BUSINESS MODELING: COST ANALYSIS IN THE OPERATIONS ENVIRONMENT

The Society of Cost Estimating and Analysis

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ABSTRACT

Traditionally, cost estimators find themselves estimating elements of major acquisitions, whereas operational environments rarely require the same level of cost support. However, operational programs are under the same pressures to reduce costs and manage limited resources efficiently. This paper explores the application of cost and quantitative analysis in the operations environment, and illustrates practical examples of cost-related analytic toolsets. Specifically, this paper will describe environments apt for business modeling, propose metrics related to cost analysis that usefully measure operational performance, and illustrate tools that allow the cost analyst to perform quantitative analysis and communicate with stakeholders.

For a cost analyst, there is life beyond creating the cost estimate. Measuring the fiscal efficiency of a program's activities opens a whole new set of cost analysis opportunities. With an administration focused on increasing accountability for spending, as evidenced by reverse-outsourcing activities, the operational components of government environments will be affected. Profitability and efficiency analysis are required, both as prerequisites for insourcing and as recurring measures afterward, to ensure a sustained and value-adding operation. This is of particular importance in the federal working capital fund environment where agencies must operate in the fee-for-service style of a commercial business, but it also should not be ignored in the appropriated operations environment to ensure efficient use of funds. Business modeling applies from both the contractor and federal perspective. Contractors should be interested in remaining competitive by reducing costs, while federal oversight organizations need to be able to allocate resources to address productivity gaps. Ideally, both organizations can work together to create an environment of operational transparency.

Cost estimators and analysts have a role in operations divisions that lend themselves to process management, a domain in which efficiency metrics can provide key insight into production characteristics such as workload management, quality, productivity, resource management, schedule and operating risk. The analyst must study the production process characteristics to answer which portions are direct, indirect, or G&A, and then allocate cost to the process. Reliable metrics provide leadership sound footing to quickly and confidently justify cost-driven decisions such as whether to hire additional staff or work overtime, or to pinpoint which division is operating the least efficiently. Without agile information, a manager is strictly limited in his/her ability to respond to business needs. Furthermore, these responses are typically reactive because a model is required in order to predict future performance.

Finally, the estimator must have the ability to share results and communicate methodologies to stakeholders. This paper will illustrate the changing industry environment, the need for additional information to effectively operate, and detail analytic toolsets available to help decision makers at every level understand how to allocate resources to improve performance.

The Traditional Role of the Estimator

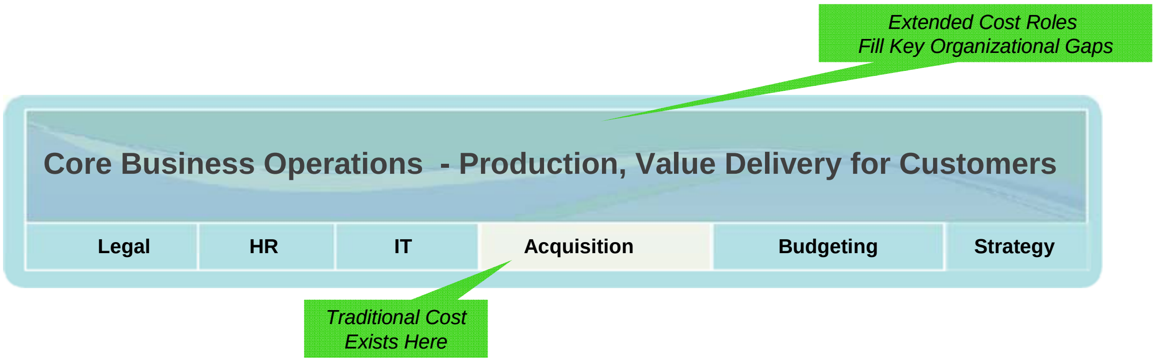
For the past several years, the Department of Defense (DoD) and other major government agencies have received over five hundred billion dollars to spend on the development, acquisition, and sustainment of everything from shoelaces to ballistic missiles. The vast majority of this funding is spent on Research, Development, Test, and Evaluation (RDT&E) and Procurement of prominent technological systems. Commonly, these are referred to as 'acquisition systems' because the primary goal is to facilitate the acquisition of new items for the procuring agency's portfolio. The most expensive programs are designated as Acquisition Category I (ACAT I). The procuring offices estimate that these programs will require eventual expenditure for research, development, test, and evaluation of more than $355 million (FY 1996 constant dollars) or procurement of more than $2.135 billion (FY 1996 constant dollars). An overwhelming amount of Federal cost policies follow this designation; smaller programs that receive other designations also require cost support. Overall, these policies are more than enough to provide long careers for thousands of cost estimators.

The ACAT I policies mandate that creators of acquisition systems must accurately answer basic questions about their systems. The standards are well-documented and provide lengthy guidance for cost estimators as well as many other professions in the acquisition process, but for the sake of brevity there are a handful of common products that cost estimators have a role in creating. For example, one of the first studies for any new system is an Analysis of Alternatives (AoA) which evaluates different technological solutions in order to determine which is the most cost effective. Once the procuring agency has a fair understanding of what type of system is best suited toward closing gaps in the existing infrastructure while still being generally affordable, a following step is to create a Life Cycle Cost Estimate (LCCE) to be more precise about how much the system will cost. LCCEs come in many shapes and sizes, from many sources, and can be created to almost any degree of accuracy. For large acquisitions, LCCEs are created and compared by formal Program Offices and cost agencies. For smaller acquisitions, LCCEs can be created as components of Cost Benefit Analysis (CBA) and Business Case Analysis (BCA). Every year as new acquisition programs begin and existing programs mature, cost estimators provide the products that the ACAT I process requires and the cost analysis that leaders need.

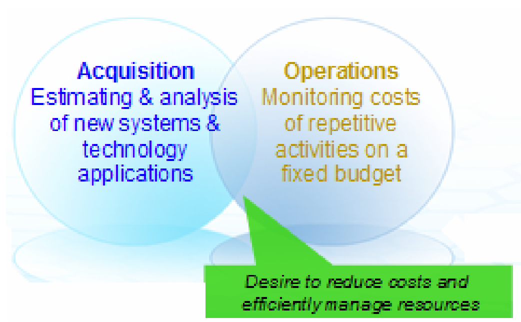
However, fewer rules exist for the sustainment of these systems, and certainly there is less scrutiny from the OSD. This is not because sustainment is a low-cost proposition. Major systems generally tend to last for a long time, and require many years of constant funding to maintain. For example, the F35 planes coming off the assembly line today are likely to be in sustainment for decades.

While systems in sustainment do not receive acquisition scrutiny from the Office of the Secretary of Defense (OSD), they are certainly subject to budget cuts and constrained resources. In order to make funding available for the development of other systems, DoD budgeteers often cut operations and sustainment funding profiles of established systems by a few percent each year. Over the course of several years these cuts force leaders to make difficult decisions about how to get the same amount of work done with noticeably fewer resources. Perhaps because there is no Federal directive requiring cost analysis support, usually these leaders do not have cost analysts on hand to ensure decisions are fiscally justified and operationally optimized.

Furthermore, organizational areas such as the legal department, IT, human resources and others that are outside of acquisition do not face the same level of federally mandated cost accountability and often go unscrutinized when leaders have less understanding of overhead functions. However, the same truths about limited resources apply here. It is important to understand the financial health of these organizations to make informed resource management decisions.



A large percentage of a program's funding is executed during the sustainment phase; organizations outside of acquisition draw personnel and funding resources away from direct acquisition roles as well. This makes it critical that Federal programs focus analysis beyond the early phases. There is a significant case to be made that understanding a program's health outside of early-system acquisition is an important and worthy cause.



Operational leaders find themselves in a novel situation, lacking formal cost analysts yet still requiring a similar degree of analytic support. What can these leaders do to improve their situation? What opportunities should a cost analyst target? Measuring the fiscal efficiency of a program's activities opens a whole new set of analytical opportunities that can benefit the US Government. There is life beyond system acquisition.

The Changing Industry and Burning Platform

The latest decade has delivered a host of changes and revised priorities in government operations. Cost analysis has characteristically been used in government operations to quantify program costs in acquisition, but is occasionally used in certain agencies (to varying degrees of maturity) to support improvements in operations via cost reduction. Examining perspectives over time, shifts in roles & policies are evident.

	Past Decade	Current Discussions
Roles	Contract staff, in conjunction with government staff, have conducted Cost Analysis and Estimation (most notably in the Defense subsector) , focusing on acquisition of major programs, systems, and material	Cost Analysis and Estimation will still be required for acquisition, but these functions are becoming increasingly classified as Inherently Governmental (IG), based on SECDEF Gates' intent to convert 11,000 contract positions to government[1]
Policies	Many federal agencies outsourced more work than they actually performed themselves, with some agencies having over 50 % contracted staff[2]	Presidential policy and congressional opinion indicate that in-sourcing can balance the federal workforce and ensure that IG work is retained in-house[2]

- *1: ExecutiveGov Journal; 9 Mar 2010, Garrettson, Jim, http://www.executivegov.com/2010/03/personal-conflicts-of-interest-and-inherently-governmental-functions/*
- *2: Federal Computer Week; 1 Mar 2010, Lipowicz, Alice, http://fcw.com/articles/2010/03/01/dhs-has-too-many-contract-employees-senators-charge.aspx?s=fcwdaily_020310*

Acquisition, while a major focal point of cost analysis, is not the end-point for the profession. Applying methodologies to the operations environment will support government efficiency improvement initiatives and build the foundation for the key elements of accountability and transparency which were a recurring campaign theme during the 2008 Presidential elections and are again a theme in the 2010 Congressional, state, and local campaigns. For operations managers in the federal environment, pressure to do more with less is increasing, and pressure to demonstrate value to the American public is growing in focus. To decide how to allocate limited financial resources to obtain the most output is challenging without the right data; even more challenging is to explain how the elements of a business are inter-related in a defensible, clear manner.

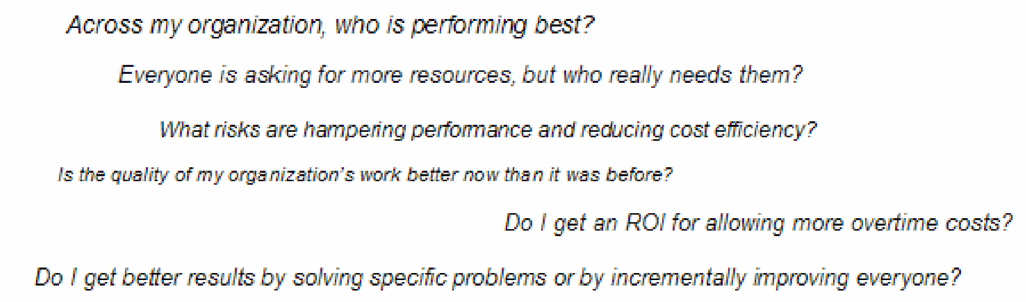
This demonstrates the platform for two types of change: 1) transition of acquisition activities to 'inherently governmental' status, and 2) increasing demand for accountability of spending and responsible resource use.

> **Acquisition**: Government insourcing and re-adjudication of inherently governmental activities directly results from Secretary Gates' desire to convert 11,000 positions currently contracted to government control and employment. This will result in a general shift in industry resulting in possible oversupply of analytical skills on the consultant/contractor side, and a skill gap on the government side.
>
> **Accountability & Decision Support**: Managers in government agencies must respond to demand for accountable spending and responsible decision-making. While managers are empowered to make decisions believed to be in the best interest of the agency and the country, without quantifiable evidence of decision options and supporting data, it comes down to simple judgment.

Recognizing the capability that quantitative analysis provides to both acquisition divisions and operations divisions permits exploration of the types of business intelligence to be brought forward.

Key Operational Questions

Imagine a leader of an operational organization – one that has multiple branches that have worked together to repeatedly produce similar products, year over year. This organization might be processing invoices, releasing critical software patches, or manufacturing ammunition. While managing from one crisis to another throughout the course of the day, what types of questions does that leader have running through his or her mind?



Typically, that leader probably relies more on experience and gut-feeling than quantitative evidence to deal with these questions. Very few leaders have the tools to see across the organization to assess the performance of one branch compared to another. Bottlenecks always exist, but it's not always the person who is complaining the most that needs the additional resources. In addition to not being able to see across at any moment in time, it can be even harder to compare historical performance to today. Determining performance improvements or declines is difficult, but certainly a comparison that can be made by a cost analyst with the right tools.

Business Modeling – A Solution

This paper recognizes that the skill of a cost analyst goes beyond understanding how to apply a regulation against a program to quantify its value. To create a valid cost model for acquisition, an analyst must understand how to:

- Use computer tools to model time-based data streams
- Quantify the effects of a program's implementation on an organization
- Manage a data collection effort and catalog multiple sources and streams, applying confidence intervals to each
- Prepare presentations to detail results to decision makers
- Quantify the effects of risk on a program's ultimate result
- Mirror the program's implementation using numbers

To provide decision support to operations managers, business models can be created based on the goals and production efforts of divisions, much in the same way as for a project/acquisition. The skills required are exactly the same, and thus are already present in the cost analyst toolkit.

Consider an example of the Internal Revenue Service. The major activity of the IRS is to process and audit tax return documentation, then reconcile the revenue collected from amount owed, processing the difference. The primary goals of this activity can be summarized: 1) Efficiency – documents should be processed at the lowest resource expenditure to the government, 2) Effectiveness & Accuracy – first-time processing should be correct; minimal re-work should be required, 3) Timeliness – time to collection should be as short as possible, 4) Customer Satisfaction – individuals and corporations should have minimal complaints about interactions with the IRS.

A cost analyst possesses the skill set to analyze data streams that directly inform the degree to which the goals are met. To determine efficiency, productivity must be considered – are we obtaining maximum output (returns processed) per unit of input (people, dollars, hours)? Considering effectiveness, what is the cost of quality; how much more money must be spent to raise the performance level by X? Regarding timeliness, what is our total-time-in-process, and how much money can be saved by accelerating this process? Modeling operational data and understanding the estimating relationships and correlations provides the answers to these, and countless other questions, with a defensible platform on which to act.

Business Modeling – Application

Metrics form the foundation for quantitative operational analysis. These metrics are measures of an organization's performance in support of a range of requirements across operational levels. As a part of this process, the cost analyst can focus on financially-based metrics but it is also important to consider measures of other factors that are likely to affect the cost outcome of the process.

The table below categorizes cost and other factors into metric indices. These indices are meant to cover the complete spectrum of measuring a process. Even in a cost-constrained environment, processes should be measured against more than cost. Every process also has a quality component, a timeliness component and a productivity component that help answer questions related to how well, how quickly, and how much of the job was completed. Each of these has a strong correlation to the ultimate cost of performing the process. In turn, all of these actions should relate to a customer while also recognizing environmental risks. Finally, metrics related to workload management (the amount of work to be done) and manpower are both informing factors. The table below contains examples for each of the recommended indices.

Metric Index	Description & Business Decisions	Examples
Cost	Are we keeping cost low or maximizing value per dollar?	**Overtime as a % of Total Cost** = OT$ / Total Execution
Productivity	Are we maximizing output per unit of input?	**Units per Hour** = Total Unit Output / Total Production Hours
Quality	Are we producing to an acceptable standard?	**Process Error Rate** = Units Defective / Total Population
Timeliness	Are we producing within service-level objective cycle times?	**% Timely** = Units Delivered On Time / Total Population
Customer Service	Are our customers happy?	**Cust. Sat. Score** = # of Favorable Answers / Total Answers
Operating Risk	Are we going to be derailed by a future event?	**Seasonal Spikes** = % Change in Slope of Incoming Workload
Workload Management	Are we outputting what is incoming?	**Processing Ratio** = Units Processed / Incoming Units Received
Manpower	Do we have the right staff to do the job?	**Avg. Yrs Experience** = Sum(# yrs exp)/ count(Staff-on-hand)

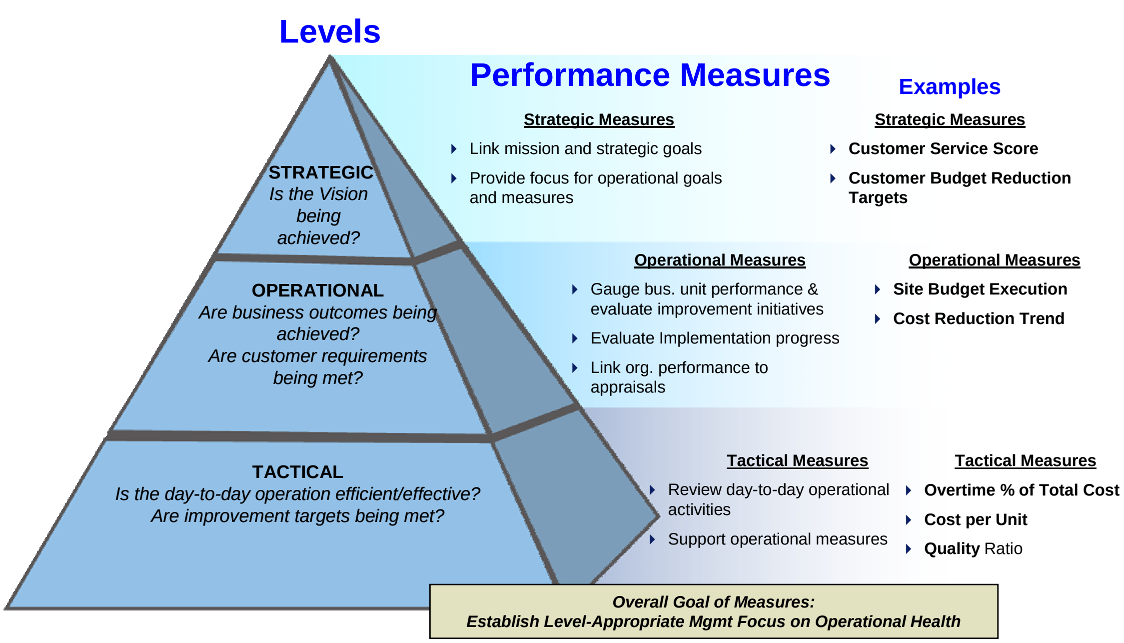
As indicated, these metrics can cross operational levels, and represent the performance of the organization against requirements that range from tactical to strategic. In fact, several tiers of metrics are a preferred approach, especially when tactical metrics measuring performance on the floor get rolled up to measure performance against metrics measuring strategic performance. For example, Customer Service may be a function of performance in other indices, which in turn are comprised of various metrics.

Customer Service = *Function*(Cost = *Function*(Quality, Productivity, Timeliness, Workload Management, Operating Risk, Manpower))

Tactical metrics measure the day-to-day operational effectiveness and efficiency of smaller teams within the organization. Metrics such as the quality ratio, cost per unit and overtime percentages are useful to determine if the team is doing a better job now in comparison to last month. At this level, it is easier to see if improvement initiatives are having the desired effect. Fundamentally, organizations should have these types of measures in place before performing process improvement activities, although few government agencies or corporate counterparts do. The number of tactical metrics to choose from can be overwhelming because at the tactical level there can be a lot of measurable data. Determining the right metrics is largely based on the operational and strategic metrics that exist to measure the organization's progress towards a stated vision.

Operational metrics exist to determine if the organization is achieving business goals and meeting customer requirements. For example, operational metrics might measure site budget execution, or perhaps might exist in the form of aggregated customer service satisfaction scores. The relationship between these operational metrics and tactical metrics does not need to be one-to-one but should relate and roll-up when appropriate. For example, a metric measuring budget execution at the site level does not need a correlating tactical-level metric for the budget of each team. A correct implementation might have a tactical metric measuring the overtime budgets for each team, and the thresholds for those metrics are such that when tactical overtime is 'red,' or unhealthy, then this information would feed into the site level budget execution metric at the operational level might either directly or indirectly so that lower level performance influences operational level reporting.

Strategic metrics measure the highest level of performance, and provide quantitative indicatorsthat the organization is (or is not) meeting strategic goals. Strategy is a concept that determines and reveals an organization's objectives, produces the principle policies and plans for achieving these objectives, defines the operational range of activities that the organization will pursue and structures the nature of the economic and non-economic contributions the organization intends to make to stakeholders. An organization is likely to only have two or three strategic metrics, and once again these metrics should be related to the operational metric set.



This is work that a cost analyst cannot do alone -- creating high-quality metrics is not a simple process without involvement from multiple organizational levels. However, a cost analyst is well-positioned to understand the operational and tactical levels which are very related to management and performance of cost and personnel resources. For reference, "good" metrics have the following characteristics:

- Focused on business results OR performance drivers
- Clearly link to operational health
- Simple, easy to understand
- Limited to critical few
- Supportable by existing objective data
- Align strategic, operational, and tactical goals/objectives

Ultimately, the cost analyst's goal for the metric set is to establish level-appropriate management focus to measure and improve organizational health.

Potential Measurements / KPIs

After addressing why, when, and where, discussing how to do operational analysis is the next point. What are the Key Performance Indicators (KPIs), measurements and metrics? Is it true that daily tasks have quality, timeliness and risk components that affect cost and are measurable through metrics?

COST-SPECIFIC METRICS

Cost metrics provide information on financial resource usage in an agency and its divisions. This grouping aims to answer questions related to efficient execution of funds and determines whether value has been created for each dollar in the budget. Managers and executives need to make trade-off decisions between using overtime, limiting leave and absences, reallocating staff, and reallocating funding. Metrics here can also relate to financial performance – is the organization meeting its reduction targets? All decisions have cost implications, and metrics that measure cost directly can and should be correlated with quality, timeliness, workload management, risk, and other families. Primary, secondary, and tertiary relationships will always exist between measurements. For example, for each point increase in quality, there will be an associated increase in cost that will be reflected in metrics related to overtime, capital spending, or cost-spending trends.

An index of metrics should also be designed to favorably rank an organization when its goals are met. These will vary by organization. As an example, the Defense Working Capital Fund aims to operate like a commercial business. As such, in a healthy agency, overtime will be minimized. Costs for recurring functions will be smoothly executed over time, with some exceptions for surge periods. An optimal mix of labor and non-labor resources will be used, budgets will be executed at or below target, and budgets will be driven through standards of productivity as opposed to organizational status quo or division size. When these criteria are met, the index will rank cost favorably. In an unhealthy agency, cost for recurring functions will not be executed in a stable fashion over time. Overtime peaks and valleys will be prevalent, budgets will be over-executed, labor and non-labor will be imbalanced, and budgets will be set through assumptions as opposed to hard standards. When these characteristics are displayed, the index will rank cost unfavorably and managers should be prepared to address problems reflected in cost by changing driving elements of the business.

MANPOWER METRICS RELATING TO COST

Manpower metrics provide information on human capital usage and characteristics in an agency and its divisions. The index aims to answer questions related to efficient staff utilization, qualities and characteristics of employees, and supports determining whether an agency has taken the right steps to obtain an indispensable, qualified workforce capable of producing at the levels identified in the parallel quality and productivity indices. The parallel cost index also reflects the expense of this manpower level, illustrating that the various perspectives of business are inter-related and reflected in data. The types of metrics that can be developed in the index will help managers and executives make trade-off decisions between providing additional training to staff, spending on systems improvements, process changes, or investing in a more mature staff with more years experience. Additionally, the index will inform managers about the degree of supervision required as learning curve positions can be assessed.

An index of metrics should be designed to favorably rank an organization when its goals are met. These will vary by organization. As an example, the Defense Working Capital Fund aims to operate like a commercial business. As such, in a healthy agency, manpower will have sufficient experience to deliver work to degrees of quality, timeliness, and productivity. Staff turnover will be low; cross-training, employee development, and similar programs will be in place and effective. In turn, employees will be satisfied with their jobs, challenged, and consider the agency an employer of choice. Sourcing and staffing will be rapidly handled, and positions will be flexible/cross-trained so that multi-division supportability is possible. When these criteria are met, the index will rank manpower favorably. In an unhealthy agency, manpower will be unevenly distributed or improperly allocated across divisions. The level of available, experienced staff will be limited; training will be unavailable, insufficient, or otherwise not taken. Both internal and external turnover and attrition rates will be high, employee satisfaction surveys will return low scores, and open positions will not be sourced or staffed expediently. When these characteristics are displayed, the index will rank manpower unfavorably.

QUALITY METRICS RELATING TO COST

Quality metrics specifically measure the accuracy and defect rate of the work being performed. Quality measurements can also measure the amount of re-work that an organization has to perform because re-work is typically the result of an error somewhere in the process. The cost analyst should be keen to identify and measure quality metrics because of the direct impact that quality has on the cost of an activity. Key organizational measurements regarding cost per unit are directly affected by quality; if organizational performance falls below quality standards, then the number of acceptable units produced using the available resources falls and will directly cause an increase in cost per unit.

When grouped into an index, quality metrics inform leadership as to how well the work is being performed. In a sense, the quality metric is a perfect compliment to workload, productivity and schedule indices because together the four describe how much, how efficiently, how quickly and how accurately a unit of work is being performed. Essentially all types of work can be broken down into these four major categories an analyzed in a quantitative fashion.

WORKLOAD MANAGEMENT METRICS RELATING TO COST

The workload management index measures the amount of work that needs to be performed and the volume of work that is being performed across the organization. This index of measurements is easy to confuse with productivity, except that in this case, workload management almost never exists on a per-person basis but rather attempts to measure large-scale volumes of work.

An example of workload management is a metric measuring the number of work units that need to be performed in a given time period to meet customer demand. It may refer to number of invoices that need to be processed, number of images a satellite system needs to process, the number of accounting journal vouchers to create, or the number of missiles that need to be manufactured before the end of the month. Also, metrics in this index might measure the actual total volume of work performed. Other metrics may provide ratios of work performed to work on hand, in hopes that the ratio is always close to 1:1 (meaning that if staff can consistently perform the amount of work that needs to be done, then there are not periods where staff are under-leveraged and causing a higher cost per unit situation to occur).

A perfect complement to the workload management index is the productivity index, which provides more discrete and personal measurements.

PRODUCTIVITY METRICS RELATING TO COST

Productivity metrics provide information on production efficiency for given units of input (people, systems, facilities, dollars) in an agency and its divisions. The index aims to answer questions related to efficient production by staff, per hour, through systems, and at sites, and determines whether an organization is getting the most output from each unit of input. The metrics in this index will help managers and executives make trade-off decisions between taking steps to improve productivity through training, process improvements, additional supervision, redefinition of standards, etc., and applying efforts to other components of the business if productivity levels are deemed sufficient. Additionally, the index will inform managers about the degree of supervision required as learning curve positions can be assessed. Productivity is a direct function of quality, process inputs, and process requirements. There are moderators and catalysts of productivity. Metrics used to measure productivity will always be positively correlated with cost savings – the more productive, the less money spent.

An index of metrics should also be designed to favorably rank an organization when its goals are met. These will vary by organization. As an example, the Defense Working Capital Fund aims to operate like a commercial business. As such, in a healthy agency, productivity will be high or increasing – as a measure of efficiency, the units of output produced per unit of input will continually increase until a maximum level of production is reached. Standards will be set for units produced per employee, per hour, per system, etc., but demand will be what determines success in conjunction with the volume standard. Inputs (employees, hours, systems) will be available and applied in the manner that makes the most economic sense considering tangible and intangible benefits and costs. A realistic standard will be established and maintained for the amount of time an employee should be working (available hours). When these criteria are met, the productivity index will return favorably. In an unhealthy agency, productivity will be low or decreasing – as a measure of efficiency, the units of output produced per unit of input will not increase, remain stagnant, or otherwise cease to approach a maximum level. Standards for production may not be set or enforced, demand and driving production factors may not be tracked. Inputs will be frequently unavailable (employee absenteeism or slack time, system downtime, etc), and as a result will be a cost burden on the agency. Standards for available hours per person may be insufficiently set or not enforced. When these conditions are present, the index will rank productivity unfavorably.

SCHEDULE METRICS RELATING TO COST

Schedule metrics provide information on whether outputs and products are produced against the right time standard. Metrics in this index reflect the relative speed at which all the units in the process can work together, and this speed will ultimately determine the cost of the process since time and cost are closely related. Producing 30 units per day on the same machine will cost less per unit since overhead and some direct labor may be lower than producing 5 per day under the same conditions. Schedule metrics also frequently reflect service level objectives that organizations establish with their customers…e.g. "Once we've received your request, we will complete the work within 10 business days or pay a 2% interest penalty."

An index of metrics should be designed to favorably rank an organization when its goals are met. These will vary by organization. For example, the Defense Information Systems Agency relies on short turnaround times for maintenance activities and other events that cause downtime. As such, in a healthy agency, schedule and cycle times will be as low as possible or decreasing – turnaround times will be as short as possible while maintaining a given standard of quality, level of staff, currency of systems and processes, etc. Standards will be set for turnaround times within processes based on service level objectives, productivity standards, and fixed cost targets. When these criteria are met, the schedule index will return favorably. In an unhealthy agency, schedule and cycle times will be high or increasing – increased turnaround time will reflect inefficiency or problematic processes in staff, systems, machines, etc. Standards for production may not be set or enforced, process improvement exercises should be undertaken. When these conditions are present, the index will rank schedule and cycle time unfavorably.

Examples of schedule metrics may be the turnaround time for service requests measured in hours, the % of requests performed within a certain timeframe, or perhaps the median wait time for a customer service call.

RISK METRICS RELATING TO COST

Operational risk is the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. These risks are inherently a key component of a cost analyst's evaluation criteria. Operational risks are caused by activities that occur within the organization's daily business functions and extend to areas of physical, environmental, legal, or procedural risk that may have a negative effect on operations. These operational risks are primarily caused by failed internal processes, inexperienced or untrained personnel, issues related to IT systems, or from external events that are beyond the control of leadership within the operations branch. The goal of the operational risk identification process is to forecast potential problems so that the organization can establish safeguards to protect against systemic failure of critical processes. This metric subset aims to provide leadership the information needed to take the steps necessary to mitigate the cost effects of risks. In many cases, risks are either external to the organization, but can still be mitigated by intelligently allocating personnel, adapting processes, or through other proactive means.

Risk metrics function as leading indicators, meaning that risks metrics are meant to precede other operational metrics and influence or help predict the performance of those other metrics. Just like in other areas of risk management, an operational risk by definition has less than 100% chance of occurrence. If and when the risk does occur, risk analysts begin referring to it as a problem. These problems, or risks which have transpired, act as the first domino in a series of negative impacts across the organization's health. For example, unexpected system downtime is always present as a risk, but once a primary operational system goes offline during normal business hours, leadership can expect productivity and timeliness metrics immediately begin to trend downwards. Sometimes the lead is even greater, like when the organization sees a rise in the number of defective inputs provided by suppliers. Typically this causes re-work as staff are forced to spend more time sorting good and bad inputs and sending back the bad inputs. The rest of the team may be able to surge to meet the additional workload but eventually quality, timeliness and productivity will suffer.

Similar to KPIs, these risks are primarily informed by Key Risk Indicators (KRI), which are measures used to indicate how risky an activity is. KRIs give the operational manager an early warning to identify potential events that may harm continuity of the activity/project. The scope is not limited to a single branch of the organization but extends to all stakeholders in an attempt to determine the end-to-end impact of operational risks. KRIs should be quantifiable so that it is clear when the event has been triggered and should be reflected within the models graphics and displays.

Quantifying the risks is an important step in the development of KRIs. A KRI should have clearly defined thresholds that relate to specific dates, dollar amounts, personnel activities, or supply volumes. These thresholds are quantified so that it is clear to leadership when the risk is likely to start impacting other operations internal and external to the MA. Examples of quantification include Systems Downtime measured in minutes. Another is New Systems Implementation measured as a count of deployments within six months that directly affect the area in question.

Environment Specific Application

Several environments provide a good opportunity to apply the principles of metric creation and quantitative performance analysis. The first is a Working Capital Fund (fee-for-service style) agency that charges customers a fee for support. Examples include Defense Finance and Accounting Service (DFAS), Defense Logistics Agency (DLA), and the Defense Information Systems Agency (DISA) . In each case, the agency *modus operandi* should be to centralize around the idea of keeping costs to a minimum and efficiency to a maximum. Ultimately, these organizations should be managed like commercial businesses.

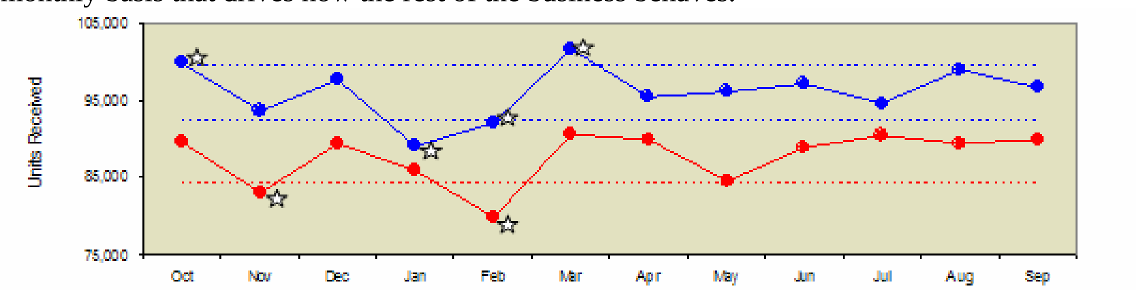
The other environment is comprised of any appropriated fund agency, most of which typically rely on an inadequate supply of operations funding to sustain their programs. This is a much more broad classification as it applies to all sorts of operations. It could refer to any agency program that is in sustainment mode, using appropriated funding to perform routine actions. An example might be a satellite operations program, a software sustainment organization, or perhaps a missile range. Each of these environments are similar because each relies on a stream of sustainment funding, and yet typically sustainment funding is not adequate —forcing difficult resource allocation decisions. The agency should focus on making the most of the limited resources Congress provides. The ability to better manage those resources by identifying the branches or teams that are not performing efficiently or could benefit from additional funding to solve quality or performance issues is critical to effective program stewardship.

Given that both parties should have motivations to control costs, maximize returns and remain competitive, it is clear that this process applies to both contractors and federal employees. Federal oversight organizations need to be able to allocate resources to address productivity gaps, while contractors focus on either maximizing profits or demonstrating better performance than a competitor can offer. And another benefit of measuring cost and performance is that it helps give leadership on both sides of the equation a clear look. Ideally, working together to improve metric performance allows both organizations can work together to create an environment of operational transparency

Decision Making: Metric Pairs and Artifacts

Using the oftentimes hundreds of metrics available in a fully-modeled business, relationships and conclusions can be drawn. For example, how much money must be spent to increase production by 30 units per month, per person, or per system? If the agency can predict the demand for services, what staffing level is appropriate given a productivity standard to remain within service level objectives? Many questions of this nature can be posed, many cost-estimating relationships (CERs), schedule-estimating relationships (SERs), and the like for independent/dependent variables can be created. A business model system is typically multi-dimensional, meaning that most variables and metrics can be viewed as dependent or independent given a specific context of analysis.

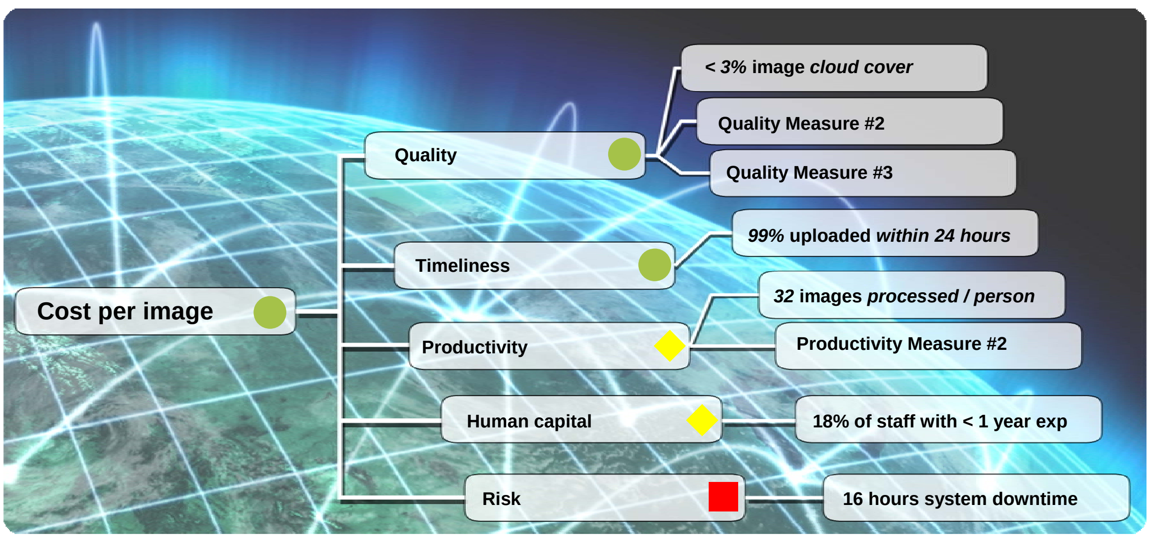
A business calendar or business cycle chart is a decision making tool that directly supports the decision-making process. The business cycle shows the fluctuations in the workload of an operational unit over time. One method is to create a line chart that is based on the primary workload driver of the business unit. The goal is to identify the primary input or activity on a monthly basis that drives how the rest of the business behaves.



Cyclical trends emerge, sometimes surprisingly. These trends show when a business is less busy, and therefore the cost per unit processed will be much higher unless the organization can offload processing personnel to training, vacation, or other divisions during low-activity months. For example, the number of invoices that a department has to process may spike near the end of each quarter as businesses scramble to meet revenue targets, and then fall at the beginning of the next quarter. What used to take 10 personnel to process 100,000 invoices will only need 7 people to process 70,000, and having all 10 on hand during a lull will dramatically increase the cost per invoice processed. Cost analysts who see the world in dollars and cents use this chart to determine when fixed costs are likely to negatively affect unit prices. Experienced leadership may not need a business cycle to manage personnel, but an inexperienced manager will certainly benefit from the cost support.

Another useful tool is an Impact Diagram, which is a way to relate metrics in the form of a decision tree. The tree-like structure of the Impact Diagram helps relate numerous metrics across different indices to show the effect on one Key Performance Indicator (KPI).

In the example below, a KPI for this organization is the cost per image. Many metrics directly and indirectly inform the cost of a satellite image, and as discussed in the Business Modeling – Application section, it is important to group metrics into indices that allow leadership to get a complete view of how accurately (quality), how quickly (timeliness), and how efficiently (productivity) operational work is being performed given the performance of the people on the job (human capital) and the obstacles facing them (risk). Each metric should have clearly defined thresholds, so that the cost analyst can objectively determine if metrics meet performance standards. In the example, baseline metrics in the Quality and Timeliness indices indicate that the team was able to gather images with less than 3% cloud cover and upload 99% of images within 24 hours. However, the 'yellow' rating for productivity indicates that the team was not quite able to process 32 images per person during the reporting period. The 'yellow' rating for the Human Capital index shows that the team was close but did not meet the experience threshold. Finally, the 'red' Risk index shows that the downtime metric was above 16 hours – something that was out of the team's control, but nonetheless had an adverse impact to operations.



In total, the Cost per Image KPI is 'green,' indicating that the team met or exceeded the performance standard despite having a low productivity, inexperienced personnel, and suffering risks. A key takeaway for the cost analyst is that future resources and budget recommendations should focus on projects that increase productivity, reduce personnel turnover, and most importantly improve system reliability by reducing downtime. While metrics can be assessed independently, an Impact Diagram helps provide the framework to improve the understanding of performance relationships.

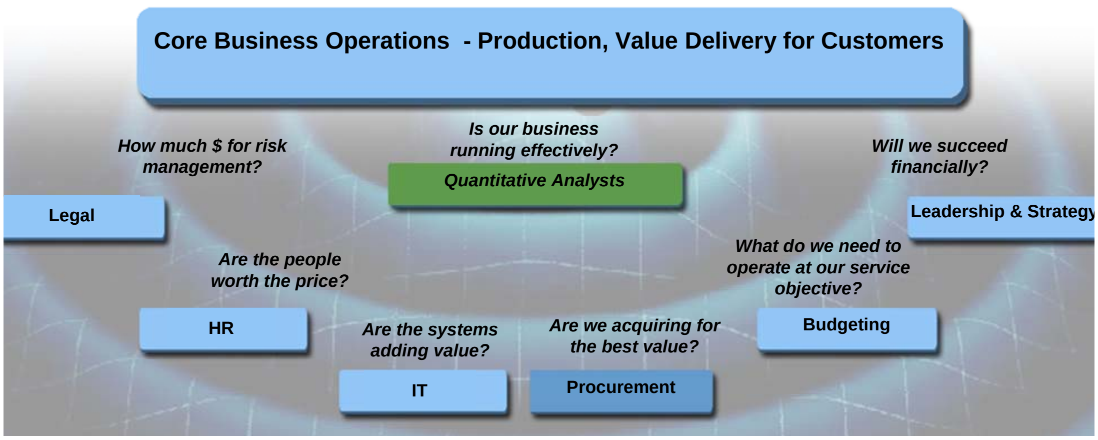
Another common tool is the metric pair. This is directly related to estimating relationships discussed at the beginning of this section. A good example is, how much does supplier failure result in increased cost? Here we have an example of a direct CER; a situation in which cost is being driven by another, quantifiable and parametrically predictable, element of the business. Two metrics were developed to track bad input to the process (reject rate – supplier error) and the monthly cost of operations.

Question	How much does supplier failure result in extra cost to the customer?							
Scenario	*Items are returned to suppliers due to incompleteness or error*							
Metrics	**Logic: Determine % of erroneous transactions imposed by suppliers**							
Reject Rate - Supplier Error *Monthly Cost of Operations*	***Example:***	Operating $ / Month	$1,000,000	Rejects (5,000) / Total Volume (100,000)	=5%	Operating $ * Reject Rate		=$50,000

Such examples can be drawn from any amount of metrics within the categories detailed in the Business Modeling – Application section.

Integration

The cost analyst serves as a logical integrator for many other organizations -- risk, scheduling, Lean6, and most importantly, leadership. Measuring the performance of a program across organizational barriers and not discriminating against the lifecycle phase allows leadership to manage in an environment of financial transparency, and behave in a proactive manner.



As these organizations struggle to work with one another, it is clear that cost analysts should have a greater role in the operations environment. Providing a context for these organizations to relate to one another is a critical role that a cost analyst can fulfill because of the inherently cost-related nature of program sustainment and resource management. Undoubtedly, measuring the fiscal efficiency of a program's activities opens a whole new set of analytical opportunities in today's environment of increasing accountability for spending. There is life beyond system acquisition!

Biographies

Andy Beck supports business modeling and quantitative management development as an Associate in the Booz Allen Hamilton Economic Business Analysis practice in Indianapolis, Indiana. He recently designed several quantitative management tools for the Defense Finance and Accounting Service (DFAS), including historical and cyclical operations models and multi-dimensional metrics. Mr. Beck is a Project Management Professional, a Certified Defense Financial Manager, and a Lean 6 Green Belt. He holds a Master's Degree in Finance from the Indiana University, a Bachelor's degree with an Engineering concentration from Purdue University, and speaks two foreign languages. He can be reached at beck_andrew@bah.com or 847.769.7345.

John Teal is an Associate with Booz Allen Hamilton in Columbus, Ohio and lately he has been focused on business modeling for the Defense Finance and Accounting Service (DFAS). Prior to this, his eight years of cost and finance experience centered on space and aircraft programs for the Air Force, intelligence agencies, DoD joint programs, and NASA. Additionally, from 2006 though 2009 years he served as the Program Chair for the Pikes Peak SCEA chapter. He has an MBA from Regis University and a Bachelor of Science degree from the United States Military Academy at West Point. Mr. Teal is a Certified Cost Estimator/Analyst (CCE/A) and a Project Management Professional (PMP). He can be reached at teal_john@bah.com or 719.661.9541.