UNDERSTANDING RESOURCE CONSUMPTION AND COST BEHAVIOR PART II – OPERATIONAL MODELING AND RESPONSIVENESS

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The first part of this article series highlights the widespread practice of exclusively using operational cost concepts to support decision making (i.e. the blended cost concept error). Understanding the difference between decision cost concepts and operational cost concepts is one of the first steps in applying theory appropriately in enterprise modeling and optimization. Foundational to these two objectives of MA is an accurate understanding of resource consumption and cost behavior.

If we truly want to *properly* consider the nature of operational cost behavior, we will be required to cost-beneficially model the complexity involved in resource consumption. Do we really know what costs are variable and fixed? Decisions are inferences relying on insights into known cause and effect relationships; and managers are provided with many of these insights by using information contained in MA's cost model. This demands a modeling approach that is reflective of the complexity inherent in resource consumption. The degree to which this is accomplished reflects the value of a MA approach. As we will explain in this article, we believe we can attain this value by embracing vital principles reflected by Resource Consumption Accounting (RCA).

The major points of the first article can be summarized as follows:

- To properly understand cost behavior we must *not* seek a particular costing approach, but rather, the proper way to model and understand cost behavior regardless of the type of decisions to be supported.
- Fixed and variable costs (FC/VC) are defined in relation to outputs. Decision relevance is defined in relation to whether the cost will change with the decision alternative being considered (i.e., avoidable/unavoidable costs).

- The blended cost concept error is committed by exclusively using *operational* concepts (fixed and variable) in support of decisions rather than *decision* concepts (avoidable and unavoidable).

- Management Accounting (MA) textbooks and business literature do not provide consistent or correct application and treatment of operational cost concepts and decision cost concepts.

- The challenge for MA is exacerbated by the fact that the term *variable cost* has become ambiguous and for the most part meaningless. Moreover, the principle of variability no longer adequately reflects cost behavior in the 21st century enterprise.

- Determining decision relevance requires both reliable operating concepts and scrutiny regarding the potential outcome and its effects on cost avoidability.

In this article we discuss RCA's proposed solutions to the issues identified in the first paper with regard to modeling and decision support. We also take a look to the future and highlight developments in two other disciplines (information technology and business management) that signal a future that will require modeling sophistication beyond anything traditional or contemporary MA practice is capable of satisfying.

Aren't the Concepts Often the Same?

Despite the clear theoretical differences between operational and decision support cost concepts, practice often confuses their application. As highlighted in the first article, operational cost concepts (fixed and variable) reflect consumption and cost behavior based on invested resources and their cost characteristics in relation to outputs within the relevant range. Operational cost concepts are important for predicting future results, measuring performance, and analyzing outcomes with the view of determining how a stated objective can be achieved. In contrast, decision support cost concepts (avoidable versus unavoidable) find appropriate application when operational cost information is applied in a particular decision scenario and the manager must determine the optimum alternative to select, whether within or outside the relevant range.

Nevertheless, the two sets of concepts can appear to be very similar when changes in output are small i.e., when a decision considers change in output within the relevant range. For example, in a decision to make one less unit, the decision concept (avoidable cost) and the operational concept (variable cost) might appear to be similar (e.g., for material costs) and often result in the same decision alternative being selected.

As decisions that involve changes in output get larger—beyond the relevant range—the potential for confusion significantly increases as the economic principles reflecting operations are clearly inadequate for decision support. For example, in the trucking example presented in the first paper, the new fleet of trucks resulted in both fixed and variable maintenance costs for one crew becoming avoidable. However, the rest of the company's maintenance costs (the remaining crews' fixed and variable costs) are unavoidable.

The Importance of Operational Costs

This divergence of the two sets of concepts makes operational cost concepts seem an unlikely place to start in determining avoidable/unavoidable costs. Moreover, one has to grant that there are times when decision cost elements are reasonably straightforward and referencing current resource consumption information will be unnecessary. As noted by the first paper in the series, most current costing systems are not likely to produce operational cost concepts that reflect accurate resource consumption. To continue the discussion about considering the proper information in support of decision-making, we must examine the importance of operational cost concepts and their place in decision support. This should seem especially apparent given that we have made such an issue of distinguishing operational and decision cost concepts.

In the first paper we made what can be considered a negative argument for why MA must model operations and not decision cost concepts (i.e., relevant costs are specific to each decision

and can only be modeled in an endless number of models). However, the reasons for modeling operational costs include more than just *that is all we have*. The reasons are rooted in MA understanding its customers' (i.e., managers') needs to be able to provide monetary information highly suitable to enterprise optimization.

Managers invest in resources for the enterprise and must pursue their optimal use in producing and selling the enterprise's products and services. Managerial activities comprise a number of entrepreneurial actions such as planning, simulation, defining and analyzing alternatives, and finally selecting an optimal outcome. These activities—and enterprise optimization for that matter—must be accomplished with the enterprise's existing resources and their capabilities (i.e., current operations).

The importance of operational cost information for enterprise optimization is underscored by the following:

- The enterprise's resources represent the status quo—that which managers must use in their optimization endeavor,
- adjustments to the enterprise's resource base uses the status quo as the baseline to evaluate change (i.e., in enterprise optimization a net incremental gain over the status quo is a prerequisite), and
- understanding current operational cause-and-effect relationships is often a manager's best guidance as to future outcomes when considering optimization alternatives.

Add to this the fact that MA is the primary source of monetary information in optimization activities, and it is clear that accurate operations modeling in MA is essential to supporting managers' decisions. Foundational to insight into operational information is the understanding of resource consumption; every decision managers make is a resource application decision.

The Basis for Operational Modeling

The modeling starting point for all existing MA approaches is the general ledger (i.e., approaches are fundamentally based on parsing the general ledger and thus captive to monetary information compiled for the purposes of external financial reporting rather than enterprise optimization). As regards external financial reporting, cost management is relegated to the rules required in producing the general ledger based on accrual accounting, GAAP, fair presentation, comparability, articulation, conservatism, full-absorption costing, the matching principle, and an endless list of other items irrelevant to achieving reliable operational costs—much less enterprise optimization. The operational costs we start with in determining relevant costs will greatly impact the information we use as management accountants in support of decision making.

Moreover, when saddled with information from the general ledger as a starting point and we find ourselves multiple allocations down the road, we cannot be confident that the 'operational' dollars we are using have adequately captured the economic essence of our actions or the actions we are considering. We cannot be sure that we have dependable operational information with which to make decisions. Thus, we must recognize that current MA approaches start off on the wrong foundation for purposes of determining accurate operational cost distinctions and thus useful baseline decision support information.

Instead, we must look to a cost management approach such as RCA that departs from today's general ledger parsing practice (i.e, fundamentally ignoring the general ledger as the source of resource consumption information) and also incorporates sound operational modeling principles to ultimately attain useful decision cost concept information.

The basis for operational modeling in RCA is twofold. First, through its concept of value chain integration RCA keeps resource quantities and their values intact throughout the value chain and is therefore no longer dependent on the general ledger for monetary information in

modeling. Value chain integration recognizes resource quantities as central to cost modeling. The cost model is constructed (decentralized) in operational systems without separating resource quantities and their values (from source documents e.g., goods receipts and invoices) as is the traditional practice where the quantities are recorded in operational systems and dollars are captured separately in the general ledger. This brings us to the first of the new developments referred to in the introduction.

The REA framework (resource, event, agent) is an approach to enterprise modeling in the information technology (IT) field that leap frogs traditional thinking in two ways. These include (1) the enterprise schema it uses to model enterprise reality and (2) the underlying technology (i.e., object orientation) as opposed to traditional hierarchical or relational database technologies.[1] The REA framework was introduced as an accounting framework to address problems with the traditional stand-alone, double-entry general ledger. However, research quickly highlighted its applicability to all of the value chain. In this regard, it perfectly complements RCA's concept of value chain integration in that value in the REA framework becomes an information layer that permeates its entire resource-event-agent model. Moreover, alternate value layers (e.g., one for external reporting and another for decision support) are naturally accommodated. This alignment between RCA and what is arguably IT's next big leap means MA is, for once, ahead of the technology curve.

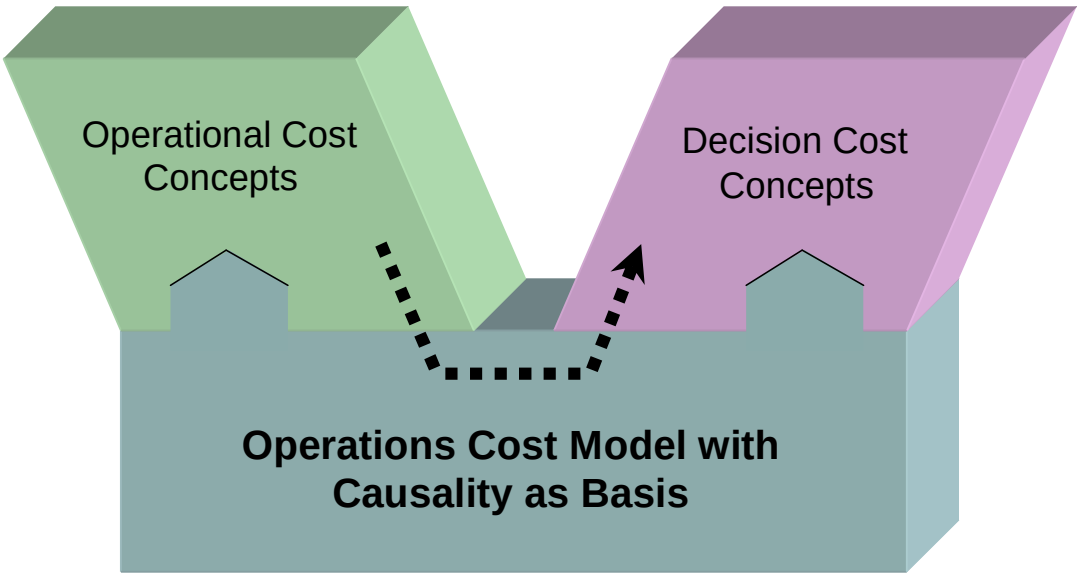
Second, RCA goes to great pains to emphasize causality as the overriding principle that governs operational modeling and decision analysis. We highlighted the importance of cause and effect insights in operations modeling above. From a decision support perspective causality is in a similar manner central to MA satisfying managers' information needs. Consider for example

[1] For more information on the REA Framework see http://www.msu.edu/user/mccarth4/rea-ontology/.

managers' extrapolations and projections as to future outcomes or their control and corrective activities that must understand what transpired and select appropriate corrective actions. The principle of causality permeates managerial activities and is therefore fundamental to MA—so much so, that its absence as the basis for MA information undermines any effort whatsoever to support managers.

Causality as the common foundation between operational cost concepts and decision cost concepts is graphically depicted in Exhibit 1.

Exhibit 1: Causality as the Basis for All Cost Concepts



As is evident from Exhibit 1 both operational and decision cost concepts are grounded in causality. The operational concepts provide insight as to what it looks like for the enterprise to function with its existing resources. The operational cost model reflects the fact that managers plan for success and the implicit assumption is that enterprise objectives (and enterprise optimization) is achievable within the invested resources' relevant range. However, the business

world is dynamic and decisions are often required to adjust both outputs and inputs. Many of these adjustments invariably exceed the limits of the invested resources' relevant range and this is where decision cost concepts come into their own.

As the dotted line from operational concepts to decision concepts in Exhibit 1 indicate, there are *some* decisions where an operational concept does represent the decision concept adequately. Examples of these are variable material costs that equal the avoidable costs in throughput decisions highlighted earlier and a resource's variable costs that represent the opportunity cost of committing that resource to a particular course of action.

Causality as RCA's foundational principle holds significant benefits in other respects. For example, even in current leading edge management science thinking (e.g., cybernetics) causality maintains its foundational role. Although the cybernetics net is cast much wider than just traditional operational modeling, monetary insights into optimal outcomes remain essential. In fact, opportunity cost—of which operational cost is a primary source—will become more important in holistic cybernetics thinking. In this regard, RCA's modeling practices of focusing on causal input-output relationships are highly conducive to systems modeling.

RCA's concept of value chain integration is new to the MA profession in the U.S. RCA's treatment of the two sets of cost concepts is not new and neither is the fact that both sets of concepts must be anchored in the principle of causality. However, as we pointed out in the first paper, MA theory and practice is in such disarray that these relationships and causality as their basis must be emphasized.

The Need for New Modeling Practices

You may at this point recall, from the first article, we stated that to properly understand cost behavior one must not first seek a particular costing method, but rather, the proper way to

model and understand consumption and cost behavior. This remains true because we are seeking a reflection of operations that consistently provides proper treatment of operational cost concepts regardless of the time frame. The proper recognition of operational cost concepts must not be dependent on the particular cost tool or an approach's treatment of time. Rather it should employ consistent principles of sound operational modeling such that we attain cost results that are reflective of the *true* representation of resource consumption. To do this, we need a comprehensive approach that does not unrealistically restrict model parameters or distort model results but provides us with the flexibility to obtain a result that is as reflective as possible of the true economic flow of goods and services' quantities and their costs.

There are three modeling practices incorporated in RCA that addresses these needs:

- replacing traditional variability with the principle of responsiveness to accurately represent current business reality;
- classifying causal consumption relationships in accordance with the new principle of responsiveness i.e., variability is inadequate and so are the concepts *variable* and *variable cost*. Moreover, as indicated in the first paper, the term variable has become meaningless; and
- recognizing that consumption relationships in the value chain are dynamic and have a definitive effect on cost behavior.

First, as discussed in the initial paper in this series, the principle of variability is no longer adequate to fulfill modeling requirements. In defining variability, traditional costing (and most other costing regimens) relate cost behavior to total product volume rather than to the actual determinant (i.e., the consumer in the value chain) of the level of output being modeled. This treatment oversimplifies the result and does not accurately reflect causal consumption relationships across the value chain.

To resolve the issue of the inadequacy of the principle of variability to enterprise modeling in the 21st century, RCA introduces the principle of responsiveness. Responsiveness

describes the relation between a particular output quantity and the input quantities required to produce it. This relationship is typically of a linear nature. Responsiveness aims at reflecting consumption and cost behavior as it flows across the value chain; truly reflective of the cause and effect relationships that form the basis for inferences in decision making about outcomes in the future. Converging on consumption and cost behavior at the level of resource consumption would seem to be the ultimate form of reflective MA. This process would also provide a reliable way of maintaining the integrity of operational cost concepts.

Second, to properly determine how cost is incurred operationally, we must define consumption relationships in a way that reflects their inherent causality (i.e., are the causal relationships static or dynamic)? In RCA these responsiveness relationships are defined as *fixed* or *proportional* in nature.

A fixed responsiveness relationship recognizes that the input is incurred regardless of changes in the level of the consuming output (e.g., the license fees for a fleet of trucks). A proportional responsiveness relationship recognizes that demand for an input will change as the consuming output's level of activity change e.g., diesel fuel cost is proportional to the number of miles traveled. There are many transactions within the organization that more accurately define the proportionality (or lack thereof) of consumption of resources to their immediate outputs (and thus the true nature of costs) than the variability of costs with the final units of product. This recognition is a major advantage of RCA as derived from German costing more generally.

It is important to understand that the cumulative effect of a number of responsiveness relationships solves the modeling problem that variability ran into. Responsiveness has the ability to reflect an *inverse* relationship between total volume and total cost. For example, although total production volume may go down (i.e., when manufacturing fewer, more complex products in a larger number of smaller batches), the higher cost of an increased number of

smaller batches and inspections would be reflected in planning, scheduling and inspection outputs through their respective responsiveness relationships. RCA's more specific outputs in each of these areas would therefore be higher and thus, also their input costs would be higher (e.g., due to overtime) even though final cost object output would be reduced.[2] Thus the concept of proportional costs in RCA is in one sense similar to traditional variable costs (it changes with changes in output) but in another sense it is quite different (it can and will when appropriate behave inversely to total volume).

Third, traditional costing and most other approaches lack recognition of the fact that proportional costs can change to become fixed. Both TOC and lean accounting seem to claim to be concerned with optimization of the entire value chain and overall enterprise (as opposed to its components). Alternatively, traditional approaches seem to be more sweeping in associating the nature of costs in total with their dominant consumption pattern as related to the ultimate product output. However, unlike RCA, none of these approaches recognize that, not only does proportional consumption vary with immediate outputs; it can change to become fixed as resource consumption occurs. That is, a resource that is normally *acquired* proportionately can be *used* in a fixed manner (i.e. its consumption is constant regardless of output). Electricity used for lights that are always on would be an example. Moreover, once a cost is fixed, it cannot again become proportional to the enterprise. Thus, costs will become increasingly fixed as resources flow through consecutive consumption relationships. As patterned after GPK, RCA recognizes these flow dynamics. This feature, as with others we've described, results in more accurate operational costing.

[2] It is essential that the term *output* here be interpreted as specific to the immediate transaction in the value chain (i.e., inspection outputs, scheduling outputs, and planning outputs—not finished goods).

Using these three modeling practices RCA provides managers with a superior operational foundation on which to base their inferences and extrapolations in optimization decision making. Moreover, regardless of the accuracy of the operational cost model, if the concepts are not correctly applied in decision analysis, suboptimal outcomes will result. Unfortunately, objective reality can only highlight subjective error after the fact—it cannot prevent it.

What are the Alternatives?

With traditional operational cost concepts, the variability of resource consumption with regard to the final cost object cannot possibly be accurate. First, a particular cost often contains both variable and fixed portions. For example, direct labor contains costs that are likely proportional to the final product output in general; but direct laborers also consume costs for training that are fixed with regard to output. Neither traditional systems that absorb *all* costs (regardless of causality) nor contemporary costing approaches such as TOC or lean accounting that under-absorb costs to promote simplicity (here, inconsistent with the principle of causality) provide an accurately reflective view of operational costs. Moreover, methods that re-define variable costs for decision purposes or try to contrive some other means to manipulate operational cost concepts to make them fit a decision scenario are hopelessly inadequate and exacerbate the potential for confusion. For example, the concept of totally variable costs attempts to re-define operational cost concepts to make up for operational cost concept inadequacies for decision making. The danger of falling into the blended cost concept error by doing this is particularly acute when changes in output fall outside the relevant range.

Second, RCA recognizes that the nature of costs can change as outputs are consumed. This and the fact that fixed costs increase as resources are consumed is not reflected by other costing approaches. This is why it is so important to recognize resource consumption at individual consumer (e.g., cost center, product, segment) levels (i.e., so that we accurately

preserve and reflect the proportional and fixed cost relationships that naturally occur). There are many decisions (e.g., outsourcing decisions) where these types of resource consumption and resulting fixed cost insights are crucial to optimization.

Conclusion

As we have explained here, although operational cost concepts should not be exclusively used in decision-making and enterprise optimization, they provide a consistent baseline of information upon which decision makers rely. Current MA practices threaten the effectiveness of optimization decisions based on inappropriate MA approaches to compiling this baseline information. In summary, this tends to show up in five important ways:

- Using the general ledger as the fundamental source for compiling operational costing concepts as based on the principles of external financial reporting;
- lacking an overriding principle that governs cost modeling consistent with managers' decision support and optimization needs;
- failing to recognize the true proportionality of certain inputs (and their costs) and the degree to which the content of any given consumption pattern is truly proportional to the output of the immediate consumer in the value chain;
- failing to recognize that as costs flow across the value chain, proportional costs have the ability to change their nature to that of fixed costs based on consumption patterns; and
- (based primarily on the discussion in the first paper in this series), the prevailing approach of confusing operational cost concepts with decision cost concepts and applying those concepts inappropriately.

Contemporary modeling practices therefore fail to provide a clear or accurate characterization of variable and fixed operational cost concepts. This alone has caused many problems. Some approaches have tried to solve this by ignoring the costs (e.g., those that attempt to manage operations by using throughput). Yes, direct material consumption typically can be characterized as reflective of proportional cost behavior. However, there are a host of

other costs that also reflect proportional cost behavior that are ignored. On the other end of the spectrum, full-absorption costing clearly does not provide accuracy either.

Fortunately, there are new costing systems that *do* attempt to recognize proportional and fixed consumption in a manner that is as reflective of causes and effects as is feasible. Resource Consumption Accounting (RCA) does this to achieve the most accurate reflection of quantity consumption (and its costs). What is the value to decision making of achieving this kind of accuracy in operational costing? What we know now is that RCA is patterned after the German GPK system where managers (per recent survey data presented at the December 2006 CAM-I meeting), are very satisfied with this approach. We also know that U.S. managers are *not* satisfied with their approaches. Hopefully, this discussion will help us to understand a bit more about the importance of operational and decision information and how they can be more appropriately used to improve costing in the U.S.

Finally, RCA's modeling capabilities should not only be viewed within the context of problems that it corrects from the past but also for the potential that it holds for the future. In this regard we highlighted two developments likely to impact MA, namely the REA framework and cybernetics. RCA principles and practices are complementary in both instances. For once there is not only a MA approach that corrects the errors of the past but one that is ready to integrate with leading edge business thinking and related technology tools of the future.