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Managing Input and Output Efficiency with Activity Based Costing (ABC) and Responsibility Accounting

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***Abstract*—The focus of the literature on ABC systems has been primarily on optimizing the use of ABC cost pool resources to produce output. However, since operations departments provide the primary resource inputs to ABC pools, coordinated control is needed for both the inputs provided to ABC pools as well the output from ABC pools to products. Procedures are described to manage input capacity as well as control nonvalue added output from ABC pools to production.**

Keywords—component; activity based cost; capacity management; cost control; cost assignment; output cost

I. Introduction

When measuring efficiency in activity based cost (ABC) systems, the focus has typically been on output efficiency [4]. Attention is paid primarily to optimizing the use of ABC cost pool resources to produce output [17]. Controlling the efficiency of inputs to ABC pools has generally been ignored in the literature. Since cost is first assigned from departments to ABC pools, it is necessary to control the efficiency of inputs (departments) to ABC cost pools as well as control of output efficiency from ABC pools to output [11]. Managers are typically responsible for both department-level efficiency (the inputs provided to ABC cost pools) and the efficiency of production output as ABC cost pool resources are used. Effective control in an ABC system requires a coordinated effort.

The objective of this paper is to describe coordinated methods to control the efficiency of ABC pool outputs in the production process concurrently with the efficiency of departments that provide costly inputs to ABC pools. Effective control of operations in ABC requires both department-level input efficiency measures and ABC cost pool output efficiency measures. To this end, it is important to manage the capacity of inputs as well as control nonvalue added output from ABC pools to production.

II. Activity Based Costing (ABC) and Activity-Based Management (ABM)

As production complexity increased and traditional cost systems were unable to effectively assign complexity cost to output, ABC systems arose as an alternative [4]. For example, traditional cost systems directly-trace the purchase cost of materials to output, but the *total cost* of relations with suppliers is hidden in overhead cost to be spread across all output. Thus, a traditional cost system provides little information to address the cost of poor vendor responsiveness and out-of-spec component deliveries. In contrast, the total cost of supplier relations and materials management becomes evident when it is included in ABC pools and assigned directly to output. Moreover, a traditional cost system, often using volume-based cost drivers, such as labor hours or labor cost, effectively assigns a 'surcharge' on labor. Thus, labor savings appear to be accompanied by saving in overhead motivating engineers to design labor out of products [6]. However, labor cost often has little relation to overhead cost and undue automation of labor processes often leads to a loss of flexibility and an inability to respond to shifts in demand.

Beyond using activity analysis for output cost estimation, activity analysis can also provide tools for effective operational control. Traditional output-based standard cost variances have often been found lacking for operational control [2]. In contrast, activity-based management (ABM), can provide effective tools to control and evaluate the efficiency of operations and ABC systems [4]. The premise underlying ABM is that spending follows from the *activities* that are performed in an area of responsibility. Thus, rather than controlling cost directly, managers must focus on the control of costly activities [12]. This is illustrated in Fig. 1.

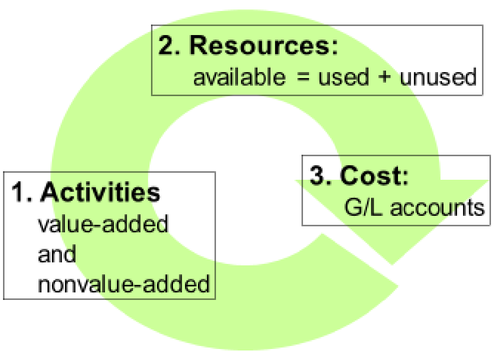

Figure 1: Managers control activities, not cost

The tools for ABM derive from an ABC system. As shown in Fig. 2 (the so-called 'CAM-I cross'), ABC (vertical dimension) can improve output cost estimates, but ABM (horizontal dimension) provides better control of cost drivers and the activities that cause cost to be incurred [13].

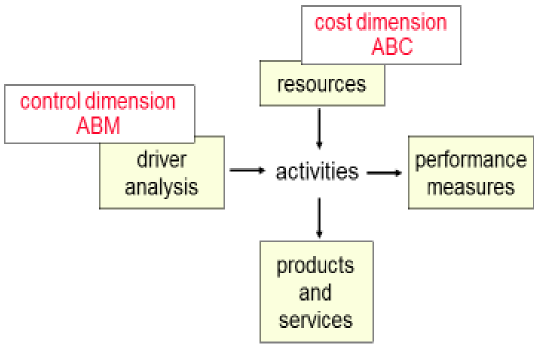

FIGURE 2: CAM-I CROSS

III. FLEXIBLE AND COMMITTED RESOURCES

The activity hierarchy provides structure to understand activities for cost management through ABM. As shown in Fig. 4, activities are classified in the hierarchy based on their relation to output [3]. Unit-level activities in the hierarchy are variable with output as the cost driver. Unit-level activities (resources) are considered *flexible* because these resources can be easily adjusted to changes in output volume. Unit-level resources can be acquired as needed so that none is wasted, regardless of actual output [4]. For example, hospital linens or office supplies can be acquired as needed and stored in inventory if not used immediately so that none is wasted.

The cost of *higher-level* activities, however, is fixed with respect to output but related to higher-level cost drivers. Higher-level resources are *committed* because they cannot be adjusted easily to changes in output volume and they cannot be stored for later use. Committed resources must be acquired in advance and must be used when available or they are wasted. Moreover, committed resources must be acquired in blocks or increments. Hiring an engineer, for example, provides a new block of 2,000 engineering hours. However, if only 1,500 hours are used, the value of the 500 unused hours is lost, even though the entire cost of the resource must be incurred including the cost of the excess capacity.

Thus, committed resources lead to excess capacity. An important principle of ABM is that unused resource (excess capacity) should not be charged to output so it does not distort output cost [9]. For example, consider again the cost of engineering services. If the total fixed cost is $50,000 and 8,000 hours are used in output, the cost per hour is $6.25 and the cost assigned to product A, which requires 700 hours, is $4,375 (6.25*700). If demand falls for engineering service to, say, 6,000 hours then the cost per hour is $8.33 and the cost assigned to product A, which requires 700 hours, is $5,831 (8.33*700). The charge to product A will increase even though the same level of resource is used.

In fact, the economic cost of engineering service has not increased in this example. Excess capacity has increased and engineering cost is being spread over fewer hours of service. Information should be provide to managers that capacity management is needed, not cost control [12].

IV. EFFICIENCY MEASURES FOR INPUTS AND OUTPUTS

In an ABC system, cost is first directly-traced to departments, then assigned from departments to ABC pools using each department's cost driver. Finally, cost is assigned to output (products and services sold to customers) using cost drivers in each ABC cost pool. Thus, the efficiency of inputs (departments) must be measured through the responsibility accounting system [11].

Variable and fixed cost are planned at the department level with respect to each department's cost driver. This allows period-end preparation of flexible budgets and performance reports to calculate department level spending variances to maintain the authority structure in the responsibility accounting system. In addition, capacity activity levels are planned at the department level since capacity estimates are a function of cost behavior, which is defined at the department level. Moreover, capacity management is typically the responsibility of department managers. Excess capacity should remain a separate common cost in the departments where it arises so that responsibility for capacity management can be appropriately assigned through the responsibility accounting (authority) system. Thus, excess capacity cost is not assigned to ABC pools to prevent misleading changes in output cost caused by fluctuations in production volume. This avoids the so-called 'death-spiral', where falling volume appears to cause output cost to spiral higher.

The cost of output is based on activity from ABC pools. Benchmark activity levels are identified in ABC pools through studies by engineering and operations personnel. Benchmark activity levels are denoted 'value added' since they represent ideal activity levels. Value added (benchmark) activity is identified at the ABC pool level where the relation exists between ABC activities and output.

V. PLAN EFFICIENCY

Planning efforts often rely on ad-hoc, subjective evaluations at the beginning of the period. For example, [14], in a series of interviews at several successful firms, find that the planning process is informal with few standardized methodologies. Evidence in the literature, however, is clear that planning efforts that incorporate an effective framework to facilitate operational improvements can provide significant benefits for firms, including cost savings and operational efficiency [7].

To illustrate, assume an Engineering Department plans 11,500 hours of service and 15,000 hours of service is available (capacity level). Given plan cost and cost driver levels in table I, cost driver rates can be calculated. When comparing the rates shown in table I, one might ask what is the true cost of engineering service? Note that the plan cost per hour is higher than capacity cost per hour because the plan rate includes the cost of *not* providing service in the hourly cost of the service that *is* provided. In other words, the plan cost driver rate represents both the cost of providing service plus the cost of service that could be provided but is not needed. Thus, the capacity rate of $15.55 per hour represents the 'true' cost of service because excess capacity does not burden the cost of hours provided. The cost at capacity can be denoted the *economic cost* because it is the minimum cost at which service can be provided, given present technology (no excess capacity cost). Efforts at cost control by the department's manager would be misguided if they focused on efficiency and failed to include attempts to reduce (or find alternative uses for) the department's capacity.

The total cost of excess capacity can be explicitly calculated. As shown in table II, $36,225 is being spent for resources (hours) that are not being used. The cost of resources used is calculated as the economic cost per hour multiplied by the number of hours actually needed. Thus, if the department were exactly the size to provide 11,500 hours needed, the cost would be $178,825. The balance of cost is for service that is not needed.

Clear targets can now be established for managers to focus on operational improvements identified through spending variances in performance reports and capacity management identified in the plan. Managers would be misguided if they attempted to improve operating efficiency when they should be managing capacity, including reducing or finding alternative uses for their department's capacity. Such objectives may prevent some managers, when faced with cost reduction mandates, from simply throwing up their hands and making arbitrary resource cuts, potentially reducing firm value [5].

Engineering Department cost is then assigned to ABC cost pools and ABC cost driver rates are calculated, as shown in Table III. Of the 11,500 hours of service planned in the Engineering Department, 9,200 is planned for ABC pool, *Process Support*. The remaining hours are planned for other ABC pools. Capacity cost driver rates are used to assign cost from the Engineering Department to ABC pools so excess capacity cost is not assigned to ABC pools but remains a common cost in the departments where it arises. This prevents transfer of excess capacity cost to output and prevents volume fluctuations from affecting output cost.

TABLE I. PLAN DIRECTLY-TRACED COST - ENGINEERING

VC: supplies	$15,000
personnel	44,800
FC: depreciation	30,000
supervision	125,250
TC	$215,050
cost driver-plan	11,500
cost driver-capacity	15,000
cost rate-plan	18.70
cost rate-capacity	15.55

TABLE II. PLAN EXCESS CAPACITY - ENGINEERING

plan cost (18.70*11,500)	$215,050
economic cost (15.55*11,500)	178,825
excess capacity	$36,225

TABLE III. ABC POOL - PROCESS SUPPORT

Engineering (15.55*9,200)	$143,060
plan cost driver (procedures)	1,600
pool rate	$89.41

TABLE IV. PLAN NVA COST - PROCESS SUPPORT POOL

plan cost (89.41*1,600)	$143,060
value added (89.41*1,400)	125,174
NVA	$17,886

The cost driver in the Process Support pool is 'procedures'. The plan level is 1,600. However, after study by operations and engineering, the benchmark cost driver activity for the Process Support ABC pool is set at 1,400. The pool rate is calculated in table III.

Given the plan and benchmark cost driver levels, nonvalue added activity cost can be calculated in the ABC pool. This is shown in table IV. The nonvalue added cost represents the work needed to support output beyond the value added level of activity.

VI. PERIOD END EFFICIENCY

At period end, assume the Engineering Department has assigned 13,000 hours to the ABC pool *Process Support*. Period end excess capacity can be calculate to measure efforts at capacity management as shown in Table V. Actual assigned engineering hours must be based on 'allowed' levels based on actual work done in the Engineering Department to ensure volume changes do not distort capacity measures. The capacity-use variance equals plan excess capacity if actual cost driver equals plan. If the plan cost driver is greater than (less than) the actual cost driver, excess capacity is reduced (increased). The capacity-use variance is favorable because period-end excess capacity is less than plan excess capacity. Note that period-end excess capacity is equivalent to excess capacity in the plan less the capacity-use variance.

Conventional price and quantity variances for materials can be calculated in the usual way. Period-end responsibility accounting performance reports for line and support departments should also be prepared in the usual way.

TABLE V. PERIOD-END EXCESS CAPACITY - ENGINEERING

(1) plan cost (18.70*11,500)	$215,050
(2) economic cost (15.55*11,500)	178,825
(3) applied to Process Support (15.55*13,000)	202,150
(1-2) excess capacity	$36,225
(2-3) capacity use variance	$23,325

TABLE VI. PRODUCTION ORDER ABC VOLUME VARIANCE - PROCESS SUPPORT POOL

plan (15.89*65)	$1,032.85	
applied (15.89*50)	794.50	
ABC volume	$238.35	F

A period end volume variance should be calculated for the Process Support ABC pool to assess use of ABC pool resources. Assume a production order was completed during the period using 50 procedures from the Process Support ABC pool. Planned procedures was 65. Plan and actual cost driver levels should again be based on 'allowed' cost driver inputs so effective comparisons can be made. Table VI shows the period-end ABC volume variance for the Process Support cost pool. The variance is unfavorable because more input was required than planned, given the output. Period-end labor efficiency and output volume variances are not calculated since cost is assigned to output from ABC pools, not departments. Evidence in the literature is clear that efficiency and volume variances have little value for cost or efficiency control and can often impair efforts to build a team-based, world-class, operation [15].

VII. DISCUSSION, SUMMARY AND CONCLUSIONS

Procedures are provided to identify the cost of excess capacity and the cost of nonvalue-added activities as department level inputs are assigned to ABC pools and then to output. The cost of excess capacity and nonvalue added cost was identified and measured during planning and at period end. Nonvalue added cost represents the difference in cost between plan cost driver and benchmark cost driver levels. Excess capacity is the difference in cost between plan and capacity cost driver levels. Eliminating excess capacity from the cost assigned to output eliminates misleading changes in the cost of output caused by fluctuations in production volume. In addition, identifying nonvalue-added cost provides a useful signal to managers for cost control and an improved mechanism to manage efficiency. Moreover, these variances are provided in the operational language used by engineers and operations managers, unlike traditional standard cost variance reports, showing spending by general line items which provide modest guidance, at best, to managers as they work toward efficiency improvements [16]. Thus, the potential value of these variances is enhanced for operations manager to develop explicit initiatives for cost reduction and capacity management [17].

These tools allow managers to improve their ability to differentiate between operating efficiency and capacity management. If cost exceeds the benchmark, it is useful for managers to understand how to apply their control efforts. Clearly managers would be misguided if they attempted to improve operating efficiency when they should be managing capacity, including reducing or finding alternative uses for their department's capacity.

While lack of system capabilities has hampered reporting of capacity and value added information in legacy cost management systems, currently available ERP systems have overcome these early limitations and can routinely provide information for management of capacity and nonvalue-added cost. For example, SAP, one of the largest ERP systems, allows routine capacity and benchmark planning for all cost centers in a company. Thus, this information can be prepared for cost centers throughout a company so detailed objectives are available for every cost center manager to optimally direct his or her efforts at efficiency improvements or capacity management, as needed.

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