Practical Issues in Level of Precision and System Complexity

The fourth in a series of articles exploring cost measurement issues.

Dr. Dale R. Geiger
California State University
George Washington University

Introduction

The first article in this series focused on the purpose and motivation for cost measurement. The second article emphasized the importance of management's role in choosing the cost object, the view of cost to be measured, and in selecting from alternative measurement methodologies. The third described the fitness of selected cost drivers along three dimensions: managerial usefulness in promoting desired behavior, technical aspects of measurement credibility, and cost of the driver measurement process itself. This installment will discuss the inherent practical limits to precision in managerial costing.

Defining the precision requirements of a managerial costing system is important for three reasons, which are closely related to the three dimensions discussed in the previous article. The most important is that managers need information, not data. Attempts to build highly precise systems may fall into the trap of producing a lot of precise data while failing to supply reasonably accurate, relevant information. Such a system falls short in the dimension of managerial usefulness.

The second reason to carefully consider a system's requirement for precision is that precision is expensive. Attempts at great precision require greater dis-aggregation, increased detail and more direct costing. This will increase the cost of the system or decrease its functionality in other areas such as the frequency of update. It is always possible to measure to greater precision and easy to spend more on cost measurement than it is worth.

The third and final reason for examining the level of precision to be built into a cost measurement system is that there may be technical and physical limits to the precision of a measurement. A system that reports costs to the penny, while utilizing a cost measurement methodology that is

inherently bound by physical or technical limits may give a false sense of precision.

Consideration of a managerial costing system's requirement for precision is an important topic for managers and managerial cost accountants *before* building the system. There seems to be a facet of human nature that encourages excessive precision when starting cost measurement.

Consider the activity based cost accounting system found in a federal organization that used 275 activities to distribute annual overhead of $3.5 million. The burden of feeding raw accounting data and updating the distribution mechanisms resulted in the system only being updated once a year. It is not surprising that the manager of the organization found little use for the information in continuously improving his operation.[1]

The areas of *physical or technical limits of precision*, *managerial relevancy requirement for precision*, and *cost of precision* will be discussed in theoretical terms and illustrated with practical examples. The goal of a managerial costing system is to provide information of practical value to cost managers. The goal of this paper is to address the issue of "how much precision do cost managers need?"

Physical Limits of Precision: Weakest Link Theory

Engineers and scientists use a term called "significant digits" to express the precision inherent in a physical measurement. In measuring the distance to a star, precision may only be possible within the nearest light year.[2] It makes no difference where on earth you are measuring from or where in its trip around the sun the earth sits because these differences are

[1] It should be noted that this approach was a good front end for a re-engineering effort. Such effort typically maps the process in great detail and scrutinizes each detail for value added to the process. The outcome from re-engineering is a re-designed organization. While certainly useful, continuous organization re-design is not a sustainable paradigm for continuous improvement in cost management.

[2] Remember that light travels at 186 thousand miles per second and that a light year is roughly 6,000,000,000,000,000 miles. The diameter of the earth is a relevantly insignificant 8,000 miles.

small in comparison to the distance light travels in a year. In other words they are not within the significant digits.

A related way to think about this issue is remember that a chain is only as strong as its weakest link. Overall precision in costs to be aggregated can be no greater than that of the least precise: the "weakest link." It makes little sense to measure some costs to the nearest penny when that measurement will be added to cost that can only be estimated to the nearest thousand dollars.

It is crucial to recognize that any allocation process is depends heavily upon assumptions, and these assumptions have an impact on precision. As discussed in the previous article, the selection of a cost driver implicitly assumes that each unit of that cost driver is reasonably homogeneous. Allocation based on a cost driver is essentially an average cost per unit of cost driver. In reality, there is some varying range of cost per each individual unit of cost driver. Therefore, allocations inherently limit precision. The unavoidable assumptions required by the allocation process create a "weak link" in the overall costing process.

Physical Limits of Precision Illustration

Consider the measurement process you would use in calculating the driving distance for a vacation. The trip can be visualized as the aggregation of several distance segments.

The first segment you might consider would be the distance from the town nearest your origin to the town nearest your destination. You could then also estimate the distance from your community to the nearest town, the distance from your street to your community, and the distance from the town nearest your destination to the destination itself.

Each of these segments has a different level of precision imbedded in its measurement process. The road atlas may be accurate to a mile or so, but your estimates of the other segments are likely to be less precise. The estimate from town nearest destination to destination is likely to be the least precise and may be "wrong" by several miles. The "weakest link" theory says that the total distance can be no more accurate than this least accurate segment.

This is why we do not get our ruler and measure the distance from our garage to our street in order to get a more precise measurement. The distance to the street **can** be measured very precisely, perhaps to the nearest foot, but it makes no sense to do so. The precision limitations of the other measurements make driveway measurement an unnecessary waste of time. Just because we can measure that segment very accurately does not mean that we improve the overall measurement for our trip: the underlying management purpose of the measurement itself.

Similarly, in a cost measurement where one component of cost can be measured to the nearest cent, and another can only be measured to the nearest one hundred thousand dollars, the entire calculation can be no more precise than the nearest one hundred thousand dollars. Think about this the next time you see a "cost" measurement of millions of dollars that includes the number of pennies.

Managerial Relevancy Requirement for Precision: The One Percent Theory

The issue to be addressed here is how much precision do managers need. In the vacation planning illustration, how useful would it be to actually know the distance to the nearest foot? Would this information be relevant to any decision you might make. Would it improve your trip planning or budgeting to any meaningful degree?

It is proposed here that management generally needs precision to no greater than one percent. Management decisions rarely hinge on the tenths of percent differences found in numbers with three or more significant figures. Managers typically look only at the first two digits. Precision in terms of dollars and cents is simply irrelevant in decisions involving thousands of dollars.

Making generalizations, however, is somewhat risky. As "beauty is in the eye of the beholder," so is precision in the mind of the manager. There are some distance measurement applications (programming cruise missiles, for example) that need very precise measurement capability to be effective. Likewise, some managers feel comfortable with more detail and others with

less. In general though, it seems clear that there is a practical limit of one percent to the precision needed and really required.

Relevancy Requirement for Precision Illustration

Another way to think about the issue of practical relevancy for precision is to look at the clock in Figure 1 and determine "what time is it?" Is it 2:00 or 2:05? Or is it 2:03 or 2:02:47? Would you ever answer the question by saying that it is 2:02:46:35? It is illustrative to think about how and why you answer the way you answer.

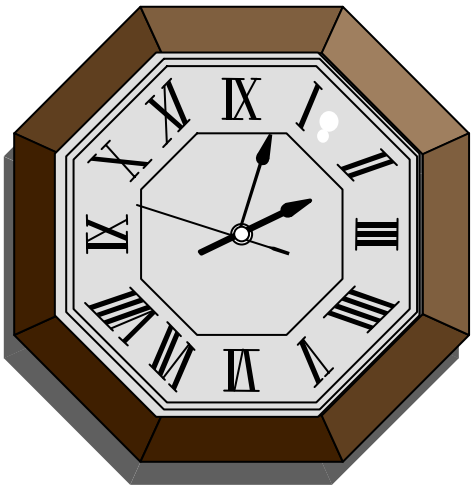

Figure 1 "What time is it?" The level of precision in time measurement is subject to physical limitations, and differing levels of precision serve different management needs. Cost benefit relationships must also be considered. It would be silly to pay $100,000 for an atomic clock when a $100 wristwatch would do.

For most of us, there are *physical limitations* to our time keeping equipment. We know that our watches' significant digits do not include hundredths of a second. But more importantly, we also know that for all conceivable uses, hundredths of a second simply do not make any difference. They are irrelevant and do not meet measurement's *relevancy requirement*.

As mentioned earlier, the determination of relevancy is a function of the measurement's management application. Radio station operations probably demand time measurement to greater precision that more individuals require. Furthermore, some highly time sensitive applications

like synchronous data transmission can require extremely accurate time measurement.

Cost of Precision: Cost Benefit Theory

Precision costs. The highly accurate distance measurement process for cruise missiles and the highly accurate time measurement clock for synchronous data transmission are expensive. Designers must use a cost-benefit logic to determine whether increasing precision in any area increases the overall value of the measurement.

Any costing methodology incurs costs of measuring, accumulating, storing, editing, manipulating, reporting, and explaining. These costs increase substantially as greater levels of precision are attempted.

Cost systems that attempt great precision require greater dis-aggregation. A hundred-activity cost system is likely to be more precise than a ten-activity cost system, but will cost substantially more. The hundred-activity cost system could certainly be done more precisely by using 1000 activities, again with an increase in the cost of the cost measurement process. It is proposed here that the incremental benefit of increased detail must exceed the incremental cost of measurement.

Cost of Precision Illustration

An Army installation recently developed an activity based cost accounting system that tracked 1700 activities for its Maintenance Department. The size of the system and the burden of repopulating cost data and revisiting cost distributions meant that the system provided only annual data for the previous year some months after the end of the year. Management found the benefit of the presumably precise, but ancient, history unworthy of its subsequent updating and never repopulated. Unfortunately, the system was discontinued rather that simplified to the point where it would provide a positive cost-benefit.

Similar efforts at Fort Huachuca, Arizona started in the same mode of striving for great precision. The activity-based cost accounting system developed for its Logistics Directorate originally had 350 activities and was

updated annually. Fort Huachuca also found this reporting irrelevant, but chose to evolve its system towards greater usefulness. By the third iteration the entire directorate was comprised of 35 activities updated quarterly. Management reports that the system is an essential part of the garrison's cost-based management effort that has yielded millions of dollars in productivity improvement in the last two years.

Dining Hall Illustration: A Comprehensive Case Study

The Dining Hall Department at Fort Huachuca was part of the Directorate of Logistics described above. In the first system it contained fifteen activities associated with providing its service, along with the costs associated with each activity. In rank order these costs in thousands of dollars were:

Cool Food	$237
Clean	$119
Serve	$64
Collect Money	$63
Prepare Food	$36
Do Paperwork	$22
Wash Dishes	$20
Prepare Vegetables	$20
Prepare Salads	$20
Plan Meals	$18
Drive Trucks	$18
Unload Trucks	$14
Stock Shelves	$14
Replenish Line	$14
Maintain Equipment	$14
Total	$693

An important question to consider is "how many activities should be considered in the system?" Let's consider three approaches. One approach is to consider all 15 activities. The allocation of these activities to cost objects must then measure the cost for each activity, determine the distribution methodology for each activity, and then measure the distribution metric for each distribution methodology.

A second strategy would involve aggregating a number of the smaller activities into a single cost pool we could call "all other." "All other" would then be distributed on a weighted average of the larger activities' distribution results. Aggregating the smallest 12 activities into the "all other" activity decreases the effort (and the cost) of the cost distribution process by 80%.

A third strategy is to expand the number of activities by considering smaller value subsets of each of the 15 activities shown. Preparing vegetables could be divided by process into cutting, washing, cooking, etc. Each of these activities could be further subdivided into activities by vegetable type: potatoes, beans, peas, carrots, cauliflower, etc. Cooking activities could also be subdivided into separate activities for different cooking processes: frying, baking, steaming, etc.

Each of the three strategies can be used to distribute the dining hall costs to costs objects. Each represents a different level of accounting cost and accounting precision. The important tradeoff to be considered here is the marginal cost of increased detail versus the marginal benefit of increased detail. It should be clear that there is a diminishing return to the increased detail, since the maximum number of possible activities is theoretically infinite while the marginal benefit is undoubtedly limited.

Discussion: Cost Management of the Cost Measurement

Pareto Analysis can be a helpful tool to provide the best value in cost measurement. It also helps to avoid the likely diminishing return to accounting effort that occurs when an overly detailed system is attempted.

Pareto Analysis simply observes that any distribution has a few significant components, but many trivial ones. This is sometimes called the 80-20 rule since is often happens that 80% of an effect is represented by 20% of the causes.

This 80-20 rule holds true in the dining hall example. The largest four activities (actually 27% of the 15 activities) account for 78% of the cost. We would call these high-ticket items the "significant few." They are the ones to target first in order to make an efficient impact on the overall cost measurement.

Evaluation of the "trivial many" will generally have little impact on the overall cost distribution. Considering them in detail will likely increase the cost of the measurement process without adding much benefit. Consider that a 10% measurement error in the largest activity, cooling food, is larger than the total cost involved in each of the smallest ten activities. (See Figure 2.)

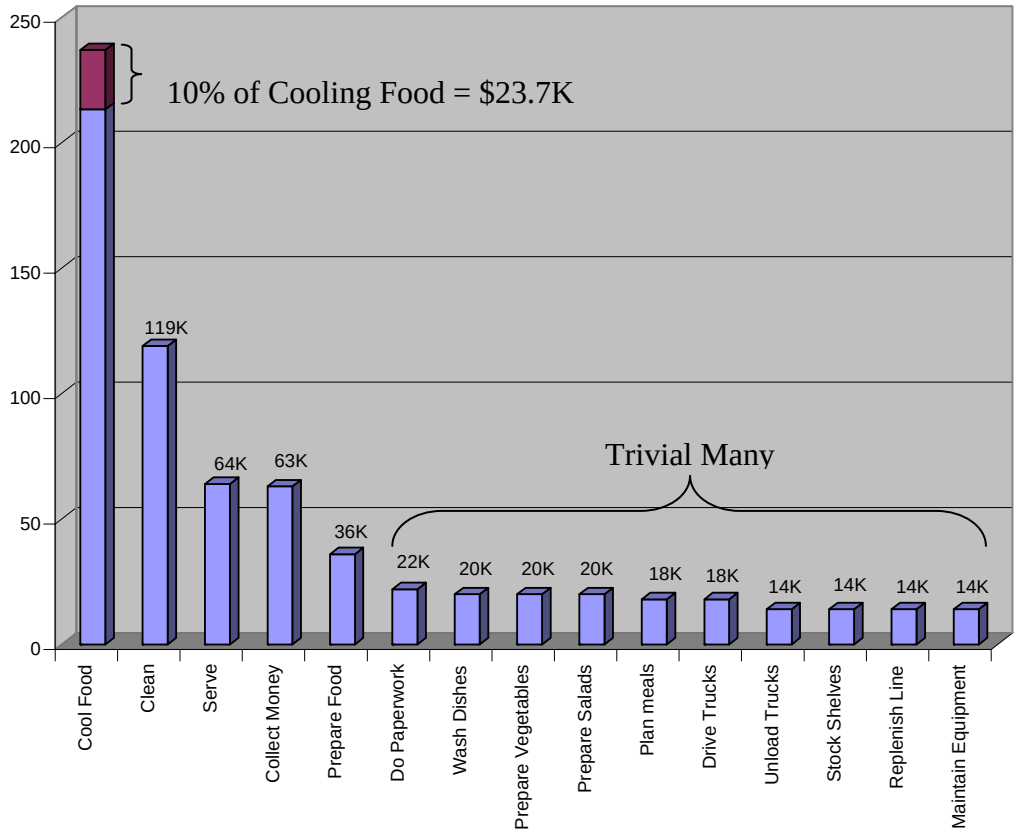

Figure 2 demonstrates how a 10% measurement error in the largest activity, Cooling Food, is greater than the total cost involved in each of the smaller activities.

Evaluating the cost/benefit ratio of additional activities is difficult. While the benefit contribution of the small cost activities is likely to be small, the cost of measuring them is not. In the dining hall example, let's assume that the cost of measuring an activity, determining a distribution methodology, and measuring the distribution metric is $180.

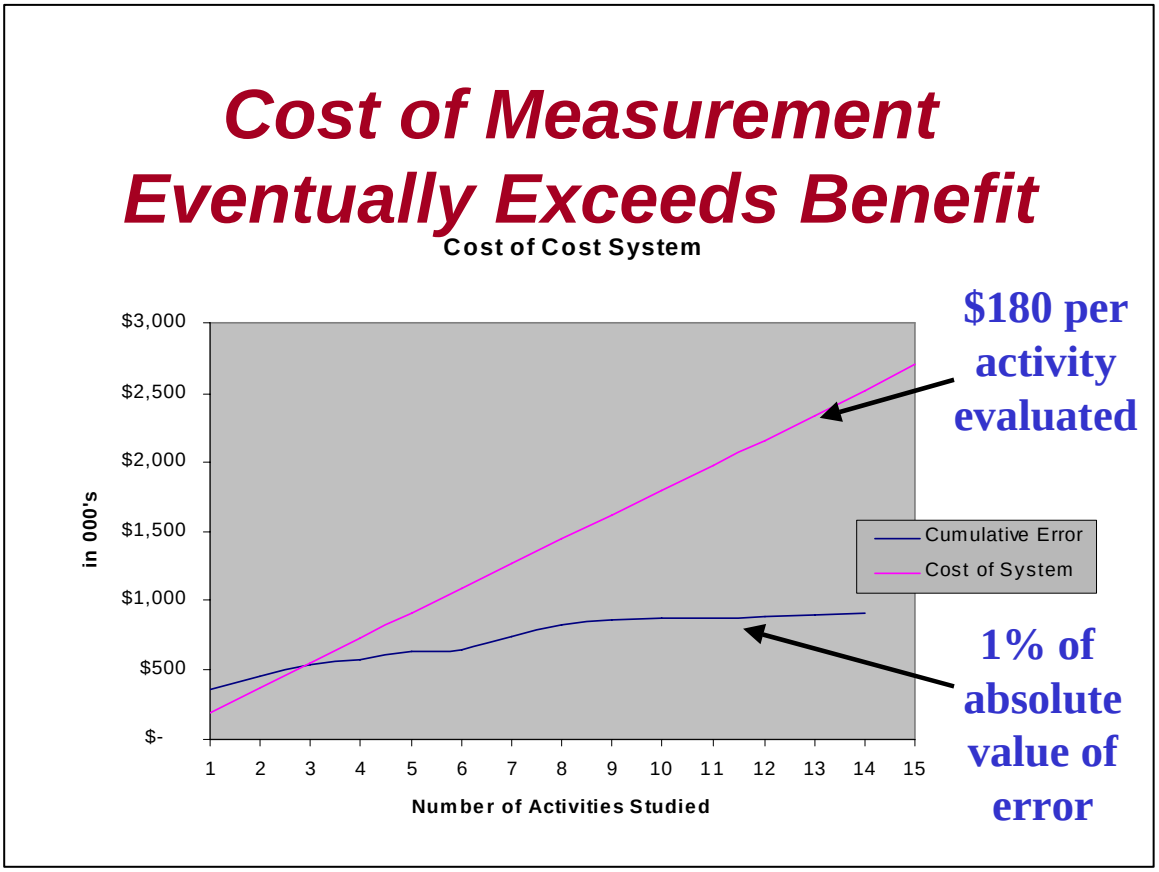

Figure 3 demonstrates how the total cost of the cost measurement rises with each activity studied, while the marginal benefit derived from each additional activity studied decreases.

Defining the benefit is more arbitrary, although it would seem reasonable that the incremental benefit is related to the incremental improvement in measurement. Arbitrarily valuing the benefit as one percent of the absolute value of all cost redistribution between cost objects yields the graph in Figure 3. While the cost and benefit parameters are arguable, the general shape of the lines is clear given the decreasing return to accuracy as more activities are evaluated to distribute a total cost that remains unchanged.

Generally then, it makes good sense to consolidate small activities into a single pool. Yet there are exceptions to the general rule. If one of the small activities was distributed to cost object in a unique way, it might make sense to not aggregate it with the others. For example, if one of the small activities was "dinner music" and dinner cost was one of our cost objects, it

would make sense to allocate “dinner music” 100% to dinner cost and not aggregate it with activities that support breakfast and lunch. Keep in mind though, that “dinner music” cost of a very small amount will not effect the cost distribution in any relevant way and should be ignored.

It should be clear that the significant few must be determined and addressed in the managerial costing process. This is where effort will yield the best value in cost measurement. It may be useful for managerial costers to consider the Willie Sutton Law of Managerial Costing. When Mr. Sutton was asked why he robbed banks, he replied, “Because that’s where the money is.” Cost system designers should recognize that higher levels of effort are desirable in big-ticket items, because “that’s where the money is.”

Summary and Conclusions

Physical limits to precision bound the accuracy of measurement to that of the least accurate component or “weakest link.” Making assumptions concerning the homogeneity of cost drivers creates weak links in allocation based cost distributions. Managerial costing systems that are dependent on allocations or estimations cannot achieve a level of precision comparable to bookkeeping systems. Implying such precision is misleading. Great precision in managerial costing is NOT POSSIBLE.

Relevancy requirements for precision demand that management’s intended use of cost information drive the measurement process and its specified accuracy. Management use of information generally requires reasonable approximation rather than precise aggregation. Managerial costing systems should recognize that managers typically do not need or use a level of precision that may be technically possible. Great precision in managerial costing is NOT NEEDED.

Costs inherent in precision are theoretically infinite, as greater levels of detail are always possible in cost measurement. The benefit of precision is subject to a diminishing return that generally does not justify a highly detailed system. The requirement for system benefit to exceed system cost is a practical necessity. Great precision in managerial costing is NOT AFFORDABLE.

Consideration of the physical limits to precision, relevancy requirements for precision and costs of precision differentiates managerial costing from traditional bookkeeping and accounting processes. Ignorance of this difference will result in costing efforts that fail to provide the right kind of managerial information that justifies the effort. As a practical matter, in managerial costing *it is better to be reasonably right than precisely wrong*.