THE METRICS REFERENCE MODEL:

The Metrics Reference Model gives organizations a valuable tool for building a holistic framework.

A JUMPSTART FOR BUSINESS INTELLIGENCE INITIATIVES

SHOBHIK CHAUDHURI, JOSEPH STAIER, SHIVA VERMA, JEFF LAWTON, AND JOHN MILLER

Performance measurement allows an organization to align human behavior and assess the effectiveness of any actions taken towards achieving its mission and goals through the strategy it selects. Metrics allow organizations to measure performance quantitatively and are used widely as the basic building blocks for all performance management frameworks.

Until business intelligence (BI) techniques became mainstream, organizations measured performance in relatively primitive ways (e.g., spreadsheet data entry, data calls) that were labor intensive, were often untimely, and frequently did not present the right information to the right people. BI provided best-practice-based approaches and technologies to collect, report, and analyze metrics in an automated manner to all levels of an organization.

Over the past decade, most organizations have started using holistic frame-works (e.g., Balanced Scorecards) that allow them to measure and examine all aspects of their business, rather than focusing on a limited set of business activities. Such frameworks require an organization to first determine what the "right" set of metrics is to measure a business outcome effectively, and then to understand how these metrics relate to each other. Otherwise, actions taken to improve metrics in certain areas could have unanticipated or overlooked effects on other metrics.

CAM-I is a consortium of manufacturing and service companies, government organizations, consultancies, and academic and professional bodies that have elected to work cooperatively

SHOBHIK CHAUDHURI, JOSEPH STAIER, SHIVA VERMA, JEFF LAWTON, *and* JOHN MILLER *are members of the BI Working Group of CAM-I, a consortium of manufacturing and service companies, government organizations, consultancies, and academic and professional bodies who work to solve management problems and critical business issues. For further information, contact Ashok Vadgama at a shok@cam-i.org.*

to solve management problems and critical business issues that are common to the group. The BI Working Group of CAM-I was formed to explore the relationships between cost, process, and performance management, which are considered by CAM-I to be the three pillars of management disciplines for organizations. As a result, the BI Working Group created the Metrics Reference Model (MRM) to allow organizations to jumpstart the building of these frameworks. The MRM does this by providing a listing of metrics common across most industries and categorized by business areas typical for most organizations. The MRM defines each metric; describes its inherent strengths, weaknesses, and opportunities; and provides target-setting guidance. For each metric, the MRM also identifies the nature (i.e., positively or negatively correlated) and relative strength (i.e., weak, moderate, or strong impact) of its relationship to other metrics. Thus, the MRM provides organizations with a valuable tool for building a holistic framework because it helps them determine the "right" set of metrics to measure a business outcome effectively and to understand how those metrics relate to each other.

To best understand the usefulness of the MRM, it is important first to understand the role of BI in effective performance management.

BI defined

Electronic data have proliferated since the start of the Computer Age. Over the years, organizations have used an increasing number of systems to automate their business processes. These systems have been successful in their primary mission, but they are very often stove-piped, minimally interconnected, and contain data of questionable quality. It is true that organizations have come to realize the data can be leveraged for increased revenues, process efficiency, performance improvement, cost management, and improved customer interaction.

However, turning these data into timely, accurate, and relevant information (e.g., metrics) for business management has been challenging.

Many companies and governments have turned to BI to leverage the value of data and to stay ahead of the curve. Information for trend analysis is a particularly valued output of BI applications. For example, organizations want this information in order to react early when a line of business is underperforming. BI-derived knowledge then helps executives understand the reasons for that performance and how it may be improved. Some organizations apply BI to enhance customer loyalty, while others use it for risk management.

BI has many definitions throughout industry—CAM-I's definition of BI is *a set of strategies, processes, technologies, and tools that integrate data and transform it into useful information that helps the organization understand its past and shape its future performance.* This knowledge can be used at all levels of the organization to make informed decisions to achieve organizational objectives and influence its future. Some common uses of BI include fraud detection, risk management, insurance claim analysis, direct marketing, market basket analysis, inventory logistics, profiling, monitoring performance, predicting opportunities, updating business models, and executing new business processes.

BI is not simply a technology, tool, or methodology used to perform queries and reports and implemented in isolation by the information technology support team. Rather, a mature BI environment will have multiple elements working together:

- It will have a *business culture* that supports transparency, openness, and a willingness to share data. Information is treated as a corporate asset and a willingness to treat it as such stretches to all levels of the organization.
- It will have *technology and infrastructure* to integrate data across the enterprise and distribute it to its users. At the core is an enter-

Exhibit 1 CAM-I's Organizational Structure Taxonomy.
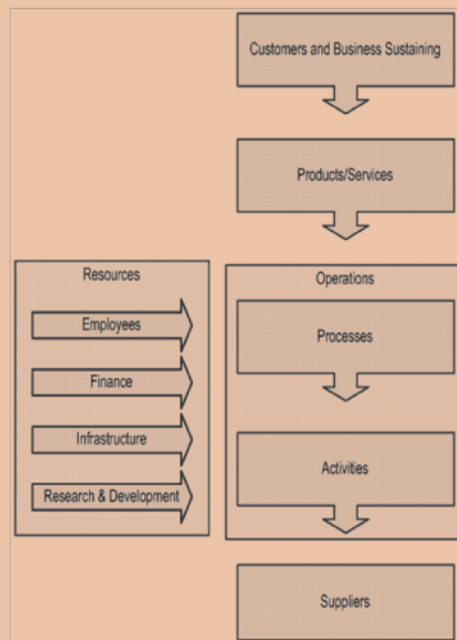
prise data warehouse and/or departmental data marts that standardize, cleanse, and centralize corporate data. Data are distributed from the warehouse and marts through feature-rich analytical reporting tools to users at all levels that facilitate the exploration of that data. A robust metadata capability exists to describe the data in these data stores, and a governance model exists to manage that data.

- It will have *human capital* components that can best use the products of a BI environment. Information users are skilled in using not only the supporting tools, but also know how to use data to drive decision-making. These positions are recognized by the organization as valuable, with supported career paths and workforce strategies (e.g., recruitment, retention).
- Lastly, it will have supporting *internal business processes*. Policies, procedures, and guidelines for the sharing and use of data across com-

ponents of the organization exist. A data management strategy describes how each component will support acceptable uses of data and information.

Thus, one can see how BI aids the development, operation, and sustainment of an effective performance management process by converting the right data into the right information, delivered at the right time. Although a BI environment can be developed for performance management without the MRM, the MRM facilitates the development of a new BI program and the continuous improvement of an existing BI program. In addition, it provides focus on the information that is critical for understanding an organization's performance.

The MRM

Reference models provide an abstract view of an environment (e.g., business process, technology, data) by providing an inventory of the environment's components, functions, and relationships. Thus, reference models provide a foundation upon which solutions to a prob-

Exhibit 2 A Performance, Cost, and Process Metric from the Customer Component of the MRM.

Cost, Performance, or Process	Type	Metric	Definition/ Calculation	Strengths/ Opportunities	Weaknesses/ Problems/ Risks	Target Setting
Performance	Customer/ Consumer satisfaction	Average customer review	Average customer rating	Easy to capture via consumer surveys	Satisfaction is a subjective measure Response rates to surveys tend to be very low Extreme opinions tend to dominate surveys, as they are the most motivated to respond	Usually want to be high
Process	Customer/ Consumer satisfaction	Resolution rate	Percentage of customer issues favorably resolved (Tier 1)	Proxy for customer satisfaction Resolution in Tier 1 is cheaper	May be hard to measure in certain cases Subjectivity in favorable resolution	High
Cost	Customer/ Consumer satisfaction	Return rate due to defect or trial	Percentage of return/rework vs. sale	Quality measure (may not apply to all products)	Difficult to differentiate	Generally low

Exhibit 3 A Performance, Cost, and Process Metric from the Employee Component of the MRM.

Cost, Performance, or Process	Type	Metric	Definition/ Calculation	Strengths/ Opportunities	Weaknesses/ Problems/ Risks	Target Setting
Performance	Retention	Average turnover rate	No. of employees departing/no. of employees total	Easy to capture Easy to understand	High cost of retention (leaves of absence, etc.)	0% not necessarily good depending on job role
Cost	Recruiting	Average fully burdened cost per hire	Average variable cost per hire + average recruiter and interviewer hours spent (* their hourly salary) per hire	Allow comparison with retention costs	Full costs vs. variable costs Difficult to calculate Lowering this would give incentive for turnover (increase volume to lower average cost)	Usually want to be low
Process	Recruiting	Ratio of interviews to the number of open positions	Candidates who actually come in for an interview for a single position	Indicates strength of advertising/job description precision May indicate speed of response effectiveness	No distinguishing between our choice of interviewees and their choice to continue pursuit Do not know how to set a decent target goal for this High values might mean higher costs	Looking for a number less than 1 to take action (depends on value of above measure)

lem found within that environment can be architected.

For example, a technology reference model might list all the computer hardware and software that is needed by any typical organization to operate, including components such as accounting systems, e-mail systems, payroll systems, and personal computers. Each component is described in terms of its capabilities, and any relationships between them are documented. As such, reference models can be useful tools for education, communication, and standardization. For example, the US government's *Federal Enterprise Architecture* consists of five interrelated reference models designed to facilitate cross-agency analysis and to identify duplicative investments, gaps, and opportunities for collaboration within and across agencies.

The MRM[1] is a reference model that inventories performance metrics and their relationships to each other. The MRM provides a common structure of performance, process, and cost measures and metrics (as of this publication, nearly 150 have been identified) defined generically such that they can be used by most organizations, be they public, private, or nonprofit. The MRM defines each metric, discusses its individual strengths and weaknesses in

everyday use, offers guidance on target setting, and—most importantly—identifies the strength (i.e., strong, moderate, or weak) and nature (i.e., positively or negatively correlated) of relationships between the measures and metrics.

There are many taxonomies of organizational structure. Furthermore, each organization likely will exhibit unique variances that could frustrate any attempt to categorize it with others. To avoid these issues and to provide a generic, easy-to-apply foundation from which to build the MRM, the BI Working Group elected to use CAM-I's definition of the basic components of any organization. As depicted in Exhibit 1, the basic components needed for an organization to achieve its mission include a customer, a product and/or service, an employee, operations (e.g., processes, activities), finance, research and development, a supplier, and infrastructure. Although alternative categorization strategies may exist that are considered more comprehensive, the use of components in the MRM is just a means to organize metrics into logical groupings, and any additional resolution would not affect the final product.

For each component, the BI Working Group developed a list of metrics that could be used to describe the performance of that component. An exception is the Operations component; the group determined that metrics in this component are so diverse that only very generic metrics (i.e., efficiency, effectiveness, and cost) are universal in nature. Thus, MRM users will need to customize Operations metrics to their own organization. For the other components, metrics were identified, qualified, and described based on experiences of the BI Working Group members that represent a variety of organization types, research, and an academic review. Each metric was documented with the following attributes:

- *Cost, Performance, or Process.* CAM-I believes that cost, process, and performance management disciplines are linked inexorably and

that all three need to be managed in an integrated manner to achieve optimal operational maturity. To facilitate the MRM's use within CAM-I, this attribute allows the classification of a metric by the discipline it best supports.

- *Type.* Natural, logical groupings of metrics within a component that tend to have the closest relationships with each other. For example, the Customer component has customer satisfaction (e.g., how do customers feel about our organization?) and financial (e.g., how much money do our customer make us?) types of metrics.

- *Metric.* This is the name of the metric. The BI Working Group defines a measure as a single data point, such as a temperature reading. A metric is the calculation or comparison of two or more measures. For example, four temperature readings taken over time would be a metric that described falling or rising temperature. Additionally, one temperature reading could be combined with wind speed to determine the wind chill index metric or combined with humidity to determine the heat index metric. Although there can be many names for the metrics listed, the BI Working Group strived to select the name most commonly used in industry.

- *Definition/Calculation.* If a metric is calculated or derived using a formula or from a particular approach, that formula or approach is described.

- *Strengths/Opportunities.* Where a metric is recognized as having a particular strength or opportunity in its application, use, or interpretation, it is recorded here.

- *Weaknesses/Problems/Risks.* Where a metric is recognized as having a particular weakness, problem, or risk in its application, use, or interpretation, it is recorded here.

- *Target Setting.* Provides guidance on how targets can be set or the desired

MRM USERS WILL NEED TO CUSTOMIZE OPERATIONS METRICS TO THEIR OWN ORGANIZATION.

Exhibit 4 Relationship Matrix.

		Customer			Employee		
		Average Customer Review	Return Rate Due to Defect or Trial	Resolution Rate	Average Turnover Rate	Ratio of Interviews to the Number of Open Positions	Average Fully Burdened Cost Per Hire
Customer	Average customer review	■	M-	M+	W	W	W
	Return Rate due to defect or trial	M-	■	M	W	W	W
	Resolution rate	M+	M	■	W	W	W
Employee	Average turnover rate	W	W	W	■	W	W
	Ratio of interviews to the number of open positions	W	W	W	W	■	W
	Average fully burdened cost per hire	W	W	W	W	W	■

Strength: (S)trong, (M)oderate, (W)eak | Nature: (+) Positively correlated, (-) Negatively correlated

direction of movement—if such guidance is considered universal across most types of organizations under typical business conditions.

As an example, Exhibit 2 is an excerpt of a performance, cost, and process metric from the Customer component of the MRM.

As another example, Exhibit 3 is an excerpt of a performance, cost, and process metric from the Employee component of the MRM.

The process by which each of the metrics' attributes was developed involved a significant level of discussion among the BI Working Group members that is beyond the scope of this article. Rather, the intention of the BI Working Group is that members of any organization that wishes to adopt or use the MRM will use the information in these tables to guide their own discussions that are relevant to the unique context of their organization.

The Relationship Matrix component of the MRM is a table with all of the metrics listed as row and column headers. The intersecting cell of any two metrics contains nomenclature that identifies the nature (i.e., positively or negatively correlated) and the strength (i.e., strong, moderate, or weak) of the relationship between those two metrics. The Relationship Matrix thus allows fully-informed actions to be taken by MRM users on decisions regarding the mix of metrics selected for any performance measurement initiative (i.e., what the "right" set of metrics is to measure a business outcome effectively). The Relationship Matrix also allows the MRM user to take a broader view of any actions taken to effect a change in one metric by showing which metrics may also be impacted by the change (i.e., understand how the metrics relate to each other).

Using the same metrics in Exhibits 2 and 3, an excerpt of the Relationship Matrix is provided (Exhibit 4). For example, an MRM user performing an analysis of customer satisfaction is using only the Average Customer Review metric. A review of the Relationship Matrix reveals that the Resolution Rate metric has an M+ relationship to the Average Customer Review metric, meaning that there is a moderate relationship between the two and that an increase in one metric's value likely would see a corresponding increase in the other metric's value. This knowledge may influence the user to incorporate the Resolution Rate metric into the analysis. Conversely, had the Average Fully Burdened Cost Per Hire metric been considered for inclusion in the same study, the MRM user, after

consulting the Relationship Matrix, would see that the Average Fully Burdened Cost Per Hire metric has only weak relationships with the Customer metrics (i.e., sees a W in all of the intersecting cells of the matrix), and thus is of little relevance to the analysis. The user may be influenced to remove the Average Fully Burdened Cost Per Hire metric from the analysis as a result.

Suggested use of the MRM

The MRM is not a replacement for performance management frameworks. Rather, it is a complementary tool for developing them by translating management vision into an appropriate set of metrics. For example, the near ubiquitous Balanced Scorecard is a performance measurement framework that evolved from narrowly focused financial metrics by adding additional metrics to evaluate customer, internal process, and learning processes to give managers a more balanced view of organizational performance. Thus, as a tool, even an organization with an existing Balanced Scorecard could benefit from using the MRM. The organization could cross-reference its existing metrics to the MRM to determine whether additional metrics should be added to the Balanced Scorecard to improve its ability to assess overall performance.

For organizations just starting to develop a Balanced Scorecard from a strategy map, the organization could benefit by using the MRM to determine which metrics to use and validate their selection using the Relationship Matrix. In this particular scenario, a standard-use case would include these steps:

1. Develop the vision, objectives, and strategy for the organization
2. Determine what actions are to be taken to achieve strategic goals
3. Define metrics to define progress towards those objectives using the MRM as a reference
4. Review the characteristics of the metrics in the MRM (e.g., strengths, weaknesses)

5. Choose appropriate metrics based on strategy and organizational priority
6. Use the Relationship Matrix to validate the selected metrics, adding or removing metrics as appropriate

For example, if an organization was responding to a business challenge to increase subscriptions to a printed journal by 10 percent, it might review the metrics contained in the Customer, Product and Service, Finance, and Supplier components of the MRM. From there, it might choose this portfolio of metrics from the MRM and confirm them using the Relationship Matrix:

- Customer: Average customer review, customer retention rate, order frequency, average customer lifetime value, cost of customer acquisition, response time
- Product and Service: Market share, sales rank, acquisition costs, total sales, sales growth versus market growth
- Operations: Print quality, cost per copy, content management, defect rate
- Finance: Total operating expenses, profit margin, return on assets, fixed asset turnover
- Supplier: Average inventory, surge capacity, order fill rate, defect rate, cycle time, purchase delivery

ORGANIZATIONS TODAY SHOULD BE ABLE TO ANSWER BASIC QUESTIONS ABOUT THEIR COST, PROCESSES, AND PERFORMANCE.

Conclusion

Organizations today should be able to answer basic questions about their cost, processes, and performance. The use of BI provides automated, reliable means of answering these questions. Yet BI systems need to be architected to accommodate the unique facets of an organization. Rather than reinventing the "metrics wheel" each time, the MRM can be used as a tool to accelerate the process by which metrics are selected and validated as opportunities arise, goals change, or strategies evolve. For organizations with mature BI systems, the MRM can be used to validate and optimize their existing selection of metrics. In addition, it allows organiza-

tions to evaluate fully how the impact of actions taken to influence the performance of a particular metric may affect other metrics.

The BI Working Group expects to complete the MRM in the fourth quarter of 2010. Under development now is the Relationship Matrix, which, at the time of printing this article, is approximately 70 percent complete. Following its completion will be a review by recognized academics in the BI industry and performance management experts, subsequent integration of comments, and a search for a candidate on which to apply the MRM as a prototype. Upon completion, access to the MRM and its materials will be available through CAM-I.[2] ■

NOTES

[1] http://en.wikipedia.org/wiki/Metrics_Reference_Model (accessed)
[2] Interested readers should contact Ashok Vadgama at ashok@cam-i.org