Constraints In Management and Accounting Financial

Gholam Reza Khorshidi 1, Ali Naghdi 2, Hamed Alizadeh 3, Hamideh Honarmand 4, Zahra Shabani 5

Master Students of Business Management. Islamic Azad University, Rasht, Branch, Iran.

Corresponding author email: Kourosh.Khorshidi@yahoo.com

ABSTRACT: This paper examines in detail the relative utility of the Theory of Constraints compared to traditional management accounting approaches to resource utilisation in aiding decision making. It also considers the propagation and evolution of the Theory of Constraints and critically examines the response it has generated in the accounting and management literature. The continuing survival of cost accounting in the face of frequent assaults similar to Goldratt’s may in part be due to the ability of the discipline to adapt its practices to integrate the mandated improvements into practice and educational curricula. One example is the Theory of Constraints itself (e.g. Horngren et al (1999), Morse and Zimmerman (1997)). The paper reflects on the process by which new ideas are assimilated into the conventional management wisdom based on this example.

keywords: Capacity Management, Capacity Plasticity, Constraints, Management Accounting, Financial Brake

INTRODUCTION

The worldwide economic reorganisation of the last decade has regularly been accompanied by appeals to concepts of lean manufacturing and flexible systems. These generally imply a scaling of productive and operating capacity to match demand and current throughput levels. The recent Irish economic boom also highlighted the importance of consideration of capacity management issues. These have arisen both because of constant appeals to greater efficiency, and because of imbalances between the supply and demand of many input resources. The problem of capacity management arises both in a macroeconomic and local, or firm level context. A question arises as to contribution of management accounting in managing such problems. Although issues related to capacity have long been considered in accounting there is a relative lack of advanced quantitative techniques in daily use as recommended in the literature.

The theory of constraints

In “The Goal” Eli Goldratt reinvigorated traditional optimisation insights by presenting them in a repackaged form (Goldratt and Cox (2003)). This management best seller took the form of a thriller following the struggle of plant manager with 90 days to save his loss making operation from shutdown. In it Goldratt and Cox attack cost accounting as the “enemy number one of productivity” and instead called for a holistic process of ongoing improvement integrating techniques such as MRP, Just in Time and Statistical Process Control. The continuing survival of cost accounting in the face of frequent assaults of this type may in part be due to the ability of the discipline to adapt its practices to integrate the mandated improvements into practice and educational curricula. One example is the Theory of Constraints itself (e.g. Horngren, Bhimani et al (2009) and Morse and Zimmerman (2007)).

The theory of constraints (TOC) describes methods to maximise operating profit by identifying bottleneck operations, recognising that the bottleneck resource determines the throughput contribution of the plant as a whole. The bottleneck may be found by identifying operations with large backlogs of stock waiting to be worked on. A summary of the development of the theory is included in Jones & Dugdale (2008).

The manager must then ensure the bottleneck resource is always kept busy and other resources are subordinated to the bottleneck in scheduling, and in prioritising investment. The Theory of Constraints is built on three central measurements:
Throughput contribution = sales revenue - direct materials cost.

Investments (stock) = Inventory (i.e. Raw materials, WiP, Finished Goods (materials content only)) + R and D costs + Buildings and Equipment.

Operating costs = includes operating costs other than direct materials, includes labour costs and overheads including depreciation. These are all implicitly assumed to be fixed. This assumption leads many commentators to the conclusion that TOC measures have a short run time horizon. TOC aims to maximise throughput contribution while decreasing investments and operating costs. This is done by following a series of focusing steps to manage bottleneck resources.

**Five Focusing Step**

STEP 1: Recognise that the throughput contribution of the entire plant is limited by the bottleneck resource.

STEP 2: Identify the bottleneck resource, generally by seeing where there is a build-up of stock waiting to be worked on.

STEP 3: Keep the bottleneck operation busy all the time, and subordinate all other operations to it. The needs of the bottleneck resource drive the production schedule of other resources. It sets the pace for other machines or operations. Producing more elsewhere only leads to excess stock without increasing throughput contribution. TOC demands the elimination of most Work in Process inventory. TOC does however advocate the maintenance of a buffer stock before the bottleneck machine to ensure that it is never unnecessarily idle.

STEP 4: Elevate the systems bottlenecks by increasing system capacity. This is done if the increase in throughput contribution exceeds the incremental cost of improvement.

STEP 5: If in the previous steps a constraint has been broken, return to step 1.

**The Theory Of Constraints And Accounting**

Goldratt & Cox's (2003) reasons for identifying cost accounting as the "enemy number one of productivity" are illustrated in the story of "The Goal". The hero, Alex, finds that as production was cut on non-bottleneck machines, to follow the beat of the "Drum", this was reported as falling capacity utilisation rates to his Divisional head office. Newer accounting measures such as Activity Based Costing (ABC) may reinforce the weaknesses of traditional accounting practices based on absorption costing, by providing an incentive for higher output at each activity and fewer setups (and hence longer production runs), leading to excessive output at non-bottleneck resources. In general the TOC emphasises the provision of information for decisionmaking, rather than for management control or product costing.

**Management Accounting And Throughput Accounting**

Despite the rhetoric the ideas of TOC are congruent with the theory and practice of management accounting prior to the publication of The Goal. The goal of maximising Throughput Contribution while decreasing investment and operating costs can be seen as an approximation of the long standing accounting rule in short run decision-making of maximising contribution per unit of the limited resource which has featured in textbooks well before the Publication of The Goal. The Goldratt approach is often referred to as Throughput Accounting.

(However there is some ambiguity of language in that the term Throughput Accounting. In the US and continental Europe “Throughput Accounting” is the term used to refer to Goldratt's recommendations for accounting techniques. In the UK members of the Goldratt Institute avoid using the term "Throughput Accounting" and uses the term "TOC in Accounting" instead. The reason is a dispute with Waldron and Galloway over the origin of the term.)

What is key to understanding the difference is the final deduction of $3,000 for operating expenses in each case. The analysis is based on the assumption that no other variable costs except direct materials exist (despite the column 3 heading in exhibit 7). While this may be true in some cases TOC assumes that variable costs will never include any element of direct labour or variable overhead. Further the narrative of the article mainly argues reasons why this should be so, rather than that it is so. The arguments used include indivisibility of the standard work-week, employee morale support from avoiding lay-offs and the value of retaining workers even when not productive through training etc. This analysis ignores real world phenomena such as part-time working, contract working, overtime working and redeployment of idle staff from quiet to busy areas, all of which can be used to make labour costs variable at least at the margin, even without layoffs.

In fact if the Atwater and Gagne example were recast with direct labour also seen as truly variable then the results would be as follows:

<p>| Table 1. Toc Production Plan | 1862 |</p>
<table>
<thead>
<tr>
<th>Total</th>
<th>P</th>
<th>Q</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>TOC METHOD – Production Plan</td>
</tr>
<tr>
<td>3.50</td>
<td>5.50</td>
<td></td>
<td>Dir. Labour cost (per unit)</td>
</tr>
<tr>
<td>36</td>
<td>100</td>
<td></td>
<td>Units produced</td>
</tr>
<tr>
<td>$676</td>
<td>$126</td>
<td>$550</td>
<td>Total direct labour cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACCOUNTING METHOD</td>
</tr>
<tr>
<td>3.50</td>
<td>5.50</td>
<td></td>
<td>Dir. Labour cost (per unit)</td>
</tr>
<tr>
<td>50</td>
<td>76</td>
<td></td>
<td>Units produced</td>
</tr>
<tr>
<td>$593</td>
<td>$175</td>
<td>$418</td>
<td>Total direct labour cost</td>
</tr>
</tbody>
</table>

Incremental direct labour cost from TOC production plan

$ 83

In the Atwater and Gagne paper (see Appendix A, Exhibit 9) TOC offers an increased weekly profit of $62 ($1,692 - $1,630). This is however based on the assumption that direct labour costs are unaffected by the production plan chosen and the advantage is reversed by the $83 extra in direct labour cost if labour is truly variable. The gap will grow wider if any of the overheads are truly variable and Appendix B shows how the difference in weekly profit could be as high as $120.

Balderstone & Keef (2009) suggest that the definition of throughput as sales minus only material costs is a result of a misreading of Goldratt's work, but even if this is so it has become the standard formulation of throughput contribution in both journals and textbooks as Balderstone and Keef themselves detail. In almost all cases direct materials costs are explicitly deducted while direct labour is not, while direct labour is usually explicitly or implicitly included in operating costs. In fact as they point out the error even extends to the Noreen et al (2005) independent report on TOC and its implications for management accounting (sponsored by The Institute of Management Accountants -USA), containing a foreword by Eli Goldratt and published by his publisher.

It is important to note that the mistaken belief that TOC provides a superior production planning tool to the marginal contribution rule in profit terms is not confined to the Atwater & Gagne paper.

It appears repeatedly in other papers, particularly in the field of production management e.g. Blackstone (2011), Umble and Umble (2008). Furthermore where the issue has been discussed in the accounting literature the discussion has tended to centre on pointing out the lack of novelty in the TOC approach, and that fact that it is a mere variation on the marginal contribution based accounting approach, (e.g. Dugdale & Jones (2008) ) rather than pointing out that it is actually inferior and potentially misleading.

**The Role Of Optimisation**

Some reviews of TOC assert that it provides additional insights beyond those available from linear programming (LP) e.g. "However, the level of analysis provided by LP via the shadow prices is not as detailed and does not provide the same level of analysis as provided by TOC through the $ return/constraint unit analysis" Luebbe & Finch (2002). This statement is misleading at best since in fact linear programming is based on the same principle of maximising contribution per unit of the limited resource. Each "pivoting" iteration of the simplex method which linear programming uses to solve optimisation problems is built on this principle. Unlike the TOC rule however linear programming runs through several iterations because it recognises the existence of several candidates for the role of binding constraint. TOC assumes that the choice of binding constraint will be intuitively obvious though build-up of work in progress inventory at particular points.

**The Current Position Of Bottleneck Management**

While linear programming has clear conceptual advantages over TOC it has clearly had limited success in the marketplace for ideas. Clarke (2002) reports a usage rate of only 5% among Irish companies. There is also no evidence of increase in usage despite the increasing access to computer hardware and software and the spread of cost databases which could presumably lower usage cost. In fact some leading management accounting textbooks have dropped linear programming.

It must be recognised that LP does itself have problems in implementation. These include its assumptions of:

- linearity in the objective function, and constraints,
- constant selling prices and variable costs, giving clear quantifiable coefficients for the objective
function. Identifiable and quantifiable discrete constraints. Brausch and Taylor (2007) found that none of their 12 research sites and only 3 of their 51 survey companies were determining available capacity, degree of usage and non-usage, or the cost of unused capacity in support areas and non-factory activities.

This paper can only begin to question the reasons for this shift from LP to TOC. It does seem to be part of a search for greater relevance and for academic text authors to follow those ideas attracting most attention in the popular business media and consulting markets, combined perhaps with students difficulty with more quantitative material.

Positive Insights From Toc And Traditional Optimisation

The contribution of TOC may be to revive interest in an optimisation approach to capacity management, which although theoretically correct was not widely applied. It can be argued that the TOC approach should not be described as holistic (as it is in Tollington 2008, Noreen et al 2005) as for instance it does not recognise the possibility of adjusting pricing of marginal output to reflect dual prices of scarce capacity.

However the insight that management should constantly search out bottlenecks from obvious clues such as build up on WIP inventory, or customer queuing in the case of services. If this is followed by focused searching for relief of the bottleneck, as mandated by TOC then it can contribute to profitability. Brausch & Taylor’s study outlined a variety of firm responses e.g. running overtime, extra days and extra shifts as well as outsourcing and employing temporary or seasonal employees in the bottleneck areas.

Costing Unused Capacity

Equally a balanced production process may have significant unused capacity. Brausch and Taylor’s study found that in general firms do not capture the cost of unused or excess capacity. They recommend that firms explicitly quantify the lost contribution margin from unused capacity as a form of “waste” variance. An example of such a report at income statement level is given by Cooper and Kaplan (2002) as follows.

Income Maximisation from Marginal Pricing

The insight provided by linear programming of the marginal contribution to be gained from scarce resources has been operationalised in the airline industry in sophisticated yield management systems. These enable firms to practice price discrimination reflecting the degree of capacity filled on a flight based on current bookings and expected final capacity occupancy. Thus early bookers get cheaper tickets than those who have left themselves the flexibility of booking late (with final assessments of unused capacity leaving the possibility of cheap marginally costed seats for the least risk averse consumer. The transaction costs of such systems have fallen dramatically with the advent of internet booking which now accounts for a significant percentage of ticket sales.

Table 2. Income Statement

<table>
<thead>
<tr>
<th>INCOME STATEMENT WITH UNUSED CAPACITY DISCLOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
</tr>
<tr>
<td>Less variable costs</td>
</tr>
<tr>
<td>Contribution margin</td>
</tr>
<tr>
<td>Less Fixed costs</td>
</tr>
<tr>
<td>Process A</td>
</tr>
<tr>
<td>Used</td>
</tr>
<tr>
<td>Unused</td>
</tr>
<tr>
<td>Process B</td>
</tr>
<tr>
<td>Used</td>
</tr>
<tr>
<td>Unused</td>
</tr>
<tr>
<td>Process B</td>
</tr>
<tr>
<td>Used</td>
</tr>
<tr>
<td>Unused</td>
</tr>
<tr>
<td>Operating Income</td>
</tr>
</tbody>
</table>

CONCLUSION

The most significant question arising from this paper is not merely that the TOC’s criticism of accounting metrics are flawed, or that its own metrics are merely simplified (and inferior) versions of other measures or methods in accounting and management science, and whose restrictive assumptions apply in fewer cases than the models it draws on. Rather it is why the accounting literature has in many cases embraced what is effectively a regressive (or dumbed down) theory. This is interesting since narrative stands as a substitute for empirical evidence in most of Goldratt’s work and he ignores academic debates on accounting theory and practice (Jones and Dugdale, 2008). They point out that Goldratt almost never cites any other writer, although in presentations he frequently appeals to Plato and Isaac Newton.

Despite this Jones and Dugdale accept the TOC as having considerable potential as a theory of
transformation. They claim it has “a methodology capable of directing change in specific ways, and it anticipates objections and hindrances so that they may be countered”. This last point is at best arguable since it anticipates only selective objections and simply assumes away others e.g. in assuming that there is normally only one binding constraint which is clearly identifiable, and stable, it ignores the frequent inter-relationship of different constraints.

However TOC clearly has clear potential to act as a vehicle to encourage firms to adopt the marginal costing techniques for decision-making purposes recommended by the textbooks. An over-simplified applications of those principles is better than no application at all. It also directs managers to the strategically important insight that relative product profitability is unimportant, it the profitability of resource usage that matters, in particular the profitable use of the scarcest resources. In this it has emerged as a competitor for activity based costing in the popular marketplace.

REFERENCES

Tollington T. 2008. ‘ABC v TOC same cloth as absorption v marginal, different style and cut?’, Management Accounting.