Integrated Management Control System for Small and Medium Sized Enterprises

Toyohiko Hachiya* and Pablo Gonzalo Ramirez*

ABSTRACT

Nowadays the role of SMEs in national economies is widely recognized. However, due to its limited resources availability, especially the lack of capital, SMEs have no margin for mistakes. The leading objective of this study is to develop a management control system to provide SMEs a resource to address its lack of information for decision-making purposes. The research proposal contributes to determine the volume and mix of core business by the integration of Theory of Constrains (TOC), Activity Based Costing (ABC) and Economic Value Added (EVA™). The election of management tools relies on its potential to address the profitability when considering a multiple product and limited resource environment. Results confirm that the integrated management system provide insights into the mix that leads to the maximization of the firms economic profit with respect to the trade-offs among resources deployed and constraints faced by the firms.

Keywords: control system; ABC; TOC; EVA; SMEs

1. Introduction

The role of Small and Medium Sized Enterprises (SMEs) in a national economy is well known, considering their contribution to the total Gross National Product and employment. Mitchell and Reid (2000) stated that despite its economic importance and the considerable attention afforded, researching management accounting in the small firm setting has never been fashionable. However, Dilts (1989) suggests that the range of strategic options is considerably narrow by necessity, since SMEs have insufficient resources to compete effectively. Sophisticated and costly strategies are often precluded by the lack of specialized expertise, capital and personnel necessary to their implementation. Moreover, the above-mentioned limitation means that managers at SMEs have little margin for mistakes and misjudgments and the use of financial management tools can enable them to make more efficient and practical use of their scarce resources. The main objective of this work is to suggest a management control system that provides accurately and timely information for decision-making purposes in the context of SMEs. The suggested management control system would help SMEs with the evaluation of its core business by means of integration of Economic Value Added (EVA™), Activity Based Costing (ABC) and Theory of Constrains. In order to assess the robustness of the proposed system we evaluate whether the benefits of the integrated system (scenario 4-5 respectively) surpass the benefits of grouping the same tools in pairs (scenario 1-2-3 respectively) using scenario analysis.

* Department of Industrial Engineering and Management, Tokyo Institute of Technology, Tokyo, Japan.
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The subsequent objective of this study is to investigate how SMEs could incorporate concepts originally developed for large firms in their decision making process.
This work provides an overview of three management tools as well as prior works where tools were combined. Then, it presents the benefits of the proposed model; and its implementation in a case study.
Finally, we summarize the findings of this work and offer conclusions.

2. TOC, ABC and EVA

Management control was defined by Anthony (1965) as the process by which managers make sure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives. Primarily management control system was designed to support the firm strategy, matching organizational structure and environment. Nowadays firms are facing new challenges associated with global competition and dynamic markets. Under these circumstances, many firms are increasingly using management tools in order to deal with accuracy in product cost, pricing, production, and investments decisions.

The integration of TOC and ABC had been problematic, since these two theories are considered simultaneously as incompatible and complementary to each other. However, Holmen (1995) pointed out that ABC and TOC are based on different time horizons; ABC has a long-term horizon while TOC has a short run. Along this line, Spoede et al. also (1994) state that ABC generates accurate data to support the TOC process. Cooper and Slagmulder (1999) suggest that TOC - ABC combination is useful when the resource supply is limited.

On the other hand, Goldratt (1990) claims that ABC was designed to control product distortions, and that tool does not address the profitability side, the most important problem in the firm's decision making. Corbett (2000) insinuates that the debate should not be centered in the short versus long-term issue, but instead has to be focused on the type of constraints.

The combination of effects between ABC and EVA have also been documented by Hubbell Jr. (1996) who argues that the integration provides managers a corporate system that improves the process of managing both cost and capital. Anctil et al. (1998) provides evidence of how the combination helps to identify residual income, as well as (selling price minus cost of raw material and components). However, we decided to use primarily EVA as decision criterion to judge each management integrated system regarding its capability to determine the product mix that leads to the maximization of firm's economic profit. We shift from throughput accounting to EVA, because the first subsumes the second, which accounts for absolute amount of surplus value over and above the resources deployed (we rely on throughput accounting when EVA is not available). It is also remarkable that resource usage complements the clear-cut selection criteria as a source of information regarding constrained resources.

This study also introduces a variation in EVA's calculation, which adds to the traditional weighted average cost of capital (WACC) procedure. The EVA calculation, which uses only the cost of debt, was introduced to gain detailed information regarding product's interest expenses coverage capacity. It also yields detailed information about the capacity to finance its growth in the future.

According to the well-documented lack of resources and knowledge expertise, implementation was adopted to SME's needs and resources. The individual implementations of TOC, ABC and EVA were done using an inexpensive and reasonable available resource such as Microsoft Excel and Excel Solver.

3.1 Background of the Firm

We applied the proposed management control system in a glass-manufacturing firm, with annual sales of approximately $5,000,000 capital size of $4,000,000 and 13 employees in 5 identifiable areas: warehousing, production, marketing, delivering, and general and administrative.

The firm provided three different types of products for three different client categories: construction firms (large firms), department stores (big chains), furniture firms and small retailers.

The products, here on named P1, P2 and P3 (all of them), had experienced increase in demand in the last two years. Indeed the firm was using its full time production capacity in order to deliver the products orders. Additional investments in equipment as well as hiring new personnel were out of options in the short term.

3.1.1 Modeling and Implementation of TOC

In the context of deciding how to exploit internal and external firm's constraints, three elements were considered: demand, machine time requirements, and throughput accounting per product.

The optimal products mix was calculated as follows:

$$\text{Maximize Z} = \sum_{i=1}^{3} z_i x_i \leq M \qquad (1)$$

$$\text{Subject to} \quad 0 \leq x_i \leq D_i \quad i = 1,\dots,3$$

As shown in the equation, Z is the maximization of firm's throughput accounting; z_i is the throughput accounting per unit of product i; x_i number of unit per product i to be produced; m_i machine time requirements in minutes per unit of product i; M total machine time availability.

D_i and zero represent the upper and lower bounds respectively, over the number of units of product *i* and are determined from forecast of demand.

It should be noted that for simplicity of representation, single constraints for each machine usage were shown.

3.1.2 Modeling and Implementation of ABC

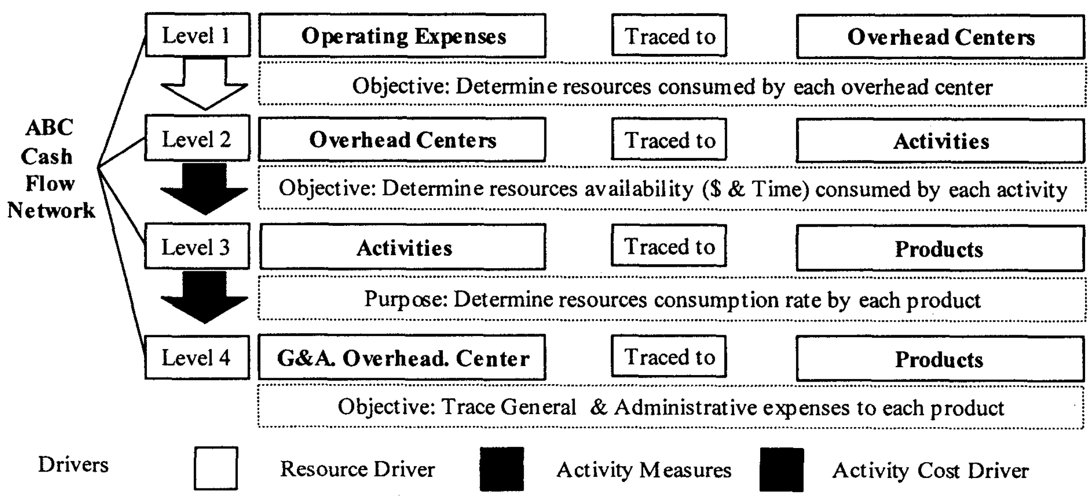
The implementation of ABC was done according to three critical factors a) the capacity of the resources supplied which was acquired in advance independent of its usage related to current production volume and mix; b) the cost of supplying an hour of productive time and c) the time required to perform each activity (Cooper and Kaplan, 1998).

The operational system's data was used as critical inputs in the working out of an ABC network to the following ends:

1. To calculate committed capacity at each overhead center, as well as overhead centers' labor-hour cost.
2. To calculate resource consumption pattern per activities per product in terms of hours.
3. To determine excess or shortage of capacity at each overhead center in terms of hours.
4. To calculate standard cost rates per product.

Figure 1 gives the implementation steps.

Figure 1 - Activity Cash Flow Network Levels

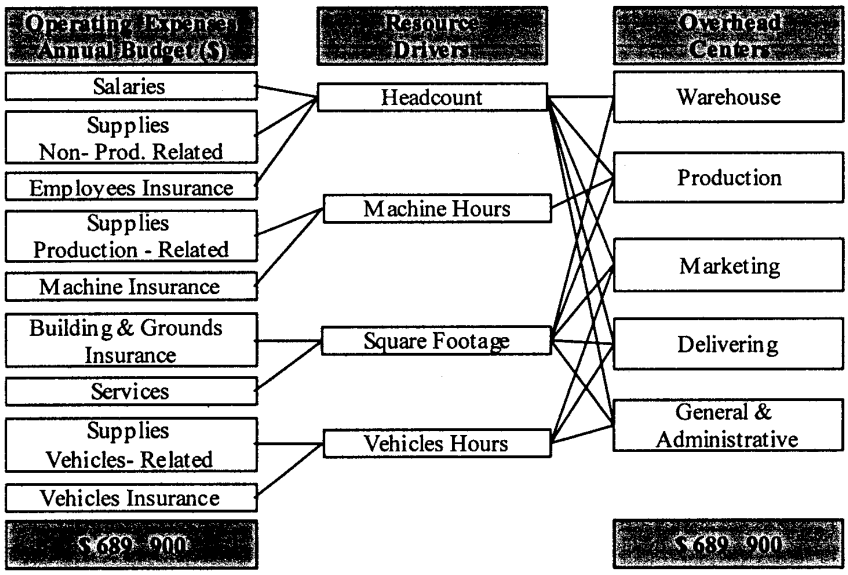


As a first step, committed capacity was set as a function of the costs of resources directly attributable to the specific overhead center according to its resource consumption patterns.

Using resource drivers cost, the firm's operating expenses were grouped in terms of resource driver cost pools and then traced to each of the five overhead centers mentioned before. For instance in figure 2, headcount grouped the annual cost of payroll, employee's insurance and supplies non-production related, from the left to the center. Then the cost of resources (cost pool) was traced to overhead centers by using a resource driver rate (percentage of employee per center in the case of headcount).

At the second step, the total labor hours available in conjunction with the time required to perform each activity was calculated in order to evaluate used and unused human resource capacity at each center. The activities performed at each center were measured in terms of labor hours required by each product demand. Measurement was done through "activity drivers." Those drivers are units of measure to represent an activity volume.

Figure 2 - Resource Drivers



Types of measures used were a combination of frequency, duration, and physical measures. Table 1 shows activities as well as the drivers used to evaluate activity labor-hours' resource consumption pattern per product at each center.

Table 1 - Activity Measures at production overhead center

Activities	Cost Classification	Activity Measures
Machine attendance	Batch	Machine operator ratio - Production time per batch
Machine setups	Batch	Number of setups - Setup Time per batch
Assembly	Unit	Assembly time per product
Handling final product to warehouse	Batch	Handling time per batch

The excess or shortage capacity of different product mix was evaluated by confronting labor hour's (demanded and available) per product.

For instance, the implementation of results obtained at production overhead center is expressed as the following function:

$$p = 0.3114ma + 0.3109ms + 0.3603as + 0.174h \leq 10{,}400, \quad (2)$$

where p represents production overhead center and ma, ms, as, h represent activities, machine attendance, machine setups, assembly, handling respectively, and 10,400 represent the total annual labor hours available for the mentioned center. In addition, the activities analysis per product allowed the identification of resource consumption pattern per activities per product (driver rates in term of labor hours demanded by each specific product), as follows;

$$ma = 0.4697\ P1 + 2.0666\ P2 + 4.2166\ P3 \leq 3{,}238.56 \quad (3)$$

$$ms = 0.9628\ P1 + 2.128\ P2 + 2.584\ P3 \leq 3{,}232.92 \quad (4)$$

$$as = 1\ P1 + 2\ P2 + 4\ P3 \leq 3{,}747.38 \quad (5)$$

$$h = 0.0512\ P1 + 0.1\ P2 + 0.18\ P3 \leq 181.25, \quad (6)$$

where P1, P2 and P3 represent each product's quantities.

Through this procedure we estimated labor hours needed to deliver total annual sales orders per product. Then overhead centers' cost were traced to products according to labor-hours resource consumption patterns..

3.1.3 Modeling and Implementation of EVA

Most of the information needed to calculate EVA could be obtained from firm's financial statements (Income Statement and Balance Sheet). The implementation required the calculation of total and per product's net operating profits after taxes (NOPAT), capital charges, and cost of capital.

Due to the identification of used and unused capacity, NOPAT reflected the costs of idle capacity and NOPAT per products were not penalized by excess capacity, reflecting products true contribution.

According to EVA's procedures, the firm's operating capital could be calculated by the estimation of total net fixed assets plus net working capital (Bennett Stewart III, 1991). Hubbell (1996) suggests that in order to look for improvements opportunities, management has to analyze each business process (products) capital cost.

The identification of capital charges per product was carried out in two steps. First, each item of the balance sheet was associated with an activity that demands the assets (ABC rationale). Afterwards activities driver rates per products (Identified by ABC premium and betas) regarding SMEs context. For SMEs, since betas are not published, a comparable firm methodology was used to estimate the firm's beta. In addition, weighted average beta was estimated in order to avoid differences in capital investment risk per product. Finally, market risk premium was approached through small firm publicly stocks and the risk free rate with long-term government bonds.

The EVA calculation was done in two steps, first by subtracting from NOPAT the cost of debt only (EVA 1) and second, by subtracting the weighted-average cost of capital (WACC), (EVA 2). The two steps EVA calculation accurately reflect financial as well as operational leverage per product allowing the firm to set priorities regarding market development, pricing, and process improvement policies.

4. Scenarios

At the first scenario, the firm integrated ABC-EVA into its strategic planning; the underlying assumption was that the firm continued producing as it had been doing during the last years. At the second scenario, the firm integrated TOC-ABC and it was assumed that the integration answered to firm's decision to evaluate its constraints as well as resource usage. At the third scenario, the firm integrated TOC-EVA; the assumption was that the firm decided to evaluate its product portfolio as well as its economic profit. At the fourth scenario, the firm decided to evaluate its performance through an integrated management control system that comprises TOC-ABC-EVA in order to evaluate product portfolio, resources expenses committed and capital deployed. At the fifth scenario, the integrated management control system incorporated human resources constraints identified in the production center through the ABC cash flow. The five scenarios are summarized in Table 2.

Table 2 - Scenarios analysis

Integration	ABC EVA	TOC-ABC	TOC EVA	TOC-ABC-EVA	TOC-ABC-EVA
Scenario	1	2	3	4	5
Setting	Historical levels		Optimal Level		Optimal Level
Assumption	Historical levels		Machine Constraints Demand Constraints		Machine Constraints Demand Constrains Labor Hours Constraints
Product 1 (units)	80,000		77,760		95,000
Product 2 (units)	30,000		34,500		23,919
Product 3 (units)	20,000		25,000		19,983
Throughput Accounting ($)	2,930,000		3,187,180		3,047,346
NOPAT ($)	1,061,672		1,215,980		1,132,080
EVA ($)	239,958	n/a	353,250	353,250	302,102
Resource usage ($)	637,014	708,716	n/a	708,716	635,024
Spread (ROI - COC) (%)	6.54%	n/a	9.17%	9.17%	8.15%
Resource usage ratio (%)	92.33%	102.72%	n/a	102.72%	92.04%

4.1 Scenario 1 ABC - EVA Combination

By this integration, identification of product's resource consumption pattern helps managers to identify constrained resources, as well as accurate information regarding products' costs. The explicit information regarding excess capacity (excess of resources committed) allowed the system to reflect the products' profitability without penalization due to the inclusion of unused capacity.

Indeed, this combination is unable to deliver the maximum EVA according to resources deployed (Scenarios 3, 4 and 5 outdo this scenario (higher EVA), and also the scenario 2 (higher Throughput accounting, the alternative selection criteria when model do not present EVA). Despite positive benefits of ABC-EVA combination, it did not provide insights related to what products and in which quantities the firm should produce in order to become more profitable.

4.2 Scenario 2 TOC - ABC Combination

The most important contribution of TOC-ABC combination is related to the potential identification of new constraints, giving management insights about resource usage and short-long term resource adjustment.

Resource adjustment depends on the firm's ability and capacity to compensate shortage or excess capacity among centers internally gaining more efficiently resource usage and consequently improving its profitability. On the other hand, inability to reorganize resources allowed the manager to recalculate optimal mix with the introduction of identified constraints.

Even if the integrated TOC-ABC system was useful when the firm presented machine and human resources constraints, the system did not address neither the firm nor the products' value creation (EVA, EVA per product, the clear-cut selection criteria).

4.3 Scenario 3 TOC - EVA Combination

With TOC-EVA combination, the decision-maker achieves a full comprehension about short-term profit maximization and profitability. In this regard, if the firm could not create value even if exploiting its constraints, it would indicate that the firm must evaluate its product portfolio, market potential, demand elasticity as well as processes improvements.

Even if this combination met our first selection criteria, this system could send wrong signals to decision makers. The system does not identify constrained resources (specifically human resources) and consequently the firm's inability to deliver the product's mix. Moreover, without the identification of resource consumption patterns per product, capital charges could not be traced to products, looking at total EVA instead of a complete picture that include EVA per product, in this regard the three tools integrated system outperform TOC-EVA system.

4.4. Scenario 4 TOC - ABC - EVA Combination

The integrated management control system provides the decision-maker with accurate information not only at the firm but also at product levels. In this regard, specific actions at operational and strategic levels could be undertaken in order to improve firm and product performance as well.

Due to integration of ABC, two aspects related to overhead center could be identified: availability and capacity measured in terms of labor hours. As shown in table 3 at historical production levels (ABC-EVA scenario 1), resources deployed at production and commercialization centers present no excess capacity, whereas at distribution and warehousing centers present almost 25 % excess capacity. This excess capacity in terms of hours represented 500 hours at each department annually.

By the integration of TOC (Scenario 2 to 4), the firm exploits its constraints (demand and machine time) switching the production from mix 1 to mix 2. However, increased profitability would be possible only whenever labor hours among centers could be reorganized.

In the short-run, if reorganization among centers were possible this should lead to "favorable" over-utilization (resource usage ratio 103%) of capacity (Cooper and Kaplan, 1992). However, if labor hours among centers could not be reorganized in the short-run, because special training is required to upgrade employee's skills, the integrated system (scenario 4) shows labor hours at production center as a new additional constraint (for simplicity we assume commercialization centers labor hours shortage are reorganized). In this particular, the integrated system (as pointed out before, ABC generates information to support the TOC process) provides accurate information

40% P1's sales volume, therefore P2 contributed with 26% of the total gross profit. In addition, P2 presents positive EVA (1, 2).

Finally P3, in spite of its highest contribution margin (100% more than P1), the contribution to total gross profit reaches only 25% due to the smallest sales volume compared to other products. Additionally, P3 presented the highest resource consumption pattern (35%) and capital employed (40%) consequently for P3 EVA (1, 2) became negative, showing P3 inability to cover interest expenses as well as its capacity to create value respectively.

In addition, if reorganization were possible (mix 2), EVA per product analysis showed that if 25% increased in sales volume by P3 could be achieved, EVA 1 turns from negative to positive. However, volume was not enough to cover the total cost of capital (EVA 2). It is highly remarkable that despite the decrease in products A's volume sold, increase in EVA (1, 2) was achieved due to decrease in capital employed (decrease in inventories stock and account receivables attributable to P1).

By the integration of labor hour's constraints at production center (Scenario 5), changes in volume sold per product showed that P2 became a wealth destroyer, as the result of its negative spread between return on capital and the weighted-average cost of capital. Even so, P2 did not lose its interest coverage capacity. P3 presented negative EVA (1) and EVA (2).

Results obtained through integrated management control system (scenario 5) suggest a potential excess of capital investment attributable to P2 and P3. The findings present a starting point for, in depth analysis, including potential market growth and pricing, as well as inventory and receivables policies.

Table 4 - Economic profit per product

	Product	Units	EVA (1)	EVA (2)
Scenario 1	1	80,000	473,748.23	374,595.02
	2	30,000	112,942.06	25,414.75
	3	20,000	-1,781.14	-128,320.07
Scenario 4	1	77,760	486,716.09	401,084.28
	2	34,500	138,808.75	40,222.46
	3	25,000	59,463.56	-76,441.51
Scenario 5	1	95,000	609,353.95	508,589.29
	2	23,918	43,859.88	-44,007.40
	3	19,983	-3,997.32	-131,734.87

5. Discussion

The results obtained suggest that the implementation of three-management tools in SMEs can not only be accomplished satisfactorily, but also surpass the benefits of grouping them in pairs.

The proposed control system ascertains profit contribution variance between historical firm behavior and optimal product mix regarding important elements like constraints and resources committed.

The scenario analysis shows that implementation in pairs subsume to the integrated system (scenario 4 or 5) presenting the following shortcomings:

a) ABC-EVA combination does not provide signals related to what products or quantities the firm should produce to become more profitable.
b) By the combination of TOC-ABC the system is not capable to provide evidence of value creation as well as genuine product profitability.
c) TOC-EVA system does not identify causal relationships between resources committed, activities performed, and volume produced. That is why it does not address the firm's lack of resources and consequently it is unable to provide signals regarding possible productions targets.

6. Conclusions

The objective of developing the integrated system was to provide SMEs a resource to address its lack of information for decision-making purposes in order to evaluate the performance regarding its product portfolio. The election of three management tools relies on its potential to address the profitability analysis when considering a multiple product and limited resource environment. In this regard, scenario analysis confirms that the integrated management system delivers insights about the mix that leads to the maximum EVA possible, according to the trade-off among firms' resources deployed and their constraints. The integration of TOC into the management control system helps firms to focus on their short-term regarding cash generation and liquidity. In the middle-long run, ABC and EVA integration helps managers to identify areas where improvements are workable. ABC-EVA provides managers with insights into their costs and capital charges per product by the identification of idle or shortage capacity which shows areas where inefficient resources could be cut or reorganized. Identification of resources consumed at product levels provides managers with real information regarding trade off among assets, expenses and profitability of individual products. The limitation of the present work is related with the difficulty of applying the management control system freely to all SMEs. Because there is a gap into the nature of every enterprise, it is necessary to adapt the proposed tool and tailor it to each firm behavior.

Additionally the model does not incorporate non-financial strategic control measures (lead-time, quality, and customer satisfaction) that are critical to a firm's success.

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