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Throughput accounting heuristics is still adequate: Response to criticism

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ABSTRACT

During the years, number of authors have argued against of possible non-optimality of throughput accounting product mix preference. Lastly, Linhares (2009) criticized throughput accounting heuristics in expanded product mix selection of Blackstone (2001). It is shown in this work that throughput accounting still outperforms any other approach in this referred hypothetical situation, if overall capacity availability of a constraint resource and total throughput per week delivered are being considered (vs. only using throughput per minute of a product). It is critical to expand own point of view to the profit of a system, instead of solely justify decisions on shorter time units, which are not the same with the decision period. However, as we illustrate further, throughput accounting has still its caveats, which arise especially from step-wise increasing operating expenses or from the requirement of integer product mixes. These could be addressed properly by analyzing situation as illustrated in this research work, or alternatively using expert systems concerning customers and operations optimization. Impacts of these actions on short-term profitability are significant.

1. Introduction

Within discipline of theory of constraints (TOC), throughput accounting was the third avenue in the development applications, and it was released in the early 1990′s (Goldratt, 1990; Watson, Blackstone, & Gardiner, 2007). Goldratt often referred that cost accounting systems were *"the public enemy number one"* for gaining productivity improvements (Watson et al., 2007), and therefore new accounting approach was needed to be developed. Original two product and four resources as well as demand constrained product mix problem by Goldratt (1990) was introduced, and solved to highlight the path for higher profits. This static example attracted research works in the following decades, and PQ product mix selection was enlarged to incorporate outsourcing, new products and demand increase alternatives (Atwater & Gagne, 1997;Corbett, 1998; Draman, Lockamy III, & Cox III, 2002; Hilmola, 2001; Ray, Sarkar, & Sanyal, 2008; Ruhl, 1997 & 2004; Mohanty, Mishra, & Mishra, 2009). Other ever larger product mix problems appeared too in the research works (like Blackstone, 2001; Coman& Ronen, 2000; Nazari-Shirkouhi, Eivazy, Ghodsi, Rezaie, & Atashpaz-Gargari, 2010; Patterson, 1992). In these, typically hypothetical models, throughput accounting was found to perform well, and it usually produced higher profits than conventional accounting heuristics. In double or more constraint situations, its performance was not optimal one, and it has been proposed that throughput accounting should incorporate linear-integer programming to achieve sustainable and optimal results (Aryanezhad & Komijan, 2004; Balakrishnan, 1999; Mabin, 2001; Plenert, 1993; Rajesh, 2014). As in the beginning, throughput accounting was put against full costing systems; this is not any more that much the case. Full cost accounting is nowadays more concerned about long-term performance, and analyzing companies in the light of social, environmental and economic dimensions (Jasinski, Meredith, & Kirwan, 2015).

Together with multiple constraints situation, Linhares (2009) argued substantially against throughput accounting heuristics, and used as base hypothetical example of Blackstone (2001). Adding one more product to considerably production resource constrained product mix situation seemed to break-down most of the profit producing ability of throughput accounting. Problem is rooted in capacity vs. one product need for the capacity in the decision time period (e.g. week or day). Although, Linhares (2009) research work is convincing with all propositions and proofs, we intend to illustrate in this research work that its major findings are arising from the poor understanding of management philosophy of theory of constraints and its throughput accounting application. Illustrated

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situations of poor decision making ability of throughput accounting could and should be solved with throughput accounting, but with proper understanding of system level performance and objective of the system to maximize its results. Bang for the buck heuristics works still well in throughput accounting, but it needs to take into account the availability of production capacity to fulfill the demand. Priority of products by scaling their throughput with production resource cycle time should be checked against the ability to deliver and produce profits. It could be so that highest throughput accounting favored product should be produced as second, and first one priority should be acknowledged to better capacity fit product.

It should be emphasized that this research work is not taking steps to incorporate more uncertainty in the model (Hilmola & Gupta, 2015) or to apply better artificial intelligence algorithms in problem solving (Nazari-Shirkouhi et al., 2010; Rajesh, 2014). Both of these have been used and proposed in recent years to be applied, due to increasing amount of uncertainty in management systems, and options to overcome excessive demand. Artificial intelligence has also been used in accounting context to process demanding amount of qualitative reporting data (Van den Bogaerd & Aerts, 2011). However, this research is partly supporting with described decisions, initiative of using real-time reporting in management accounting (Trigo, Belfo, & Estébanez, 2014), where cost and profit control is completed more frequently with modern technology and devices (not in retrospective within longer periods of time). Throughput accounting also gives more attention on purchases, and recently industrial case study of Chompu-inwai, Jaimjit, and Premsuriyanunt (2015) emphasized the importance of improving material efficiency through material flow cost accounting. Purpose of this research work is to return back to the roots and origins of throughput accounting, and illustrate that this accounting approach is not inadequate in product mix decision. However, understandably, some further analysis is needed in product mix decisions, and bang for the buck approach solely and alone cannot be used to maximize results.

This manuscript is structured as follows: In the following Section 2, we review the static product mix selection research works. Research environment follows in Section 3. Analysis and solutions of Blackstone (2001) and Linhares (2009) product mix problems are shown in Section 4, where it is illustrated clearly that throughput accounting could overcome described problems stated in Linhares (2009). After this, we shall discuss over the results in Section 5. Research work is concluded in Section 6, where also additional avenues for further research are being proposed.

2. Literature review: Performance of heuristics in product mix selection process

There exists number of different heuristic methods to solve product mix decision. One of the oldest is the cost accounting based decision. Logic in here proceeds in a way that we have to trace all the costs, which product accrues and make the evaluation based on absolute and/or relative profit of the product. Some of the product costs are easy to trace to products, like raw materials and purchased components as well as possibly needed transportation services (e.g. to acquire raw materials and/or distribution of products). However, after this all certain ends and overhead, indirect labor as well as indirect purchases are allocated with some sort of drivers and/or departmental/functional rates (Fisher &Krumwiede, 2012). This leads in product profitability examination to full costing result from where decision maker just selects most lucrative product to produce. Selection could be made again in absolute or relative basis. This is cost accounting heuristics based approach.

Another alternative in product mix selection is to use throughput accounting principles, where only direct costs such as raw materials and transportation costs are devoted to products. Rest of the costs are considered as operating expenses, which are seen as fixed in the short-term (Fisher & Krumwiede, 2012 refer similar approach as 'throughput costing'). Best products to be produced are typically found by scaling throughput of particular product (sales price minus direct costs) to the used time at constraint resource. Product priority list shall contain in descending order all products based on their throughput abilities.

In original example (manufacturing of P and Q) it was found that cost accounting produced $300 of deficit per week as throughput accounting produced $300 of profit (Goldratt, 1990; Hilmola & Gupta, 2015). Research works in previous decades have found similar differences, and in most of the cases logic and heuristics of throughput accounting was more profitable for a manufacturer. Early study of Patterson (1992) showed remarkable difference in profitability of these two approaches, favoring that of throughput accounting (weekly loss was $818 with cost accounting, while profit using throughput accounting was $8872). Hilmola (2004) enlarged original P and Q product mix problem to consist new additional products of R and S; this resulted on further losses within traditional cost accounting approach (-$550), while throughput accounting prospered further ($1249.98). Blackstone (2001) found in three product example (same as analyzed further in this research, which was enlarged by Linhares, 2009) that conventional cost accounting produced weekly deficit of $410 as throughput accounting resulted to $820 of profit. Outsourcing study of Mohanty et al. (2009) found difference in real-life case study out of Indian manufacturer that standard cost accounting produced profit of $745.25 in work shift, while throughput accounting achieved level of $760.52. Nazari-Shirkouhi et al. (2010) found similar difference in hypothetical production outsourcing example (same as reported in Coman & Ronen, 2000), where standard cost accounting produced profits of $17,200, and throughput accounting in turn $18,428.

Even if evidence supports throughput accounting superiority over standard cost accounting and it is well documented, this alternative approach is not the final answer to the product mix problems. As told earlier, when multiple simultaneously holding constraints exist, then throughput accounting is not necessarily producing best results, but different optimization will (Plenert, 1993; Balakrishnan, 1999; Mabin, 2001; Aryanezhad & Komijan, 2004; Rajesh, 2014). Also adding uncertainty to the product mix models has brought findings that throughput accounting needs to be incorporated with balanced scorecard type of measurement (to assure correct continuous improvement; Gupta, 2012), while Hilmola and Gupta (2015) showed that uncertainty in original P and Q model will erode profits easily away from throughput accounting product mix too. Great uncertainty in production cycle times of original P and Q model (Hilmola & Lättilä, 2008) could also possibly favor emphasizing product Q in product mix selection (under certain premises).

3. Research environment

In original product mix selection situation of Blackstone (2001) there were three products, called X, Y and Z. These had sales prices of $90, $100 and $70 respectively. All of the sold products needed some raw materials, where product X had needed for in total $40 (RM1 and two RM2), while product Y in turn $30 (RM2 and RM3). Lastly, product Z needed $25 for raw materials (RM3 and RM4). Manufacturing of these three products also consumed production resources A, B, C, D and E. Fig. 1 illustrates situation in details. In original product mix situation manufacturing company had operating expenses of $8000 per week. These were considered as fixed and included all other costs (indirect and direct labor, indirect purchases, rents, depreciation of machinery, energy etc.) than