PERFORMANCE METRICS

The Levers for Process Management

DUKE OKES

Performance Metrics

The Levers for Process Management

Duke Okes

Okes, Duke, 1949–

Performance metrics : the levers for process management

Includes bibliographical references and index.

Cover design by David Walker Designs - davidwalkerdesigns.com

To Liesa Jo Jenkins, a leader extraordinaire

Contents

List of Figures and Tables . . . . . *ix*

Preface . . . . . *xi*

Acknowledgments . . . . . *xv*

Chapter 1 Process Management **1**

Process Thinking 3
Business Process Models 8
The Role of Metrics 11
Conducting a SIPOC Analysis 12
Organizational Hierarchies 16

Chapter 2 Types and Functions of Metrics **19**

Chapter 3 Selecting the Right Metrics **29**

Reviewing Selected Metrics 36
Summary of Metrics Selection 39
Considerations for Unique Situations . . . 40

Chapter 4 Detailing Each Metric **45**

Process Owner 46
Stakeholders 46
Operational Definition 46
Formula, Normalization, and Precision . . 47

Baseline, Target, and Benchmark. 48
Source of Data and Frequency for Collecting. 49
Security/Access 49
Responsibilities and Frequencies for Analyzing and Reporting 50
Date for Next Review. 50
Detailing Ad hoc Metrics. 52
Aggregate/Composite Metrics 52

Chapter 5 Presenting and Using the Data 55

Data Presentation 55
Types of Information Displays. 57
Impact of Type, Scaling, and Time Span 58
Where to Present Metrics. 60
Dashboard/Scorecards 61
Making Decisions and Taking Action . . . 61

Chapter 6 Psychological Impact of Metrics. 65

Common Problems with Metrics 66
Games People Play 68
Responses to Changes in Metrics 69
Avoiding Problems with Metrics 70

Chapter 7 Maintaining the Metrics 73

The Metrics Life Cycle 73
The Supporting Infrastructure 76
Improving Process Management 78

Appendix A Basic Measurement Theory. 83
Appendix B Statistical Control Limits 87
Appendix C Example Metrics 91

References and Recommended Reading 99
Index 103

List of Figures and Tables

Figure 1.1 Shewhart's PDCA model 2
Figure 1.2 Fundamental view of a process. 3
Figure 1.3 Generic SIPOC diagram 4
Table 1.1 Examples of SIPOC components for various industries 5
Figure 1.4 Additional SIPOC elements 7
Figure 1.5 Baldrige Award model 8
Figure 1.6 High-level business process map 10
Figure 1.7 SIPOC analysis 14
Figure 1.8 SIPOC analysis (next level) 15
Figure 1.9 Levels of process 17
Table 2.1 Parallels of types of metrics 24
Figure 2.1 Leading and lagging metrics in a hotel laundry process (horizontal view) 24
Figure 2.2 Leading and lagging metrics in the laundry process (vertical view). 25
Figure 2.3 Outcomes and controls in the laundry process 26
Figure 3.1 Organizational strategy development and implementation 30
Table 3.1 How strategy drives metrics 34
Figure 3.2 Checking for gaps, misalignment, and conflict 36

Figure 3.3 Matrix method (with conflict identified) 37
Figure 3.4 Diagram method (with some potential gaps identified) 38
Figure 3.5 Differences in cycle time 41
Figure 3.6 Audit effectiveness ratio 44
Table 4.1 Metrics worksheet. 51
Figure 5.1 Impact of type, scaling, and time span 59
Figure 5.2 Example scorecard 61
Table 6.1 Comparing metrics 67
Figure 7.1 The growth/maturity curve 74
Table 7.1 Process management maturity matrix. 79
Figure A.1 Measurement error 84
Figure B.1 Analyzing variation in a process. 87
Table C.1 Example metrics 91

Preface

For someone steeped in the discipline of business performance management, it's always frustrating to have someone ask, "Which performance measures should I use?" The obvious answer is that it depends on what you want to achieve, which someone else should never define for you. After all, it is your organization, your department, or your process.

Once you're clear about what you want to accomplish, how do you sort through a variety of possible metrics and decide which are best? Then, given the list of metrics you believe are useful or necessary, how do you define them in more detail to ensure that the right data are gathered at the appropriate frequency and that the resulting information gets to the right people so that they can make proper decisions?

In my opinion, one of the worst things you can do is to copy the metrics being used by other organizations, whether it's your competitors, benchmark organizations, or someone you highly respect. Every highly effective organization is unique in some strategic way, and the metrics used should reflect these differences. That isn't to say that studying high performers can't be useful from a learning standpoint, but simply adopting what someone else is doing is likely to take you off your track and put you on theirs. If you're on the same track, competition is

much more difficult than if you've each carved out a specific track that is a solid match to your unique competencies.

Note that this book is *not* about setting strategy, setting goals, developing action plans, or managing continuous improvement. Those are key components for creating and managing business success, but our intent is to focus on making sure that the metrics selected will guide people and processes in the direction the organization wants to go, and allow continual evaluation of success.

The book is organized as follows. Chapter 1 looks at process management, which is the foundation concept on which performance management is based. It includes the ability to see an organization or any part of it as a system designed to satisfy the needs of the external environment. The ability to see each part of the organization as a system of interacting processes, and to drill down or step back to gain different perspectives, is necessary for fully understanding the linkages and trade-offs required.

Chapter 2 covers the different types of metrics that can be used and how their functions differ according to why the metric has been selected and who will use it for decision making. Chapter 3 provides the thinking process for selecting the right metrics, which requires understanding both horizontal and vertical alignment of processes and determining whether there are significant gaps, misalignments, or conflicts between metrics.

Chapter 4 discusses defining the details for each metric so that the intent is clear and the necessary data are gathered from a reliable source and appropriately processed to allow equivalent comparisons. Chapter 5 covers ways to present and use the data so that decision making is neither overly complicated nor unintentionally or intentionally biased.

Chapter 6 discusses an often overlooked factor, the psychological impacts of metrics. While performance measurement is necessary, considerable stress can (and usually will) be created

by the mere presence of metrics. Metrics need to be maintained in an organization over time, and thus Chapter 7 looks at the concept of how a metrics life cycle can be used to evaluate the continual relevance of each metric, as well as the supporting infrastructure needed for metrics management. The chapter concludes with the section "Improving Process Management."

Three appendixes are also provided. Appendix A is an introduction to measurement theory, which might be useful information for those who have never been involved in a formal measurement process. Appendix B is a brief discussion of statistical control limits that can be used to help analyze data in a probabilistic way, which improves the chances of correct interpretation. Appendix C is a list of some example metrics used within various industries.

Note that this book is designed to cover the fundamentals of performance metrics, rather than the complex details of presentation and analysis possible in today's highly computerized businesses. The topics of information dashboards, predictive analytics, business intelligence, and business process management systems have been well covered by others, and references are provided for these in "References and Recommended Reading."

I compiled much of the information in this book when I was working with a volunteer organization, but then converted it to a training course conducted for numerous organizations. I believe the value has been that of providing a clarifying perspective for those who know that metrics need to be developed but are unsure as to the steps to follow in developing and deploying them. I hope you'll find likewise.

Acknowledgments

I would like to thank those who helped create this work. Northeast State Community College provided me with the electronics knowledge that underlies much of my measurement thinking, and TRW Automotive provided me with many years of practice. For my clients who allowed me to transfer the concepts into measuring business processes, I hope you gained as much knowledge as I did from the experience.

After multiple experiences working with ASQ's Quality Press, I can say only that it's been a pleasure. They are extremely easy to work with. Thank you, Matt Meinholz and Paul O'Mara. Thanks also to the staff at Kinetic Publishing Services, LLC. And, of course, no writer gets such work done without the understanding of family members, who lose countless hours while we bang away at the keyboard or sit staring off into the distance thinking about the next chapter. Thanks again, Nancy!

1

Process Management

Perhaps it has always felt this way, but the competitive and other performance pressures on organizations today are phenomenal. Not only is it critical to have a strategy that is a solid connection to a specific niche, but execution of that strategy needs to be almost flawless, given the many other channels available for satisfying nearly any need or want. It is the connection between these two—strategy and operations—where performance metrics are vitally important. Proper metrics can help ensure that processes at all levels of the organization are aligned with, and consistently meet or exceed, the strategic goals and objectives.

I was lucky in my first choice of college degrees. It was in electronics technology before the advent of computerized diagnostic testing. One simply couldn't succeed as a troubleshooter without being able to look at any electronic device as a system of interfacing components and think about the cause-and-effect relationships between them. Further along in my career I came to realize that a business is no different, with the exception that instead of chips and other electronic components, it's processes (e.g., equipment, information, and people) that are interacting, and it is the totality of that interaction that creates the organization's results.

The point is that managing an organization means managing a system. So what is a system? It's a set of interacting

components designed to achieve some output that satisfies the environmental requirements within which it is operating. The components might be a processor chip, memory chips, disk drives, a monitor, and so forth, when we're talking about a computer. When talking about a car it's an engine, transmission, chassis, tires, body, and so forth. When talking about a human being it's a heart, lungs, brain, skeleton, and so forth. But when we're talking about organizations, the components are processes.

Whether the focus is on managing an entire organization or a single process within it, the Plan-Do-Check-Act (PDCA) cycle is a great perspective to use (see Figure 1.1). Developed by Dr. Walter Shewhart and widely communicated by Dr. W. Edwards Deming (who recommended that Check be relabeled Study to emphasize that the purpose is to learn), it emphasizes that it is important to know what is desired and how it is to be accomplished (the Plan), which can then be implemented (the Do). The plan might be a strategic plan, a departmental plan, a product plan, a daily schedule, or a set of instructions on how to carry out a detailed activity.

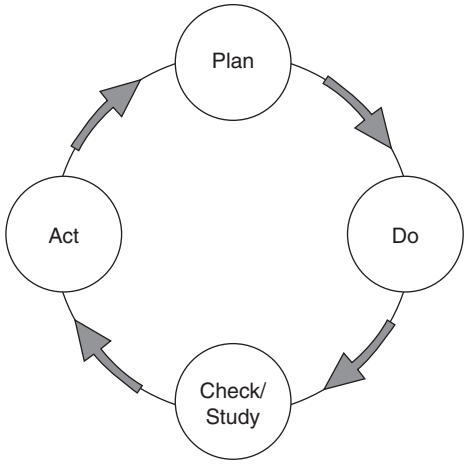

Figure 1.1 Shewhart's PDCA model.

Metrics are one of the ways (an audit is another) of knowing whether the plan was actually implemented and whether it achieved the desired results (the Check). Action can then be taken (the Act) based on what was learned from the review of performance. The importance of these two steps is emphasized in many management system standards for quality, the environment, health and safety, information technology, and so forth, that require measurement, corrective action, and improvement.

PROCESS THINKING

Since the system consists of interfacing processes, it is useful to understand what we mean by process. At the most fundamental level, a *process* is a series of activities that use resources to convert inputs into outputs (see Figure 1.2). Let's look at a simple example.

Suppose you want to hang a picture on a wall in your home. The steps might include something like the following: (1) decide where to hang the picture, (2) gather the picture, a nail, and a hammer, (3) mark the location where the nail should go, (4) drive the nail into the wall, and (5) hang the picture on the nail. The inputs are the picture and the nail, the resources are the hammer and you, and the output is the picture hanging on the wall.

Now let's imagine we're operating a test lab. Inputs would be the samples to be tested, resources would include the test equipment/supplies and technicians, and the output would be the test report.

Of course, the process isn't operating in isolation. There's a need or desire for the output, and the person communicating

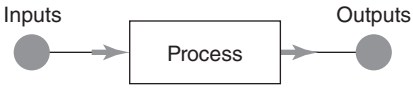

Figure 1.2 Fundamental view of a process.

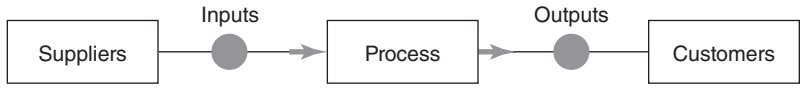

Figure 1.3 Generic SIPOC diagram.

this need is the customer. On the other end of the process are the suppliers, who provide the inputs. Figure 1.3, commonly known as the SIPOC diagram (Suppliers providing Inputs to Processes that produce Outputs for Customers), demonstrates this relationship.

If we're talking about an entire organization, the customers are the reason the organization exists—those to whom the organization's products and/or services are provided. These are the external customers. Suppliers are the external organizations that provide the raw materials (which might be chemicals, people, information, etc., depending on the type of business) that are transformed into the outputs. Table 1.1 demonstrates some of the elements for different types of organizations.

As stated, an organization needs to know how well it's performing, so throughout the SIPOC there are several opportunities for measurement:

Customers—Customer feedback, solicited or unsolicited, is an important measure of how well the organization is meeting the customer's needs and expectations

Outputs—Evaluation of the product/service before it is presented to the customer allows earlier detection of how well the organization is functioning

Process—Measures within the organization, such as at each process step, allow even earlier detection and control of those processes

Inputs—Measures of inputs allow the organization to know whether suppliers are effectively meeting requirements, as well as to compensate (when necessary

Table 1.1 Examples of SIPOC components for various industries.

Organization	Suppliers	Inputs	Process	Outputs	Customers
Car dealer	Auto manufacturers	Autos to sell	Sale of autos	Family autos	Families
Hair salon	Hair product manufacturers	Shampoo, person desiring cut	Washing and cutting hair	People with hair cut	Individuals
Movie theater	Movie studios	Movies, consumers	Show movie for a fee	Entertained people	Consumers
Hospital	Doctor offices	Patients needing intensive medical care	Diagnose and treat disease	Treated patients	Individuals
K–12 school	Families	Children needing education	Educate	Educated people	Society

and/or technically and economically viable) for variation in supplier performance

Suppliers—Evaluation of supplier performance is often predicted through the use of assessments conducted of the supplier's processes

The SIPOC diagram can be expanded to include additional process components (see Figure 1.4):

Requirements—These include contractual obligations placed on the process by the customer, or placed on the supplier by the owner of the process.

Resources—Inputs are those items that typically enter the process at the time of and/or for each transaction (think of them as consumables), while resources are items maintained within the process that are necessary to carry out the activity (and while they may also eventually be consumed, it is at a much lower rate, e.g., replacement of a computer, retirement of an employee). An example of inputs when fixing breakfast would be the eggs and bacon, while the resources would be the cook, stove, frying pan, and so forth.

Controls—These are operating instructions, measurements, guidelines, and so forth, that help the process operate correctly. For example, the stove used to fry the eggs has adjustable temperature settings, just as a microwave oven has adjustable time and intensity settings.

Feedback—A process or system that operates with no feedback is considered an open-loop system and will often end up not maintaining the desired outcomes (consider a heating or air conditioning system without a thermostat and control mechanism). Adding feedback loops allows subsequent steps of the process to provide information to the previous steps to let them know how they are doing so that they can make appropriate changes.

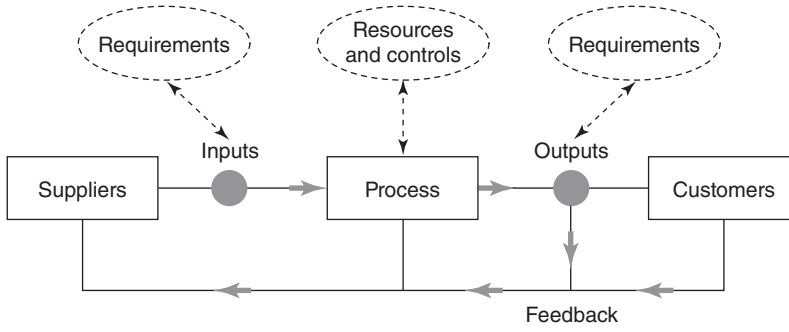

Figure 1.4 Additional SIPOC elements.

The process box in the SIPOC diagram can be an entire organization, a division within that organization, a facility within a division, a department within a facility, a process or group within a department, or even an activity carried out by a single individual.

In effect, an organization is a large combination of processes that are connected horizontally and vertically. Understanding how each process operates and the impacts of the interrelationships between processes is vital for effectively managing an organization.

A plant was receiving complaints from another plant within the same company. Some of the internal discussions included how the customer facility may have been at fault, how it was "picky," and so forth. After a SIPOC diagram was created, someone suggested that they visit the customer facility (perhaps with the intent of trying to talk them out of some of the complaints).

When they arrived at the facility, they were taken to the process line where the deficient supplied parts were being used. When the person on the line explained the impact not only on the product but also on the process and the person doing the work, the visitors became determined to eliminate the problem and subsequently did an excellent diagnosis.

BUSINESS PROCESS MODELS

Several movements in the past few decades have helped organizations become more effective at business process thinking. One is the development of the Malcolm Baldrige National Quality Award (more recently titled the Baldrige Performance Excellence Program) in the 1980s. Similar awards exist in Canada, Europe, and Japan.

Figure 1.5 is a diagram showing the high-level view of the Baldrige criteria. Note that one can see the SIPOC concept at work here where leadership, customer focus, and strategic planning come together to set the direction for the organization, and execution is carried out by operations focus (formerly called process management) and workforce focus (formerly titled human resources management). Measurement, analysis, and knowledge management are there to support all the processes. Results are a function of effectiveness of the strategy itself as well as its execution.

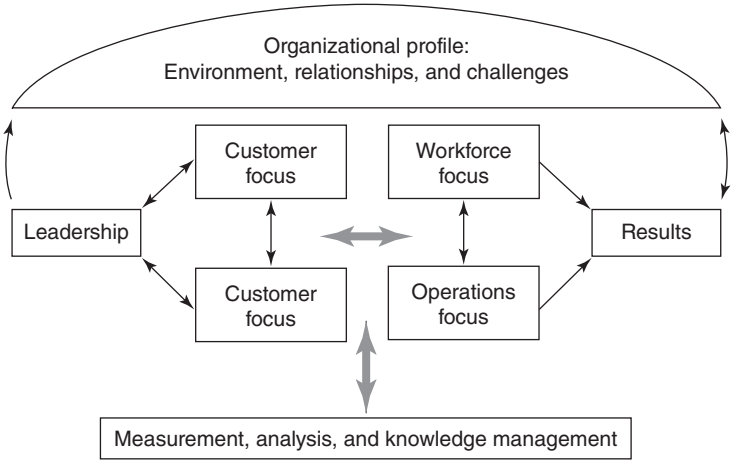

Figure 1.5 Baldrige Award model.

Another view of business processes comes from the business process reengineering movement and says that organizations have two types of processes: *Core processes* are the customer interfacing processes that capture customer wants/needs and convert them to products/services that are then created and delivered to the customer; *enabling or support processes* are those that are necessary in order for the core processes to work. Following are examples of the processes within these two groups.

Core Processes

- *Strategy development and deployment*—Determining, communicating, and executing strategic initiatives
- *Technology development and deployment*—Identifying, designing, and validating new products/services and transferring them into operations
- *Order fulfillment*—Actually producing the product and/or carrying out service activities
- *Customer relationship management*—Sales and marketing to find customers, taking customer orders, and maintaining communications with the customer throughout the product/customer life cycle

Enabling Processes

- *Human resource management*—Hiring and developing personnel needed to carry out business strategy
- *Information technology management*—Managing the hardware and software necessary for managing information required to support all business processes
- *Financial management*—Budgeting, accounting, and reporting on financial transactions

- *Regulatory compliance*—Ensuring that product, environmental, safety, and other externally imposed laws and regulations are met

Other processes can, of course, be defined or included in one of these lists. For example, facilities management could be a technology issue, an order fulfillment subprocess, or an enabling process. SCOR and the APQC Process Framework are standard process frameworks that have been developed and can be of value for helping understand levels of processes.

Figure 1.6 is an example of how the relationships between these high-level business processes might be viewed by members of an organization. Each of these processes has multiple subprocesses, such as hiring, compensation, development, and benefits management within human resources.

Some organizations may find it easier to develop a business process model by building from the bottom up. Having people within the organization list the activities they carry out and then creating multiple affinity diagrams building from the detailed level up to higher levels can provide a view of the organization's business processes.

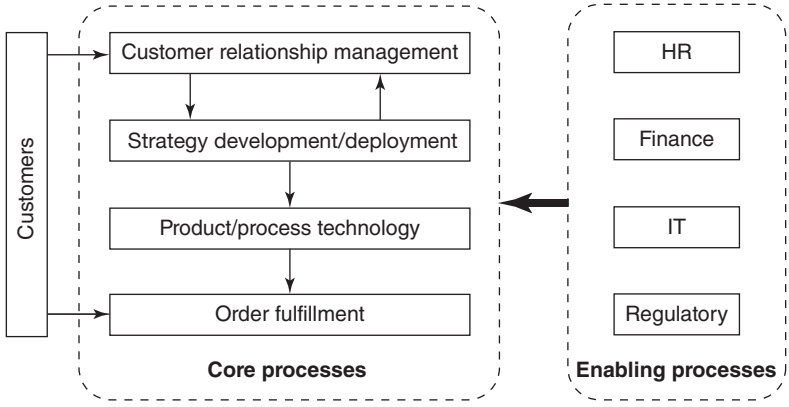

Figure 1.6 High-level business process map.

THE ROLE OF METRICS

Having processes in place is a start, but members of the organization also need to know how well the processes are achieving objectives (imagine if your car didn't have a speedometer or fuel gauge). This is the role of metrics. They can tell us whether targets for strategic objectives (e.g., sales and/or profit growth, market share growth, and new product success rate) are being hit, as well as more tactical objectives (e.g., on-time delivery, employee turnover, cycle time, and productivity).

While the term "customers" is used in the SIPOC diagram, it is often useful to think more broadly about other parties that also care how well the organization operates. We'll call these parties "stakeholders," and they can include:

- Direct customers, such as retailers or distribution centers involved in transporting and/or selling the product.
- End users who actually acquire the product for day-to-day use.
- Regulatory agencies that try to ensure that the organization and its products do not create harm. The Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), the Occupational Safety and Health Administration (OSHA), and the Securities and Exchange Commission (SEC) are such examples in the United States.
- The community in which the organization operates, which has an interest in stability or growth of the workforce, as well as taxes paid by the organization.
- Employees who work within the organization, who would also like employment stability, personal growth, and no physical harm from accidents.
- Financiers that enable the firm to utilize the financial leverage necessary to operate and grow.

Metrics can also be utilized to monitor how well the requirements/expectations of each of these stakeholder groups are being met. Of course, the organization also needs processes that actually capture and prioritize those needs and expectations.

Development of a new process is ideally done using a "backing in" process that begins with the stakeholders. Here's an example of the sequence to follow:

1. Who are our customers and other stakeholders?
2. What are their requirements, needs, and interests?
3. How can compliance with these requirements be measured (*the metrics*)?
4. What activities are necessary in order to meet those requirements (*the process steps*)?
5. What inputs, resources, and controls are necessary in order for the process to be able to operate as desired?

If an organization already exists, which means the processes already exist, establishing metrics simply requires asking the question, "What metrics are necessary or useful in order to be able to evaluate, control, or improve this process?" Once the proper metrics are in place, the process may be found to be adequate, or significant opportunities for improvement may be identified.

CONDUCTING A SIPOC ANALYSIS

Whether it's a new or existing organization or process, a good way to help people understand the role of their function/group/process within the larger organizational context is to have them conduct a SIPOC analysis. Figure 1.7 is an example of one

conducted for a hospital outpatient X-ray process. The following steps are used to build the SIPOC analysis:

1. Define the process to be analyzed and its goal.
2. Write the process name in the process box.
3. Identify the process owner.
4. Identify the outputs produced by the process.
5. Identify to whom (customers/stakeholders) each of the outputs goes.
6. Identify the inputs required in order to produce the outputs.
7. Identify the suppliers from whom the inputs are received.
8. Identify resources and controls necessary for operation of the process.
9. Ask how the customers and the organization would measure the outputs. These are the output metrics.
10. Ask how the process personnel would measure the inputs. These are the input metrics.
11. Identify the process boundaries and major steps between them.

Note that the steps can be done in a different order, depending on whether it is an existing process or a new process, as well as the level of process thinking/understanding of the personnel involved. Also, people are often surprised to find that the customer is also a supplier!

This is a single-level SIPOC analysis and may be sufficient, depending on the scope of the process. However, sometimes it is useful to do a deeper analysis—as shown in Figure 1.8, where one step from Figure 1.7 has been analyzed. Such an

SIPOC Analysis Form				
Process goal: Conduct X-ray diagnosis at a hospital outpatient center			**Process owner:** Medical director	
Suppliers	**Inputs**	**Process**	**Outputs**	**Customers**
Requesting physician	Patient X-ray order	Conduct X-ray diagnosis	X-ray Report of diagnosis	Requesting physician Patient
	Input metrics	**Resources**	**Output metrics**	
	Timeliness of patient Order accuracy	Computers X-ray machine Administrative and clinical personnel	Accuracy of diagnosis Timeliness of report	
		Controls		
		Training X-ray maintenance		
Major process steps				
Process start boundary	Patient arrives at hospital → Outpatient admission process → Perform X-ray → Radiologist reads image → Report sent to physician			**Process end boundary**
Physician writes order				Physician receives report

Figure 1.7 SIPOC analysis.

SIPOC Analysis Form				
Process goal: Read X-ray image				
Suppliers	**Inputs**	**Process**	**Outputs**	**Customers**
X-ray technician	X-ray file	Reading X-ray	Diagnostic report	Requesting physician
	Input metrics	**Resources**	**Output metrics**	
	Quality of image Timeliness of delivery	Computer Diagnostic guidelines	Accuracy of diagnosis Timeliness of report	
		Controls		
		Education		
Major process steps				
Process start boundary	Radiologist receives file → Scans file for indications → Interprets indications → Records findings			**Process end boundary**
Technician forwards image				Report sent to physician

Figure 1.8 SIPOC analysis (next level).

analysis may be useful when the process flow at the first level crosses departmental/individual boundaries. Doing a deeper analysis can help emphasize the customer-supplier relationships between the different entities, as well as identify metrics along the process flow that might be useful for ensuring better process control or that might act as leading indicators of probable outcomes.

ORGANIZATIONAL HIERARCHIES

An organization consists of high-level business processes that consist of multiple processes, and those processes contain subprocesses and activities (see Figure 1.9). An outline format is another way to show this hierarchy, as done in the following two partial examples—one for a core process and the other for a support process:

4 Order fulfillment
- 4.1 Take order
  - 4.1.1 Receive order
  - 4.1.2 Review order
  - 4.1.3 Accept or reject order
- 4.2 Schedule order
- 4.3 Produce order
- 4.4 Ship/deliver order

8 Regulatory management
- 8.1 Identify relevant regulations
- 8.2 Develop systems to meet the regulations
- 8.3 Implement those systems
- 8.4 Monitor compliance and report results as required

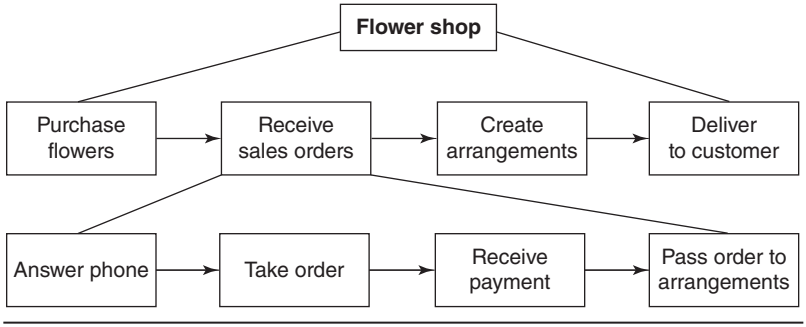

Figure 1.9 Levels of process.

Since there are levels of process, there are also likely to be levels of metrics. Generically, the hierarchy might be described as:

Strategic outcomes

Tactical/operational results

Process outcomes

Individual results

Note that if properly aligned, the lower-level metrics will support the higher-level ones. Following is a similar partial hierarchy specific to a rental car organization/industry, with the name in parentheses indicating the level/group responsible for the metric:

% loyal customers (corporate)

Customer satisfaction (corporate)

Vehicle availability (operations)

Cleaning done on time (cleaning group)

Maintenance done on time (maintenance department)

Friendliness of counter staff (operations)

Training effectiveness (training group)

This hierarchy is played out within the organization chart, which is of course also a hierarchy. Basically each level of the organization has a different span of control, or range and number of processes for which they are responsible (the process owners). For example:

- The CEO/general manager is responsible for the entire organization, that is, all processes
- The VP/manager of sales, finance, or production is responsible for designing and managing his or her respective processes, even though the processes often cross departmental lines
- A line supervisor, team leader, or business unit manager is responsible for the processes within his or her area
- Individuals are responsible for the tasks (portions of processes) as identified in their job descriptions, procedures, and so forth

Imagine working in an organization where the processes and performance metrics have not been well established. How would an individual or group know what they are responsible for, how the activities are to be carried out, and how well they are performing? Both accountability and performance improvement would be difficult in such an environment, and requests regarding either could appear to be quite arbitrary.

What also makes process management difficult is that some organizations use the term "performance management" to mean the annual individual performance appraisal done with each employee (which of course almost no one enjoys). Performance management is instead about managing performance of the organization and its processes. One cannot manage people; they instead need leadership.

2

Types and Functions of Metrics

One thing we should clear up is what we mean by metrics. When a person hears the term "metrics," he or she might think about the English versus the metric measurement system. Although performance metrics are measurement related, that's not the context for this book.

Other terms sometimes used for performance metrics are "performance measures," "key performance indicators (KPIs)," "process outcomes," and "results." All are related to some measurement of a process or organization in order to know how well it is operating. Typically KPIs are the higher-level, organizational outcome metrics, although it may depend on the level of organization one is thinking about when developing metrics.

However, people sometimes confuse objectives and metrics. The difference is that objectives are the target performance level, while metrics are how we know whether the objectives are being achieved. Think about speed limit signs along the road as objectives (a maximum in this case) and the reading on the car speedometer as the metric.

As demonstrated by the SIPOC model, metrics can be used for different purposes at different places in the process. One use is to know how well the outputs of a process/organization/system are performing, another is to monitor the inputs to ensure they are suitable for use, and still another is to control

for various factors within the process to improve the likelihood that the outcomes will be acceptable.

Another way to look at metrics is related to the particular objective for which the metric was derived. In some cases it is so that performance can be increased (e.g., growing sales or market share). In other cases it is to maintain a certain level of performance (e.g., temperature in a laboratory). And in still others it is a defensive posture (e.g., minimize the number of accidents).

When establishing objectives and their related metrics, the metaphor of a three-legged stool is often used. Each of the three legs is a different aspect of performance of a process/organization that should be managed. The stool can be applied at the strategic or operational level.

Strategic Level

- Marketplace performance metrics that tell how well the company is competing in its space, such as market share and customer satisfaction.
- Financial performance metrics that let the company know how well it is achieving financial goals, such as sales, costs, and profitability.
- Innovation/agility metrics that indicate whether the organization is able to stay ahead of the curve relative to product and organizational maturity. Examples would be the time to launch a new product/service or the number of new offerings.

Operational Level

- Quality-related metrics that measure how well the output meets the objectives of the customer. Defect rates, rework, and process capability are examples.

- Cost-related metrics that measure how many resources are required to produce the output. While cost may not be captured on a regular basis at a process level (unless the company is using activity-based costing), it is often estimated in order to set standards and make pricing decisions, and is obviously captured at a macro level within the budgeting and expense-tracking processes.
- Speed-related metrics that measure how long it takes for the output to be produced, such as order cycle time, manufacturing cycle time, IT desk response time, or length of a hospital stay.

Organizations therefore need to balance their attention among these aspects, since a deficiency could result in dissatisfied customers, investors, or other stakeholders.

There are many terms used to describe different metrics, primarily as a means to indicate the purpose of the metric. Following are some common terms presented in pairs of "similar but different":

- *External vs. internal focus*—External metrics evaluate trends and/or feedback from the environment in which the organization operates, while internal metrics allow an organization to see how well it is using its resources. Market share would be an external metric, while financial performance measures would be internal.
- *Effectiveness vs. efficiency*—Effectiveness metrics let the organization know how well it is satisfying its stakeholders, while efficiency lets people know how well the organization uses its resources. Customer satisfaction measures effectiveness, while productivity looks at efficiency.
- *Leading vs. lagging*—Leading indicators allow predicting future outcomes (e.g., effectiveness of customer

service training may predict customer satisfaction), while lagging indicators (e.g., the level of customer satisfaction) measure outcomes that resulted from activities that occurred in the past. As organizations develop more mature measurement systems, they should have a higher leading-to-lagging metric ratio as they learn the relationships between factors and can be more proactive in managing performance. Note: Whether a particular metric is leading or lagging may depend on who established it and why, as well as whether it is being viewed from an upstream or downstream perspective.

An organization saw a dramatic increase in customer complaints relative to a particular failure. When the organization went back and reviewed internal data, it found that the failure rate at the test station had dropped significantly. However, it wasn't because of a product/process improvement; it was because the test station wasn't working correctly. Had the organization paid attention to the change in test performance it could have predicted the potential field failures and taken action to prevent them.

- *Outcomes vs. controls*—Outcome metrics focus on results at the end of the process, while controls are those metrics used to adjust or stabilize performance of the process. How many doughnuts were produced in an hour might be an outcome metric, while the speeds of the mixer and the moving conveyor oven belt would be the controls.
- *Monitoring vs. ad hoc (or diagnostic)*—Some metrics will likely always be in place in order to help the organization manage performance, while others might only be used for a short period of time to help solve a problem. Number of deliveries is an example of a monitoring metric for a pizza delivery service, while volume of traffic per hour in

An organization was receiving complaints about the quality of its product. Although employees measured the parts using statistical sampling prior to shipment, in order to gain additional knowledge about how the process was performing they set up a temporary data collection process whereby a particular characteristic would be measured on every part at each step of the process. This was done only for a limited time period until they were able to identify the step of the process responsible for the problem and apply corrective action. This temporary (ad hoc) measurement process was then eliminated.

a particular area might be measured for a length of time to help plan routes for improving timeliness of deliveries.

- *Objective vs. subjective*—Objective metrics are those items that may be easily quantified (such as time or cost), while subjective metrics are those items that are less easy to quantify (but may in many cases be more important when dealing with people, such as customer perceptions). Asking people to rate their satisfaction based on a scale of 1–10 is an example of a subjective metric, but the scale allows it to be quantifiable and allows trend analysis over time.

In a hospital setting, patients are often asked to describe the level of pain they are experiencing by pointing to which face (in a series described as the Wong Baker Faces Pain Rating Scale) best describes how they feel. While it is not necessarily an accurate or finite measurement, it does allow determination of whether the pain is increasing, decreasing, or staying the same.

Several of these metrics have somewhat logical parallels, as shown in Table 2.1. For example, both external and effectiveness metrics are focused on issues outside the organization, while

Table 2.1 Parallels of types of metrics.

External	Internal
Effectiveness	Efficiency
Lagging	Leading
Outcomes	Controls

internal and efficiency metrics are more about within-company concerns. Similarly, outcome metrics and lagging indicators are later in a process than control or leading indicators.

Figure 2.1 is a horizontal view of a process and three metrics that might be used within it. Note that "availability of clean laundry" is a lagging metric, while "amount collected" and "time required to clean" are leading metrics that will impact whether sufficient clean laundry will be available; each is also an outcome for a specific process step. All metrics are internal (as opposed to external) since they tell how well a process is working that does not interface directly with the customer. All are easy to measure, and so they are objective. But all might not be regularly monitored; rather, they might be used on an ad hoc basis if there were recurring problems the organization wanted to diagnose. All three are also operational-level (as opposed to strategic) metrics.

Figure 2.2 is a vertical view that shows additional metrics that can impact the availability of clean laundry. Availability

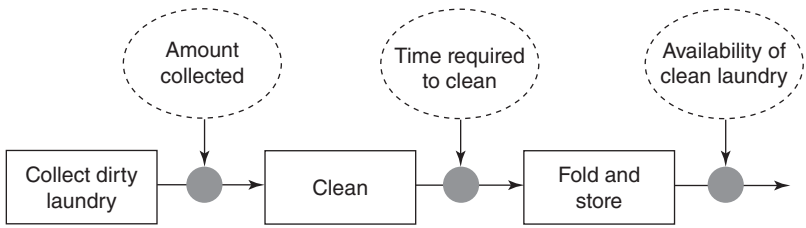

Figure 2.1 Leading and lagging metrics in a hotel laundry process (horizontal view).

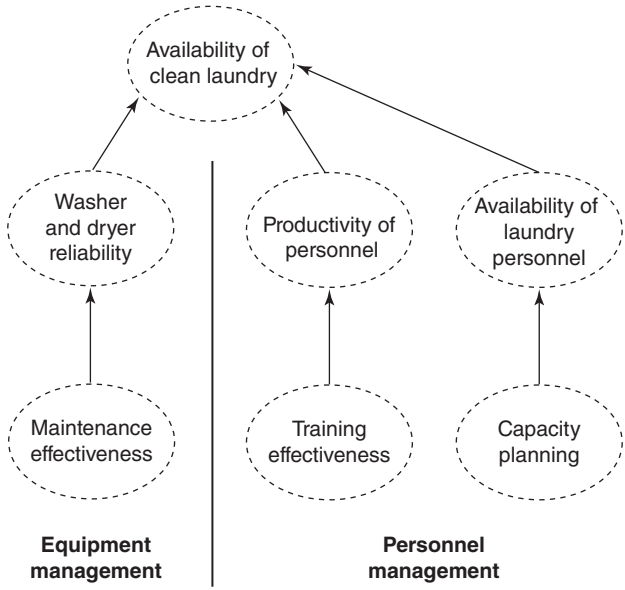

Figure 2.2 Leading and lagging metrics in the laundry process (vertical view).

would again be an outcome or lagging indicator for this process, while the metrics below it are leading indicators that would allow some prediction of the outcome. Note that the midlevel metrics are also lagging indicators impacted by the leading indicators at the level below them. In this case there are metrics that are somewhat more subjective, such as "maintenance effectiveness." Again, all metrics are operational rather than strategic, but in thinking about availability of clean laundry, one might see it as a potential leading indicator for whether rooms will be made up on time, which will impact the timely availability of rooms for arriving guests, which will affect customer satisfaction. The latter is obviously a strategic metric driven by all the metrics below.

Figure 2.3 is similar to Figure 2.1 but with added controls that might be used to adjust performance of the process. For example, "time required to clean" would be impacted by the

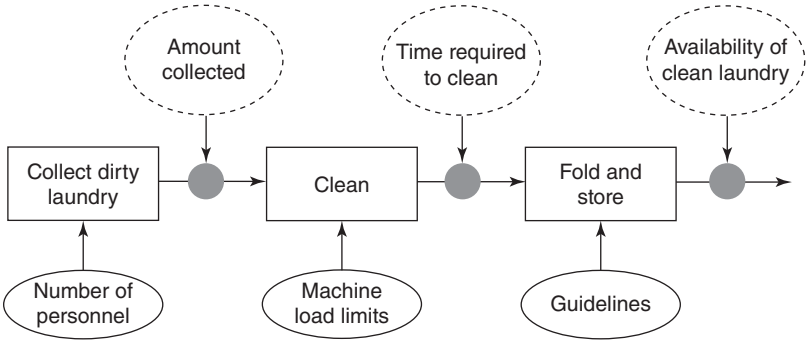

Figure 2.3 Outcomes and controls in the laundry process.

limits the organization has set on how many pounds of laundry can be washed per load.

These diagrams (the vertical format being preferred) provide the organization with a view of the cause-and-effect relationship between metrics and their related processes. Building such diagrams can be very useful if an organization wants to perform root cause analysis or process improvement.

Since an organization can have many metrics, the goal is to identify which will be most critical or useful. The organization needs to know which metrics are most important relative to where it wants to go, and so it focuses its efforts on where the greatest leverage will be achieved.

Organization X had metrics displayed throughout the facility, as many as 30 in one location. It had so many that there was an individual dedicated to just updating the charts and posting the updates each day.

However, for a project that had been under way for many years, there were no metrics that allowed the organization to track progress. Once a couple of simple metrics were developed that could inform the organization of the project status, the project was quickly and successfully completed.

A common problem related to metrics is that organizations measure what is easy to measure, rather than what is more strategically useful. For example, computer help-desk operations usually pay a lot of attention to the number of calls they handle and the amount of time required per call. These are easy to measure since they can be tracked by the software used for handling inbound calls. What might be more useful to measure is what percentage of problems are resolved on the first try or how long it takes to resolve a problem. These are measures of effectiveness of the process—something the customer of the process is a lot more concerned about!

3

Selecting the Right Metrics

If an organization wants to develop performance metrics, where should it start? Figure 3.1 shows the major steps, cascading from understanding what business the organization is in (the mission) through developing strategy, providing the processes and resources for implementing the strategy, and evaluating how well the organization is succeeding. Note that the steps are the same whether it's a new organization or an existing one (e.g., an annual strategic planning process or a strategic shift or new business niche), and the concept shown in the figure also applies at lower levels of the organization in that each department should also have a mission, strategy, and so forth, aligned with those of the overall organization.

Note that metrics first show up after the strategy and specific strategic objectives have been set. Otherwise it's hard to determine what should be measured. The metrics are then deployed down to the process and project level. Of course, metrics are also critical during strategy implementation and evaluation, ensuring that there are no surprises (or if there are, that they are used for organizational and individual learning).

A question often comes up about how many metrics an organization should have. A specific answer is, of course, impossible, as it will depend on size and complexity of the organization, the number and types of stakeholders, and management philosophy (e.g., the culture of the organization and

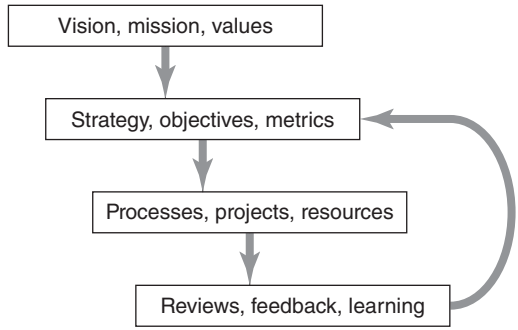

Figure 3.1 Organizational strategy development and implementation.

the degree to which people are empowered to use data to manage the business).

Regardless of how many metrics it has, the organization must ensure that it uses the Pareto principle (80/20 rule), paying attention to the vital few metrics necessary for ensuring success. That is, what are the critical factors that will allow the organization to drive and measure success? While today's computerized businesses certainly allow more metrics to be gathered and reported, there is a limit as to what people will be able to pay attention to and manage.

Other factors to consider include:

- *Data availability*—Although a particular metric might be useful, sometimes it may be difficult getting access to the necessary data. While that might sound strange in a world overwhelmed by data, issues around security, confidentiality, or other proprietary factors may limit access.
- *Reliability of the data*—Just because data are available doesn't mean they are accurate. How data are collected, processed, and stored often introduces errors, and there's always the possibility that someone is intentionally skewing the data for personal or political reasons. In some

I once encountered a barrier when trying to obtain a medical report for an evaluation that I, not my insurance company, had requested and paid for. While the medical provider was willing to send a copy of the report to my primary physician (who had no involvement in the decision to have the test performed), I had to sign a release form so that I, the sole requester and payer, could get a copy. This barrier was no doubt an unintended result of the HIPAA (Health Insurance Portability and Accountability Act) regulations intended to keep patient information private.

situations, making decisions with incorrect data might actually be worse than making decisions with no data.

- *Cost of collecting and analyzing the data*—Data may appear to be free, but they definitely are not. There are costs associated with gathering, processing, storing, reporting, and using the data. The relative value of a particular metric should be weighed against these costs. Some organizations quantify the value versus the cost as part of the decision on whether to capture some metrics.

Another factor that drives the number of metrics is related to where the metric is located in the flow of business processes, which, as pointed out in Chapter 2, is related to the function or purpose for which the metric was developed. The following are typical locations:

- *Final outcomes*—Examples at a high level are sales, profitability, and customer satisfaction. These are the results of all other processes and metrics within the organization as well as in the external environment. Although it may be too late to do anything about these past-focused results, they are usually necessary for measuring overall performance of the enterprise.

- *At the end of major business processes*—Final outcomes are a function of business processes. So measuring those business processes can be useful for establishing which factors are the major drivers of performance. Examples might be "# of new products developed" for product technology or "% on-time delivery" for order fulfillment.
- *At subprocess points*—Business processes often cross departmental lines or are subdivided within a particular department among different people/stages. Metrics can be used at these handoff points for earlier detection of variances.
- *Where significant control factors are managed*—Factors that must be properly controlled within processes (whether high-level or detailed-level) should also be considered for monitoring.

Some criteria for whether a metric will be useful include:

- *It focuses on one or more strategic objectives.* That is, regardless of the level at which the metric exists, one can see a logical connection to higher-level metrics that eventually roll up to a strategic priority. If this linkage isn't there, someone should ask why the data are being collected.
- *It accurately measures results.* There's enough noise and chaos in an organization as it is. No need to add more by using a metric that may cause poor decisions because of its inaccuracy.
- *It is deployed down and across the organization.* Having a high-level metric that does not have supporting metrics existing in the right processes will not add value other than letting management know that things aren't going well.

- *It will be able to predict results.* Good leading indicators are those that are known to have a high correlation to outcomes and can let the organization know sooner what those outcomes are likely to be.

A fitness center serves three major segments: elderly folks who want to maintain strength and agility, baby boomers who want to delay aging, and bodybuilders who want to bulk up. The organization has separate metrics for tracking satisfaction, turnover, injuries, and facility/equipment usage so it can better meet the unique needs of each segment.

- *It allows differentiating between business segments.* In many organizations there are different market segments and different customers with different needs, as well as multiple products and/or services being provided to those niches. A metric that does not allow drilling down to look at particular segments will not have enough resolution to help the organization understand sources of variation in processes.

Some common errors seen in organizational metrics include measuring whether something gets done rather than how well it was done or how long it took, and focusing on what's easy to measure rather than what will add value for managing performance. While a metric tracking whether something gets done might be useful for tracking a project, it is useless for evaluating whether the project had a useful impact.

It's also not uncommon to find several metrics that were established at some time in the past but are not currently being used for decision making. More than one IT department has slowly stopped producing some reports and waited to see if anyone complained. If no one complained, the report was eliminated.

To emphasize how metrics vary from one organization to another, it's useful to think of several organizations simultaneously and consider how their metrics—that is, what's important to each (and may not be to others)—might differ. Table 3.1 is an example of four different strategies and some metrics that are likely used by one but not by all.

Various frameworks are available to help an organization ensure that the range of metrics it utilizes is not too narrow. While most organizations have financial metrics, it's not unusual to see others that have all too few metrics for the processes that drive financial performance.

The Baldrige Award for Performance Excellence is one widely used framework. An organization applying for the award must include information in what is called the Results category, which requires metrics for:

- *Product and process outcomes*—This includes measures of product/service performance (e.g., # of returns/rejects, reliability) and of process performance (e.g., waste, efficiency, cycle or lead times).

Table 3.1 How strategy drives metrics.

Strategy	Example	Metric
Design of leading-edge electronic consumer products	Apple	Number of new product releases/year
Low-cost retailer for consumer products	Walmart	Sales/sq. ft.
Unique, self-directed higher education	Walden University	Number of graduates who experience a step change
Delivery of the ultimate variety of consumer products	Amazon	Number of products available

- *Customer-focused outcomes*—This includes issues such as customer satisfaction and retention, and customer complaints and loss (known as churn in the telecom industry).
- *Financial and market outcomes*—This typically includes the classical indicators on which most organizations focus, such as revenue, profitability, and market share growth.
- *Workforce-focused outcomes*—Examples include turnover as well as employee development and engagement.
- *Leadership and governance outcomes*—This area focuses on how well senior management has considered other stakeholders, such as legal and regulatory issues, which might be indicated by audit findings or fines.

The Balanced Scorecard, made popular by Kaplan and Norton (1996), is also widely used and contains four components: financial, customer, business process, and learning/growth. These are often shown as a hierarchy (a "strategy map"), where learning and growth will impact business process performance, which will affect customer metrics, which will impact financial performance. The idea is to ensure that the organization's measurement system looks at all levels and aligns the metrics appropriately.

While such frameworks are useful, each has advantages and disadvantages. People can become locked into a particular framework, which doesn't allow them to look at the organization from different angles. A particular framework might also cause an organization to implement metrics that have no significant value but are there because the framework recommends them. If a particular framework doesn't fit with senior management's philosophy or worldview, the organization's business model, maturity of the organization, or industry or product, then it shouldn't be used rigidly. After all, each organization can create its own framework based on its unique needs.

REVIEWING SELECTED METRICS

When an organizational unit (whether process, department, facility, etc.) has selected what will be measured, it will need to answer the following questions (see Figure 3.2):

- Are there significant gaps in what is being measured? That is, are there factors that are critical to performance for which there is not a metric?
- Is there misalignment between metrics? That is, does a specific metric drive one variable in the good direction but another in the bad direction?
- Is there conflict between metrics? This occurs when two (or more) metrics drive the same variable but in different directions, when both are "improved."

An outline, a matrix, or a diagram can be used to look at these issues in a structured way. The outline format appears on page 38, while Figures 3.3 and 3.4 demonstrate the other two options.

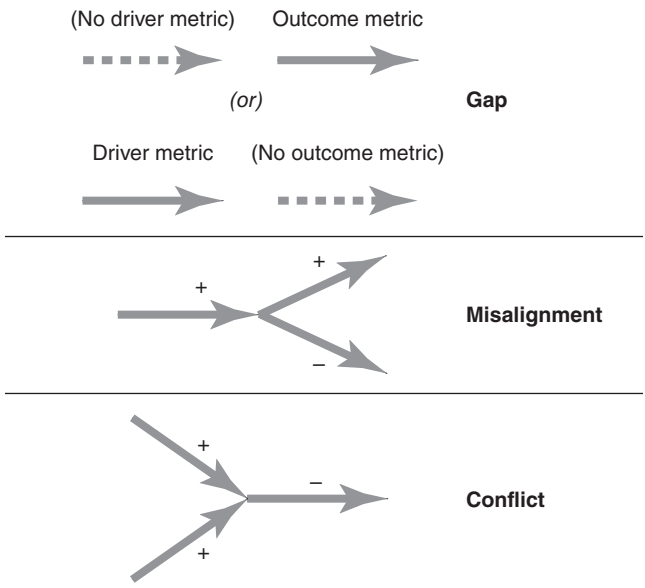

Figure 3.2 Checking for gaps, misalignment, and conflict.

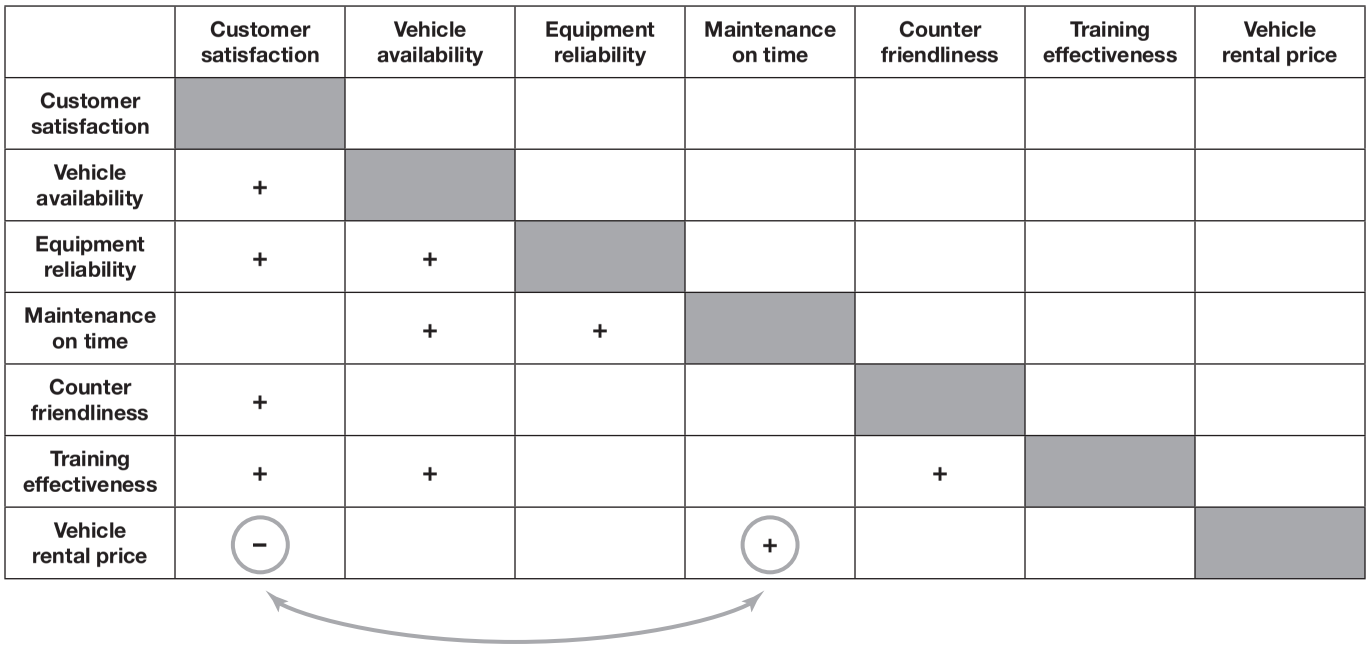

Figure 3.3 Matrix method (with conflict identified).

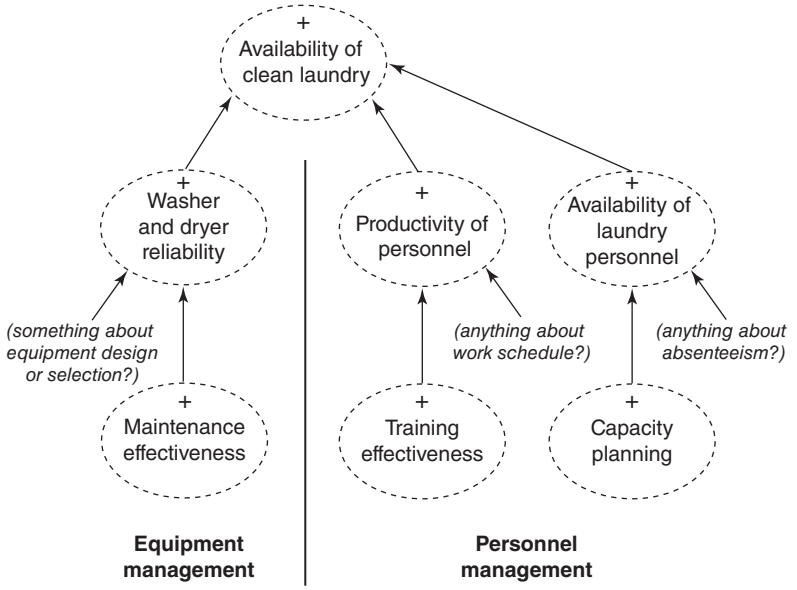

Figure 3.4 Diagram method (with some potential gaps identified).

% loyal customers (corporate)

Customer satisfaction (corporate) +

Vehicle availability (operations) +

Cleaning done on time (cleaning group) +

Maintenance done on time (maintenance department) +

Friendliness of counter staff (operations) +

Training effectiveness (training group) +

Doing such an analysis on all metrics in an entire organization would obviously be a monumental task. It is therefore likely to be done looking at one particular process or an interaction between interrelated processes, or looking at one organizational interface level at a time.

It is important to recognize that some gaps, misalignments, and conflicts are likely to exist (e.g., you can't measure everything, and there is always an opportunity for suboptimization), and thus the organization should be managed based on systems-thinking principles, for example, being aware of multiple impacts of decisions and ensuring proper consideration of relative values and priorities.

SUMMARY OF METRICS SELECTION

Performance metrics should cascade from the top of the organization down through each level. Just as strategic objectives turn into department objectives and then into process objectives and finally into individual objectives, performance metrics should also flow down. However, this flow-down process will ideally not be an imposed one but will instead involve discussions between levels of the organization to ensure alignment of objectives and metrics from top to bottom of the organization. While the metrics themselves are obviously important, in many ways it is the conversation that occurs when developing and aligning the metrics that helps the organization better focus systemically and cohesively on what's really important.

A relatively new volunteer organization wanted to use quality management concepts to help manage its processes. However, the organization's committees had not yet defined the processes, and the facilitator believed that asking them to do so would not be seen as a useful activity. So instead, each committee (strategy, finance, technology, communications, etc.) was asked to define what metrics it could use to evaluate how well it was carrying out its respective mission. The result was a set of valuable conversations that could help clarify which processes might be more important and worthwhile defining explicitly.

There is also the tendency to measure only what is currently being produced/provided, while long-term sustainability of the organization may be more driven by activities that focus on creating future value, such as gains in knowledge, new product/service concepts, and so on.

A consumer electronics company had technology maps that looked out as far as 10 years, considering where it believed technology might go. The company used this information to plan for development of design personnel so that if a particular potential future technology became viable, the company would be able to take advantage of it early.

Another factor that can impact metrics selection is risk management. Many business risks are often in unpredictable areas (e.g., the tails of the distribution), so members of the organization must not become complacent, regardless of how well the measurement process is able to predict/produce the desired performance during a particular time period. They may want to measure some things that appear irrelevant at that particular point in time but that could become highly important if a significant event or shift occurred.

CONSIDERATIONS FOR UNIQUE SITUATIONS

Metrics for Project and Program Management

Metrics typically aren't difficult to identify in situations where the process being carried out is repetitive, that is, high frequency. But how about when the cycle time between beginning and completing the process is very long (see Figure 3.5)?

This is typical of what happens in many project management environments. While transactions in banks, grocery stores, and manufacturing companies may take seconds, minutes, hours,

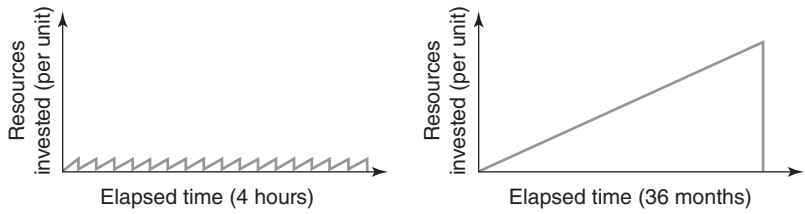

Figure 3.5 Differences in cycle time.

or days, the duration of a project may be months or years, and this has an impact on which performance metrics will be useful. In such environments (such as construction, R&D, major consulting projects, IT projects, or environmental remediation), process owners can't wait until the project is completely done to find out how well it has gone.

While project management may appear to not involve repeating the same process over and over, in reality there are still items that must be managed in order to accomplish the ultimate goal. These include project scope, resources (human, material, equipment), finances (revenues and costs), quality, and activities. Project planning involves laying out the sequence of activities and the use of resources over time, which then allows the use of metrics that monitor deviations from the plan.

Some examples of metrics in project management might be:

- *Overall process:* Cumulative % on budget, cumulative % on other resources
- *Effectiveness:* # of required actions after project quality reviews
- *Leading indicator:* Estimated completion (date, cost, resources)
- *Lagging indicator:* % of deliverables
- *Final outcomes:* Project profitability, customer satisfaction, total development cost

The key is to remember that while the project itself may have a long cycle time, the PDCA cycle is continually being carried out on a much shorter-term basis within the project. This means that at the end of each task, activity, or milestone, there is an opportunity to evaluate performance.

Some organizations have recognized the critical role of effective management of projects and programs in achieving strategic outcomes and may set up project or program management offices (PMOs or PgMOs) that provide guidance for standardizing and improving practices. I was asked to copublish an article on how to measure the value of PgMOs, considering that their role and level of sophistication would vary over time as they matured. Following are example recommendations.

For a Newly Formed Office

- Number of interactions among stakeholders, project managers, and other key players
- Rollup status of projects (e.g., variance in timelines and resource usage, projected outcomes)

For a Medium Maturity Office

- In-depth status of critical interfaces, such as the number of problems encountered and resolved, and estimates of reliability/risks of program outcomes
- Alignment of program with stakeholder interests, such as stakeholder feedback relative to concerns and satisfaction
- Cost of operating the PgMO

For a Mature Office

- Value added and costs avoided, divided by the cost of the PgMO
- Project, program, and/or system technology knowledge/skills developed and deployed across projects and the organization through PgMO efforts

- Comparison of the office with benchmark-level offices
- Percentage of issues for which root cause was determined, and the ongoing benefits resulting from resolving the root causes through changes in PgMO processes

Metrics for "Check" Processes

Some organizations/groups have a role whereby they evaluate activities or outputs produced by others. Examples are inspections, tests, reviews, and audits. In these cases, while time and cost may be easy to capture, quality metrics are more difficult.

Imagine a teacher is grading a student's math test and finds seven errors. What does this indicate—the quality of the work done by the student, or the quality of the teacher's grading process? Actually, it's both (or neither?), but the score has to be thought about carefully.

The number of errors found is actually a measure of the student's performance, but *only if* (1) the grader found all errors, and (2) the grader didn't incorrectly identify a correct answer as an error. So in order to know the quality of the grader, we need to know the quality of the student's work—a dilemma!

To measure Check processes, it is often necessary to introduce a known value into the system and see whether the findings are correct.

A Check process with which I have extensive experience is internal quality auditing such as that performed by organizations registered to the ISO 9001 standard (and its derivatives). Research conducted with managers of these audit programs typically found the following metrics in use:

- # or % of audits done on time
- # nonconformities (NCs) by department, process, element
- # audit person-days, # done within budget
- Cycle time to report & close audit

- Staff competency/training/qualification levels
- # NCs disagreed with, # observations acted on
- Coverage of audit universe, % of controls audited

While many of these may indicate whether the audit program is being run efficiently or whether the system being audited has problems and is able to resolve them, none truly capture the effectiveness of the audit process. Truly measuring this would require looking at a combination of two factors:

1. Which potential system failures were detected or prevented by the audit process (# of NCs found by audits)
2. Which actual system failures occurred that should have been able to be detected or prevented by the audit process (# of customer complaints, product/process defects, etc., caused by management system NCs not found by audits)

In effect, the larger the ratio of factor 2 to factor 1, the less effectively the audit process is performing. This is demonstrated in Figure 3.6.

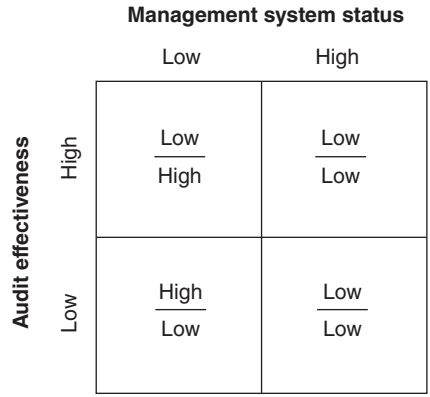

Figure 3.6 Audit effectiveness ratio.

4

Detailing Each Metric

To ensure that a metric captures what is intended and is processed in a manner that allows it to be useful for decision making, several details must be specified. Following is a summary list and then a description of each detail.

- Process owner
- Stakeholders
- Operational definition
- Formula (e.g., numerator/denominator)
- Normalization
- Precision
- Baseline, target, and benchmark
- Source of data and frequency for collecting
- Security/access
- Responsibilities and frequencies for analyzing and reporting
- Date for next review

PROCESS OWNER

Each metric should be assigned to someone who has ultimate responsibility for ensuring that it captures information useful for management of the process. This is usually the process owner, the individual responsible for allocating resources to carry out the process. Depending on the level of metric, it could be a senior manager, department manager, team leader, supervisor, project manager, and so forth. This individual is responsible for the outcomes of the process being evaluated and, if appropriate, reports results to higher levels of the organization.

STAKEHOLDERS

As mentioned in Chapter 1, stakeholders are individuals or groups who have an interest in how well a particular process is managed, and may include customers (external or internal to the organization), regulatory bodies, financial backers, and so forth. By clarifying the stakeholders for each metric, it will be clearer why the metric is necessary and/or useful, and it will aid in defining later details. In fact, a conversation between stakeholder and process owner can help clarify the requirements as well as whether the metrics being established are an appropriate measure of success.

OPERATIONAL DEFINITION

A vitally important detail is the specific definition of what the metric is intended to capture and evaluate. A poor operational definition will result in gathering data that are inaccurate or unusable or that cause poor decisions to be made. It requires a clear specification in unambiguous words, an exact definition of what information is required.

For example, "customer satisfaction" would be a really poor operational definition. What specifically does that mean?

Is it a score from a survey, the number of customers who come back for more, or the number who recommend the organization to someone else? Note that each of these will not only capture different types of information but will also have different costs and difficulties associated with it.

The same is true for even a simple metric such as cycle time. What are the specific start and end points to be captured, and what are the units of measure? For example, if a process takes 26 days on average, does that mean 26 calendar days or 26 working days? Does it include partial days?

Metrics need to be defined in a way that will allow the data gathered to be both valid and reliable, and have a consistent meaning across the organization. Otherwise, comparisons over time and/or between groups of data may not be accurate.

Another factor that enters into the operational definition is unit of analysis. Data cannot be analyzed at a more granular level than that at which they were collected. For example, if sales data are collected only by state, the organization will not be able to look at how they vary from one county to another within the state.

FORMULA, NORMALIZATION, AND PRECISION

A single metric is often made up of multiple components, such as a numerator and a denominator. When this is the case, all components, and their relationship (e.g., the mathematical equation), need to be defined. For example, suppose an organization wants to track safety incidents and defines it as accidents per quarter. Exactly what is meant by an accident? What are the proper boundaries for a quarter?

Normalization of the data is also sometimes necessary in order to allow the data to be comparable over time. For example, as an organization grows (increase in number of employees), perhaps the definition given earlier will be further refined as accidents per 100 employees, per quarter.

For some metrics, the precision (e.g., how many decimal places should be reported) should also be defined. When performing a calculation, an infinite number of digits might be available, but only a certain number are of any value. The standard rule often used is one decimal place beyond the unit of measure.

BASELINE, TARGET, AND BENCHMARK

In order to make a decision based on a metric, there must be something to compare it with. Typically these include:

- *Baseline*—How do the metric data compare with previous levels of performance? For a new metric there is typically some minimum level of time in which the data will be gathered and reported, but no decision will be made about trends until a baseline has been established from the data.
- *Target*—This is the desired level for the metric; it may be a minimum, a maximum, or a specific number. Examples are specifications, control limits, and organizational/process objectives.
- *Benchmark*—While comparison of the metric with internal targets may show the process to be performing well, it is often useful to compare them with external benchmarks that indicate how well someone else performs on the same metric. The benchmark can be other comparable processes internal to the company, competitor performance, or what are called "best-practice" results that are not necessarily industry-specific.

Some metrics are very difficult to benchmark, since each organization captures them in different ways. An example is cost of quality (COQ), which includes the four categories of prevention, appraisal, internal failure, and external failure costs. Reporting is often done as "total COQ as a % of sales." However, what each organization elects to include in each category is somewhat open to interpretation, or will vary from one organization to another depending on whether it believes it to be material (financially significant). Additionally, some organizations track the cost of poor quality (COPQ), which only includes failure costs.

SOURCE OF DATA AND FREQUENCY FOR COLLECTING

Once the metric content has been specified, the source for the data must then be defined, as well as how often the data will be gathered. Example sources might be a particular database (and field name within it), an individual, a report, and so forth. That is, where would one go to find those specific data?

The frequency for gathering the data may or may not be the same frequency at which they are generated, but instead the frequency at which the organization wants to evaluate performance. In addition, the specific point in time may need to be specified (e.g., which day of the week or month), as well as the time period to be gathered (e.g., monthly, cumulative for year).

SECURITY/ACCESS

Although metrics are vital for making business decisions, significant risks may exist if the information gets into the wrong hands. Examples are legal or regulatory risks, confidentiality issues, and contractual obligations. For each metric the process owner should assess whether there are strategic or operational

risks, and what boundaries should be set for reporting or allowing access to the data.

RESPONSIBILITIES AND FREQUENCIES FOR ANALYZING AND REPORTING

The next detail is to specify how often (and again what day, time of day, etc.) the data will be reported and to what locations/individuals/groups. This requires considering who must monitor and/or act on the metric. Some of these frequencies will be defined by laws or contractual requirements, while others will be driven by the need for internal decision making. The same metric may then have different frequencies depending on where the information is being sent.

Some metrics might not need to be reported on a regular basis, but instead only on an exception basis. This helps reduce information clutter yet still allows attention to be focused when necessary or useful. In retail, exception-based reporting is often used for losses. Statistical process control can also be used in this manner, with the intent of helping organizations primarily pay attention to unusual, rather than normal, variances.

DATE FOR NEXT REVIEW

As Chapter 7 will discuss, metrics sometimes have a limited life span. It is useful, then, for metrics to be reviewed at some frequency to determine whether they are still necessary or useful. Specifying a particular date or venue (e.g., during strategic reviews) helps ensure that the organization doesn't continue to invest resources gathering and reporting information that has no value.

Table 4.1 is an example of a metrics worksheet with definitions and example information for a metric. Some organizations find it useful to add a row specifying the metric number,

Table 4.1 Metrics worksheet.

Term	Definition	Answer/Detail
Metric	Title of item being measured	Sales per order
Owner	Person responsible for the metric	Sales manager
Stakeholders	Individuals/groups with an interest in the process	Finance, senior management
Operational definition	Information the metric is intended to capture	Average dollar sales/order
Formula	Numerator and denominator	Total sales/month divided by number of orders that month
Normalization	Adjustments to allow equal comparisons	None
Precision	Number of decimal places	Zero
Data source	Where the data come from	Total sales = accounts receivable, number of orders = scheduling
Frequency to gather	How often the data are gathered to create the metric	Monthly on financial close date
Target	The desired level of performance	$200K by end of 20XX
Baseline	Historical level to which the new metric will be compared	$160K in previous year
Benchmark (and source)	Best-practice results for the metric	None
Frequency to report	How often the metric will be reported	Monthly at sales meeting
Security	Any constraints on access to the information	Senior management only
Next review date	When the metric will be assessed for usefulness	Next strategic planning session

which allows keeping track of different metrics having similar names.

DETAILING AD HOC METRICS

For data that will be collected only for a short period of time (e.g., for research or problem diagnosis), not all these details are necessary. For example, while source, precision, and others related to the data are important, those related to the process, such as stakeholders, target, baseline, and benchmark, are less likely needed.

AGGREGATE/COMPOSITE METRICS

Multiple lower-level metrics are often rolled up into a single metric that integrates multiple factors into one. While this reduces the amount of information that must be processed by personnel making decisions, care must be taken to ensure that variation in the underlying measurements is considered.

Consider a common metric used by investors to evaluate a common stock—price/earnings per share (PE) ratio. Let's assume someone is considering buying a stock that has a low PE ratio because he or she believes it to be an undiscovered, low-priced stock. Is it?

Keep in mind that the PE could be low because the price is low, or because the earnings are high. If it's because the price is low, is that because the general market believes that earnings are about to plunge, or is a low PE typical of the industry? If it's because the earnings are high, is that because earnings have gone up, or because the company has bought back many of its own shares, reducing the number of shares that go into the earnings/share equation? As this example shows, when an aggregate moves (or doesn't move), one must be careful not to make assumptions.

A common example in the quality field is creating a supplier performance index (SPI) that rolls up performance on quality (Q), delivery (D), and response (R) to requests for information or corrective action (SPI = Q + D + R). The problem is that these aggregate indexes can smooth out fluctuations in the individual metrics, allowing things to degrade without giving any signal.

This isn't to say that aggregates shouldn't be used. After all, it is a multivariate world. Caution is advised since such composites may be useful for trend analysis but not necessarily for decision making. At a minimum, consideration should be given to weighting each component of the composite based on its particular criticality, reporting both the aggregate as well as the underlying components, or providing notes on each of those components.

5

Presenting and Using the Data

DATA PRESENTATION

Having data isn't of much value unless they are presented in a way that allows effective decision making. People need to be able not only to see performance at a particular point in time and compare it with action limits, but also to look for trends, differentiate between sources of variation, and evaluate for possible correlation.

Statistical summaries can be a dangerous way to present information. A famous demonstration of this is called "Anscombe's quartet" (available on Wikipedia). It demonstrates that four sets of data can have nearly the same average, variance, correlation coefficients, and regression lines, but when viewed graphically will be found to have some significantly different properties.

Outliers

Outliers are data that do not appear to fit with the rest of the data set. They may indicate an error in the data emanating from the source or processing of the data, or they may indicate a significant or temporary shift in performance of the process. They are also sometimes precursors of things to come. Outliers should ideally be detected during the processing of the data,

and if not due to a source or processing error, they should be flagged so that people can quickly focus on finding the cause.

Trending

Displaying data in a line graph allows quick evaluation of change over time, but the time period shown must be sufficient to see equivalent past periods. The resolution and scaling of the graph will impact the ability to detect trends. Graphs should ideally also include targets and benchmarks.

Sources of Variation

One of the worst things that can happen is for people to respond to variation that is not significant, or to not respond when it is. For this reason it is best if line graphs include statistically based control limits that show what normal variation looks like within the process (see Appendix B). Of course, some variation within the limits can also be significant, so people need to know the proper rules for interpreting the graphs.

Correlation

If line graphs of metrics are thought to be related (e.g., control or leading indicators that are expected to affect an output or lagging indicator), these graphs should be placed close to each other so that correlation can be evaluated visually. Of course, statistical analysis would be a better approach, since correlations that are low or are in opposite directions are more difficult to identify visually. Also, a time shift (advance or delay) in one metric may be necessary in order to see the true correlation.

Caution is always necessary when talking about correlation. Just because two variables move in tandem doesn't mean that one causes another. So while correlation might hint of a causal relationship, either logical or experimental testing is required to confirm.

TYPES OF INFORMATION DISPLAYS

Following are common ways of presenting information in order to allow decision making:

Tables—These column/row displays can be useful as supporting information, but they are typically not useful for detecting outliers (unless they are really out there!) or trends. However, when used in combination with limit detection signals (e.g., red, yellow, or green), they can be of value.

Line graphs—When trend analysis over time is desired, a run chart is often the best choice. Multiple lines can be included as long as the scales are equivalent or if two scales are used (one on the left axis and one on the right). However, symbols along the lines are necessary to help differentiate between them.

Bar graphs (horizontal, similar to line graphs)—These also allow comparing performance over time, but they can be especially beneficial when what is being measured has more than one component and there is a desire to see both the total variation and the variation in each of the components, which a stacked bar graph handles well.

Bar graphs (vertical)—This form of display is best for making comparisons among different groups. The groups can be sorted high to low or be arranged in some other logical order.

Pie charts—These are only useful for looking at proportionality (e.g., percentage of the total allocated to each group), since the size of the pie chart itself (i.e., the diameter) is too difficult to interpret.

Figures/diagrams—Anything that makes analysis of the information almost intuitive, such as color-coded maps, meters (e.g., speedometer or gas gauge), or other pictures, can often display data in a way that is much easier to interpret, as the context can often be included or implied.

Graphic supports—Run charts and bar charts should include limit lines (target, benchmark) and an arrow indicating which direction is best (up, down, sideways). Also, adding event notes to graphs to indicate changes that occurred in the process is beneficial. While color can be highly beneficial, remember that not everyone will be able to see the differences, so in some cases different patterns (e.g., cross-hatching) should be used instead of or in addition to color. Symbols or different line types may also be necessary in addition to different colors used in a line graph that has multiple lines.

IMPACT OF TYPE, SCALING, AND TIME SPAN

The human mind is very visually oriented, but takes in only a small amount of the total information available to it. This means that if data aren't properly presented, people can easily make incorrect conclusions and decisions. The type of graph, how it is scaled, and the amount of data included need to be considered.

Figure 5.1 is an example of the same data in three graphs, but the fourth (bottom) has less historical data in it. The difference between the two bar graphs is simply the scale of the *y* axis; in the top graph, the variation is almost washed out. The second bar graph and the first line graph have similar scales, but note how the line graph is easier to read correctly for variation. And the bottom graph, since it has less data, might be interpreted as a slow, downward trend. However, when more historical data are included, it is easy to see that the range of variation is not unusual.

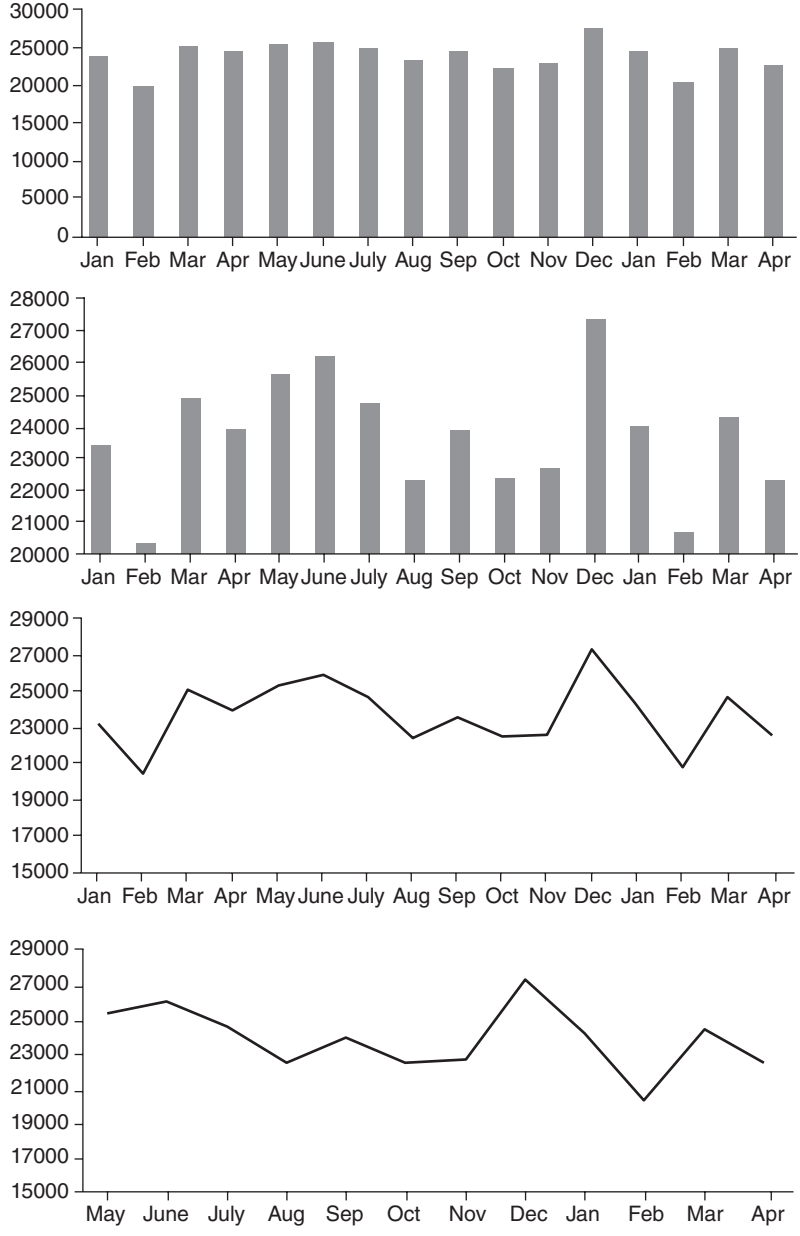

Figure 5.1 Impact of type, scaling, and time span.

Edward Tufte (2001) is a well-known guru on data presentation and visualization. His principles can be summarized as:

- Present a lot of information in a small space
- Promote comparisons of data (over time, macro-level vs. micro-level views)
- Watch proportionality of data vs. graph since it impacts interpretation of the significance of differences
- Use equal time periods
- Use colors and clear labels
- Make key points clearly and immediately apparent, without misrepresentation

WHERE TO PRESENT METRICS

Where metrics are presented needs to take into consideration their multiple and different uses. Obviously where the process is being monitored or controlled is important, so presenting the metrics in these locations allows people to take timely action.

Other stakeholders may also need access to the information, so it may need to be reported through multiple channels. And since performance of one level of the organization is often reviewed at higher levels, some metrics, especially

An organization produced a report summarizing monthly results and reviewed it with operations personnel. This historical perspective did not allow any significant learning or response for day-to-day activities. However, when a graph was placed in the production area at the end of each process line and was updated at the end of the shift by the supervisor, personnel were able to relate what they had done that day to their results. The resulting improvements were rapid!

outcomes/results, will often be reported to higher levels of the organization.

DASHBOARD/SCORECARDS

One way that performance of a work group, a department, a facility, or an overall organization is presented is through the use of what are called dashboards or scorecards. *Dashboards* or *scorecards* are summary views of multiple metrics that allow a quick assessment of overall performance (see Figure 5.2). Some include only a snapshot, while others also include a time-oriented view. A good summary includes color-coding that enables quick assessment, and good scorecards further allow drilling down into supporting information (such as disaggregating a composite metric or looking at the time orientation of data from a snapshot view).

MAKING DECISIONS AND TAKING ACTION

Metrics themselves, like audits, have no inherent value. The value comes from the knowledge gained and how that informs people so that they can take appropriate actions. The actions can

Metric	April	May	June	YTD
Sales	$109M	$110M	$121M	$687M
Profits	$7.3M	$8.2M	$10.1M	$70M
Customer satisfaction	96%	96%	97%	96%
Number of calls	1250	1146	1405	7477
Conversion	30%	32%	34%	31%
Percent vehicle hours	51	53	60	54

Figure 5.2 Example scorecard.

be proactive (e.g., if responding to a leading indicator that will result in better performance of a lagging indicator) or reactive.

Frequency of Reviews

The decision on frequency of reporting and analyzing the data should be made along with the decision to create the measure. Those frequencies will vary based on the purpose of the metric, but in general will be less frequent at higher levels of the organization or the metric hierarchy. For example:

- Process controls are likely to be monitored hourly or daily (or, as is the case with computerized monitoring of some manufacturing processes, hundreds or thousands of times per second!)
- Process outcomes may be evaluated daily or weekly
- Aggregated operational outcomes may be reviewed weekly or monthly
- Strategic outcomes are likely to be reviewed monthly or quarterly

Of course, there is significant variation in frequencies depending on the type of process, organization, and industry. And as more organizations implement computerized business process management systems (BPMSs), many of these reviews will be done more frequently and automatically, raising alarms when action is warranted.

Actions to Take

When reviewing a metric, an individual/organization will make one of the following decisions:

- None: The metric is performing as desired and/or expected
- A change in the average is desired in the upward or downward direction in order to change the level of performance

- A change is desired in the process to reduce or increase the amount of variation

Creating the desired change requires identifying and effecting respective control metrics or factors, or leading indicators and their associated processes. However, although change may be desired, there are other considerations:

- Are sufficient resources (financial, personnel, technical expertise, and time) available to create the change?
- Is the change effort important enough relative to other possible allocations of those same resources?
- What might not be known that could impact whether the change is appropriate?

When a change is made, it is important that it be documented (to allow traceability) and communicated to those who need to act on it or who may be able to detect any adverse affects. After the change, the metric should be monitored to see whether the desired result was achieved, and if so, whether the same change could be applied elsewhere in the organization (leveraging the learning).

For some processes, preplanned responses to metrics may be defined, as the automotive industry does in control plans used to monitor production processes. This is less feasible when dealing with higher-level metrics where cause-and-effect relationships are more complex. The point, though, is that metrics have little value if people don't know how to interpret and respond to them.

This means that in some organizations there is a need to consider whether sufficient data literacy exists. Do people know how to read graphs (which requires spatial skills for dealing with the combination of magnitude and direction)? Do they have the ability to think logically about cause-and-effect relationships? Can they think probabilistically? One way to think

about it, as I often state during my training courses, is that data do not answer questions. Instead, they raise questions the organization needs to answer.

The Use of Analytics

In organizations where the amount of process data available is extensive (e.g., data collection has been done over a long period of time or involves a high number of computerized transactions in a short period of time), the use of analytics provides opportunities to leverage metrics even further. This typically involves the use of databases (or specialized data marts) and statistical software that allows extensive quantitative/statistical modeling.

The terms "business intelligence" and "predictive analytics" are often used to describe this application, and some organizations that have been defined as highly effective in the use of the technology include Marriott International, Harrah's (now Caesars) Entertainment, Progressive Insurance, the New England Patriots, and Walmart. Each carved out a strategic application for the use of analytics that significantly impacted business performance, whether it be revenues, speed, customer retention, or win rates.

However, success of these initiatives highly depends on the quality of the data being used. This is a lesson for anyone involved in the use of metrics. Poor or inconsistent operational definitions, the lack of data entry standards, and questionable accuracy and reliability of the data source can bring a halt to the effective use of metrics.

6

Psychological Impact of Metrics

This book provides information on the value of performance metrics for helping management of processes and organizations. That's the good news. Unfortunately, there is also bad news.

If you ask people to remember times in their past when measurements were used, they often think of:

- Grades received in school
- The time of night their parents required them to be home
- Highway patrol using radar to issue speeding tickets
- Personnel evaluations

Many people don't have a positive view of metrics, since metrics have often been imposed on them or used against them in the past.

Medicare and several insurance companies have stated they will no longer pay for extra health care services caused by what they deem hospital errors (called "never events"). Patient falls in the hospital are one such example. Physician Bob Wachter (2009) wrote a great blog titled "Strapping Grandma to the Bed," in which he imagined what hospitals might do to respond to this use of a metric such as "number of never events" and how it might be used against them.

However, metrics provide feedback on how well an organization and/or process is working; properly used, metrics can facilitate learning.

In his later years Deming modified Shewhart's PDCA model to PDSA, changing the Check step to a Study step. In effect, he was saying that if, when results are checked, they are different from what was expected, then there's something the organization doesn't know. Either some of the theories (e.g., cause-and-effect relationships) on which the plan was developed are incorrect, or the plan itself wasn't carried out as expected.

Metrics can be positive when they communicate what is important. In fact, goal setting and performance monitoring is one technology used by organization development professionals to help drive change in organizations. Of course, people need to have the capability and authority to act on the metrics, or they will feel powerless.

COMMON PROBLEMS WITH METRICS

Following are some of the more common issues found when looking at the metrics used within organizations:

- *The metric doesn't capture what is intended.* For example, organizations often assume that if a customer indicates they are highly satisfied, they will return the next time they want to make the same type of purchase. Given the wide range of options and pricing strategies of the competitive marketplace, this might not be an accurate interpretation.
- *The metrics ignore other factors that might also be important.* This was referred to in Chapter 3 as a gap. For example, ensuring that clean laundry is available for hotel

housekeeping personnel might ignore the actual condition of the linen.

- *There are too many metrics, causing overload.* One way to deal with such a problem is to alter the reporting frequency of those metrics that are less critical.
- *People are not able or do not know how to respond to measures.* This could be caused by a simple inability to read the data, lack of cause-and-effect thinking, or lack of training as to what is and what is not an appropriate response to a particular type of situation.
- *The metrics focus on what is easy to measure rather than what is important.* A Dilbert cartoon points out the same problem referred to in Chapter 2 regarding IT help-desk metrics. While Dilbert wants an effective resolution to the technical problem he has encountered, the phone tech support person just wants to keep the call short. Guess who wins?

Table 6.1 gives examples of both a poor metric and a corresponding better metric that might be used in particular environments.

Table 6.1 Comparing metrics.

Poor metric	Better metric
Traffic to a website	Sales made through the site
Percentage of employees with college degrees	Performance of the employees
Number of people who don't smoke	Number of people who never smoked
Auto gas mileage	Total operating cost/mile

GAMES PEOPLE PLAY

Since metrics provide transparency, everyone in the organization can see how well its processes are performing, and thus the process owners may take defensive measures to make sure they look good. Following are some typical examples:

- *Setting easy targets*—If the target for a particular metric isn't imposed by others, in order to ensure that it will be hit, people will make sure not to set a stretch goal. Of course, setting a stretch goal might cause them to achieve better results, but if they don't hit it . . .
- *Accelerating or delaying activities*—A classic example of this (I have not confirmed this independently) is a computer manufacturer that used to ship a computer chassis to the customer site without installing several of the required circuit boards. This allowed the facility shipping the computer to claim it as shipped, even though many of the critical components had to be installed later by field service personnel.
- *Suboptimization*—This is making oneself look good at the expense of others, including the whole organization. The classic example here is that the purchasing department finds a supplier of a component that sells it at a lower cost, and then claims a cost savings for the company (and is rewarded for that savings). However, the lower-cost item may in fact be of lower quality, causing huge disruptions of production operations, customer operations, warranty, and the supply chain.
- *Changing or poor scaling of graphs*—A popular US newspaper is famous for this. It sets the *y* scale on its graphs to make what is actually a small increase (e.g., in accidents, death rates) appear large (e.g., a 5% increase may appear to be a 500% increase).

- *Aggregates vs. segmentation*—Imagine having three different metrics but reporting them as one by aggregating them. The ability to see whether any of the three is degraded can easily be offset if another happens to improve at about the same time. So while overall performance may appear stable, there may actually be significant variation in some of the underlying data.
- *Focusing on what is good and ignoring the bad, or what is known as cherry picking*—We see this when a politician is discussing his or her accomplishments. People in business organizations do the same thing, reporting on their successes and ignoring the bad stuff, hoping no one will notice.

RESPONSES TO CHANGES IN METRICS

It's also useful to consider how adding a new metric, or changing or deleting one, can cause concern among some people. Following are some examples:

- Adding a new metric often elicits defensive responses since people may interpret it as monitoring of their performance. They will typically cast doubt on the validity or the source of the data. Allowing a period of time for people to evaluate the metric to gain confidence in its value can help.
- Changing an existing metric (e.g., operational definition or how it is normalized) can also upset some people. They may interpret it as raising the bar (e.g., invalidating previous performance) or shifting priorities. It is important that the rationale behind such changes be clearly communicated, and again, a period for developing comfort should be allowed.

- One might not think that deleting a metric would elicit negative responses. But remember, change is change! Once people have gotten comfortable with using a set of metrics, they are likely to be concerned with loss of control if a metric is deleted. Consider what would happen if automakers stopped putting fuel gauges on the dashboard and simply added a light that went on when the fuel got below a certain level. Again, clear communication as to why the change is being made, along with supporting validation studies, can help.

AVOIDING PROBLEMS WITH METRICS

Being aware of the issues mentioned is, of course, one way to avoid them. Other things that can be done include:

- *Understand that it is a multivariate world.* No matter how many metrics an organization has, there may still be surprises and frustrations, or even unexplainable successes. There are so many factors that can impact performance, some of which are not under the control of the organization. However, by monitoring what is believed to be important, the organization may be able to at least explain, if not control, undesirable deviations.
- *Select/review metrics from a systems perspective.* A systems perspective means understanding that organizations are complex adaptive systems and are not as linear and predictable as a machine. This means allowing certain metrics to perform at what seems less than optimum in order to allow other factors to be improved.
- *Focus on learning.* As Deming stated, it's all about learning. If we had perfect knowledge, things would be easy. But we don't, so we should always be striving to increase

our knowledge, especially in a complex world where what works in one time period may not work in another.

- *Don't tie financial rewards to specific metrics for individuals.* No doubt I will get some pushback on this one. Human beings do strange things when money is involved. For high-level overall organizational performance, where the effects of suboptimization will show up, financial incentives are fine. But even then the organization must ensure that a balanced set of metrics is used to calculate the benefits. Tying individual rewards to a narrow set of metrics is hazardous to organizational health, as people will do what will enrich themselves but hurt the entire organization in the long run. An example from the airline industry involved paying pilots based on fuel usage. Guess what happened? Turning off the air conditioning and flying more slowly to conserve fuel resulted in unhappy customers (Marquis 2006).

7

Maintaining the Metrics

THE METRICS LIFE CYCLE

Everything ages, albeit at different rates. Change occurs quickly or slowly. The system decays and/or develops. These are all different ways of talking about a life cycle.

Metrics are no different. What may make sense to measure in the future might be different from what works well now. So organizations need to continually ask these questions:

- Who are our customers and stakeholders?
- What are their requirements, needs, and interests?
- How can we monitor compliance with those requirements?
- What resources and controls are necessary in order for the process to meet the requirements?

In effect, metrics may need to evolve when there has been a change in customers or stakeholders, a change in the specific requirements of the customer or stakeholder, or significant changes to the processes used to meet those requirements.

Figure 7.1 is a curve familiar to systems thinkers. It indicates that as a system begins operating, performance slowly rises. As it begins to gain experience, the rate of change will increase, and it will grow very rapidly as long as the system continues to have a synergistic relationship with the environment in which

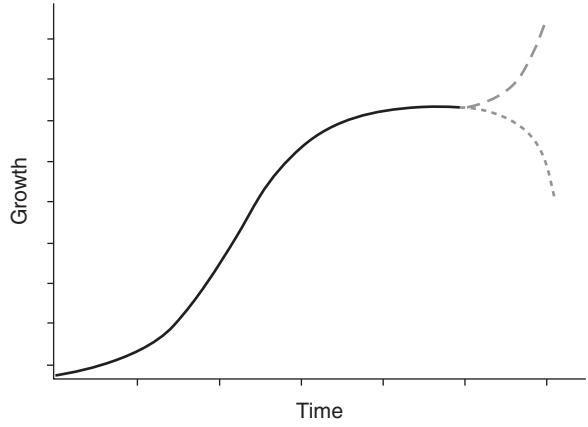

Figure 7.1 The growth/maturity curve.

it is operating. However, at some point the rate of growth will begin to level off and the system will either go into decline (the curve begins turning down) or change to where it now has significantly new capabilities, which starts the curve all over again as if it were a new system. This concept applies to organizations, to products, to people's learning, and even to many plants and other biological organisms.

The metrics that will be useful at a particular point in time might then be different, depending on where the organization, its products, and its processes and people are in this life cycle. In effect, organizational strategy usually shifts to account for whether the company is a start-up, is a growth company, or is serving a mature market. When strategy shifts, so too should the metrics used to manage and monitor performance.

The metrics might need to be modified at any point in the curve. Examples are when:

- Performance of the organization/process is deemed inadequate, requiring modification of how processes are managed.

- The relationships between leading and lagging metrics are better known, so a shift occurs in which types of metrics are used more prevalently.
- A strategic move (e.g., different market segments) that will require additional metrics is about to take place. An example would be a restaurant that currently serves just dinner deciding to also offer lunch. Rather than just tracking sales, the restaurant will likely want to track dinner and lunch sales separately, plus the aggregate.

Because metrics tend to evolve over time, organizations should occasionally take time to review the adequacy of their current metrics. Following are typical triggers for this review process:

- *As part of strategy setting and reviews*—When the strategic plan is developed or revised, or a review is conducted of how well it is working, the viability of current metrics should be questioned.
- *When the external marketplace changes significantly*—If the environment served by an organization shifts (e.g., economic, social, technological, or regulatory factors), a change in processes and what is measured may also be necessary.
- *When surprised or disappointed with results*—If the organization is surprised, whether positively or negatively, this may be telling them that there's something they didn't know, understand, or predict. This indicates the potential to alter the metrics mix to make it more robust.
- *As part of ongoing operational reviews*—Not all changes to metrics will be driven by a high-level change (e.g., strategy, marketplace, product maturity). Some may occur simply because an operational review of a particular process or department has identified opportunities to improve how that portion of the organization is managed.

THE SUPPORTING INFRASTRUCTURE

Oh, if only the processes for selecting, detailing, collecting, reporting, using, and reviewing metrics were as simple as (it is hoped) this book has presented. The reality is that it can be a significant undertaking if the organization has for a long time been operating primarily only with high-level, financially oriented metrics. As some authors state, designing the metrics (the primary focus of this book) is primarily a cognitive process, but implementation is a manual exercise that needs to be effectively managed (Bourne et al. 2000).

Luckily, the Baldrige Award, ISO 9001 and its industry derivatives, industry associations, lean production, and other methods for improving organizational performance have pushed many organizations to deploy broader and more detailed metrics. However, not everyone who picks up this book will necessarily be in an organization that has a sophisticated infrastructure for managing organizational metrics.

Let's think about some of the potential decisions/needs:

- Who will decide what metrics will be deployed? Will this be done by each process owner, or will personnel involved in the process be included in the decision process?
- Who will define the details for each metric? Who has sufficient understanding of measurement theory and can help ensure that metrics are properly designed?
- Who will set up the processes or interfaces for collecting the data? Which metrics will involve manual data collection, which metrics will require gaining access to certain sources, and which metrics will be automated?
- How will the reports be generated and distributed? How many reports will be available within the organization's current business software (e.g., enterprise resource

planning system)? Which ones might need to be created using Microsoft Excel or Crystal Reports?

- What training/development will be necessary in order to help people make effective decisions based on the metrics? What knowledge gaps exist and how will they be filled?

If the number of new metrics likely to be identified is more than a few, there is likely to be a need for a metrics team to oversee the process. The group might consist of individuals from finance, IT, HR, operations, and quality, who bring a range of skills necessary for supporting the process.

The rollout to lower levels and across the organization can be either a centralized process or a decentralized process whereby process owners, along with members of the management team or a business analyst, work to identify metrics for their respective processes.

A project plan should be developed to guide the process, ensuring that resources are available for both design and implementation. The time required will likely be months just for identifying and detailing the metrics, and much more for implementation (developing reports, collecting and validating the data, and training). Sufficient attention should also be paid to whether currently existing measures are useful or should instead be modified or deleted.

The plan should also address concerns that employees may have about how the metrics might be used inappropriately. In some cases it will require and/or create a significant cultural shift, and it will require conversations across the organization to help people understand the importance of metrics and how they will be used. Pilot testing of metrics (e.g., putting them in place but not immediately requiring their rigid use) can help alleviate some concerns about potential negative impacts.

One thing to avoid is turning metrics management into a major IT project. It is far better to try doing it manually or with small applications than to develop or purchase a major software package for managing metrics. Some reasons include:

- It will add significantly to the amount of time required
- It will lock the organization into a large application that may not have the flexibility needed
- The failure rate of IT projects is far too high to risk subjecting personnel to this additional headache

This doesn't mean that a BPMS won't eventually be used. Companies such as Procter & Gamble and Siemens have very advanced metrics management systems called decision cockpits, but trying to integrate many metrics into such a system would be better done after the organization has proved that it can effectively gather and use performance management data.

And finally, as with any change in an organization, an audit process should be considered that will monitor how well metrics have been identified, deployed, and used. This becomes the Check in the PDCA process for metrics management. Such an audit should be performed after each deployment stage of new metrics, so as to ensure that the potential value added will be achieved.

IMPROVING PROCESS MANAGEMENT

While the primary focus of this book is on performance metrics, it is also a book about process management, which means using a process perspective to manage an organization. Many aspects impact how well process management is carried out in each organization, and therefore it is worthwhile to summarize them here.

Table 7.1 is a maturity matrix that I developed to help personnel understand some of the issues. As it indicates, an

Table 7.1 Process management maturity matrix.

Level		Assessment Criteria					
		Activities	**Metrics**	**Ownership**	**Connections**	**Improvement**	**Changes**
Improved	5	Processes/ activities are continually improved	Metrics are altered as necessary to identify new opportunities; leading metrics are used where feasible	Process owners place high value on ensuring that all employees have ownership of processes	Internal customers and suppliers work together on improvement projects	Processes have been continually improved in line with business objectives and desired outcomes	The method for changing processes is continually upgraded to provide rapid and effective response to changing needs
Managed	4	Processes/ activities are reviewed for acceptable performance	Metrics are reviewed regularly to provide feedback and improve	Process owners regularly discuss process performance with team members	Discussions between internal customers and suppliers have resulted in process changes	Process improvement is regularly carried out but may not impact business performance	Process changes are evaluated, validated, and documented

(continued)

Table 7.1 Process management maturity matrix. *(continued)*

Level		Assessment Criteria					
		Activities	**Metrics**	**Ownership**	**Connections**	**Improvement**	**Changes**
Standardized	3	Processes are documented and personnel trained in them	Standard metrics are in place for most processes but do not impact performance	An owner has been identified for most processes	Regular feedback exists between internal customers and external suppliers	A standard process improvement methodology exists	A process for reviewing and approving process changes exists
Repeated	2	Personnel try to replicate actions each time	Processes are measured when there are problems	Individuals are responsible for certain portions of processes	Discussions occur between members of related processes when there are problems	Attempts are made to improve processes when there are problems	Sketchy records are kept of process changes
Unmanaged	1	Processes are carried out as each person sees fit	Performance of processes is not measured	Anyone or no one may claim to own a process	Interconnection of processes has not been discussed	Processes are seldom improved	Anyone can make a process change

organization can develop different levels of capability/competency, and a maturity matrix for self-assessment can be useful for identifying not only the current status but also what improvements might be available. Using a radar chart to demonstrate overall organizational status, as well as individual charts for each process, would be one way to display this information as a metric.

For an organization that wants to implement process management to its fullest potential, the use of a business process management office (BPMO) or team is an option. Similar to project management offices that help develop standards for managing projects, a BPMO can guide an organization in the implementation of process management. In a large organization the BPMO might be a dedicated group, while in a small organization it might simply be a committee that meets on a regular basis to guide and monitor progress.

Regardless of how the BPMO is organized, the following issues need to be addressed:

- What is the business architecture (e.g., core processes and enabling processes and their interrelationships)?
- What is the current level of process management maturity?
- What are the priorities (which should be aligned to strategy) for where process management will first be improved?
- What levels of skills need to be developed within the process owner community?
- What standards would be useful for data, information displays, problem solving, and process improvement efforts?

As the organization becomes more advanced, the BPMO can help drive continuous improvement through guiding the implementation of:

- Improvement methodologies such as Six Sigma, lean, theory of constraints, and so forth

- BPMSs that integrate workflow and metrics
- The use of organizational data to develop more in-depth understanding of cause-and-effect relationships between processes (e.g., through sensitivity analysis of metrics, analytics, and business intelligence)

Regardless of what type of organization one works within, there are always opportunities for improvement. Without metrics, it is difficult to know how well the overall organization and each level of the process are working, and it is hoped that this book will help lead you along the path.

Appendix A

Basic Measurement Theory

Measurement theory is based on the principle that we learn about our world by making observations and then quantifying those observations. Whether it's in the physical sciences, the social sciences, or our daily lives, the need to measure is vital to explanations of what we know or think we know. Much of the progress in science comes when we develop new or more precise measurement systems that allow us to observe and explain things better than before.

In order to quantify something, a measurement scale is needed, and if the measurements are to be useful over the long term (e.g., allowing comparison), the scale needs to be standardized in some way. Imagine how poorly a GPS would estimate distance if a mile in one state were a different length than a mile in another state.

So there are standards for weight (e.g., pound, kilogram), length (e.g., inch, centimeter), and probably any other agreed-to physical property in science (e.g., pH in chemistry, volt in electronics). This allows comparisons to be made from one location to another, or from one time to another, if the measurement has been made using a standardized and accurate measurement device.

Another way to quantify our observations is simply to count the number of times that something occurs or exists (e.g., number of students who graduated from a particular college).

Even here there are standards, since varying numbering systems (decimal, binary, octal, etc.) have been established.

However, whether the quantities are measured or counted, they will not always be accurate. Imagine that your car's speedometer is incorrect, or that whoever counted the number of students made an error. These are examples of the two types of primary measurement errors (see Figure A.1):

- Accuracy/validity: This is how far the measured/counted value is from the true value. Imagine a person who is target shooting and consistently hits somewhere on the target, but not in the center.
- Precision/reliability: This is how much scatter there is in the values if one would make the same measurement/count over and over. Imagine the target shooter who consistently hits the same point on the target.

To reduce errors in measurement, calibration or training is often done in order to improve accuracy and reliability. Reducing the noise (external interferences) that makes it difficult to capture the real value is also done.

Not everything is easily quantified, but there may still be a desire to measure it. In such cases the simple presence or absence, or degree of observability, is somehow recorded. A typical example is the use of sensory data (sight, smell, taste,

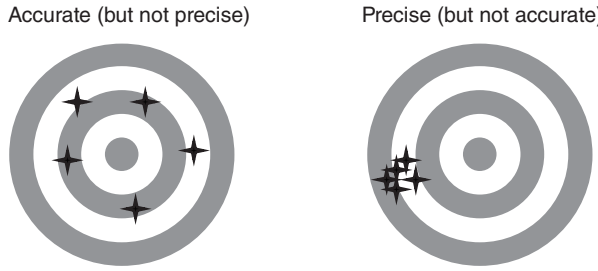

Figure A.1 Measurement error.

touch, hearing). Subjective scales that attempt to capture relative changes in degrees of the factor are often used when trying to quantify the information. While this may mean the data are not highly accurate, it is perceived as more useful than no measurement at all.

There are three types of measurement scales, each oriented toward measured, counted, or sensory-type data:

- Interval/continuous/variable—This scale has an unlimited number of possible values, limited only by the resolution (e.g., number of significant digits or decimal places) of the measuring device. Of course, there are physical limitations imposed by what is being measured, such as the height of a person (typically not above 8 feet).
- Nominal/discrete/attribute—This scale consists of integers only (e.g., a university cannot graduate a partial student).
- Ordinal—This scale uses descriptors to describe levels, although the gap between levels may not be mathematically equivalent. Examples include a son, a father, and a grandfather, or a freshman, a sophomore, a junior, and a senior. While the descriptor reflects the individual's role in a particular hierarchy, the number of years of age, or of college credits, will not be the same between each level for two sets of data.

Each type of measurement can be displayed in various ways. While tables showing raw data or statistical summaries are useful, visual or graphic displays are highly preferred, especially when trying to compare two or more points or sets of data.

Appendix B

Statistical Control Limits

Think about how long it usually takes to get home from work (or go grocery shopping, play a round of golf, etc.). You're probably thinking of a range, such as 20–30 minutes, with 25 being the midpoint (see Figure B.1).

So as long as it takes between 20 and 30 minutes it's just a normal day. But if it takes 34 minutes, something is different about that day. Perhaps it was an abnormal traffic condition caused by rain or a new road construction project. Whatever the cause, this data point is considered to be an outlier, and the cause is considered a "special" cause.

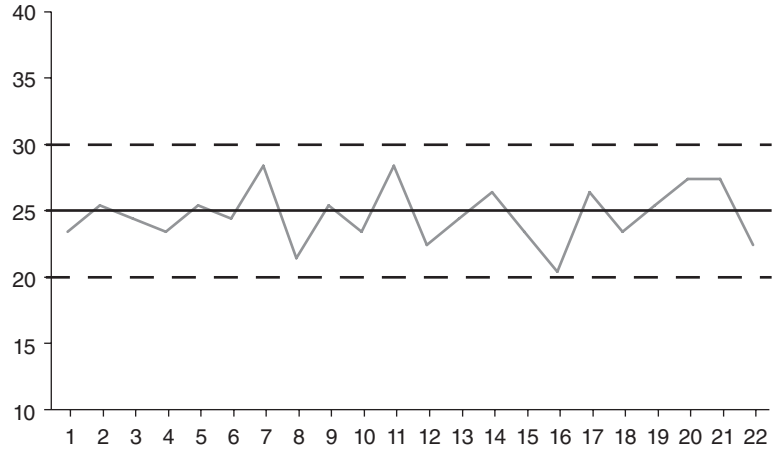

Figure B.1 Analyzing variation in a process.

This same concept can be applied to any measurement, such as a performance metric used within an organization. If data are collected for a while, the normal amount of variation can be determined and future data can be compared with that. If it's within the same range, it is assumed that nothing has changed. But if the latest data point is outside the limit, it is assumed that something is different. And there might be interest in finding out what is different, either because the organization would like to prevent it from occurring again or because it would like to replicate it over and over.

Rather than just using a range, simple statistical calculations are done in order to find the normal amount of variation in the data. These calculations define the control limits. The formulas are different depending on whether the data are measurement data or count data, as well as whether they contain a single piece of data or multiple pieces at each time interval.

This time-oriented statistical analysis is known as statistical process control (SPC). Within SPC, many different types of charts can be used, such as X/MR charts or X-bar/R charts for variable data, and *p* charts or *u* charts for count data. Regardless of the type of chart used, the control limits on the chart demonstrate the normal amount of variation in the process.

There are also many rules for interpreting whether new data are considered "in control" (part of normal variation) or "out of control" (special variation). For example, not only is a single point outside the control limits likely considered a special cause, but also several points in a row on the same side of the average/center line (this would be like flipping a coin and continually getting the same side up).

The difference between common and special causes is critical, because it calls for different types of responses:

- For a metric where there is a special cause, one or more specific factors have created the shift in performance, and those specific factors must be identified if the shift is

to be prevented or intentionally duplicated in the future. This is the purpose of root cause analysis, to identify the reason for the shift in performance.

- For a metric where there are no special causes, this indicates that it is stable (i.e., in control). Thus, if the organization wants to improve performance of the process, it could change many possible factors. The organization would first identify those factors that it believes might be more useful (i.e., have a greater impact) and then do a feasibility and cost-benefit analysis.

A caution is warranted here. The use of statistical control limits was originally designed for and suited to processes where there is a desire to maintain some target level. However, in our organizations we often want to intentionally and continually drive a particular metric in the upward or downward direction. In addition, some industries have cyclical variation (e.g., seasonality) that will impact control limits. So, while statistical limits can help us understand variation in our processes, their application/interpretation require an in-depth understanding of the underlying dynamics of the process being measured.

Appendix C

Example Metrics

Table C.1 is only a small sample of the metrics used by organizations (for a listing of thousands of metrics, go to http://www.kpimegalibrary.com). They are presented only to demonstrate the range of potential performance measures organizations might use, depending on their industry, strategy, sophistication, and maturity. Although indicated as used by one specific type of organization, the same metric will often be used by many different types, with somewhat modified terms.

Table C.1 Example metrics.

Metric name	Business type/area
Units sold per salesperson	Auto dealership
Number of products/customer	Banking
Loan loss ratio	Banking
Customer satisfaction	Business general
Customer complaints	Business general
Return on investment	Business general
Return on capital employed	Business general
Return on equity	Business general
Delivery performance to customer	Business general

Table C.1 Example metrics. *(continued)*

Metric name	Business type/area
Customer retention rate	Business general
Gross margin	Business general
Rework	Business general
Budget performance	Business general
DPMO—defects/million opportunities	Business general
PPM—parts/million (defects)	Business general
FPY—first pass yield	Business general
Time to market	Business general
Percentage of revenues from products launched in last two years	Business general
Revenue per full-time employee (FTE)	Business general
Abandon rate	Call center
Sales volume	Call center
Calls resolved in one try	Call center
Number of calls answered	Call center
Number of tickets older than *x* days	Call center
Average speed of answer	Call center
Average talk time	Call center
Average wrap-up time	Call center
Upsell or cross-sell revenue	Call center
System utilization	Call center
System availability	Call center
Energy efficiency	Construction
Maximum occupancy	Construction
Billable hours	Consulting
Graduation rate	Education

Table C.1 Example metrics. *(continued)*

Metric name	Business type/area
Rating by accreditation agency	Education
Full-time student %	Education
Acceptance rate	Education
Endowments per full-time student	Education
Student-to-faculty/staff ratio	Education
Number of design changes	Engineering
Product component reuse	Engineering
Number of patents	Engineering
R&D expense as a percentage of sales	Engineering
Reliability	Engineering
Quick ratio	Finance
Current ratio	Finance
Sales/employee	Finance
Intellectual capital	Finance
Accounts receivable past 60 days	Finance
Cash on hand	Finance
Number of patient falls	Hospital
Number of postoperative infections	Hospital
Length of stay (LOS)	Hospital
Insurance claims rejected	Hospital
Use of guest's name	Hotel
Room cleanliness	Hotel
Percent occupancy	Hotel
Employee turnover	Human resources
New resources or knowledge acquired	Human resources
Number of employees trained	Human resources

Table C.1 Example metrics. *(continued)*

Metric name	Business type/area
Training classes held	Human resources
Training satisfaction rating	Human resources
Days key positions are vacant	Human resources
Manager satisfaction with new hires	Human resources
Turnover rate of new hires in the first year/ second year	Human resources
Dollar impact of a bad hire in a key position	Human resources
Pay and benefits costs to generate a dollar of revenue	Human resources
Percentage of employees rated in the top performance appraisal level and paid above the average salary for the position	Human resources
Percentage of new hires reporting excellent training opportunities	Human resources
Experience of mentors/mentees in a mentor program	Human resources
Attendance	Human resources
Grievances	Human resources
Recordable incidents	Human resources
Lost work days	Human resources
Terminations	Human resources
Head count	Human resources
Fraction of prior work reused	Information technology
Customers supported	Information technology
Software applications supported	Information technology
Computers supported	Information technology
Visits to website	Information technology
Number of spam/viruses blocked	Information technology

Table C.1 Example metrics. *(continued)*

Metric name	Business type/area
System uptime/downtime	Information technology
Number of seats	Information technology
System search/retrieval time	Information techology
Maintainability	Maintenance
Work backlog	Maintenance
Preventive maintenance compliance	Maintenance
Ratio of preventive to emergency maintenance hours	Maintenance
Overall equipment effectiveness	Manufacturing
Total effective equipment performance	Manufacturing
Indirect costs as % of total costs	Manufacturing
Cost of poor quality	Manufacturing
Average setup time	Manufacturing
Order cycle time	Manufacturing
Manufacturing cycle time	Manufacturing
Process capability/Cpk	Manufacturing
Market share	Marketing
Brand awareness	Marketing
Response rate to advertising	Marketing
Time required to develop and launch a new marketing initiative	Marketing
Click-through rate	Online advertising
Overtime rate	Operations
Accident ratios	Operations
Finished goods quality	Operations
Inventory turns	Operations
Capacity	Operations

Table C.1 Example metrics. *(continued)*

Metric name	Business type/area
No-shows	Physician office
Number of suicides	Prison
Number of repeat offenders	Prison
Number of escapees	Prison
Project completion rate	Project management
Projects on cycle time or schedule	Project management
Project latency (wait times)	Project management
Earned value variance	Project management
Supplier performance	Purchasing
Reduction in spend	Purchasing
Supplier turnover	Purchasing
Supplier lead time	Purchasing
R&R—measurement system variability	Quality
Quality department expense as percentage of sales	Quality
Quality department expense as percentage of quality costs	Quality
Timeliness of quality evaluation reports	Quality
Requests for support by other departments	Quality
Number of audit nonconformities	Quality
Percentage of false positives	Radiology
Percentage of false negatives	Radiology
Inventory shrinkage	Retail
Sales per square foot	Retail
Same store (versus new store) sales	Retail
Traffic	Retail

Table C.1 Example metrics. *(continued)*

Metric name	Business type/area
Number of events that occurred that were not predicted	Risk management
Count of sales leads	Sales
Dollar value of sales	Sales
Number of calls made	Sales
Marketing expense	Sales
Conversion rate	Sales
Referrals gained	Sales
Testimonials gained	Sales
Calls per sales rep	Sales
Customer lifetime value	Sales
Test case efficiency	Software testing
Defect severity	Software testing
Churn	Telecom

References and Recommended Reading

APQC. "Process Classification Framework." http://www.apqc.org/process-classification-framework/.

Bertles, Thomas. 2010. "The Art of Measuring What Matters." *iSixSigma,* November/December.

Bititci, Umit, and Jill C. MacBryde. 2002. Special Issue on Performance Measurement. *International Journal of Operations and Production Management* 22 (11).

Bourne, Mike, John Mills, Mark Wilcox, Andy Neely, and Ken Platts. 2000. "Designing, Implementing and Updating Performance Measurement Systems." *International Journal of Operations and Production Management* 20 (7): 754–771.

Brown, Mark Graham. 2006. *Keeping Score: Using the Right Metrics to Drive World-Class Performance.* New York: Productivity Press.

Byatt, Gareth, Gary Hamilton, Jeff Hodgkinson, and Duke Okes. 2012. "Measuring the Value of Program Management Office." CIO, July 24, http://www.cio.com.au/article/431392/measuring_value_program_management_office/.

Davenport, Thomas H. 2007. *Competing on Analytics: The New Science of Winning.* Boston: Harvard Business School Press.

Faldu, Tejas, and Srikanth Krishna. 2007. "Supply Chain Metrics That Measure Up." *Supply & Demand Chain Executive,* April/May.

Few, Stephen. 2006. *Information Dashboard Design: The Effective Visual Communication of Data.* Sebastopol, CA: O'Reilly.

Gardner, Robert. 2004. *The Process-Focused Organization: A Transition Strategy for Success.* Milwaukee, WI: ASQ Quality Press.

Hammer, Michael, Anders Wester, Carole J. Haney, Rick Ciccone, and Paul Gaffney. 2007. "The 7 Deadly Sins of Performance Measurement and How to Avoid Them." *MIT Sloan Management Review* 48 (3): 19–28.

Harbour, Jerry L. 2009. *The Basics of Performance Measurement.* 2nd ed. Boca Raton, FL: CRC Press.

Hatch, David. 2007. "Smart Decisions: The Role of Key Performance Indicators (KPIs)." White paper for the Aberdeen Group. Accessed November 16, 2012. http://www.dashboardinsight.com/articles/digital-dashboards/fundamentals/smart-decisions-the-role-of-key-performance-indicators-kpis.aspx.

Hatry, Harry P. 2006. *Performance Measurement: Getting Results.* Washington, DC: Urban Institute Press.

Howell, Marvin T. 2006. *Actionable Performance Measurement: A Key to Success.* Milwaukee, WI: ASQ Quality Press.

Hubbard, Douglas W. 2007. *How to Measure Anything: Finding the Value of "Intangibles" in Business.* Hoboken, NJ: John Wiley and Sons.

Janczak, Roger. 2012. "Meaningful Performance Metrics for Compliance." In *Achieving Quality and Compliance Excellence in Pharmaceuticals,* edited by Madhu Raju Saghee, 459–478. http://businesshorizons.com/sample_pages/compliancemetricssample.pdf.

Kaplan, R., and D. Norton. 1996. "Using the Balanced Scorecard as a Strategic Management System." *Harvard Business Review,* January–February, 75–85.

Kellen, Vince. 2003. "Business Performance Measurement: At the Crossroads of Strategy, Decision-Making, Learning and Information Visualization." http://www.kellen.net/bpm.htm.

Kennerley, Mike, and Andy Neeley. 2002. "A Framework of the Factors Affecting the Evolution of Performance Measurement Systems." *International Journal of Operations & Production Management* 22 (11): 1222–1245.

Klubeck, Martin. 2011. *Metrics: How to Improve Key Business Results.* Berkeley, CA: Apress; Distributed by Springer Science+Business Media.

KPI Mega Library. http://www.kpimegalibrary.com.

Marquis, Hank. 2006. "7 Dirty Little Truths about Metrics." itSM Solutions, July 5. http://www.itsmsolutions.com/newsletters/DITYvol2iss26.htm.

Napier, Rod, and Rich McDaniel. 2006. *Measuring What Matters: Simplified Tools for Aligning Teams and Their Stakeholders.* Mountain View, CA: Davies-Black.

NASA. "EVM Implementation Handbook." http://evm.nasa.gov/handbooks.html.

Neely, Andy. 2002. *Business Performance Measurement: Theory and Practice.* Cambridge: Cambridge University Press.

"Non-financial Performance Measures: What Works and What Doesn't." Knowledge@Wharton, December 6, 2000. http://knowledge.wharton.upenn.edu/article.cfm?articleid=279.

Okes, Duke. 2008. "Driven by Metrics." ASQ *Quality Progress,* September, 48–53.

———. 2009. *Root Cause Analysis: The Core of Problem Solving and Corrective Action.* Milwaukee, WI: ASQ Quality Press.

Parmenter, David. 2007. *Key Performance Indicators: Developing, Implementing, and Using Winning KPIs.* Hoboken, NJ: John Wiley and Sons.

"Performance Measurement Challenges and Strategies," June 18, 2003, http://www.whitehouse.gov/sites/default/files/omb/part/challenges_strategies.pdf.

Phelps, Bob. 2004. *Smart Business Metrics: Measure What Really Counts and Manage What Makes the Difference.* Upper Saddle River, NJ: Prentice Hall/Financial Times Management.

Poister, Theodore H. 2003. *Measuring Performance in Public and Nonprofit Organizations.* San Francisco: Jossey-Bass.

Pyzdek, Thomas. 2007. "Managing Metric Madness." *Quality Digest,* February.

Schonberger, Richard J. 2008. "Lean Performance Management (Metrics Don't Add Up)." *Cost Management,* January/February, 5–10.

Spitzer, Dean R. 2007. *Transforming Performance Measurement: Rethinking the Way We Measure and Drive Organizational Success.* New York: American Management Association.

Tufte, Edward R. 2001. *The Visual Display of Quantitative Information.* 2nd ed. Cheshire, CT: Graphics Press.

US Department of Defense. *Earned Value Management Implementation Guide.* http://guidebook.dcma.mil/79/EVMIG.doc.

US Department of Energy. 1995. *How to Measure Performance: A Handbook of Techniques and Tools.* http://www.orau.gov/pbm/documents/handbook1a.html.

Wachter, Bob. 2009. "Strapping Grandma to the Bed: The Unintended Consequences of 'No Pay for Errors.'" Wachter's World. http://community.the-hospitalist.org/2009/07/07/strapping-grandma-to-the-bed-unintended-consequences-of-no-pay-for-errors/.

Watson, B. 2012. "How P&G Maximizes Business Analytics." *CIOInsight,* January, 18–20.

Index

Note: Page numbers followed by *f* refer to figures; those followed by *t* refer to tables.

A

accuracy, 30, 32, 84, 84*f*
actions and decision making, 61–64
ad hoc metrics, 22–23, 52
aggregate/composite metrics, 52, 69
Anscombe's quartet, 55
audits, 43–44, 44*f*, 78. *See also* review process
awards, 8, 8*f*, 34–35, 76

B

"backing in" process, 12
Balanced Scorecard, 35
Baldrige Award, 8, 8*f*, 34–35, 76
Baldrige Performance Excellence Program. *See* Baldrige Award
bar graphs, 57, 68
baselines, 48
benchmarks, 48, 49
bonuses, 71
business process management office (BPMO), 81–82
business process models, 8–10, 8*f*
business process thinking, 3–7, 3*f*, 4*f*, 5*t*, 7*f*

C

change, 69–70
charts. *See specific types*
check processes, 43–44, 44*f*, 75, 78
cherry picking, 69
communication, 69–70
competition, xi–xii
complaints, 7, 22–23, 33
composite/aggregate metrics, 52, 69
computer help-desk operations example, 27, 67
consumer electronics company example, 40
controls
  component examples of, 6
  metrics for, 22, 25, 26*f*, 32, 87–89, 87*f*
  in SIPOC diagram, 7*f*
core processes, 9–10
correlation, 56
customers, 4, 5*t*, 7, 7*f*, 22–23, 33. *See also* stakeholders
cycle times, 40, 41*f*

D

dashboards, 61
data
  analysis of, 50
  correlations in, 56

display of, 57–58, 59*f*
metric factors and, 30–31
normalization of, 47
operational definition and, 46–47
outliers in, 55–56, 87–89, 87*f*
presentation of, 55–56
security/access to, 31, 49–50
source of, 49
trends in, 56
variation in, 56
decision cockpits, 78
decision making and actions, 61–64
Deming, W. Edwards, 2, 66, 70–71
diagrams/figures, 58
Dilbert technical support example, 67

E

effectiveness metrics, 21, 27
efficiency metrics, 21
80/20 rule, 30
enabling processes, 9–10
exception-based reporting, 50
external metrics, 21

F

feedback
component examples of, 6
from customers, 4, 7, 22–23, 33
in SIPOC diagram, 7*f*
figures/diagrams, 58
financial rewards, 71
fitness center example, 33
flow-down process, 39
formulas, 47

G

gaps, 36, 36*f*, 38*f*, 39, 66–67
graphs. *See specific types*
growth/maturity curve, 74*f*

H

health insurance example, 65
Health Insurance Portability and Accountability Act (HIPAA) example, 31
help-desk example, 27, 67
high-level business processes, 10, 10*f*, 16, 17–18, 17*f*
hotel laundry metrics example, 24–26, 24*f*, 25*f*, 26*f*, 38*f*, 66–67

I

inputs, 4, 5*t*, 6, 7*f*
internal metrics, 21
internal quality auditing, 43–44, 44*f*
interval/continuous/variable measurement scale, 85
ISO 9001, 43, 76
IT help-desk example, 27, 67

K

key performance indicators (KPIs), 19. *See also* high-level business processes

L

lagging/leading metrics, 21–22, 24–25, 24*f*, 25*f*
life cycles, 73–75, 74*f*
line graphs, 57, 68

M

Malcolm Baldrige National Quality Award. *See* Baldrige Award
math test example, 43
maturity/growth curve, 74*f*
maturity matrix, 78–81, 79–80*t*
measurement theory, 83–85, 84*f*
Medicare example, 65
metrics. *See* performance metrics; *specific types*
models
business process models, 8–10, 8*f*
Plan-Do-Check-Act (PDCA) model, 2–3, 2*f*, 66
monitoring metrics, 22–23

N

never events example, 65
nominal/discrete/attribute measurement scale, 85
normalization, 47

O

objective metrics, 23, 32
objectives, 19–23
operational definition, 46–47
operational level, 20–21
operations, 1, 3, 4*f*
ordinal measurement scale, 85
organization charts, 18
organizational hierarchies, 16–18, 17*f*
organizational strategies, 29–30, 30*f*, 34, 34*t*
organizations
  infrastructure of, 76
  management of, 78, 79–80*t*, 81–82
outcome metrics, 22, 25, 26*f*, 31
outliers, 55–56, 87–89, 87*f*
outputs, 4, 5*t*, 7*f*

P

Pareto principle, 30
PDCA (Plan-Do-Check-Act) model, 2–3, 2*f*, 66
PE (price/earnings per share) ratio example, 52
performance metrics. *See also specific types*
  common problems with, 66–67, 68–69, 70–71
  comparison of, 67, 67*t*
  definition of, 19
  examples of, 91, 91–97*t*
  factors of, 30–32
  future value of, 40
  levels of, 17–18
  logical parallels of, 23–24, 24*t*
  management of, 77–78
  management systems for, 78
  operational definition of, 46–47
  psychological impact of, 65
  purpose of, 1–3, 2*f*, 11–12
  selection of, 29–30, xi–xii
  usefulness criteria of, 32
PgMOs (program management offices), 42–43
picture-hanging process, 3
pie charts, 57
Plan-Do-Check-Act (PDCA) model, 2–3, 2*f*, 66
PMOs (project management offices), 42–43
precision, 48, 84, 84*f*
processes. *See also specific types*
  alignment of, 1
  definition of, 3, 3*f*
  management of, 78, 79–80*t*, 81–82
  metrics for, 32
  models for, 8–10, 8*f*
  owner of, 46
  SIPOC diagram and, 4, 4*f*, 5*t*, 7*f*
  systems and, 1–2, 2*f*
  teams for, 77–78
process perspective, 78, 79–80*t*, 81–82
process thinking, 3–7, 3*f*, 4*f*, 5*t*, 7*f*
program management, 40, 41*f*
program management offices (PgMOs), 42–43
project management offices (PMOs), 42–43

R

reliability, 84. *See also* precision
requirements/resources, 6, 7*f*
review process. *See also* audits
  frequency of, 64
  review of, 36, 36*f*, 37*f*, 38–39, 38*f*, 50, 51*t*, 52
  triggers of, 75
rewards, 71
risk management, 40

S

scorecards, 35, 61, 61*f*
security/access, 31, 49–50
segmented metrics, 69
Shewhart, Walter, 2, 2*f*, 66
SIPOC (suppliers, inputs, processes, outputs, customers)
  analysis and, 12–13, 14*f*, 15*f*, 16
  business process thinking, 4, 4*f*, 6–7, 6*t*, 7*f*
  component examples of, 5*t*

components of, 4, 6–7, 7*f*
diagram of, 4, 4*f*
SPC (statistical process control), 50, 87–89, 87*f*
SPI (supplier performance index), 53
stakeholders, 11–12, 46, 60–61. *See also* customers
standards, 43, 83
statistical process control (SPC), 50, 87–89, 87*f*
"Strapping Grandma to the Bed" (Wachter), 65
strategic level, 20
strategy alignment, 1
subjective metrics, 23
suboptimization, 68
supplier performance index (SPI), 53
suppliers, 5*t*, 6, 7*f*
support processes, 9–10
systems, 1–2
systems perspective, 70, 73–75, 74*f*

T

tables, 57
targets, 48, 68
technology maps, 40
three-legged stool, 20–21
trending, 56
Tufte, Edward, 60

V

validity, 84
variation, 56
volunteer organization example, 39

W

Wachter, Bob, 65
Wong Baker Faces Pain Rating Scale, 23

About the Author

Duke is a knowledge architect specializing in quality management. He has been in private practice since 1985 working with organizations in the U.S., Aruba, Bermuda, Canada, England, India, Jamaica, Mexico, Netherlands, South Korea and Wales. He was formerly a quality professional in TRW's automotive sector.

Duke holds undergraduate degrees in technology and business, a masters degree in adult education, and has completed doctoral coursework in applied management and decision sciences. He has served as an adjunct university faculty member teaching statistics and management research. He is also a graduate of the international program in the Gestalt approach to organization and system development.

During his career he has held certifications as an electronics technician (ICET), quality technician, quality engineer, quality auditor and quality manager (ASQ) and management consultant (IMC). In 1998 he was elected Fellow of the American Society for Quality. He has taught review courses for ASQ's CMQ/OE, CQA, CQT and CQIA certifications, and was a national instructor for ASQ for two decades.

www.aplomet.com