)? If yes, By how much?
3. Reduce or Increase Operating Expenses? If yes, by How much?

The answers to these questions determine the effect of proposed changes on system-wide measurements:

1. Throughput = Sales Revenue – Totally Variable Cost = SR- TVC
2. Net profit (NP) = Throughput - Operating Expense = T - OE
3. Return on Investment (ROI) = Net Profit / Investment = NP/I
4. TA Productivity = Throughput / Operating Expense = T/OE
5. Investment Turns (IT) = Throughput / Investment = T/I

In summary, Throughput Accounting is an important development in modern accounting that allows managers within both Private and Public Sector organizations to understand the contribution of constraint resources and the frequently non-linear impact of local actions or decisions on the overall profitability and viability of an organization.

Knowing the impact of changes on these variables plays a vital part in both knowing WHERE TO FOCUS scarce resources (especially management time) and knowing HOW TO PREDICT the impact of changes on the organization’s profitability / viability. Table 1 below shows the leverage achieved in a 1% increase in average selling price, 1% increase in volume sold and 1% reduction in wages.

	Baseline		Price Increase Impact		Volume Increase Impact		Wage Reduction Impact	
	Value	% of SR	Value	% of SR	Value	% of SR	Value	% of SR
Sales Revenue	\$ 100.00	100%	\$ 101.00	100%	\$ 101.00	100%	\$ 100.00	100%
Variable Cost	\$ 50.00	50%	\$ 50.00	50%	\$ 50.50	50%	\$ 50.00	50%
Throughput	\$ 50.00	50%	\$ 51.00	50%	\$ 50.50	50%	\$ 50.00	50%
Operating Expenses	\$ 40.00	40%	\$ 40.00	40%	\$ 40.00	40%	\$ 39.80	40%
Net Profit	\$ 10.00	10%	\$ 11.00	11%	\$ 10.50	10%	\$ 10.20	10%
Impact of 1% Change			10%		5%		2%	

Table 1: Using TA to show the leverage with a 1% change in Price, Volume Sold & Wages

Management not focusing on the highest leverage opportunities is only one of the mistakes that can cause bad decisions or delays in good decisions. To date, 6 common management decision mistakes have been identified.

TOC's Throughput Accounting can be used to prevent 6 common mistakes caused by applying traditional Cost Accounting for judging important management decisions, which include:

1. Mistakes in judging company performance
 - Today, this is done using Traditional Financial Statement
2. Mistakes in judging business unit performance
 - Today, this is done by measuring BUs as Profit centres (P&L)
3. Mistakes in judging product/service profitability
 - Today, this is done by comparing Selling Price vs. Std Costs
4. Mistakes in Make/Buy decisions
 - Today, this is done by comparing Price to Buy vs. Total Internal Cost to Make
5. Mistakes in making New Investments decisions
 - Today, this is done through Cost saving calculations
6. Mistakes in Setting Product/Service Pricing
 - Today, this is done mainly through $\text{Price} = \text{Cost} + \text{Margin}$

These mistakes show that a change is needed in the process by which management decisions are made. The need for this change can be summarized as follows:

Need for change

- The management of any organization (especially those characterized by complexity & uncertainty) has to make, every day, important decisions (e.g. whether to accept a new project with very challenging due-dates and/or requirements; whether to hire additional people or make a substantial investment etc.) that can and most frequently do impact the organization as a whole and specifically its financial performance and even viability.
- Using traditional accounting and thinking, such management decisions are prone to mistakes that will at best delay good decisions and/or not achieve the desired improvement in performance, or at worst, really damage the financial performance of the organization now and/or in the future.
- Many traditional “local optima” performance measurements can drive, even the best of employees and managers, to behave in a way and/or make decisions that can hurt the organization
- In most organizations it frequently happens, that when decisions have to be made, that either the decision is delayed unnecessary (waiting for a manager / customer or more

“accurate” info) and or that the impact of decision on the company as whole is not evaluated /not evaluated correctly.

Objective of a change

All management decisions, as well as the performance measurements, at all levels in the organizations are made quickly and always considers the net (Δ) impact on the organization as a whole.

Assumptions

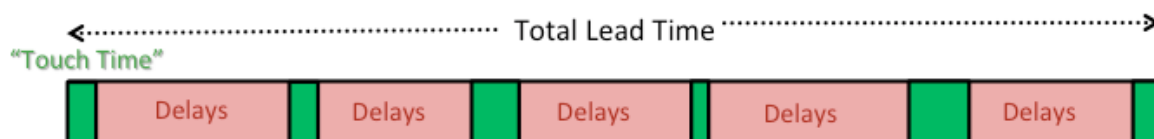
- It is possible to differentiate Totally Variable Cost (TVC) from Operating Expenses (Fixed Costs).
- Using the 5 Focusing Steps of Theory of Constraints, the Δ Impact of any decision (at least in order of magnitude) on Co.
- Decisions based on performance measurements that use Throughput ($T = \text{Sales} - \text{Totally Variable Cost}$), Operating Expense (OE) and Investment (I) lead to better decisions at all levels of the company.
- Acquiring the data for determining the impact on T, I and OE of a project and/or a critical decision is not a real obstacle.

Proposed Change

The Company implements Theory of Constraint’s Throughput Accounting & Decision Making to ensure all performance measurements and decisions are done based on T, I and OE and the five focusing steps

Warnings

- Any decision can be optimal only up to the level of the “noise” (the amount of uncertainty) in the environment. Any attempt to optimize within the noise is both futile and damaging..
- A significant amount of the delays (gap between touch time and lead time) is caused by delays in making decisions. To reduce overall Lead Time and increase Throughput and ROI, we need a practical mechanism to expedite significantly, the making of good global optima (rather than local optima) decisions at all levels of the organization.



1. Delay due to late arrivals of pre-requisite (e..g “supplier” delivered a part late)
 - *Delay will be equal to Lateness of delivery of part or service*

2. Delay due to unavailability of a Capacity Constrained Resource (CCR) including the unavailability of a key manager that can make a decision without delay.
 - *The delay will be equal to queue in front of CCR*
3. Delay due to Batching Rules
 - *The delay will equal the size of the batch. E.g. Waiting to complete all 5 in batch before transferring the one that is needed now.*
4. Delay due to not having a rule or not applying the right rule
 - *The delay will be equal to the time to identify and apply the right decision rule (that will enable better protection, exploitation and or elevation of the system constraint)*

The analysis of many organizations have shown that there are four types of scenarios where “not having or applying the right rule” can cause significant decision delays.

1. **There is no rule** (the organization is now facing a new situations)
2. There is a rule but despite it being documented it is clear – i.e. the rule is not always followed not because some disagree with the rule, but they really did **not understand the rule**.
3. There is a rule, but some people do not agree and therefore do not (always) follow with the rule but inertia (comfort zone) causes **resistance (many times for good reason) to change the rule**.
4. There is a rule, but **no rule to break the rule**.

If an organization wants to evaluate to what extent TOC’s Throughput Accounting can help all levels of management make better, faster decisions, it is recommended for the Management Team to answer the questions below.

Divide your management team into 6 groups, each representing one of the 6 identified types of “mistakes” and get each team to analyse and present their answers to the following 4 questions

1. What MEASUREMENTS are currently used in that part/for those decisions?
2. What MISTAKES can be made in using the measurement for making decisions (BAD DECISIONS) AND OR what UNDESIRABLE BEHAVIOIRS can these measurements drive?

3. What are the possible CONSEQUENCES of the bad decisions or bad behaviours on the company as whole (impact on ΔT , ΔOE & ΔI)?
4. What can be done to prevent these Mistakes (bad decisions and or bad behaviours) i.e. What do you recommend to:
 - START doing/measuring?
 - STOP doing/measuring?

The Appendix below provides details of the TOC analysis for each of these 6 types of generic mistakes.

APPENDIX

Mistake 1 - Judging the Co. Performance as a whole

Need for the Change

On a P&L statement prepared according to GAAP (where inventory is valued at raw material cost + value added in labour and overhead), a change in inventory levels for the measured period is a component in calculating cost of goods sold. When inventory decrease, cost of goods will go up and therefore profitability goes down, can result in “punishing” a required FG stock reduction in a period while rewarding unnecessary FG stock increases

Objective of the Change

Management can quickly and accurately judge the real impact of past and future decisions or changes on the company as a whole

Assumptions

- For management accounting, the Balance Sheet should value inventory only at Raw Material costs.
- For management accounting, the P&L statement should separate “Cost of Goods Sold” into Totally Variable Cost and Operating Expenses (all expenses not totally variable)
- The impact of any decisions and changes on the company as a whole can be quickly and accurately judged by judging the impact of the past or future decision or change on ΔT (SR-TVC), ΔOE and ΔI .
- To judge the impact on T, managers must know the impact of the decision or change on the “system constraint”

Proposed Change

The Company uses the 5 Focusing Steps and the impact on Δ Throughput (Sales – Total Variable Cost), impact on Δ Operating Expenses and impact on Δ Investment in order to judge the impact of any local decision or change on the company as a whole (impact on its Net Profit and ROI)

Mistake 2 - Judging Product/Project/Customer Profitability (Viability)

Need for the Change

When the profitability or viability of a product, project, programs or even customer is judged based on its “profitability” after Labour and Overhead Cost Allocation , there is a risk that management decide to either STOP supplying a product, project , program or customer that still has a positive contribution (which might not be replaced) or decide to START supply /supply more when the price/unit is more than cost/unit when in fact the contribution is either negative or less than what another replacement can provide (with same capacity)

Objective of the Change

Management can quickly and “accurately” judge the viability and real impact of past and future decisions or changes within a product, project or customer on the company as a whole.

Assumptions

- Since a large portion of company costs fixed in relation to output (Operating Expenses), “Profitability” can only be calculated for Company as a whole, not for a specific product, project, program or customer.
- It is possible to identify the “Selling Price x Volume” and Totally Variable Cost per product, project, program or customer to calculate “Throughput per grouping”
- It is possible to identify “Direct Operating Expenses” for any specific or group of products, projects, programs or customers where $OE_{\text{direct}} = \Delta OE$ that will go away if company stops supplying that product, project, program or customer)
- When evaluating the contribution of a product, project, program or customer, its Throughput – OE_{direct} should be calculated.

Proposed Change

For all groupings where the company needs to judge the grouping’s “profitability/viability”, the Contribution is calculated as Sales Revenue – Totally Variable Cost – Direct Operating Expenses. All other Operating Expenses are treated as Indirect and only allocated to company as a whole

Example:

Should we accept an export order for \$1250/t if our “Standard Cost” is \$1500/t but we have the capacity to do it?

DESCRIPTION	CURRENT	+ CHANGE	= FUTURE
+ Sales Revenue (SR)	\$ 5,000,000	\$ 500,000	\$ 5,500,000
- Variable Cost (VC)	\$ 2,000,000	\$ 250,000	\$ 2,250,000
= Throughput Value Added (TVA)	\$ 3,000,000	\$ 250,000	\$ 3,250,000
- Operating Expense (OE)	\$ 1,500,000	\$ 50,000	\$ 1,550,000
= Contribution Margin (CM)	\$ 1,500,000	\$ 200,000	\$ 1,700,000
- General Expense (GE)	\$ 1,600,000	\$ 0	\$ 1,600,000
= Net Profit (NP)	\$ -100,000	\$ 200,000	\$ +100,000
+ Inventory ($I_n = Rm + Wip + Fg$)	\$ 2,000,000	\$ 0	\$ 2,000,000
+ Assets (Ia)+Debtors - Creditors	\$ 3,000,000	\$ 0	\$ 3,000,000
= Investment (I = In+Ia)	\$ 5,000,000	\$ 0	\$ 5,000,000
= Return on Investment (ROI=NP/I)	< 0%		24% pa
= Productivity (Pr = TVA / OE)	< 0%	500%	105%
= TVA per Constraint Unit(TVA/Cu)	\$ 17,360/hr 144hrs /month		\$17187/hr 160hrs/month

Result:

We would have achieved a 200% Improvement in Net Profit if we accepted the order. Yet, following Cost Accounting, the order would have been rejected.

Mistake 3 - Judging (impact of) Make/Buy Decisions

Need for the Change

Judging “Make/Buy” decisions by comparing in house “standard cost/unit” with external purchase price can result in poor decisions since in most cases, little, if any of the labour and overhead allocated within “standard cost/unit” is removed when processes/parts /products are outsourced resulting in most of the Operating expenses remaining while variable cost goes up – i.e. total cost increasing while we expected total cost to reduce

Objective of the Change

Management can quickly and accurately judge the real impact on the company as a whole of past and future decisions relating to Make vs. Buy-out/Outsourcing.

Assumptions

- It is possible to identify the “Selling Price x Volume” and Totally Variable Cost per group of products or sub-projects/programs being considered for Make vs Buy (outsourcing)
- It is possible to identify “Direct Operating Expenses” for any specific group of products, projects, programs where $OE_{\text{direct}} = \Delta OE$ that will go away if company stops supplying that product, project, program or customer)
- When evaluating the impact of Make vs. Buy, the change in contribution of a group of products, project, program should be calculated as the Throughput – OE_{direct}

Proposed Change

For all Make/Buy decisions, the company judge the impact based on the impact on $\Delta \text{Sales Revenue} - \Delta \text{Variable Cost} - \Delta \text{Direct Operating Expenses}$. All other Operating Expenses are treated as Indirect and therefore fixed (will not go away if “buy” decision is made)

Example:

Mistake 4 - Judging (impact of) New Investments

Need for the Change

Justifying investments based on a reduction in cost/unit (reducing labour hrs or increasing output) rather than validating impact on bottleneck can result in approval of investments with no bottom line impact (investments on non-bottlenecks) and no approving (or not approving fast enough) bottleneck exploitation or elevation investments

Objective of the Change

Management can quickly and accurately judge the real impact on the company as a whole of past and future decisions relating to New Investments

Assumptions

- The impact of a new investment on the company as a whole can only be assessed when the impact on the constraint of the system is known.
- A company will benefit from any investment that helps to better exploit or when needed, elevate the system constraint
- When the impact on the constraint is known, the impact of a decision on the company's ΔT , OE and I can be determined.
- ROI can be calculated as $ROI = (\Delta T - \Delta OE) / \Delta I$

Proposed Change

The Company uses the 5 Focusing Steps and the impact on Δ Throughput (Sales – Total Variable Cost), impact on Δ Operating Expenses and impact on Δ Investment in order to judge the ROI of any investment on the company as whole

Example:

Lets assume that we are considering purchasing a new machine that costs \$100,000. This machine produces parts twice as fast as the existing machine. How do we evaluate if the investment is justified (or not)?

Answer following the traditional Cost Accounting thinking

Translating Time Saved per part into Time saved per Annum

- Time saved per part = 5min.
- # of Parts produced per year = 30,000
- Time saved per year = 2500 hours

Translate Time saved to money saved per period

- Direct Labour = \$8/hr
- Overhead Factor = 4
- Total Cost per Hr = $8 + 4 \times 8 = \$40/\text{hr}$
- Money saved per year = $2500\text{hours} \times \$40/\text{hr} = \$100,000$

Calculate Return on Investment

- Machine Price = \$100,000
- Money Saved per year = \$100,000 therefore ROI = 1 year (i.e. Approved!)

Lets assume that we are considering purchasing a new machine that costs \$100,000. This machine produces parts twice as fast as the existing machine. How do we evaluate if the investment is justified (or not)?

If the machine is not 100% faster, but only 10% faster, the ROI will not be 1 year but 10years. Traditional process will not approve this investment.

Answer following the TOC way of thinking

If the machine is a non-bottleneck?

Improving the cycle time of non-bottlenecks will not increase Throughput. Unless there is a saving in operating expenses (reduction in wages or overtime) there will be no ROI.

If the machine is a bottleneck?

For a company with \$100m Sales and 50% Raw Material Cost, if this machine was a bottleneck and it can now produce 10% more, the ROI will be: $(10\% \times \$100\text{m} \times 50\%) / \$100\text{k} = 5$ (i.e. only a few months

Doing ROI / Leverage Calculations

TOC Financial Decision Model

	Before		% Change in Qty	% Change in Price	After	
	US \$	% of Sales			US \$	% of Sales
Sales Revenue (SR)	\$ 100.0	100%	10%	5%	\$ 115.50	116%
Variable Cost (VC)	\$ 50.0	50%	10%	15%	\$ 63.25	50%
Throughput (T)	\$ 50.0	50%	5%		\$ 52.25	45%
Operating Expenses (OE)	\$ 45.0	45%	10%		\$ 49.50	43%
Net Profit (NP)	\$ 5.0	5%	-45%		\$ 2.75	2%
Investment (I)	\$ 20.0	20%	0%		\$ 20.0	17%
Return on Investment (ROI)	25%		-45%		14%	
Co. Price-Earnings (PE)	5				7	
Co. Value	\$	25	-23%		\$	19

Mistake 5 - Judging (impact of) Dept / Business Unit Performance

Need for the Change

Not knowing the real contribution of a BU to the company as whole and or not knowing the impact of changes to a BU's performance, can result in decisions that can hurt the company as a whole

Objective of the Change

Each Dept or Business Unit behaves in line with what is best (i.e. most important and most urgent) for the company as whole Executives know where to Focus there attention where changes will deliver the largest impact on the company as whole

Assumptions

- It is possible to identify the company wide impact of the current performance and or any changes to a business unit based on its impact on the Total T, I and OE of the company as whole
- Transfer Prices are necessary to ensure adherence to GAAP especially when the Internal Supplier and Internal Customer are located in different countries.
- Transfer Prices are necessary to ensure adherence to GAAP especially when the Internal Supplier and Internal Customer are located in different countries.
- When transfer prices are used and are calculated based on $\text{Material Cost} + \text{lbr hrs} \times (\text{lbr rate} + \text{ovh rate}) + \text{"Fair margin"} = \text{transfer price}$, it can result in behaviour by the internal Supply Dept to increase its cost/cost allocation to get higher sales and or get internal customer to buy more or all its requirements outside.

Proposed Change

For all depts/business units where the company needs to judge the grouping's "profitability/viability", the Contribution is calculated as Sales Revenue – Totally Variable Cost – Direct Operating Expenses. All other Operating Expenses are treated as Indirect and only allocated to company as a whole

Example:

The P&L Statement

Traditional P&L by Business Unit

	Business Unit #1		Business Unit #2		Business Unit #3		Total Company	
	US \$	% of Sales	US \$	% of Sales	US \$	% of Sales	US \$	% of Sales
Sales Revenue (SR)	\$ 500.0	100%	\$ 300.0	60%	\$ 200.0	40%	\$ 1 000.0	100%
Cost of Goods Sold (COGS)	\$ 350.0	40%	\$ 225.0	50%	\$ 150.0	50%	\$ 725.0	73%
Gross Margin	\$ 150.0	30%	\$ 75.0	25%	\$ 50.0	25%	\$ 275.0	28%
Indirect Operating Expenses (OE _i)	\$ 100.0	20%	\$ 70.0	23%	\$ 55.0	28%	\$ 225.0	23%
Net Profit (NP)	\$ 50.0	10%	\$ 5.0	2%	-\$ 5.0	-3%	\$ 50.0	5%

TOC based P&L by Business Unit

	Business Unit #1		Business Unit #2		Business Unit #3		Total Company	
	US \$	% of Sales	US \$	% of Sales	US \$	% of Sales	US \$	% of Sales
Sales Revenue (SR)	\$ 500.0	100%	\$ 300.0	100%	\$ 200.0	100%	\$ 1 000.0	100%
Variable Cost (VC)	\$ 200.0	40%	\$ 150.0	50%	\$ 100.0	50%	\$ 450.0	45%
Throughput (T)	\$ 300.0	60%	\$ 150.0	50%	\$ 100.0	50%	\$ 550.0	55%
Direct Operating Expenses (OE _d)	\$ 150.0	30%	\$ 75.0	25%	\$ 50.0	25%	\$ 275.0	28%
Contribution	\$ 150.0	30%	\$ 75.0	25%	\$ 50.0	25%	\$ 275.0	28%
Indirect Operating Expenses (OE _i)							\$ 225.0	23%
Net Profit (NP)							\$ 50.0	5%

PS: “**Direct Operating Expenses**” are those “non-variable expenses” that will definitely go away when a BU is closed, a product group is no longer made/sold etc.

Mistake 6 - Setting Selling Prices for “Products”

Need for the Change

- Setting one price for a product on “Cost+Fair Margin” while the Perception of Value (PoV) for a product varies significantly from customer to customer, means that for some customers, the Price too high (compared to their PoV) while for others, the price is too Low (Customer PoV).
- Normally “too low PoV” is corrected by Sales People through price Discounting that has a devastating impact on the average selling price and profitability

Objective of the Change

The company prices are in line with the Perception of Value of clients and desired contribution by shareholders

Assumptions

- Although it is not possible to know exactly the PoV different clients have for a product/service, it possible in most cases to estimate the range for PoV of different market segments
- It is possible to separate Variable, Fixed and Stepped Variable (based on volume) for a product or service
- The Throughput / C unit of a Product or Service = $(\text{Selling Price} - \text{Variable Cost}) / \text{Consumption of Constraint units}$
- If the constraint is capacity, $T/Cunit = T/\text{hrs on bottleneck}$
- If constraint is the market, $T/Cunit = T/\text{orders}$
- $T/Cunit$ can be used to calculate a “Pricing Indifferent Point” - i.e. a Price where a product or service contributes the same desired T as others

Proposed Change

The company sets prices on a basis that not only considers both the total cost + fair margin, but considers separately Total Variable Cost, Direct Operating Expenses (expenses that will go away if product is not provided), the desired T/Cunit as well as the Perception of Value of clients and sets prices accordingly for different market segments

Example:

