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UPFRONT



Media Revolution

In publishing, only the fittest will survive

IN MY 15 YEARS in publishing, economic cycles and consumer habits have significantly changed advertiser behavior and content-delivery methods, but at no time in recent history has there been such a seismic shift in media delivery than what we're experiencing now.

Newspapers share a plight similar to that of General Motors and Chrysler: falling demand, failing business models and fierce competition. Some prominent papers have already crumbled under the pressures; many more won't survive.

The availability of free news online is just one reason. News Corp. chairman and media mogul Rupert Murdoch said in an interview on News Corp.'s U.S. Fox Business channel last month: "Within 10 years, I believe nearly all newspapers will be delivered digitally [either on computers or electronic reading devices]."

But customer preference is not the sole reason for the decline of print newspapers. Alternatives to traditional advertising and the fact that newspapers made some poor decisions when it came to monetizing electronic content are also to blame. Many newspapers created business models that couldn't sustain costly print editions.

Magazines are a bit different, mostly because their very nature has allowed them to remain attractive to advertisers—they have a shelf life, and, if done right, they provide readers information and insight that can't be found anywhere else. They delve deeper into subjects than newspapers can, so people are willing to "pay" for the content, whether it be via advertising, subscriptions or membership.

Even so, magazines certainly haven't been immune to shifts in reader preference and advertising dollars. Many, in fact, have suffered and have scrambled to salvage a web presence, or gone out of business all together. It's survival of the fittest to be sure.

Rest assured, QP is here to stay. ASQ is committed to providing QP in print—something readers demand. In fact, according to the results of QP's most recent readership study, less than 10% read QP online only. Many more verbatim comments echoed this "We want print" sentiment.

That's not to say we're not investing in QP's electronic presence. The site remains a valuable resource for your continuing education and on-the-job use—a perfect complement to the print edition. (Log in using your ASQ username and password at www. qualityprogress.com.)

This issue's highlights include articles on translating "quality-speak" into a language management can understand: money. Money talks in this economy. Learn some tips for making every word count in "All Ears," p. 16. **QP**

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Seiche Sanders Editor



PUBLISHER William A. Tony

EDITOR Seiche Sanders

ASSOCIATE EDITOR Mark Edmund

ASSISTANT EDITOR Brett Krzykowski

MANUSCRIPT COORDINATOR Valerie Funk

EDITOR AT LARGE Susan E. Daniels

CONTRIBUTING EDITOR Nicole Adrian

COPY EDITORS Susan Gronemus

ART DIRECTOR Mary Uttech

GRAPHIC DESIGNER Sandy Wyss

PRODUCTION Cathy Schnackenberg

ADVERTISING PRODUCTION Barbara Mitrovic

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SENIOR SALES MANAGER Erica Gumieny

ACCOUNT EXECUTIVES Angela M. Mitchell Mitchell Pezanoski

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EDITORIAL AND ADVERTISING OFFICES Phone: 414-272-8575 Fax: 414-272-1734

ASQ ADMINISTRATION Executive Director Paul E. Borawski

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INBOX

Editor's note: The following letter was submitted via the Quality Progress group on LinkedIn. You can join the group by visiting www.linkedin.com, and you can also find QP on Facebook and Twitter.

Log on, link in

I was reading the May issue of

QP and realized once again how fast we are moving into cyberspace. We better jump on the wagon, or we will be left behind—not only by our colleagues, but by our kids, too. *Sonia Pomalaza*

Business quality manager Johnson Controls Coral Springs, FL

Lean misconceptions

I read the May 2009 article by Gary Jing ("A Lean Six Sigma Breakthrough," pp. 24-31) with great interest. While I agree with many of his points, I think he is missing some of the primary fundamentals of lean, and thus his integration of lean and Six Sigma tools and methods is not necessarily accurate. Or, said another way, the integration from his perspective may be different than that experienced by other practitioners.

From my perspective, lean is not necessarily focused only on flow and waste. It also deals with process capability as determined by the customer and balanced across cost, service or quality.

Six Sigma practitioners and industrial engineers—actually, all engineering approaches to implementing continuous improvement—view lean from a tools perspective, which is a primary reason why results in most companies are very limited. The strength in lean is from a cultural perspective as driven by leader standard work



and standard work processes. Also, data collection is a fundamental aspect of lean process improvement—maybe not to the degree of Six Sigma, but it is nonetheless important.

The bottom line is not to criticize Jing but rather to point out there are other views of lean's role that are often over-

looked and misunderstood from an analytical or engineering perspective.

> Ken Wrobel Lean engineer Deluxe Corp. Stillwater, MN

See both sides

The published letters regarding the stimulus package (Inbox, May 2009, pp. 8-9) declared that history proves economic stimulus is "irrelevant" and has a "poor track record," which is subjective.

The letters also stated that no root cause analysis has been performed by economic policymakers (totally unsubstantiated), that Keynesian economics is "problematic" (*laissez-faire* or Chicago Friedman economics have their own issues), that logic was not applied in policy, and that "change in Washington is ruining this country" (in as little as the first 100 days).

I speak once a year at my local ASQ Section 0810 meetings. This year, it was a twohour presentation I concluded by saying the most hostile impediment to my success in quality is other quality professionals. Mindsets such as those expressed in the letters reflect my professional experiences.

> Gordon MacDowell Quality director Akro-Plastics Kent, OH



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EXPERTANSWE

Ready for action

Q: What should be included on a corrective action document? My company has never had one before, and I want to make sure all of the necessary elements are present. Name withheld

A: Whether you're sending a reply to a customer or establishing a general procedure for corrective action within your company, the content for the document is about the same.

The document should begin with a scope statement that identifies what types of issues or inputs will be subject to the new corrective action process. For example, external inputs are customer complaints or observations from your field reps, while internal inputs are manufacturing incidents that occurred recently or observations from managers who are dissatisfied with certain performance metrics.

While the initial thought might be that the scope of the document system would pertain only to quality problems, it could also be used for safety, cost and delivery issues. It also could be extended to your suppliers. In that situation, you would ask your suppliers to address certain issues with the prescribed method and report back to you.

The meat of the corrective action system should be based on a popular Six Sigma approach to improvement: define, measure, analyze, improve and control (DMAIC). A standard form with these steps could be created.

These steps are most easily understood when couched in the following scenario:

- **Define**—The customer finds an unacceptable level of defects in shipment number 65432.
- Measure—2.4% of the items contain defect X, and 0.9% of the items contain defect Y.

- Analyze—A series of designed experiments in the manufacturing process enable identification of four factors that contribute to the appearance of these defects. The details are logged in technical reports 37172 and 37173, and optimal process settings (along with an acceptable operating window for each setting) are identified.
- Improve—As a baseline, process performance is monitored for two weeks before the new settings are put in place. The changes are made, and results are monitored for two more weeks. The data indicate a reduction of 50% for each of the two targeted defects.
- **Control**—The process windows are captured in a standard operating procedure, the controllers on the equipment are programmed to integrate the new settings, and the operators are trained on the acceptable ranges. Further, the inspection procedures in the work center are amended to include descriptions of the defects. Those amendments are added to the routine audit forms.

An optional, but recommended, topic for your document is identification of a tracking system. You may also want to assign one person or more to oversee the topic of corrective action, establish a database of events being addressed, and verify the improvements and controls that are identified. Sign-off may be required to close out a corrective action.

Peter E. Pylipow

Senior design excellence engineer Vistakon—Johnson and Johnson Vision Care Jacksonville, FL

FOR MORE INFORMATION

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Stock and standards

Q: Is it acceptable to implement dock-tostock at a medical-device manufacturer without being in violation of 21 CFR 820.80? I would like to propose it to my team, but I want to make sure we will be in compliance with ISO 13485:2003 and with the U.S. Food and Drug Administration.

> Christian Sterling Alajuela, Costa Rica

A: Dock-to-stock typically means placing incoming product directly into stock. This is not allowed unless special precautions are taken, including segregating the product and placing it in quarantine until the incoming product is inspected, tested or otherwise verified as conforming to specified requirements.

Verification can be obtained via defined procedures that specfiy the means of verifying that shipments have the proper identity and are complete, undamaged and received in accordance with specifications. The procedures should also include provisions for verifying that incoming products are accompanied by supporting documentation, such as certificates of analysis or test results.

In general, the manufacturer has the burden of establishing a high degree of confidence that the supplied product meets requirements. Typically, that confidence is based on supplier evaluations and controls, past inspection history, in-plant rejection history or customer complaints, and needs to be directly related to the risks associated with the incoming product.

Joe Tsiakals Senior vice president of quality assurance and regulatory affairs Baxa Corp. Denver RS

The **meat of a corrective action system** should be based on a popular Six Sigma approach: **DMAIC**.

Utmost confidence

Q: In a recent installment of Statistics Roundtable ("In a Certain Way," March 2009, p. 59-61), Christine Anderson-Cook wrote, "The 95% confidence interval implies that if we repeated the procedure of collecting a sample many times, the resulting intervals will include the true population mean length 95% of the time."

That, of course, is consistent with the way we're taught how to interpret confidence intervals. But I'm perplexed by her subsequent statement: "This is not the same as saying there is a 95% chance the population length is contained in [13.45, 14.91]."

From her first statement, if I were to repeatedly construct confidence intervals and put each confidence interval into a bin, 95% of the confidence intervals in this bin will contain the population length. If I were to draw one confidence interval randomly from this bin, the probability of me drawing a confidence interval that would contain the population length is 95%.

My question is whether that corresponds to "there is a 95% chance that a single interval thus constructed contains the population length."

I was also wondering if it was possible to make any conjecture about the probability that the true value is inside or outside the constructed confidence interval for a single study. Is it 50/50?

Alex T. Lau

Process analytics and blending specialist Engineering Services Canada Toronto A: I think your questions are at the heart of a very common confusion about confidence intervals and how they should be interpreted. Let me attempt to clarify.

Suppose we have a large population of lightbulbs, and we are told they have 95% reliability, meaning 95% of the bulbs will illuminate when we plug them in. We know something about the population of lightbulbs, which is helpful. If we are handed one lightbulb, however, our problem has fundamentally changed—either that particular bulb will work, or it won't. We think it is much more likely it will work than not, but we still are not sure about the status of that bulb.

A working bulb means our confidence interval is correct and includes the true (but unknown) value. For a population of confidence intervals—in this case, repeating the same process of drawing a sample and then calculating that interval based on the data—we know that on average the true value will fall within the interval 95% of the time. But, for a particular study with a single set of data that matches the single bulb that has been handed to us, the interval will either be right or wrong.

Because we don't know the true value, which is the case in almost any realistic situation, we don't know if this is one of the many cases in which the true value falls within the interval or if it's one of the rare cases in which it doesn't. The big difference is whether we are talking about a population (or long-run probability) of confidence intervals or dealing with a single study with a single data set in which the answer is right or wrong.

As for your second question, there is a 95% probability that any particular confidence interval will contain the true value, because this is the long-run average of correct intervals based on the underlying theory. Perhaps another analogy would help explain.

Suppose that for a very simple lottery, there are two outcomes: a 95% chance you will lose and a 5% chance you will win. You hold a single ticket in your hand. That ticket is either a winner or a loser, but you are much more likely to be holding a loser (95 times out of 100).

Going back to the lightbulb example, you conducted a single study and have a single confidence interval that most likely will contain the true value, meaning the bulb will most likely work. But, if you're handed the true value (this would require some luck, because usually this value is unknown), either the interval would be correct and contain the true value, or it would be incorrect.

> Christine Anderson-Cook Research scientist Los Alamos National Laboratory Los Alamos, NM

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AUTOMOTIVE

Crash Course Domino effect to GM, Chrysler bankruptcies

For a snapshot of the whiplash felt throughout the automotive supply chain due to the recent bankruptcies of Chrysler and General Motors (GM), all you needed to do in the days following GM's filing was to stop by the company's suddenly outdated website.

In the "About GM" section, the company claimed to employ 244,500 people globally. On June 1, that number fell by at least 20,000 as GM announced the closing of 14 plants and three warehouses.¹

That same section of GM's website boasted the company sold 8.35 million cars in 2008 under an extensive brand portfolio that included Hummer, Pontiac, Saturn, Opel and Vauxhall. During the week following the bankruptcy filing, Hummer was acquired by a Chinese manufacturer, and Saturn was sold to auto-racing mainstay Roger Penske. Meanwhile, Pontiac is kaput, and the plan for the European brands is to say *auf wiedersehen* to Opel and goodbye to Vauxhall.

And those are just the in-house ramifications. According to estimates from consultant CSM Worldwide, the Big Three (which also includes Ford) share more than 50% of about 1,500 North American suppliers.² That tangled web means one automaker faltering would be painful enough. But a majority of the triumvirate declaring bankruptcy in an already laboring economy has shaken an industry that saw 40 major suppliers join their biggest customers in Chapter 11 in 2009.³

Many of the smaller parts firms are also headed to bankruptcy or are considering shutting down. Because those suppliers partner with several automakers, other car companies' production lines may be halted. Laura Marcero, a restructuring specialist at Grant Thornton, said, "It's going to affect the Toyotas, Hondas and Fords of the world, because they're going to have more unplanned downtime because of supplier shutdowns."⁴

On the dealership front, between GM and Chrysler, nearly 3,000 franchises will close their doors, forcing them to purge their lots,

often at significant discounts, which is great news for new customers.⁵ Some of



the existing customers, on the other hand, aren't quite so happy.

In the days following Chrysler's bankruptcy, checks issued in connection with California's lemon law bounced, and lawsuits against the car company sat in judicial purgatory as consumers were told to enter the long line of the automaker's creditors.⁶

Eventually, a group of state attorneys general hammered out a deal with Chrysler (and its new owner, Italian automaker Fiat) to honor lemon-law rights. But, under terms of a deal approved in bankruptcy court, the company won't be responsible for injury and wrongful-death claims linked to defects.⁷

The situation at GM was still muddled as of early June, with the bankruptcy court putting all lemon-law claims on hold until it decided how they should be handled.⁸

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-Brett Kryzkowski, assistant editor

CUSTOMER SATISFACTION SCORES KEEP CLIMBING

Customer satisfaction has climbed for the second straight quarter—this includes ratings from airline passengers, according to a recent American Customer Satisfaction Index (ACSI) study.

For the first quarter of 2009, the index was up 0.4% to 76 on ACSI's 100-point

scale. Passenger satisfaction with airlines improved for the first time since 2003, up 3% to an ACSI score of 64.

These scores are in sync with the Airline Quality Rating Report released earlier this year that reported airlines' improved customer service performances. The customer index is produced by the University of Michigan in partnership with ASQ.

For more details on the first-quarter ratings and related commentary about the ACSI study, visit www.theacsi.org/ index.php.

GOVERNMENT

SURVEY: MOST AGENCIES NOT READY FOR STIMULUS CASH

Three-quarters of federal and state agencies tasked to distribute funds from the \$787 billion economic stimulus package admit they aren't ready to manage those dollars, a recent survey found.

A survey conducted by APQC (formerly the American Productivity & Quality Center) revealed that 24% of respondents said they are "fully ready" to meet the requirements of managing the stimulus dollars. One-third of the respondents had goals and measures in place for the related activities, and 22% said they had the transparency actions in place.

APQC, an independent nonprofit research firm that specializes in performance analytics and benchmarking, called on the Office of Management and Budget "to develop appropriate measures of effectiveness and efficiency" to ensure the funds are distributed in an effective, timely manner.

When the new chief performance officer, Jeff Zients, is confirmed by Congress, he should create an initiative to develop standard measures to track agency performance over time, APQC recommended.

Other parts of APQC's survey addressed government agencies' perspectives on benchmarking and their plans around Web 2.0, social media, and hiring and training people. For full survey results and commentary, visit http://govsurvey.apqc.org/index.html.

STANDARDS

ISO GROUP REACHES CONSENSUS ON STANDARD

Participants in the International Organization for Standardization Working Group on Social Responsibility (ISO/WG SR) reached consensus on the future ISO 26000 standard at its May meeting in Quebec City.

The meeting addressed issues stemming from the more than 3,000 comments submitted in a successful vote on the committee draft of the standard taken before the meeting. ISO 26000 is moving to the status of a draft international standard by October.

The next meeting of the ISO/WG SR will be held early next year. Publication is targeted for September 2010. For more information, visit www.iso.org/sr. The working documents are accessible at www.iso.org/wgsr.

Who's Who in

NAME: Larry Aft.

RESIDENCE: Norcross, GA.

EDUCATION: Master's of science in industrial engineering degree from the University of Illinois.

CURRENT JOB: Director of continuing education and program development at the Institute of Industrial Engineers (IIE) in Norcross.

PREVIOUS JOBS IN QUALITY: Aft

taught industrial engineering and developed and managed the master's of



science in quality assurance program at Southern Polytechnic in Marietta, GA. The program was the first in the nation to be available entirely online.

INTRODUCTION TO QUALITY: Aft was introduced to quality at his first job as a junior quality engineer at Automatic Electric Co. in suburban Chicago. He was also exposed to quality during his first statistics class taught by Frank Gryna at Bradley University in Peoria, IL.

ASQ ACTIVITIES: Aft serves as the chair for the Greater Atlanta Section. He has volunteered for many activities and served as chair of the education board and chair of the research advisory council. He has also taken on many other roles with the Greater Atlanta Section.

RECENT HONOR: Aft recently received the 2008 ASQ Grant Medal. He is a fellow of ASQ and IIE, and he has received IIE's Phil Carroll Award.

PUBLISHED: Aft is the author of five books, and he has authored several handbook chapters and technical articles.

QUALITY QUOTE: Quality is working to continually come closer and closer to giving customers what they want every time.

KEEPINGCURRENT

Mr. Pareto Head BY MIKE CROSSEN







ONLINE **ONPAPER**

OUICK POLL RESULTS

Each month at www.gualityprogress.com, visitors can take a short, informal survey, and we post the results

Here are the numbers from the most recent **Ouick Poll:**

"What quality method is most effective at cutting costs and increasing efficiency during difficult economic times?"

• Lean Six Sigma 60.2% Total quality management 20.5% Lean 15.4% 3.6%

• Six Sigma

Visit www.qualityprogress.com for the most recent poll question posted:

"What do you find most difficult to communicate to management?"

- The value of quality-in monetary terms.
- That quality is proactive as well as reactive.
- The need for sustained resources dedicated to quality.
- That quality must be an organization-wide effort.

ASQNEWS

FORMER PRESIDENT HONORED

Former ASQ President H.J. Harrington recently received the professional of the year award at the Quality Conference in Orlando, FL. Organizers lauded Harrington's sustained, long-term outstanding contributions to improving organizational performance around the world.

SR MEDAL ASQ has unveiled the Spencer Hutchens Jr. Medal for Social Responsibility to recognize members who are leaders in advocating the cause. Hutchens is a past president of ASQ. Eligibility information and nomination forms are available at www.asq.org/about-asq/ awards/hutchens.html. All nominations are due Oct. 1.

NEW NEWSLETTER Healthcare Update: Tools and Applications is a new, free electronic newsletter from ASQ that offers useful information for professionals in the healthcare industry. Each month, the newsletter, which is available to members as well as nonmembers, highlights one tool, application or case study and relevant additional resources, such as books, magazine and journal articles, and certification courses. To register for the newsletter and to view the most recent issue, visit www.asg.org/ healthcare/update_info.html.

NETWORKS ADDED ASQ has formed five new networks, or online communities, for members to connect, share information and perhaps help solve problems together. The new networks are categorized as follows: consultants, small business, leadership excellence, social responsibility and future of quality. For more information and to explore the other 18 networks, visit www.asq.org/communities.

SECTIONS DISSOLVED The Western Colorado Section 1314, the Southern Oregon Section 624 and West Plains-Mountain Home Section 1315 (Missouri/Arkansas) have been dissolved at the request of members and the regional director. Members were transferred to other sections by request or based on their ZIP codes.

ASQ WORLD CONFERENCE HD SUPPLY TEAM WINS GOLD AWARD

HD Supply took home top honors, winning the gold award at the 24th International Team Excellence competition, which was held during ASQ's annual World Conference on Quality and Improvement in Minneapolis in May.

The team from the wholesale distribution company in San Diego demonstrated its innovative approach of using voice of the



HD SUPPLY team members Sheri Espinoza (left) and Ayesha Basheer accept the gold award at the International Team Excellence closing ceremonies.

customer data to drive customer loyalty, continuous improvement and operational excellence. The team showed how it reduced defects and saved the company \$3 million.

Littelfuse Phils Inc., a manufacturer of circuit protection products based in the Philippines, won the silver award for its work in reducing its operation's use of hazardous material, improving product quality and increasing profitability. Bronze winners included Pershing LLC of Jersey City, NJ, and Boeing's C-17 PWIT team of Long Beach, CA.

About 2,000 quality professionals attended the conference. Next year's event will be held May 24-26 in St. Louis. Visit http://wcqi.asq.org for details.

THE FUTURE OF QUALITY

CONFERENCE BOARD REPORTS ON QUALITY'S EVOLUTION

A new report by the Conference Board's Quality Council sheds light on the continuing evolution of quality and the changing roles of quality professionals.

The report, "A Leadership Prescription for the Future of Quality," addresses how quality professionals can be catalysts for change, play key roles in understanding how an organization's processes are related and enhance the connection between business planning and the bottom line.

"The role of the quality officer is evolving," said Mike Adams, vice president of quality at Allegheny Energy and a council member who helped prepare the report.

"A growing number (of quality professionals) view (themselves) as macroleaders," connecting quality practices to top-line growth and business trends such as globalization, customer sophistication, talent management, environmental concerns and social responsibility, he said.

In the report, Paul Borawski, ASQ's executive director and chief strategic officer, offers commentary on the council's findings. To view the full report, visit www. conference-board.org/publications/describe.cfm?id=1635.

CAPITOL

ASQ representatives met with U.S. Secretary of Education Arne Duncan last month to present



ASQ's case for quality in education. Duncan was in Milwaukee to talk with public officials and educators. Laurel Nelson-Rowe, an ASQ managing director, presented Duncan with ASQ's position paper on education and offered to assemble a panel of educators and Baldrige winners to brief the Department of Education about the benefits of quality ... ASQ has connected with the Institute for Citizen-Centered Service (ICCS) of Canada to learn from ICCS's public sector quality experiences and strengthen efforts to engage the Obama administration in discussions and encourage government agencies to use quality tools and become more efficient ... ASQ's Healthcare Division has produced a white paper for a forum ASQ is organizing for the House's 21st Century Health Care Caucus. The division is also recruiting speakers to present at the forum. The caucus is meant to focus attention on deploying healthcare IT in hospitals, physician practices and other medical environments.

Capitol Q is a regular Keeping Current feature that highlights ASQ's advocacy efforts with government leaders. More information about ASQ's legislative activity and other issues and activities can be found at ASQ's Advocacy Room at www. asq.org/advocacy/index.html.

STANDARDS DAY

CELEBRATION FEATURES PAPER COMPETITION

The 2009 World Standards Day paper competition has been announced by the committee planning the U.S. celebration and the paper competition's sponsor, the Standards Engineering Society (SES).

Cash prizes will be presented to winners during a banquet at the celebration Oct. 7 in Washington, D.C. In addition, the winning papers will be published in SES's journal, *Standards Engineering*.

For details, go to www.ses-standards.org/ displaycommon.cfm?an=1&subarticlenbr=77.

Al Ears



Use **financial terms** to get management to **take notice** of your quality message

by Peter J. Sherman and James G. Vono

In 50 Words Or Less

- When making proposals or submitting business cases to senior managers, learn to add the language of money to the language of statistics and quality metrics.
- Identify and understand various types of costs and their impact on margins.
- Use simple financial calculations to perform basic cost analysis.

IMAGINE YOU ARE presenting the analysis and findings of a critical operational issue or proposed improvement project to senior management. You feel confident because you've thoroughly measured and analyzed the data.

Your presentation includes several statistical and quality metrics, such as the mean, standard deviation, sigma level, percentage nonconforming, defect rates, defects per million opportunities (DPMO) and process capability. You may even produce the results of a Pareto analysis that shows the frequency of defects.

To your disappointment, you notice eyes starting to glaze over and heads bobbing. Some of the senior managers are text messaging, while others are talking. What happened? What went wrong? In short, you were not speaking the language of management, which is the language of money.¹ Your quality metrics did not include the key financial metrics such as revenues, costs, savings, margins, operating leverage, return on investment (ROI), payback period and break-even analysis—that resonate with senior management.

It's not enough to use phrases such as defect rates, late orders, number of customer complaints or the frequency of occurrence through a Pareto chart. Instead, operational issues need to be framed in terms that senior management readily understands, such as:

- "Our biggest cost driver affecting customer satisfaction is shipping damage. It represents 55% of returned orders and costs us \$200 per order—or \$5,000 a month."
- "We're losing \$25,000 a month in shop damage."
- "Our billing cycle is 90 days, with a 50% reject rate from our customers and an average receivable balance of \$500,000."
- "Inventory is \$500,000, with five turns per year."
- "Expediting charges are reducing operating margins by 4%."
- "Warranty costs have risen 150% and now represent 5% of total costs."
- "Idle time costs us \$20,000 a month in lost production and revenues."

As a manager, industrial engineer, Six Sigma practitioner or quality engineer, you must be aware of and comfortable when incorporating this language into your analysis. Ultimately, you will need to build a business case for your proposed improvements to secure approval and funding. A business case describes the issue, how you propose to solve it, key assumptions, risks and, equally important, the estimated benefits and costs so an ROI can be calculated.



What is profit?

In its most basic form, profit is what remains after subtracting costs from revenue. Profit can generally be increased in two ways: by increasing revenue or decreasing costs.

Because revenue may be impacted by factors outside your control (advertising, marketing, price, discretionary spending patterns or the economy, for example), we will focus our attention on the cost side of the equation.

The first step in building the business case for an improvement project is to capture all the associated costs, which can be grouped into categories, such as labor, technology, supplies and facilities.

Costs can be further classified as either fixed or variable. Fixed costs do not vary with the level of output. They are also known as indirect costs because they are not directly attributed to the production of goods or services sold by a company. So, whether you manufacture 100 or 1,000 components, these costs will be relatively flat.

An example of a fixed cost is the salaries associated with sales, marketing, administration and R&D. These salaries are set and would be incurred even if the firm temporarily suspended production. Other fixed costs include rent, utilities and associated overhead.

From a cost-of-quality perspective, prevention costs (design for Six Sigma, design reviews or tollgates, equipment maintenance and training) and appraisal costs (inspection, auditing and testing) are considered fixed costs.

When internal quality metrics, such as those for equipment maintenance and training, are small as a percentage of overall quality costs, this can often result in disproportionately higher external or internal failure costs and poor quality. Similarly, small increases in prevention costs often create significant decreases in total quality costs.

Variable costs increase as output increases. Variable costs are also known as direct costs because they can be directly attributed to the production of the goods or services sold by a company. For this reason, these costs vary based on overall quantity produced. Variable costs typically include direct labor, direct materials and overtime.

From a cost-of-quality perspective, failure costs are also considered a variable cost. These may include customer returns, scrap and rework. When these costs become a high percentage of total quality costs, it is generally an indication of a poor quality process. The sum of these two costs represents total costs. Figure 1 shows how total costs increase in a linear fashion with output produced. In reality, it is possible for the total cost curve to be sloped down or up, depending on the variable costs per unit.

Understanding fixed costs and variable costs is important from the standpoint of a company's operating leverage. Operating leverage is the trade-off between fixed costs and variable costs, and it measures how revenue growth translates into growth in operating income (revenue less total costs). Operating leverage can also be thought of as a measure of leverage and of how risky (variable) a company's operating income is.

The degree of operating leverage (DOL) is defined as the percentage change in operating income that results from a given percentage change in sales. This can be expressed as:

 $DOL = \frac{sales - variable cost}{sales - variable cost - fixed cost.}$

A company that has a higher percentage of fixed costs relative to overall costs generates high operating leverage. In other words, holding all else constant, high operating leverage indicates that a small change in sales will cause a large change in operating income.

On the other hand, the higher the percentage of a firm's costs that are fixed, the greater the firm's business risk. In contrast, companies with low fixed costs are more immune to business risks.

The down side to companies with low fixed costs as a percentage of total costs is that their operating margins are generally lower. Operating margins are defined as revenues less total costs divided by revenues.

Income statement

Now it's time to put costs together in a format senior management understands: the income statement. An income statement, also called a profit and loss statement, is a company's financial statement that indicates how revenue is transformed into net income. The income statement shows managers and investors whether the company made or lost money during a certain period.

Let's assume you are a manufacturer of consumer electronics. You expect to sell 10,000 units per year at \$120 each. The income statement (see Figure 2) starts with revenues at the top. In our example, revenue is \$1.2 million.

Next, the variable costs are subtracted. The ma-

Income statement / FIGURE 2



jor variable cost is called cost of goods sold (COGS). COGS is a direct cost because it is directly attributable to the production of the goods or services sold by a company.

The gross profit is what remains after subtracting these direct costs. It is the amount available to pay for fixed costs and provide any profit after variable costs have been paid.

When gross profit is expressed as a percentage of revenues, it is called gross margin (gross profit divided by revenues). At the most fundamental level, gross margin is a good indication of how profitable a company is. Companies with higher gross margins will have more money left over to spend on other business operations, such as R&D or marketing. In our example, the gross profit is \$620,000, while the gross margin is 52% (\$620,000 divided by \$1.2 million).

Next, the fixed costs are subtracted from the gross profit. These costs are considered indirect costs because what remains is called operating income or operating profit. When operating income is expressed as a percentage of revenues, it is called operating margin (operating income divided by revenues).

Operating income is a measurement of the money



Project savings waterfall chart / FIGURE 3

a company generated from its own operations. A business with a higher operating margin than its industry's average tends to have lower fixed costs and a better gross margin, which gives management more flexibility in determining prices. This pricing flexibility provides an added measure of safety during tough economic times.

In our sample income statement, the operating profit is \$225,000, while the operating margin is 19% (\$225,000 divided by \$1.2 million). Finally, after all other expenses and taxes are subtracted, we arrive at net income. In our example, the net income is \$120,000, or a 10% margin (\$120,000 divided by \$1.2 million).

Sometimes, however, operating profit is not a good financial indicator for judging quality metrics. In an effort to improve the bottom line, for example, a company may defer certain fixed costs, such as preventive maintenance or training. In the short term, operating profits may increase, but in the long term, quality metrics, such as equipment failures or defects, may rise.

In another example, a company that invests significant resources in maintaining equipment and training personnel may have lower operating profits in the shortterm. In the long-term, however, those same quality metrics, such as equipment failures or defects, should generally go down.

Savings

Now that we've defined the basic cost categories, we are prepared to identify potential operational savings. Savings can be grouped into the following major categories:

- Cost reduction: expense or capital savings.
- **Cost avoidance:** cost prevention.
- Labor productivity: time savings.

It is important to note that not all savings are the same. For example, some will have a direct impact on a company's bottom line. These are called hard savings, which are the result of improvements such as reduced rework or headcount, or lower material costs.

Soft savings, on the other

hand, are intangible and include things such as cost avoidance, saving a portion of a person's time without reducing the expense associated with that time or increasing customer satisfaction.

A simple and effective way to show projected savings to management is through a project savings waterfall (see Figure 3).

The waterfall breaks down all costs in color-coded graphical form.

- The orange bar represents the starting costs (total cost of quality).
- The green bars represent direct savings associated with the project, including labor, material and inventory.
- The yellow bars represent costs added into the operation, such as replacement of machines, training and lost production.
- The black bar that remains is your estimated net cost of quality after project implementation.

Measure performance with ROI

ROI is a performance measurement used to evaluate the efficiency of an investment. The return is measured over time and is usually stated as an annualized rate or an average rate of return per year. The investment involves expenditures that must be directly linked to measurable benefits that will be realized in the future. This is the return. ROI is calculated by dividing the net financial benefit (savings or incremental revenue) by the cost of an investment.

ROI is a popular financial measurement because of its simplicity and versatility. An improvement project, for example, costs \$1,000 and generates net annual savings of \$500 per year. The ROI equals \$500 divided by \$1,000, or 50%.

In general, the higher the ROI, the better. Sometimes, however, a high ROI is not necessarily a good indicator of the impact of quality on a product or service. Investing in critical company infrastructure (IT, for example) or regulatory-driven projects (federally mandated environmental controls) may have a low ROI. However, these types of investments should be considered strategic or regulatory. The cost or penalties of not investing in them could be severe.

Payback period

In business and economics, the payback period refers to the time required for the ROI to repay the original investment. The shorter the payback period, the better. It is typically expressed in years and can be calculated by dividing the total cost by the net annual savings or by taking the inverse of the ROI.

Using the earlier example, the payback period can be calculated as follows: Total cost divided by net annual savings (\$1,000 divided by \$500 = two years) or the inverse of the ROI (one divided by 0.50 = twoyears).

Shorter payback-period projects may not necessarily correlate to improved quality metrics. An investment decision to outsource inspection and audits, for example, might generate a short payback period due to the initial lower labor costs. But, if the third-party inspection and auditing service is not familiar with your company's particular process or does not regularly train its employees in the latest auditing processes and standards, the investment may actually result in a longer payback period. You must then consider the cost of providing additional management supervision or increased failure costs.

Break-even analysis

Another way to represent total costs is with their relationship to total revenue. The point at which total

Break-even analysis / TABLE 1

Key metric	PMO	FMO	Difference	
Unit produced	10,000	10,000	NA	
Retail price per unit	\$120	\$120	NA	
Fixed costs	\$395,000	\$430,000	\$35,000	
Variable costs per unit	\$58	\$52	(\$6)	
Break-even volume	6,371	6,324	(47)	
Break-even revenue	\$764,520	\$758,880	(\$5,640)	
PMO = present method of operation FMO = future method of operation				

costs (TC) equal total revenue (TR) is called breakeven. This can be expressed as TC = TR. Table 1 shows the break-even analysis.

Break-even volume (BEV) is the volume of units at which the firm's TRs equal TCs. Break-even revenue is the level of sales a firm must generate to cover all its fixed and variable costs. Continuing with the cost and revenue equation, we know that TC is the sum of fixed costs (FC) + variable costs (VC). Therefore, FC + VC = TR.

This equation can be further broken down as follows: FC + (variable cost per unit x BEV) = (retail price per unit x BEV).

We can derive the BEV algebraically from the fact that at the BEV, total cost and total revenue are equal. Hence,

$$BEV = Fixed cost$$

Retail price per unit – VC per unit.

Let's go back to our earlier business example. Fixed costs in your production plant are \$395,000. The variable cost per unit is \$58, which is calculated by taking total variable costs (\$580,000) divided by the number of units produced and sold in the year (10,000). The retail price you charge is \$120 per unit. The break-even volume associated with these costs and prices is:

$$\frac{\text{BEV} = \$395,000}{\$120 - \$58}$$

BEV = 6,371 units

The associated break-even revenue is 6,371 units x \$120 = \$764,520.

Figure 4 (p. 22) shows the graphical relationship between costs, revenue and BEV. Notice the profit zone

Build a business case for proposed improvements to secure approval and funding.

lies where revenues exceed costs, while the loss zone lies where costs exceed revenues.

Putting it all together

Now that we have covered the basic financial metrics of costs, savings, ROI, payback period and break-even analysis, let's apply these to a case study.

You are a project manager and have identified an improvement to the manufacturing process discussed earlier. The improvement reduces variable costs by 10%, or approximately \$52 per unit (a \$6 reduction per unit).

The improvement, however, requires an initial investment of \$65,000 on new designs, equipment and installation, plus an increase in fixed costs of \$35,000 for additional engineering and maintenance. Your facility expects to produce and sell at least 10,000 units a year. Should you proceed with the project or continue as is?

The first step might be to compare the gross profit and operating profit levels of the current situation and the proposed new improvement. An effective



technique is to develop a table comparing the present method of operations (PMO) versus the future method of operations (FMO).

Let's assume you are comparing the steady-state condition excluding the initial one-time investment (see Table 2). The earlier analysis shows the FMO results in a gross profit of \$680,000, or a 57% gross margin. This represents an incremental \$60,000 gross profit and a 5% improvement in the gross margin.

Operating income is projected to be \$250,000 per year, reflecting a \$25,000 increase. The operating margin is now 21% versus 19%. Improvements in these basic financial metrics are always reliable indicators of a proposed investment's value.

As a manager, however, it is also vital to measure the efficiency of any investment in a business. ROI and payback calculations can be used.

¢6 x 10 000 units

First-year ROI:

φ0 x 10,000 units	
\$65,000 (investment) + \$35,000 (incremental fixed cost	;)
ROI = 60%	
Payback period = \$100,000	
\$6 x 10,000	
Payback period = 1.67 years or ~ 20 months	C

Payback period = 1.67 years or ~ 20 months (12 months x 1.67)

Based on these four key financial metrics, you would probably conclude the improvement has merit.

Clearly, financial goals and objectives are unique for each company. Before making your final recommendation, let's perform a break-even analysis to determine how many units the firm would have to produce with the new improvement so revenue is equal to total costs. BEV = \$430,000

$$V_{\text{Year one}} = \frac{\$430,000_{\text{(fixed costs)}}}{\$120 - \$52}$$

BEV = 6,324 units.

This represents a reduction of 47 units from the current process. Correspondingly, break-even revenue is also lower at \$758,880 (\$120 price per unit x 6,324).

From an operational perspective, it is generally beneficial if you can reduce your break-even units and break-even revenue, particularly if demand forecasts are unreliable. Break-even analysis, however, should be tempered with the initial investment required in any situation and the cost of capital.

Let's explore the impact of the proposed improvement project to the company's operating leverage. The degree of operating leverage (DOL) is defined as the percentage change in operating income that results from a given percentage change in sales. This can be expressed as follows:

$$\begin{split} \text{DOL} &= \frac{\text{sales} - \text{VC}}{\text{sales} - \text{VC} - \text{fixed cost}} \\ \text{In our analysis, assume 10,000 units are sold.} \\ \text{DOL}_{(\text{PMO)}} &= \frac{\$1,200,000 - \$580,000}{\$1,200,000 - \$580,000 - \$395,000} \\ \text{DOL}_{(\text{PMO)}} &= 2.76 \\ \text{DOL}_{(\text{FMO)}} &= \frac{\$1,200,000 - \$520,000}{\$1,200,000 - \$520,000} \\ \text{DOL}_{(\text{FMO)}} &= 2.72 \end{split}$$

In the PMO, a 10% increase in sales generates a 27.6% increase in operating income (2.76 x 10). In the FMO, a 10% increase in sales generates a 27.2% increase in operating income (2.72 x 10). Consequently, the improvement project's impact on the company's operating leverage is negligible.

Another way of evaluating the proposed project is to calculate the total cost break-even point in number of units between the two alternatives. This can be expressed as:

$$\begin{split} FC_{PMO} + VC_{PMO} &= FC_{FMO} + VC_{FMO} \\ \$395,000 + \$58X &= \$430,000 + \$52X \\ \$6X &= \$35,000 \end{split}$$

X = 5,833 units (when rounded to the nearest whole number)

Therefore, at the 5,834th unit, total costs would start to become lower because of the proposed improvement project than they were under the current method of operations. This may be important in order to understand the magnitude of the improvement on production rates if your product or service experiences seasonal or demand cycles.

Better analysis = better decisions

As a quality professional, you inherently understand when improvements in quality metrics are made, finan-

Project profit comparison / TABLE 2

Key metric	PMO	FMO	Difference	
Unit produced	10,000	10,000	NA	
Retail price per unit	\$120	\$120	NA	
Fixed costs	\$395,000	\$430,000	\$35,000	
Variable costs per unit	\$58	\$52	(\$6)	
Total revenue	\$1,200,000	\$1,200,000	NA	
Variable costs	\$580,000	\$520,000	(\$60,000)	
Gross profit	\$620,000	\$680,000	\$60,000	
Fixed costs	\$395,000	\$430,000	\$35,000	
Operating income	\$225,000	\$250,000	\$25,000	
PMO = present method of operation FMO = future method of operation				

cial gains follow. To go beyond the language of traditional quality metrics and calculations, you must identify and understand the various types of costs within the income statement and their impact on a company's margins.

The simple financial calculations that allow you to perform basic cost analysis can be used in almost any business scenario and will allow you to make better decisions. **QP**

REFERENCE

 "Lean Six Sigma Enters the Finishing Arena," an interview with Joseph De Feo of the Juran Institute, Products Finishing Magazine, June 2005.



PETER J. SHERMAN is an associate director and senior Black Belt with AT&T in Atlanta. He earned a master's degree in civil engineering from the Massachusetts Institute of Technology (MIT) and an MBA from Georgia State University. He is lead instructor at Emory University's Six Sigma certificate program in Atlanta. A member of ASQ, Sherman is an ASQ certified quality engineer. As a visiting MIT scholar from 1986 to 1987 in Japan, Sherman her the opportunity to work with W. Edwards Deming.



JAMES G. VONO is the global quality systems leader for GE Energy Services Inc., based in Atlanta. He is a certified Six Sigma Black Belt and airframe and power plant mechanic. Vono is a member of ASO.

HELP YOURSELF

Learn how to speak the language of management when asking for a raise. Read Russ Westcott's Career Corner column, "Do You Deserve a Raise?" in the May 2008 QP, which can be found at www.qualityprogress.com under Past Issues.

A Frank Discussion

by Brien Palmer

In 50 Words Or Less

- ASQ's Pittsburgh section hosted a panel discussion with business executives who shared their views on the bottom-line value of quality.
- Among other things, the executives suggested quality professionals garner quick-hit wins to build credibility, align quality with the business' strategic plan and become part of crossfunctional teams to solve problems.

THE PITTSBURGH SECTION has been

a stalwart in ASQ. It was one of a handful of sections that co-founded ASQ in the 1940s.

Because of the concentration of manufacturing in the region, Pittsburgh has always been home to many ASQ members—and a hotspot for quality: Pittsburghbased Westinghouse Nuclear Fuels Division was one of the first recipients of the Malcolm Baldrige National Quality Award in 1988, and local medical device manufacturer Medrad is one of the more recent Baldrige recipients (in 2003).

ECONOMIC CASE FOR QUALITY

Business executives talk about taking quality efforts to the next level

Because of these quality activities, ASQ's Pittsburgh section led a pilot for the economic case for quality a few years ago. ASQ was interested in promoting quality as an agent of profit and prosperity, and it wanted to initiate some pilot runs of this strategy before rolling it out nationally. The positive results of the pilot program were detailed in May 2007's QP ("Reaching Out to CEOs," available at www.qualityprogress.com).

To further the discussion on the economic case for quality, the Pittsburgh section recently invited a group of highly respected local business executives to offer their perspectives on quality and how it best adds value to their companies. The panel consisted of:

- Merry Brumbaugh, vice president of tubular products at LB Foster Co., a 107-year-old Pittsburgh company that supports the nation's transportation industry. Brumbaugh has led significant growth in her division by instituting quality programs and good business practices.
- John Dickson, president and CEO of Redstone Highlands, a nonprofit senior living community. Dickson has presented in many forums on the responsibility of senior managers to promote organizational excellence.
- Mike Mantia, vice president at Dormont Manufacturing, a maker of flexible stainless steel connectors for gases and fluids. Mantia oversees all production efforts at Dormont, and he is a champion of quality practices.
- **Bob Wagner**, CEO of Oberg Industries, a longtime Pittsburgh-area tool-anddie manufacturer. Oberg Industries manufactures metal stamping presses and other tooling lines.

To expose more people to these executives' viewpoints, section leaders encouraged ASQ members to invite "nonquality" managers from their own companies to at-

tend the event. We wanted managers with a business focus (for example, profit and loss) to listen to executives who believed in quality. Eight to 10 managers took advantage of this offer. In all, about 50 people attended the event.

To make the session "real" and nonscripted, we gave the executives only a general idea of the questions beforehand. We wanted an open dialogue, and we encouraged them to speak from the heart. The dialogue is summarized here. Brien Palmer: Have you had any particular personal experience that shaped your views on quality or business excellence?

JD: I've always thought that, as a manager, I need to make sure every person in the organization has opportunities to grow. That's where managers should focus: on their people. If you give them the right tools and the right opportunities, they will grow and develop, and grow the company's ability to provide excellent service and gain self-satisfaction, all at the same time.

Quality directly affects margins, attendance, turnover and the cost of medical care. But you have to model this yourself, or nobody will believe you.

MM: I think my sense of quality developed during my elementary education. I don't think they called it "quality" then, but you could see that doing well required application, focus and discipline. I think this left an impression and established a sense of discipline—of needing to do the right thing to succeed. That translates pretty well into the principles of quality.

MB: At one point, I saw the quality manual was just a book on a shelf. It wasn't being used for anything. When we ran into a bit of trouble at one facility, I turned to the plant manager and asked, "What are we going to do about it?" I think he thought I was going to make all the decisions. He seemed surprised when I wanted to focus on the process of how we were working.

Quality is just the way we do things. It's a way of life. Quality is what we do every day. I don't even think of it as a program anymore.



-Merry Brumbaugh

I'm a firm believer in quality assurance and quality systems. Since we implemented a new quality system, that plant has had no lost-time safety incidents in seven years, no back charges, and excellent quality, safety and productivity rates. This division had breakthrough results from that quality initiative.

I didn't do it (initiate quality activities) because somebody from the home office was pushing me to do it. I did it because quality makes sense. It's really the way to run the division.

ECONOMIC CASE FOR QUALITY

BW: One thing I've learned is that being almost right is wrong. Everyone must be on the spot and maintain a high culture of quality. It requires a lot of dedication.

BP: What role does quality play in your organization?

MM: There's just a dramatic impact on the ability to succeed if the quality focus is lost. You can really flail around if you run into problems and you don't have the discipline and the systems of a quality program to guide you.

It makes a difference to have dedication to quality from the top. Then it flows down to all.

MB: If something happens [absent a quality program], it's disastrous. Quality is just the way we do things. It's a way of life. Quality is what we do every day. I don't even think of it as a program anymore.

Quality has really been a key component whenever I've been able to make a difference. But it's got to start at the top, with me.

BW: I agree with Merry. Quality is a given.

In the past, in other organizations, I've seen manufacturing and quality departments have differences of opinion. They would fight it out, almost acting like they were from different organizations.

At Oberg, manufacturing and quality are on the same page. They get it. This thinking carries over to the factory environment, too. It is quite clean. Visitors always comment about it. Quite often on factory tours, they are surprised to find they are actually in the production area—they thought they were walking to it.

I think a lot of this comes from our founder, Don Oberg. There's a well-known story about Oberg finding a gum wrapper on the floor. Later, he checked to see if it was still there, and it was. After the second check, he put a dime on it. The next time through, he found the dime had been taken, but the wrapper still on the floor. He then called an immediate plant meeting on cleanliness. This made quite an impression, and people still tell that story many years later.

JD: I was recruited seven years ago to replace a terminated CEO. When I got here, I found great diversity in how people were treated. For example, nonunion personnel were given perks, but it was different with union employees. There were lots of organizational silos without communication.

We undertook a major change effort, starting at the

G Quality helps develop a healthy work environment. This helps recruit good people. Quality is definitely a contributor to the bottom line.

—John Dickson



very top. It's probably too long of a discussion for this format, but I can give you some highlights of where we are today.

Redstone Highlands was the first organization to sign on to the Quality First national quality improvement initiative for the American Association of Homes and Services for the Aging. And, in spite of a nationwide shortage of nurses, we've maintained high retention rates.

This is quite a challenge, but we put a lot of focus on it, starting with the president's council, our senior team. We basically looked at everything we did and how we treated one another. We wanted to make meaningful changes, not just pay lip service to it. We want our employees to work in an environment that enables life balance, lifelong learning, truthfulness and respect.

BP: Do you believe that quality pays for itself? That is, does it contribute directly to the bottom line?

MM: Quality costs are quantifiable, but value is returned. Besides, you need to have quality to be in the game. I see differences in quality focus in Asia, Europe and other U.S. sites. It's a challenge to spread best practices across businesses.

MB: I remember years ago hearing some senior executives refer to TQM (total quality management) as "took 'em." They thought of it as just another fad—a way for consultants to make money. Consultants were really pushing the program at the time. And they weren't doing a very good job of showing how it integrated into the overall business.

There's not a doubt in my mind that quality goes to the bottom line. Quality, safety, productivity, lean and balanced scorecards—they all go to the bottom line. Like I say, we use these to run the business.

BW: Oberg understands it costs money to staff and invest in quality. But we do believe that, overall, it pays for itself. It's really a given.

Use discipline and focus on continuous improvement. This will build (quality professionals') credibility and have a **sustainable impact** on the bottom line.



—Mike Mantia

JD: Quality has factors that Redstone Highlands needs. Long-term care is the second-most regulated industry, following the nuclear power industry. We have frequent audits by regulators, and we are held to very high standards for tracking and reporting certain information.

Here's one example of how quality helps. You know how quality philosophy emphasizes respect for employees? We took it very seriously and created a good employee wellness program, and now we are told it is in the top 5% of Pennsylvania companies. All this goes to the bottom line.

Another thing is the way quality helps develop a healthy work environment. This helps us recruit good people. Quality is definitely a contributor to the bottom line.

BP: How can quality professionals best help the business and increase their value to the organization?

MB: I would say to go out and get some quick hits. Then build on the success. Nothing succeeds like success.

MM: Quality professionals can bring value by using quality tools and their detailmindedness on continuous improvement projects. Use discipline and focus on continuous improvement. This will build their

credibility and have a sustainable impact on the bottom line.

JD: Use the business' strategic plan to direct initiatives. This is really what people have to focus on. Management needs to get everyone's voices in the organization to provide input to the strategic plan. Then, people add value by aligning themselves with the plan. That's how you move the organization forward.

BW: You need to maintain an open-door policy. Quality people have a unique perspective: They are not tied to schedule and production pressures, and they can sometimes anticipate problems before others do. I like to get quality involved early in the process to avoid surprises later on.

BP: I know that we quality professionals shoot ourselves in the foot occasionally. Can you think of anything we do that is counterproductive?

BW: To me, the most obvious case is stubbornness. That hurts. Don't keep holding a position just because of pride. That just makes it seem that you are keeping things from getting done for no good reason.

MM: The best quality folks work well with crossfunctional teams to solve problems and don't just point something out and start the blame game. You've got to be part of the solution or at least be willing to help.

JD: I think the most self-defeating thing is a leader who doesn't walk the walk. It doesn't matter if you have "quality" in your title or not. If you are a leader, people will be watching to see what you do. You can talk the talk all you want—you really have to behave in a manner that shows you are living by what you say.

BP: Beyond quality and quality assurance issues, what are the biggest overall issues facing your organization today?

MB: We actually anticipate strong markets, but the big issue will always be getting and retaining good people.

BW: Getting people is an issue with us as well. Few-

You can put many names on it, but basic quality must be there. You have to have processes in place and enforce them.



-Bob Wagner

er people want to join the trades nowadays. There are fewer trade schools. The talent pool is shallow. Oberg has one of two or three apprentice programs in Pennsylvania. It's 9,000 hours long, with state certified trainers.

We work with very high levels of precision and workmanship, and that comes from good, well-trained people. People are important.

The economy is a challenge, too. We need to keep skilled people by giving them sufficient hours of work. We hate to lose people.

Oberg has some relatively new plants outside the United States. It's hard work to put quality into place there. It's just taken for granted in the Pennsylvania facility.

MM: At Dormont, the economic conditions and fluctuations make it difficult to attract and maintain talent. And who knows where the economy is going? It will be a struggle.

JD: For us, there's no direction in Pennsylvania to fund medical cost versus personal care cost. Quality

is in great danger as senior nursing care moves to personal care in homes. When this transition happens, there won't be the same level of controls from an on-site central organization.

This is all evolving, and there are always problems when the regulations and requirements have to keep up with a changing situation.

BP: How can quality professionals keep current with business needs?

BW: Read and make yourself better. You can't ever stand still. Doctors have to learn throughout their careers, and I think everybody ought to do this.

MB: Stay current. Celebrate victories. Overcommunicate. Let everybody know there are no bad ideas. Keep looking for new ideas.

MM: Find ways to use quality tools to effect change and save money in more areas. This is especially important in an economic downturn.

BP: Would you add anything else?

BW: You can put many names on it, but basic quality must be there. You need to have processes in place and enforce them.

MB: I keep coming back to continuous improvement. It's just common sense.

MM: Good quality practices used well are a competitive advantage and a good marketing tool. We are seeing a lot of competition from Asian manufacturers, and I am able to use quality as a competitive tool.

JD: There is one more interesting aspect for us. We are a nonprofit, benevolent care organization, and marketing what we have in terms of quality helps us raise donations. QP

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BRIEN PALMER is managing partner of InterLINK Management Consulting in Pittsburgh. He is a senior member of ASQ, past chair of the Pittsburgh section and team leader for the Pittsburgh pilot run of the Economic Case for Quality program. Palmer wrote Making Change Work: Practical Tools for Overcoming Human Resistance to Change (ASQ Quality Press, 2004). He has bachelor's degrees from Ohio Wesleyan University in Delaware, OH



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Don't Just Talk the Talk

by Nicole Adrian, contributing editor

In 50 Words Or Less

- The Joint Commission recently looked inward to improve processes and customer service.
- The improvement process started with five internal projects and a Green and Black Belt training program.
- The organization understands the importance of applying tools and ideas in-house that it promotes externally.

The Joint Commission tackles **its own processes** with lean and Six Sigma

CASE STUDY

MANY COMPANIES AND organizations talk big about knowing the best way other businesses and groups can work to drive continuous and process improvement. Often, these businesses don't take their own advice. Once in a while, however, a group comes along that can walk the talk.

The Joint Commission has proven it can do just that. Recently, the not-for-profit organization, based in Oakbrook Terrace, IL, developed its own Green Belt (GB) and Black Belt (BB) training program and kicked off internal improvement projects. Officers and staff believe this internal work will drive customer satisfaction, financial discipline and quality of the processes.

> The organization, led by president Mark R. Chassin, M.D., accredits and certifies more than 16,000 healthcare organizations and programs in the United States. The organization strives to continuously improve the safety and quality of care provided to the public through the provision of healthcare accreditation and related services that support performance improvement in healthcare organizations.

> > The Joint Commission staff wanted to use lean and Six Sigma to be more efficient, lower costs and operate better, said Rick Morrow, director of business excellence. "What we've done in the past hasn't gotten us to where we want to be," he said.

The Joint Commission also understands the importance of applying the tools and ideas in-house that the organization promotes externally. "I think that there have been times in the past where we have tried to introduce something to the healthcare field, but we weren't really applying it internally," said Paul Schyve, M.D., senior vice president and ASQ member. "I think what Mark has done is determine why we need to walk the talk."

There are three central reasons why the tools and methods needed to be introduced, Schyve said:

- 1. "We need to do it for ourselves—this is the way we make ourselves better and to better serve customers."
- "We need to show we're walking the talk so other people don't say, "That's fine for you to tell us we should be doing this, but how come you don't apply it to yourself?"
- 3. "If we're going to help others, we need a really good understanding of the tools and concepts—it makes us better mentors to the field."

Chassin took on the roles of a teacher and mentor to the staff, Schyve said. "Soon after he got here, he started having very interactive but didactic sessions with those in the organization to talk about how this thinking was different."

Training belts

To start the shift to using lean and Six Sigma, the organization developed its own training program to meet a need for a continuous process to train, empower and engage all employees quickly, Morrow said. "We believe that a leader's role includes teaching and coaching in quality improvement. The training program includes high-reliability methods and a unique roadmap for any project team to be successful in figuring out complex problems."

It's important for the Joint Commission to have GBs and BBs as part of its staff and business units to improve internal processes, Morrow said. This better satisfies customers' expectations and, in turn, helps those customers improve patient safety and quality, he added.

"Let's understand how we do this ourselves so that we better understand how it will work in healthcare organizations," Schyve added. "I think that was one of the reasons for saying 'Let's develop our own training program."

In the first wave of certification, 20 employees took the GB certification course. From those 20, two were recently promoted to BB, said Ann-Marie Benedicto, executive vice president and chief of staff. "We felt it was very important to grow our own," she said.

Getting started

In addition to the belt training program, staff started five internal projects to improve the organization and, in turn, benefit customers.

"We tried hard to say, 'What are our internal processes that are most greatly going to benefit our clients and customers?" Morrow said. "We felt we had a good product that would really help patient safety and quality."

Before the five projects were selected from a list of 148 potential choices, they had to be analyzed and three criteria had to be considered, Benedicto said. The criteria were:

- 1. Customer satisfaction.
- 2. Financial discipline.
- 3. Quality of the processes.

Additionally, two other important factors had to be considered, Schyve said. "The projects had to be those that the GBs-in-training would be able to handle," he said. "Also, the projects needed to be things that, when they succeeded, everyone in the organization would say, 'That was important; this really helps us.' It had to do with the training and the message to the rest of the organization about why this was important."

The officers and teams worked to tie the organization's projects to key dissatisfiers, said Charles Mowll, executive vice president of business development, government and external relations. They also worked to get back to the main criteria that qualify the project to drive internal performance excellence with real results to improve the value to customers, he added.

The first five internal projects the Joint Commission worked on were:

- **1. Improving the standards development process**—create value-added standards in less time.
- 2. Standards integration speed—ensure the clients and internal stakeholders get the new information when needed.
- **3. Surveyor scheduling changes**—reduce surveyor rescheduling, which wastes time, costs money and frustrates surveyors.
- **4. Safety products value sharing**—communicate the new services that are not being shared as much as forecasted.

5. Consistency of standards interpretation reduce the occurrence of customer dissatisfaction in standards interpretation.

Tackling inconsistencies

The standards interpretation project was important for a team to tackle, because customers want consistency in the interpretation of standards, and the Joint Commission has to find the sources of inconsistent interpretations supplied to them, Morrow said.

"One of the top five customer concerns is consistency in interpretation of the standards," Mowll said. "Either inconsistencies are being made among the survey team or occurring from one survey team to the next survey team. Some survey teams will tell a hospital one thing, while another team tells them something else."

For example, the team in charge of the project found that an external consulting source was interpreting a standard for medication storage differently than the Joint Commission does, Morrow said. "We also found different interpretations between other stakeholders," he added.

To reduce inconsistencies, the team first gathered the opinions of customers by contacting them directly, either by telephone or through web-based surveys, Morrow said. "The team also used Pareto analysis to identify the most frequent problem interpretations received by the Joint Commission's standards interpretation group. Then, the team collaborated with the standards development group to ensure that it had the correct interpretations to develop solutions."

A variety of lean and change management tools were used for this project, including:

- Chartering.
- Stakeholder analysis.
- Voice of the customer.
- Hypothesis testing.
- Surveying technology.
- Supply, input, process, output, customer diagram.
- Failure mode effects analysis.
- Statistical process control.

The team developed a package of solutions called the Standards Pak to aid organizations in standards interpretation, Morrow said. "A Standards Pak for a standard is a set of documents that includes a description of the standard, implementation expectations, information about how the Joint Commission assesses compliance with the standard, definitions of key terms associated with the standard, supporting documentation and historical information about the standard," he added. The Joint Commission is currently testing this solution.

The teams involved with the five projects had formal report-outs—meetings in which team members discussed the project's progress, successes and challenges—after every step, Benedicto said. "It was mandatory for the leadership and a growing number of team members," she added. "Those stimulated some very interesting discussions, which I think the teams benefited from. They got the benefit of perspective on the issue they were trying to tackle from all sides of the organization. The GBs were coached to look for teachable moments."

Chassin required that all officers attend the reportout discussions, even if it meant changing schedules. "It was a very clear message from the president about how important this was going to be, but it also let all the other people know that this was something the leadership of the organization was committed to," Schyve said. "This wasn't just the president's idea."

Looking to the future

The Joint Commission is committed to internal lean Six Sigma projects over the long term. Chassin and Benedicto are certified belts, and they continue to coach others, Morrow said, adding that "this shows our top leadership is committed to robust process improvement. The Joint Commission is committed to further improving our processes and assisting customers where requested."

Now, the staff is focused on 10 additional projects, and there are many more from the first wave of belts who are now working on their second projects, Morrow said. Additionally, another 20-plus GBs and 20 change agents are being trained.

With the work being done on these projects to help with in-house continuous improvement, the Joint Commission believes the internal changes will also be successful outside.

"For many years, the Joint Commission tried to encourage continuous improvement in healthcare, but never with this level of emphasis," Schyve said. "It's not as if the Joint Commission hadn't been focused on improving processes, but we think this change will be helpful to healthcare organizations." QP

In 50 Words Or Less

- Two ways to gauge a healthcare organization's effectiveness are quality of service and quality of care.
- Quality of care should define healthcare quality.
- The healthcare system needs to create incentives for hospitals to invest more in the quality of care they offer.

Hospitals must rethink incentives to emphasize quality of care
by Janusz J. Godyn, M.D.

HEALTHCARE IS THE third-

largest group in the Standard & Poor's 500, behind financial services and IT. Considering the amount of knowledge, labor and materials devoted to the industry, there is no doubt that healthcare is a major economic force in society.

As resources continue to pour into healthcare investments, how can we be confident they are being efficiently allocated? As largely not-for-profit ventures, you would think that investments in hospitals would follow a simple formula: maximize value to society by providing the highest quality of healthcare for a given level of costs. Therefore, you can think of value as directly proportional to the quality of healthcare and inversely proportional to the cost of healthcare:

Value = quality / cost.

While the cost factor of this equation is easy to measure, the quality factor is more difficult to define.

There are two independent characteristics to consider when measuring quality in healthcare: quality of care and quality of service. Quality of care is the objective measure of the outcome and the objective evaluation of the most effective ways to achieve the best outcome. This could and should be scored by professional experts based on the current medical knowledge.

Quality of service is the subjective measure of healthcare quality scored by a patient and the patient's family. It is based on the receiver's perception of the quality of the process and the outcome. That score may be significantly influenced by the pre-care level of the receiver's subjective expectations.

There are reasons these two scores (care and service) could be different. The consequences of the differences should be considered in healthcare quality financing and improvement processes.

Looking at practices for measuring the quality of healthcare, there is a clear misalignment of incentives. Some third-party payers and accrediting institutions are rewarding healthcare organizations for maximizing the quality of service they provide. Instead of quality of service, it's in the best interests of the payers, institutions and society as a whole to reward healthcare organizations for maximizing the quality of care they provide.

Perception problem

Many institutions define quality of healthcare by how it is perceived by patients and families. Even the Malcolm Baldrige National Quality Award focuses on human perceptions of quality as drivers of actual quality in healthcare. Curiously, the hospitals that have received the Baldrige award have not been listed as top hospitals by many major national newspapers, polling organizations and consumer groups in annual rankings.

The problem with relying on patient perception of quality is that perception is particularly biased in the healthcare industry. If patients, by definition, are not qualified to diagnose the severity of a disease, how can they possibly be qualified to assess the quality of the outcome? Here's a hypothetical, yet not unusual, scenario that highlights this issue.

Two surgeons

Dr. Goldenstitch is extremely knowledgeable in his specialty, is well trained and possesses excellent surgical skills. He is devoted to his patients and demands the best from hospital staff. He knows the results of his surgeries are excellent, and he tends to be somewhat arrogant in his behavior. He is straightforward and concise in his conversations with other practitioners and nurses because of his focus on results, which sometimes causes him to appear rude. In terms of the care he provides, however, he is without a doubt the most talented surgeon in the hospital.

Dr. Silvertongue is the quintessential people-person. He is a friendly and extremely pleasant person who devotes much of his time to building relationships with staff and patients. As a result, the hospital staff loves him. Unfortunately, his surgical skills are not the best, and it is obvious to other doctors that he is not as talented or experienced as Dr. Goldenstitch. Nevertheless, hospital staff recommends him to patients because of his demeanor.

Suppose Dr. Goldenstitch treated George, a patient who has an advanced disease. The patient was well prepared for the operation; however, Dr. Goldenstitch demanded that the endocrinologist spend more presurgery time with his patient to guarantee the best possible care. This caused delays. The patient and his family were anxious and irritated that it took so long before Dr. Goldenstitch operated.

The surgical procedure was quick, thorough and free of complications. The patient was discharged the next day. Again, family members were somewhat disappointed they had to take the patient home so quickly, perceiving the minimal time at the hospital as a sign of poor service when, in fact, it was the result of exceptional care. In addition, they noted an obviously formal, not warm, relationship between Dr. Goldenstitch and the nurses.

George recovered well. He is not certain, however, whether his doctor did the best job, although in reality Dr. Goldenstitch performed a superb operation.

Suppose Dr. Silvertongue treated James, who has the same advanced disease as George. The patient

Patient **satisfaction with service** should not be used as a primary **measure of quality in healthcare.**

was not quite prepared medically, a point raised by the anesthesiologist prior to surgery. However, Dr. Silvertongue, with all his people skills, assured the anesthesiologist and other staff that the operation would be short and uneventful. In fact, the procedure was extremely long with surgical complications as a result of Dr. Silvertongue's poor skills and understanding of anatomy.

After the procedure, the patient developed pulmonary complications, partly from the extended general anesthesia. The consulting pulmonologist was very dissatisfied that she was not asked to see James before surgery because the patient was a respiratory risk. Nevertheless, the patient and the patient's family were not aware of all those details.

Dr. Silvertongue presented the case to them as very difficult and prone to complications. He promised that the patient would be better despite the complications. In addition, the family could see how warmly supportive the nurses were of Dr. Silvertongue and ultimately of James. James had a long hospitalization, and he is still not quite well. But he and his family were grateful to Dr. Silvertongue and felt confident they received the best care possible.

Quality of care vs. quality of service

The scenarios highlight the two underlying factors of quality of healthcare: Dr. Goldenstitch symbolizes quality of care, which is the level of an objectively measured medical outcome; Dr. Silvertongue symbolizes quality of service, which is the perception of provided quality as seen by the patients and their families.

Moreover, these factors are independent of each other. Therefore, these two distinct entities must be measured separately. Furthermore, separate incentive and reward systems must be created for each aspect of quality. The most important conclusion to make from the scenarios is to differentiate between the aspects of quality and not to misunderstand the results of one as a reflection on the other. Thus, while both are important elements of healthcare, to minimize the cost of healthcare, the third-party payers should reward hospitals for maximizing quality of care, while patients could reward hospitals for quality of service.

Models for quality of care

The most accurate model for measuring quality of care would be to compare each medical case against a benchmark. For example, a hospital might track the following factors:

- Stage of the disease at the diagnosis.
- Stages of all the coexisting diseases the patient had at the time of diagnosis.
- Stage of the disease after the medical action took place.
- Changes to the coexisting diseases.
- Treatment-related complications.

The results of the treatment would be compared to a benchmark to judge quality of care. The relative results of the treatment would form a quality score. The following three models can be used to measure the quality of care:

1. Quality of care = measurable result of medical outcome. Even if it were possible to track all of the static variables, additional dynamic variables would further confound the quality-of-care analysis. For example, the speed of recovery may be influenced by the entire disease event and treatment on the patient's measurable anatomic and physiologic performance, and the patient's ever-changing mental wellbeing throughout the entire process.

Mechanisms for enforcing proper compliance with each treatment would have to be put into place to guarantee that treatment was administered in exactly the same way as compared to the benchmark situation. Despite these scoring problems, physicians track medical outcomes of their individual patients to enrich their own experience, to apply for privilege rights, to renew credentials, and to meet hospital risk management requirements. However, quantitative measurement of medical outcomes is difficult. As a result, hospitals and overseeing institutions also tend to focus on compliance with processes that are believed to instead lead to higher quality of care. In other words, if processes are in place so patients are matched to optimal treatments for their diseases, quality of care should be maximized. In this model of measuring quality, we do not measure quality of outcomes; instead, we measure the frequency of applying best practices, which evidence-based analysis has shown leads to the best results.

2. Quality of care = compliance with the best evidence-based practice. Unfortunately, while practical and frequently promoted, this model of quality maximization is prone to two weaknesses. make a decision regarding the capability of the available physicians and equipment to successfully treat a patient. The ethical dilemma occurs when deciding to transfer a patient to another facility, which would reduce hospital revenue.

A similar dilemma may occur when a physician has the opportunity to suggest additional, unnecessary and costly procedures, which might not harm the patient but simply increase revenue. Such decisions must be made objectively without thought of financial incentives and must be based on improving or saving the patient's life.

High quality of care depends on ethics and knowledge because these factors ensure appropriateness of treatment. Furthermore, it requires that the performed

To minimize healthcare costs, the third-party payers should reward hospitals for **maximizing quality of care.**

procedures were truly necessary and case appropriate, independent of their postprocedure good medical outcomes, which could falsely suggest good care.

Knowledge and skills can be defined as the sum of education and experi-

First, today's best evidence-based practices may be tomorrow's poorest choices. In other words, the fact that historical evidence suggests an optimal treatment does not necessarily mean that future results will be just as successful.

Second, this model shares the first model's weakness: The comparison of best evidence-based practices requires two medical cases to be extremely similar. Unfortunately, the multidimensionality of the problem confounds comparability. For example, starting antibiotics on time for pneumonia is one of the currently used evidence-based indicators. However, approximately 10% of pneumonia cases turn out to have viral etiology and should not be treated with antibiotics. Therefore, using shotgun statistics of compliance may not reflect truly high quality of care.

As a result of the impracticality of accurately benchmarking outcomes and the weaknesses of the currently employed best practices model, a third model based on drivers of high quality of care is also used.

3. Quality of care = ethics + knowledge and skills + equipment – poor safety practices. Ethics is the foundation of quality medical decision making. Ethics often comes into play when staff is forced to

ence, both of which are measurable in some way. Education of physicians is public data. It is important to include annual records of continuous medical education. Experience may be related to the number of patients treated or the number of procedures successfully performed.

Although not included in the equation, one more critical factor to providing the highest quality of care is innovation. A culture promoting innovation and proper mechanisms to apply its results should be in place. Innovation as a factor is not readily measurable, and only thorough follow-ups does it show its usefulness. Its significance might be best appreciated, not in anecdotal cases, but in population outcomes, where it may dramatically improve quality of care. Therefore, knowledge and skills can be redefined to include innovation:

Knowledge and skills = education + experience + innovation.

Modern advanced equipment is very important for effectiveness and timeliness, especially in certain complex situations. However, relying on technical results against experienced clinical judgment may not always be optimal. Remember, the useful life of equipment is a factor closely related to budgetary processes of hospitals. Poor safety practices are detrimental and may negatively influence medical outcomes by virtue of errors that unintentionally occur in the healthcare process. Therefore, good safety mechanisms may not necessarily improve quality of care, but a poor safety environment will decrease the quality of care. Perfect safety and average quality lead to average quality. Good quality and poor safety lead to poor quality.

Therefore, in the equation for high quality of care, we should add the other contributing factors and subtract poor safety. Furthermore, safety is not only a lack of error; it is also prevention of potential complications, including hospital-acquired infections or accidental events. Safety should be considered in two dimensions: patients and providers. Our duty is to protect not only patients, but also healthcare employees. Again, environment of care factors in the budget process.

Models for quality of service

Quality of service is the patients' perception of quality of medical outcomes and processes. It is measured as patient satisfaction, which is a subjective evaluation of the medical outcome and an impression of the process leading to it. The following two models capture this definition of quality of service:

1. Quality of service = perceived result of medical outcome + impression of medical processes – patient expectation of quality. I've observed quality of healthcare in many hospitals, including a Baldrige recipient hospital where I am chair of the performance improvement committee. Years ago, Gallup ranked that hospital No. 1 in one out of 10 quality-of-service indicators: most convenient to patients' homes.

After performance improvement strategies were implemented during a multiyear process, all measured indicators placed that hospital as the best in each of the other nine categories:

- 1. Most responsive to community.
- 2. Most improved.
- 3. Cleanest.
- 4. Most personal care to patients.
- 5. Pleasant and comforting to patients and visitors.
- 6. Most advanced with state-of-the-art technology and equipment.
- 7. Best doctors.
- 8. Best nurses.
- 9. Best overall.

At the same time, hospitalwide efforts were devel-

oped and deployed to improve quality-of-care indicators. When the category of being pleasant to patients and visitors was achieved as the last of the 10, the hospital ultimately won widespread praise in the media. However, the top service-quality scores did not reflect the fact that quality of care could and should be improved further.

To that point in time, the total mortality rate in the hospital was down 0.7% from the level at which it started the quality improvement process several years earlier, but the hospital still had room for further improvement. The physician leaders knew it and continued the improvement efforts. In the subsequent two years, the total mortality rate decreased by another 0.5%, well below the average mortality of the state's best quartile.

Most interestingly, overall patient satisfaction jumped considerably when the hospital introduced a food-on-demand program. Perhaps having warm food of choice on time was one of the most critical factors in shaping patients' perception of high-quality healthcare, as opposed to measurable factors of physician performance. It was not in vain that the hospital carefully studied the best service processes in the hotel industry. Therefore, the patient's evaluation of quality of healthcare can be dependent to a large degree on patient's satisfaction with processes, which would be considered the measure of quality of service.

2. Quality of service = patient satisfaction with process. Quality of service depends on:

- Having a culture of pleasantness and amiable employees.
- Being an effective organization that guarantees the most comfortable diagnostic and treatment process.
- Being a customer (patient and provider) oriented corporate culture, which includes shaping the opinions of patients and their families.
- Marketing state-of-the-art equipment and up-todate techniques to the community.
- Projecting an image of being the most advanced, knowledgeable and experienced provider.

Because quality of service is a matter of perception, it is always good to have patients who possess positive attitudes and will likely rate quality high. Therefore, through effective marketing, patients can be taught they are having the best experience they could have ever expected. This again highlights the danger of relying on patient perception in measuring quality of healthcare.

The national governmental agency overseeing

healthcare, the Centers for Medicare and Medicaid Services (CMS), uses a questionnaire with questions corresponding to performance indicators. The questionnaire is similar to one used by Press Gainey, a private polling company.

In the sections of "care from nurses" and "care from doctors," the questions have little to do with quality of care. Instead, they focus on quality of service:

- 1. During this hospital stay, how often did doctors treat you with courtesy and respect?
- 2. During this hospital stay, how often did doctors listen carefully to you?
- 3. During this hospital stay, how often did doctors explain things in a way you could understand?
- 4. During this hospital stay, after you pressed the call button, how often did you get help as soon as you wanted it?

Reward quality of care

Both aspects of quality of healthcare, quality of care and quality of service, are important. Of the two, however, there is no doubt that quality of care is more important and should shape the meaning of quality in healthcare. Moreover, this discussion of the factors that drive quality of care and quality of service has serious economic implications.

A healthcare system must create appropriate incentives for hospitals to invest in quality-of-care factors, while patients could directly compensate hospitals for incremental expenditures related to quality of service. Patient satisfaction with service should not be used as a primary measure of quality in healthcare or as the scoring system for pay-for-performance. Patient satisfaction scores should be used as local market data, which would allow patients to select the best service

place among equal care providers.

Patients could pay for service. Hospitals could provide levels of service patients **elect to receive and pay for.**

Payers and accrediting institutions should reward quality of care. Some institutions reward service factors, thus creating incentives for hospitals to

The issues that concern patients may be indirectly related to quality of care by ensuring good communication and better patient compliance, and by decreasing the risk of poor safety of the process resulting from potential miscommunication.

The questionnaire's statistics are the measured indicators of patients' perceptions of service aspects of the medical process, not the actual quality of care received by patients. This score may be inversely related to patient expectation of quality as shown in the first formula for quality of service.

It is not surprising that in the recent results, Hawaii and states in the Northeast revealed low scores in quality of service because large parts of their populations either enjoy exposure to or provide the high-quality service offered by the hotel industry. Therefore, those people surveyed may have higher expectations for hospital service quality. invest in service, when resources should always be allocated to maximizing care.

For example, the Baldrige award scoring system favors quality of service in patient and employee perception, and assigns only 10% of the score to quality of care. Third-party payers should be ranking hospitals based on the quality-of-care factors outlined earlier rather than service, which is frequently measured instead.

Moreover, third parties that finance healthcare processes, such as taxpayers through CMS and insurance companies, may only cover costs associated with quality-of-care factors.

For example, taxpayer support for patients' regular meals could be questionable. If patients weren't in the hospital, they would have to spend money on food for the same time period. However, nursing or physician care would be a covered expense and

> charged proportionally to the manpower demanded and equipment used. Cost of the medical equipment and the environment of care would be covered, too.

WHY PAY MORE?

Should insurers pay hospitals more if certain quality-of-care standards are met? Would you pay more for some amenities during a hospital stay? Post a comment on this article's page at www.qualityprogress.com or e-mail editor@asq.org. Patients could pay for service. Hospitals could provide levels of service patients elect to receive and pay for. This is similar to how hotel customers can decide to stay in a regular room or a presidential suite and pay the different fees accordingly.

Patients should be provided with standard amenities, but incremental service improvements (such as food on demand with a variety of menus items) would be charged directly to patients.

Additionally, third-party institutions may choose not to compare hospitals on service measures, understanding that service is merely a segmentation strategy, preferably leading to the matching of service-sensitive patients with appropriate facilities.

The goal would be not to reduce quality of service for patients, but to realign incentives for hospitals.

If patients—and not the third-party payers—pay for room and board as part of service fees, the overall cost of hospitalization could decrease. If patients and families are responsible for more of the bill and are required to pay for extra days in the hospital, they might consider staying in hospitals for a shorter period of time—that is, enough time to recover and be medically cleared to leave.

National effort should not be wasted on investments in service when there is still significant room for improving the quality of care hospitals provide today. The value of healthcare in our country would subsequently increase if the national cost of healthcare was applied to only support quality of care. *QP*



JANUSZ J. GODYN, M.D., is a professor at the University of Medicine and Dentistry of New Jersey. He is chief of pathology and laboratory medicine services at six New Jersey hospitals and co-director of public health laboratories at New Jersey's Department of Health and Senior Services. He chairs the performance improvement committee at Robert Wood Johnson University Hospital Hamilton, a recipient of Quality New Jersey Governor's Award (2001 and 2004) and the Malcolm

Baldrige National Quality Award (2004). Godyn received his doctorate of medicine at the University of Medicine in Krakow, Poland. He is a member of ASQ and the Academy of Clinical Laboratory Physicians and Scientists, and is a fellow of the College of American Pathologists and the American Society for Clinical Pathology.



It Doesn't Dob Up

In 50 Words Or Less

- Today's economic turmoil may have started because people did not follow the order of operations.
- Inaccurate calculations produced bad data, which may have misled business and government decision makers.
- Quality science and vector analysis help ensure accurate calculation and sound reasoning, as well as less risky and more profitable decisions.

BEWILDERED ECONOMISTS offer many

theories as to what ultimately led to today's financial woes. Analysts attempt to untangle how so many factors and variables—banks, mortgages and government oversight contributed to the mess.

Did the financial crisis begin as an arithmetic error? Some dismiss this theory as too simple and naïve. On the other hand, perhaps leaders in business and government ignored some basic quality control rules, which sent the country down the path toward today's economic troubles.

How **quality science** and vector analysis could have averted **today's financial mess**

by M. Daniel Sloan

Order of operations

Some background is necessary to explain how small mistakes could add up to create a financial crisis. The first mistake made was ignoring a simple set of rules called the order of operations. Consider the following equations:

$$3 + 4 \ge 2 = 14$$

$$3 + 4 \ge 2 = 11$$

Which one is correct? Most people will choose 14. The correct answer, however, is 11. Many will shake their heads at the question and the answer.

The question supposes that readers are unfamiliar with the order of operations. That supposition is a hypothesis. The claim that most people will choose 14 implies another hypothesis. Both beg to be tested with an experiment.

The scientific method is the best way to ask and answer questions. That is one reason why ASQ founders called their quality tool set the quality sciences.

Walter A. Shewhart, the physicist who invented the quality control chart in 1924, argued that the hypothesis, experiment and test hypothesis cycle is quality science. "It constitutes a continuing and self-corrective method for making the most efficient use of raw and fabricated materials."^{1,2} Problems arise when the cycle is derailed by miscalculation.

If you chose 14, test the hypothesis by typing the equation = 3 + 4 * 2 into an Excel spreadsheet cell. The correct answer, 11, will appear. At the next team meeting or management conference, put the equations on a white board. Give everyone about five seconds to write down their answers. Poll the room and reveal the right answer.

The order of operations is known as PEMDAS, or parentheses, exponents, multiply, divide, add and subtract. PEMDAS rules ensure accurate calculation. When you want a correct answer to an equation, you must use each relevant PEMDAS step in order.³ Because there are no parentheses or exponents in the $3 + 4 \ge 2$ equation, you must first multiply and then add.

In 30 years of management and consulting, I have never worked with any enterprise that follows the order of operations in a disciplined manner. The result is plenty of errors.

Others agree that errors are everywhere. Raymond Panko's research at the University of Hawaii is compelling. He estimates spreadsheet error rates range from 86 to 100%^{4,5} Just search "spreadsheet error rates" on Google. The results will amaze.

Did decades of miscalculations catch up with business, banking and government, leading us to colossal financial problems? We'll never know the answer or appreciate the full impact of simple PEMDAS mistakes.

Granted, there's another popular, quick explanation on why the economy is in turmoil: Everyone spent too much money. Certainly, greed, avarice, fraud, robbery, incompetence and a multitude of other variables contributed to the mess. But you can't dismiss the fact that flawed arithmetic practices may have misguided decision makers in business and government who were analyzing and acting on bad data.

Statistical reasoning

As far as solving the arithmetic problems, quality science can deliver a range of solutions the same way it did for Bell Laboratories in the 1930s. Bell and Western Electric used quality science to create a communications system that helped lead the nation to prosperity. They connected our nation in spite of a Dust Bowl economy. Science still can, and often does, continue to do the impossible on budget and at a fair profit.

Works by Albert Einstein, Ronald A. Fisher, Shewhart and George E.P. Box are best-in-class, quality science resources.⁶⁻¹¹ Their books all advocate the use of statistical reasoning vectors. W. Edwards Deming proposed that these masterworks are essential: "Problems cannot be understood and cannot even be stated, nor can the effect of any alleged solution be evaluated, without the aid of statistical theory and methods."¹²

In other words, theory and methods mandate the order of operations. PEMDAS must be at work in every correct, orderly analysis.

Correct and orderly analysis

Very few people realize data have physical properties. This is a fact of the universe. Unfortunately, this quality keystone is often omitted, even from the Six Sigma body of knowledge.

Test this hypothesis: Search the ASQ website (www. asq.org) for the keywords "physical properties of data" or "vectors." The most recent, first-hit articles are dated 1960 and 1973. When Deming observed similar oversights, he quoted the German philosopher Immanuel Kant, "Experience teaches nothing without theory, but theory without experience is mere intellectual play." Since 1920, a quality sciences order-of-operations analysis has consisted of a vector analysis applied to a data matrix. Vector analysis is a must-have, fundamental job skill. Everyone can use it to solve problems. Fisher called this method the analysis of variance (ANOVA).

With a computer, an ANOVA is fast. Highlight the data fields and click ANOVA. You will automatically get full-color, two and three-dimensional analytic graphics. With about 30 minutes of training, you can use vector software to explore response surface maps by spinning them in 3-D space.

Vectors point the way

A vector is a set of numbers treated as a single entity. It defines magnitude and direction. Vectors are a physical property law in the universe. You can measure vectors just as you can measure gravity and the speed of light. Vector analysis applied to a data matrix requires a minimum of three generalized dimensions. Those dimensions are called the Cartesian coordinate system. You can visualize them using axes labeled *X*, *Y* and *Z*.

Vector analysis is a vast, audacious and empirically true method that is transparent and that leverages the order of operations. Vector analysis is to multiplication as multiplication is to addition: It is a logical, next step forward.

A vector analysis, applied to a data matrix, is the world's gold standard. An ANOVA—whether it appears to be a control chart, a *t*-test, a *Z*-score, a designed

experiment, a regression analysis with its scatter diagram, or any other statistical tool—is the best guide for determining the likelihood that patterns concealed in a given set of numbers might have meaning.

To my chagrin, I have discovered even statisticians reject this benchmark. Insightful clients have explained the phenomenon to me more than once: "Our company motto is, 'If you can't hit the standard, lower it."

Given the challenges we face, now is the time to hit the data analysis standard.

A vector is best visualized as an arrow connecting one point to another. Evidencebased decisions—those that follow orderof-operation rules while acknowledging physical properties of the universe—focus on three vectors. They follow the equals sign in the following equation:

Raw data vector = data average vector + profit-signal vector + noise vector

A correct, orderly data analysis always takes the shape of a right-triangle tetrahedron. If one or more vectors are missing, there is speculation rather than a rigorous analysis.¹³ In Figure 1, the ANOVA tetrahedron is, as always, constructed entirely of right triangles.

Every statistical equation in the entire theory-andmethods arsenal is a function of that timeless equation: $c^2 = a^2 + b^2$. A contemporary name for this Pythagorean theorem can be the new management equation.

The square root of c^2 gives you the length of the raw data vector. What *c* means is that if you have a measurement of 5, you must square it. Take the square root of that value to get the length of the raw data vector. In this example, the length of the vector would be 5.

If you had two raw data measurements, such as 4 and 3, you must square each one, add them together and take the square root of their sum, which is also called c^2 . In this case, the sum of the squares—16 and 9—is 25. The square root of 25 is 5. The length of this raw data vector is 5, which could represent five minutes, five pounds, five miles, \$5 or \$500 billion.

You might protest that you never square any raw data values. Most companies ignore the physical properties of data along with the order of operations. Herein lies the massive arithmetic problem we face today



as we struggle to straighten out the balance sheets.

Squaresville

If you don't square each raw data point, sum those squares and take the square root, you cannot know the length of any of the six vectors that are essential to a correct, orderly analysis. You may have already guessed how big the errors are. If so, you are following the statistical reasoning of Einstein, Fisher, Shewhart, Box and Deming.

For example, let's say 4 is the average of a number set: 5, 4 and 3. To find the length of the data's average vector, you must square the average and then take the square root of it: $4^2 = 16$. The square root of 16 is 4. The length of the data average vector is 4.

This is not rocket science. Rocket scientists and airplane pilots, however, use vectors to navigate. Vectors are the global positioning system that ensures a true course.

The variation vector is called a variance. For the purpose of this article, the square root of the variation vector, or variance, approximates one standard deviation. The Greek symbol for this vector is sigma, σ . Let's say the length of our variation vector is 3.

The variation vector becomes the hypotenuse of the next right triangle constructed in an ANOVA computation process. We named the two vectors in the geometry of an ANOVA as the profit-signal vector and the noise vector, as shown in Figure 1 (p. 45).

A profit-signal vector represents the influence a given factor—such as temperature, speed or pressure may have on a production system. When the ratio of the profit-signal vector length to noise-vector length appears as it does in Figure 2 (in which the profit-sig-

Profit

signal

Statistically significant analysis of variance / FIGURE 2 Raw data

Data average





Not statistically significant

analysis of variance / FIGURE 3

nal vector is longer and stronger than the noise vector), you have a statistically significant result.

When the ratio of the profit-signal vectors to noise vectors appears as it does in Figure 3 (in which the noise vector is longer and stronger than the profit-signal vector), you do not have statistically significant results. You can prove both of these *F*-ratio facts for yourself by building a physical model of an ANOVA using actual data, a bit of clay and six skewers.¹⁴

The profit-signal/noise ratio is called the *F*-ratio, named after Fisher. The *F*-ratio is automatically transformed into a *P*-value to quantify confidence levels.

Irreconcilable differences

The answer to a subtraction problem is called a difference or a remainder. Because neither word sounds mysterious, an article in the *Times Review of Industry* in 1964 first used "variance" instead of "remainder" to describe the difference between actual and standard costs.¹⁵ Suddenly, a subtraction problem sounded like science.

Generally speaking, when one follows PEMDAS and ANOVA reasoning, the approximate, probable size of the mistake in a cost accounting variance analysis is exponential. This was the second mistake. Consider it the next time you review your company's monthly budget variance report. Maybe the reports should be renamed "the monthly difference report."

See Table 1 for a contrast comparison of ANOVA and accounting variance analysis qualities. The reasoning behind a cost accounting variance assumes physical and statistical laws of the universe do not exist. The difference between the actual dollars spent must equal the budget target. Budgets are usually based on averages. Variation, a physical property of all data, is arbitrarily assigned a value of zero. When that error of commission is corrected, the cost accounting variance formula is indefensible arithmetic by any standard.

The accounting phrase "variance analysis" gave business a license to ignore the order of operations and variation. Managers excused themselves from using exponents, square roots, vectors, geometry, the scientific method and tools that make math valuable. As an enlightened COO of a \$500 million company summarized, "In old-school cost accounting, we determine the variance, the 'remainder.' There, the analysis stops. With the new management equation we determine the variance, and there the analysis begins."

The differences between correct and orderly statistical evidence and the evidence produced by a subtraction problem are summarized in Table 2. Without all six ANOVA vectors, a spreadsheet story has no *F*-ratio, no *P*-value, no confidence interval and no independently verifiable standard of evidence.

The tool favored by cost accountants is the spreadsheet. Scientists prefer data matrix software. Data matrix software, which is the formal name for familiar statistics programs sold by reputable software providers for quality control, Six Sigma and all rigorous data analysis. Combined, spreadsheet and data matrix software applications are favored by quality professionals who respect the order of operations. This combination is mandatory when it comes to getting the right answer to an equation. Table 3 (p. 48) shows that reliable statistical software packages typically are data matrix programs.

Fortunately, computing languages can be coordinated. With a few lines of computer code, a mouse click automatically imports Excel data to a data matrix. Computers then automatically produce rich, meaningful and correctly calculated analytic graphics. Graphics become pictures that people understand. Graphics promote the recognition of patterns of variance that a column of numbers fails to reveal.

A new era of responsibility

In his inaugural address, President Obama talked about the country's many challenges: "... we have duties to ourselves, our nation and the world, duties that we do not grudgingly accept, but rather seize gladly, firm in the knowledge that there is nothing so satisfy-

Monthly budget variance

report / TABLE 1

Analysis of variance (ANOVA)	Accounting variance
(Follows the correct ANOVA order of operations reasoning.)	(A subtraction equation that calls the remainder a "variance.")
Actual = budget (average) + variance	Actual = budget (average) + variance
$C^2 = \partial^2 + b^2$	c = a + b
$5^2 = 4^2 + 3^2$	5 = 4 + 3
25 = 25	5 = 7
	(The equation uses incorrect order of operations ANOVA reasoning.)
Actual – budget (average) = variance	Actual – budget (average) = variance
$5^2 - 4^2 = 3^2$	5 - 4 = 3
25 - 16 = 9	5 - 4 = 3
9 = 9	1 = 3

ing to the spirit, so defining of our character, than giving our all to a difficult task."¹⁶

More than 20 years before hearing Obama's speech, I had already glimpsed some of what he spoke. I was a vice president of marketing for a regional medical center. I was comparing a set of Harvard Graphic cost accounting variance bar charts with my first control chart, a *p*-chart I had drawn by hand using the same data.¹⁷ Each picture came from identical data, but the charts were telling contradictory stories. Not surprisingly, the quality control chart pattern proved to be the correct analysis.

Earlier, one of my 19-year-old employees told me our management team looked foolish: "Not one of you understands the slightest thing about data analysis." She proved her point with a ruler, a piece of graph paper and an ANOVA. Her demonstration helped me understand why the information in the charts differed so

Differences in evidence / TABLE 2

Type of evidence	<i>P</i> -value	Level of confidence against the null hypothesis	Standard of evidence
Vector analysis applied to a data matrix, profit-signal and noise vectors identified.	0.01	99%	Beyond a reasonable doubt
	0.05	95%	Clear and convincing
	0.15	85%	Preponderance of evidence
Story telling and spreadsheet revisions.	None	None	None

Spreadsheet vs. data matrix / TABLE 3

	Spreadsheet	Data matrix
Appearance	Rows and columns.	Rows and columns.
Interpretation of rows	Anything you want.	Each row represents an object or event on which we have data.
Interpretation of columns	Anything you want.	Each column represents a variable for which we have data. Each column is the data vector for the corresponding variable.
Analysis method	Any arithmetical operations you want.	Vector analysis of profit signals and noise, as dictated by the interpretation of rows and columns.
Standard of evidence	None.	The relative magnitudes of signal and noise vectors are compared with thresholds representing internationally recognized standards of evidence.
Disclosure ethic	Reveal or suppress any analysis, or analysis element at your discretion.	Full transparency of all analysis elements.
Blank cells	Breaks the laws of analysis by treating them as zeroes.	Treated correctly as missing value. A missing value reduces the dimension of the data vector and requires special treatment.
Computing standard	Abacus.	Pentium.

dramatically. Had our management team acted on the cost accounting variance rather than the quality control chart vector analysis, we could have inadvertently and needlessly created a financial crisis. Her lesson improved my knowledge. That knowledge changed my life for the better.

Einstein's vectors changed our world view in 1903. Fisher's vectors improved the analysis world in the 1920s. Shewhart charts—a vector analysis applied to a data matrix—transformed quality tools beginning in 1924. Today, we have the opportunity to use vector analysis and quality science to develop a spectrum of new solutions. Time is short. But there is time to take three corrective actions:

1. Insist that people who work with numbers use the order of operations. Because data have physical properties, this means corporate spreadsheets must correctly use PEMDAS, including parentheses and exponents.

2. Reason statistically. We must study as though our lives depend on knowledge. They do. Competent teachers get their students up to speed with vector analysis, and their students usually complete their first breakthrough projects in four days time. Bottom-line results speak for themselves.

3. Automate computing power. Fisher's set of vectors can become an international language of analysis. The last spreadsheet I turned into a one-click vector analysis script took less than 30 minutes to complete. From that point forward, a report that previously took weeks to produce took nanoseconds. The improved finance report is transparent, comprehensive, informative, multivariate and correctly calculated.

Vector analysis is not the one and only solution to a dilemma of the magnitude we face. Nevertheless, the vector analysis skills and the quality science mind-set are essential to uncover sound, profitable solutions. With right-headed actions, we can start to solve the maze of problems we face together. We can think and work our way through the puzzles we confront. QP

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M. DANIEL SLOAN is the president of Sloan Consulting in Seattle. He earned a bachelor's degree in psychology from Baldwin-Wallace College in Berea, OH. Sloan is the co-author of Profit Signals—How Evidence-Based Decisions Power Six Sigma Breakthroughs and other books. He is a certified Six Sigma Black Belt and a senior member of ASQ.

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Quality Isn't a 9-to-5 Job

Tools, applications are evident outside the workplace

AS A QUALITY professional, I often think about how quality is embedded in people's everyday lives. Looking back at my own life, I was shocked to learn how long and how much quality has had an impact on me—especially outside of work.

My first quality position was as a lab technician for C.F. Sauer Co., a condiment and food spice manufacturer. I performed environmental swabbing, packaging checks, lab analysis of raw and finished materials, and facility inspections to make sure the company complied with all local, state and federal regulations.

But it was long before that job that I was first exposed to quality. In February, as I was reviewing my journal, I realized just how long I've been using quality tools and applications without even realizing it.

Practice makes perfect

One of the earliest examples in which I used quality tools and applications is when I was in band at two different high schools. Each band director persistently had us practice to make certain we had the right tonal quality.

I really noticed the importance of practice, however, during my time on the Academic Bowl team. The coaches made sure we practiced to be a successful team. The practicing paid off—we won the school's first-ever county championship.

Since then, I've realized that one of the concepts used during those practices is a well-known quality tool—the plan-docheck-act (PDCA) cycle, or, as I call it, plan-do-check-adjust cycle. After graduating from high school, I went to Clemson University in South Carolina. There, I got involved in Clemson's Residence Hall Association, first as a treasurer and later as member-at-large, and I dealt with student issues in the campus residence halls.

There, I saw quality embedded in the meeting agendas, and I visited the halls to get resident feedback so campus housing officials could make the quality of life better for students. It was there that I learned the importance of feedback and communication between students and housing officials.

One way I was involved in improving the quality of life was by helping make the areas outside the residence halls safer at night. By working with several resident directors and housing officials, we had lights installed outside the buildings, which helped reduce the risk of on-campus crime.

Thinking outside the job

Over the years, I've also seen continuous improvement used to make things better in my personal life. At my church, I make every effort as an usher captain to improve the quality of service for members and visitors so they can enjoy the church worship service.

An example of continuous improvement to make church service better occurred last year: Church officers moved the usher collection plates from an open part of the church office to a more secure place. This change led to more efficient collections, reduced the time for collec-

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tions by five minutes, lessened the offering handling by one step and helped prevent robbery and theft.

Since May 2006, I've taken up editing for Wikipedia as a hobby. I've seen many quality tools employed on the website, including PDCA; audit follow-up on any discussions regarding articles, images, templates and categories; checklists on how to write, edit and delete articles and upload images; and continuous improvement to increase the quality and quantity of articles.

One example of article auditing occurred in March with a piece for a "good article nomination."¹ I created and edited an article on the International Ski Federation Nordic World Ski Championships 2009. I worked with an editor from Norway and another from the Czech Republic to address concerns raised by a Norwegian reviewer to help the article earn the good article standing, which it eventually did.

In short, we may work in the quality profession, but when we think about it, we realize we've been dealing with quality all of our lives. I am passionate about quality because I want to make products, services and life in general better for myself and everyone else. **QP**

REFERENCE AND NOTE

 Wikipedia, http://en.wikipedia.org/wiki/Wikipedia:good_ articles. According to Wikipedia, "good articles" are articles that are considered to be of good quality, but which are not yet, or are unlikely to reach, featured article quality.



CHRISTOPHER C. MILLER is the second-shift quality supervisor for the House of Cheatham in Stone Mountain, GA. He received his bachelor's degree in agricultural engineering from Clemson University in South Carolina. Miller is an ASQ-certified quality auditor and an ASQ member.

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O Advisor Comptroller	 Machinist 	 Retired 	O Teacher	\bigcirc Healthcare (18)		O Statist	tics (12)	
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MEASURE FOR MEASURE BY JAY L. BUCHER

Be Honest

An ethical approach is the only way to go

IN MY YOUTH (and at this point in my life, youth is any age up to and including 30), my father used to ask me, "Did you make any money today?" I heard him ask my older brother and sister the same question many times, but I didn't truly understand what he meant. What I did know was that he wasn't talking about my hourly wage.

I eventually came to understand his meaning, and during my many years as a supervisor and manager of calibration laboratories and departments, I've asked that question many times. I usually get the proverbial "deer in the headlights" stare and then need to explain what I mean.

Basically, it comes down to this: Did you make nothing but honest measurements, perform continuous process improvements, make no false statements, train somebody how to do a new job or correct mistakes from old jobs, or provide quality customer service to those who asked for it or needed it?

That's quite a mouthful, and I even left out many areas that could conceivably make money for a calibration department or an organization in general. But here's the gist of what my father meant: Did you do the very best you could with the time you had?



Ethics in action

I realized early in my career in metrics and metrology that doing the best I could meant bringing a sense of honesty and integrity to my work. In truth, they are the foundations for making a quality measurement.

In today's "I want it now" environment, ethics come in many shades of gray instead of just black and white. But, unlike many aspects of our lives-work, play, family and community-much of what is done in the metrology and calibration community is black and white. The test instrument is either in tolerance or it is not. You recorded the data accurately, or you falsified it so you wouldn't need to do extra work.

The bottom line in making a quality measurement and in ethics in general is this: Everyone should be responsible and held accountable for his or her actions. It should not matter whether you're a judge, doctor, lawyer, accountant, firefighter, police officer or garbage collector. Either you do the very best you can each and every day, or you don't. And if you don't, then you should be held accountable for your actions-or inactions, as the case may be.

In the past year that I have been conducting quality calibration program and paperless records workshops, I've asked scores of attendees the same question: Did you learn anything new that you can apply to your calibration program where you work? So far, I haven't received a negative answer.

The attendees have ranged in knowledge from a young lady with 60 days in the field to a gentleman with 60 years experience. I believe that at each of those workshops, I helped the calibration community make money. That has been my primary goal: improving the calibration programs of biotech and pharmaceutical companies.

Honesty and integrity are the foundations for making a quality measurement.

The other side of the coin is that the quality field is not comprised solely of responsible and accountable people. Because of liars, cheats and thieves, compliance requirements and federal regulations are in place to keep the dishonest people in check and to make sure the honest people stay that way.

Honor system

In the tight fiscal environment most organizations foster—squeezed all the more by the current state of the economy—they cannot afford to have an extra set of eyes watching everyone do everything. Relying on the honesty and integrity of personnel has been a benchmark of successful organizations and will continue to be in the future.

This isn't a revolutionary stance. Every person I've talked to about the importance of telling the truth and getting back to the basics when it comes to ethical conduct has been in agreement. In August 2008, while I was attending the National Conference of Standards Laboratories International Workshop and Symposium in Orlando, FL, I was honored to have a discussion with a few individuals who were of the same mind as me on this subject.

While discussing ethics, a colleague of mine, Deborah Watling, wrote down a quote from Ralph Waldo Emerson and gave it to me: "The greatest homage we can pay truth is to use it."¹ We had been discussing "The Last Lecture," which the late Professor Randy Pausch delivered at Carnegie Mellon University on Sept. 18, 2007.

Both of us had watched this remarkable presentation and also were aware of the book Pausch wrote before he died. In one part of the book, Pausch instructs us to "live your life by three words: Tell the truth." And then, "Add three more if you dare: all the time."² No matter what I write, I could never best his summation. If only we could all live our lives by those six words.

What to do?

Honesty is the best policy. What goes around comes around. Everyone has heard these sayings. Why is that? It's because they are true. Honesty has always been the best policy in business dealings, in our work environment and in everything we do as human beings. But not everyone subscribes to that mantra.

What can you and I do to change the situation? The old saying that every journey starts with the first step is very applicable to this state of affairs. Each of us must step up to the plate and tell the truth all the time. If we do, others will see the results and start doing the same thing.

Call it a grass-roots effort, the right thing to do, an epiphany or anything you desire. But just do it. Start with your family, community and work environment. The only way we can get this world back on the right course is to take responsibility for our actions by telling the truth, accepting the consequences and spreading the word. I've done my part, now it's your turn to do yours.

Ethics, honesty and integrity—are they just words on the printed page, or can they be the foundation on which we build our lives, relationships and businesses? If each of us does his or her small part, the results could be amazing.

We are pioneers making our way across this final frontier, and we must be vigilant to ensure the bad element doesn't get the upper hand. Stand up to the liars, cheats and thieves. The truth is not always easy to say, believe or accept, but no matter how you cut it, it is still the truth.

When I was younger, I was told that when you tell the truth, you never need to remember what you said. It made sense then, and it makes sense now. If we don't start to tell the truth, we will never find the time to start. If we do, the horizon on that final frontier will not appear to be quite so far away.

What does this have to do with a quality measurement or making money for your company? In the big picture, the lack of ethics that leads to shoddy measurement practices could be the difference between good product and bad product. It could be the difference between a great reputation and going out of business because your company fails audits and inspections. And, in the worst case scenario, it could result in the loss of life.

It's up to each of us, then, to come up with an answer to the question, "Did you make any money today?" Or, even better, "Did you make a difference today?" **QP**

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JAY L. BUCHER is president of Bucherview Metrology Services in De Forest, W. He is editor and coauthor of The Metrology Handbook and author of The Quality Calibration Handbook, Paperless Records and Ethics—The Final Frontier. He is a senior member of ASQ, the chair of the Measurement

Quality Division and a certified calibration technician.

TELL THE TRUTH

Have you faced a difficult ethical dilemma while on the job? Tell us your story by e-mailing editor@asq.org. And for more Measure for Measure columns, visit www.qualityprogress.com.

STATISTICS ROUNDTABLE BY JULIA E. SEAMAN AND I. ELAINE ALLEN

Player Rankings

Using coefficient of variation to measure MLB players' worth

THE COEFFICIENT of variation (CV), sometimes called the relative standard deviation, is often used to assess the quality of an assay,¹ the diversity in organizations² or as a benchmark for ranking.³ It is measured as a fraction or percentage of how much variation exists in a variable in relation to the mean, so it represents a highly useful—and easy to interpret—concept in data analysis.

Alone, the mean or maximum value may not be meaningful because it does not indicate this parameter's variability. The standard deviation also may not be particularly useful without examining its relative value with respect to the mean. Within a context that relates the standard deviation to the parameter it is measuring, however, it becomes more informative. The CV is a measure that jointly provides context for the mean and the standard deviation.

For example, knowing that the standard deviation is 1.25 doesn't mean much. Understanding that past data consistently yielded a standard deviation of 2 gives context that the variability of this new sample is less than expected. Knowing the standard deviation has been 0.5 or lower in past data would lead you to believe, however, that the new value, 1.25, should be considered high. Without this perspective, the figure for standard deviation has little meaning.

The CV provides a reference value that combines the mean and standard devia-

tion. By looking at the ratio of a standard deviation (σ) to a mean (μ), which is then usually multiplied by 100, you have a measure of the percentage of variability surrounding the mean.

 $\mathrm{CV} = (\sigma/\mu)*100$ If the CV is large, the data have a great deal of variability relative to the mean.

 $\sigma = 50$ and $\mu = 100$, then the CV = (50/100) * 100 or 50%.

If the number is small, this reflects a small amount of variability relative to the mean.

 $\sigma = 5$ and $\mu = 100$, then the CV = (5/100) * 100 or 5%.

Widely used in the development of biological and chemical assays,⁴ the CV must often be below a certain value (5 to 15%) for the assay results to be considered valid. Quality specifications for assays are usually given in terms of the CV. When examining diversity, the CV is often used as an evaluation tool when comparing organizations or ethnicity within geographic areas.⁵ In hospital evaluations, for example, the CV is often used as a quality indicator when looking at variability of care or hospital infections over subgroups of patients.⁶

MLB player rankings

The CV can also be used to examine consistency of performance versus overall or peak performance. When determining the contract value of an athlete, both metrics should be considered. Using an example

TALKING MORE BASEBALL

I. Elaine Allen, Kirill Kustov and George Recck applied multivariate and univariate analysis to players' statistics in "Building a Better Fantasy Baseball Team," published in the April 2007 QP. Access the article at www.qualityprogress.com.

from Major League Baseball (MLB) to illustrate using the CV as a ranking metric along with performance, compensation received will be ranked along with the CV and overall performance to determine

The players that are **highly** ranked in consistency of performance are Manny Ramirez, Alex Rodriguez, Sammy Sosa and Gary Sheffield.

whether compensation is solely related to peak performance or also to consistency as measured by the CV.

For background, there is a phenomenon known as the *Sports Illustrated* cover jinx. Some athletes who have been featured on the cover of *Sports Illustrated* because of their unique peak performances invariably show a decline from that performance in the future.

Conversely, it is also a commonly held belief that some MLB players will perform best when they are in a contract year that is, the last year of an existing contract. During a contract year, players often produce more on the field, demonstrating their apparent value. The player hopes this surge in performance will result in a new, high-dollar contract.

Simply on the basis of contract-year performance, and standardizing by the number of at bats, Figure 1 shows there is a statistically significant improvement during a contract year. But are these peak performances also consistent?

To examine whether performance and consistency are used to determine a new contract salary, the OPS (on-base percentage + slugging percentage) has been calculated for the top 25 players with new contracts negotiated between 2000-2006. The overall CV is calculated for the five years leading to a new contract, and the salary value of the new contract is also ranked.

Figure 2 (p. 56) provides these rankings by three panels: highest OPS, lowest CV and highest salary. From these rankings, it is clear there is little relationship between the CV and salary, but there is a significant relationship between OPS and salary. When the rankings are correlated using either panel of ranks, the only significant correlation is between OPS and salary (0.463, 0.466 and 0.637, respectively), showing that as OPS increases, salary also increases.

The CV is not significantly related to the other two variables and is either negatively correlated with salary or is almost zero (-0.173, -0.245 and 0.030, respectively). Only seven players, including five of the top 10 in salary, appear in the top 25 for OPS and CV.

What can be learned from this example? First, the ranking of mean values as a measure of distribution of future reward can be misleading; however, with respect to salaries in MLB, it is the norm. Salary is strongly related to performance, with little attention to consistency.

Second, by incorporating consistency of performance along with peak performance, you can identify undervalued baseball players that have high OPS and low CV but are not in the top 25 for salary. For example:

- Travis Hafner—OPS rank 2, CV rank 22.
- Lance Berkman—OPS rank 10, CV rank 5.
- Victor Martínez—OPS rank 23, CV rank 1. Similarly, there's a group of overvalued players with high OPS but variable performance (not in top 25 for CV). The group includes:
- Barry Bonds—OPS rank 1, salary rank 4.





- Todd Helton—OPS rank 4, salary rank 8.
- Chipper Jones—OPS rank 6, salary rank 6.

Finally, the analysis also identifies players that have high OPS and highly ranked consistency of performance. These include Manny Ramirez, Alex Rodriguez, Sammy Sosa and Gary Sheffield.

It is interesting to note that all four of

these players have been linked to performance-enhancing drugs, although it is unclear how this would impact performance, consistency or both. **QP**

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Top-ranked Major League Baseball

performers / FIGURE 2

Player	OPS rank	CV rank	Salary	Player	OPS rank	CV rank	Salary	Player	OPS rank	CV rank	Salary
Barry Bonds	1	39	4	Victor Martinez	23	1	41	Alex Rodriguez	5	3	1
Travis Hafner	2	22	39	Mark Grace	21	2	30	Manny Ramirez	3	9	2
Manny Ramirez	3	9	2	Alex Rodriguez	5	3	1	Sammy Sosa	8	25	3
Todd Helton	4	30	8	Raul Ibanez	26	4	25	Barry Bonds	1	39	4
Alex Rodriguez	5	3	1	Lance Berkman	10	5	38	Gary Sheffield	9	24	5
Chipper Jones	6	31	6	Randy Winn	34	6	37	Chipper Jones	6	31	6
Jim Edmonds	7	13	9	Ichiro Suzuki	31	7	10	Ivan Rodriguez	25	29	7
Sammy Sosa	8	25	3	Mike Sweeney	18	8	19	Todd Helton	4	30	8
Gary Sheffield	9	24	5	Manny Ramirez	3	9	2	Jim Edmonds	7	13	9
Lance Berkman	10	5	38	Michael Young	24	10	36	Ichiro Suzuki	31	7	10
Brian Giles	11	37	16	Rafael Furcal	36	11	33	Jason Kendall	39	33	11
Bobby Abreu	12	15	15	Luis Castillo	41	12	34	Juan Gonzalez	14	32	12
Luis Gonzalez	13	38	17	Jim Edmonds	7	13	9	Moises Alou	19	36	13
Juan Gonzalez	14	32	12	Mark Grudzielanek	42	14	29	Johnny Damon	29	16	14
Grady Sizemore	15	42	42	Bobby Abreu	12	15	15	Bobby Abreu	12	15	15
Magglio Ordonez	16	20	18	Johnny Damon	29	16	14	Brian Giles	11	37	16
Derek Lee	17	35	31	Miguel Tejada	27	17	23	Luis Gonzalez	13	38	17
Mike Sweeney	18	8	19	Jose Vidro	28	18	27	Magglio Ordonez	16	20	18
Moises Alou	19	36	13	Mark Kotsay	37	19	28	Mike Sweeney	18	8	19
Geoff Jenkins	20	23	22	Magglio Ordonez	16	20	18	Edgar Renteria	35	28	20
Mark Grace	21	2	30	Garret Anderson	32	21	21	Garret Anderson	32	21	21
Sean Casey	22	27	26	Travis Hafner	2	22	39	Geoff Jenkins	20	23	22
Victor Martinez	23	1	41	Geoff Jenkins	20	23	22	Miguel Tejada	27	17	23
Michael Young	24	10	36	Gary Sheffield	9	24	5	Jeff Cirillo	33	40	24
Ivan Rodriguez	25	29	7	Sammy Sosa	8	25	3	Raul Ibanez	26	4	25

Overlap

	OPS/CV	5
	OPS/salary	7
	CV/salary	5
	All three	9
No color	No overlap	12

OPS = on-base percentage + slugging percentage CV = coefficient of variation

Data from 2000-2007. Top performers are considered players ranked high in batting average and playing in contract years.

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JULIA E. SEAMAN is a researcher at Genentech in South San Francisco, CA. She earned a bachelor's degree in chemistry and mathematics from Pomona College in Claremont, CA.



I. ELAINE ALLEN is director of the Babson Survey Research Group and professor of statistics and entrepreneurship at Babson College in Wellesley, MA. She earned a doctorate in statistics from Cornell University in Ithaca, NY. Allen is a member of ASQ.

A Step at a Time

A dozen strategies to help advance your career

EVERY SO OFTEN, I daydream about becoming one of those highly paid, in-demand consultants. Based on a quick perusal of the business press headlines and the top 10 best-selling business books, I have concluded two things are absolutely essential for the move from employee to consultant: a 12-step program and a strategy that spells out a catchy acronym.

Since we live in a rapidly changing, increasingly uncertain workplace with more and different challenges, I figured a good place to start my consulting career was in career management. With a little thought, I found 12 steps for a program and even came up with a trendy acronym to package them: VEND. It stands for volunteer, educate, network and document. After all, when it comes to promoting our talents to present and future employers, each one of us is a "VENDor," right?

This program is quite flexible. You can mix and match the steps to fit your own situation. Each step is good by itself. To increase the potential benefits, do these 12 things:

1. Volunteer ideas for improvement projects to the boss. It shows initiative. Coming up with the ideas sharpens your mind for other projects. To make this step work, summarize the pros and cons of the project in a brief memo to focus the discussion and hone your writing skills.

2. Volunteer for interdepartmental teams. The best ideas you come up with in step one will probably require cooperation between departments. If management sets up teams, see if you can contribute. As a side benefit, you learn more about other parts of the organization.

3. Educate yourself by doing research and applying for training courses. The two to three-day short courses can be as beneficial as semesterlong ones. When the workplace budget is tight for training, another possibility is to identify good books and suggest the organization buy them for a quality library.

4. Educate yourself by researching and applying to go to conferences. Some organizations can afford airfare to distant cities, and others cannot. If you live where good conferences are within easy driving distance so no airfare or hotel is required, urge your department to give you time off to attend. Conferences or seminars you can take over the internet are other options for those with tight travel budgets.

5. Educate yourself by studying want ads for skills in demand. This is one way to get ideas for appropriate training or conferences.

6. Educate yourself by researching possible lateral transfers and promotions. This is a good idea if you can find a lateral transfer that will give you needed skills for a future move up the ladder.

7. Network by talking to recruiters about the job market. This works well when you have established a relationship with one or two recruiters over a period of time. They know your skills, talents and traits and are willing to talk to you about what is happening in the market—even if you are not looking for a new job at the moment. There are many recruiters like this, and it is worth the trouble to seek them out.

8. Network by staying in touch with former supervisors. When either or both of you are no longer in the same reporting relationship or company, it is easier to distill and organize the lessons both of you have learned on the job.

9. Document your accomplishments by updating your résumé once a year. If the updates are few or minor, handling them yourself is probably just fine. If it has been a while, or if your skills and accomplishments have grown in a major way recently, enlisting a professional résumé writer can be money well spent.

10. Document your accomplishments by writing them up for a performance review. A good performance review is a two-way discussion. A brief write-up of your accomplishments, plans and training prepares you to contribute to the discussion. Also, it helps ensure your boss remembers all of your contributions.

11. Document updated contact information for references once a year.

12. Document updated ASQ certifications once a year. You are either certified or working on becoming certified, right?

I haven't decided whether to take VEND on the road yet. The beauty of the system is that I can use it to manage my own career in the meantime. That thought is very comforting. **QP**



JOSEPH D. CONKLIN is a mathematical statistician at the U.S. Department of Energy in Washington, D.C. He earned a master's degree in statistics from Virginia Tech. Conklin is a senior member of ASQ and an ASQ-certified quality manager, quality engineer, quality auditor and reliability engineer.

MAKING A MAJOR CAREER DECISION?

Go to www.asq.org/careers, where job seekers can post résumés, get career advice and explore career development opportunities, and employers can post jobs and search résumés.

Revised AS&D Standards Take Flight

Risk management concept expanded

THE INTERNATIONAL Aerospace Quality Group (IAQG) has released the IAQG 9100:2009 aviation, space and defense (AS&D) standards in all three of its sectors. The Americas (AS9100) and European (EN9100) versions were released in January, and the Asia-Pacific (JIS Q 9100) version was released ahead of schedule in April.

The published standard, known as *AS/EN/JIS Q 9100*, is intended for organizations that design, develop or produce aviation, space and defense products; and organizations providing postdelivery support, including the provision of maintenance, spare parts or materials for their own products.¹

The tailored versions of *AS/EN/JIS Q 9100* are being released this summer. These tailored versions include:

• AS/EN 9110 Quality Management

Systems—Requirements for Aviation Maintenance Organizations: This standard is for organizations that have a primary business of providing maintenance, repair and overhaul services for commercial and military aviation products. It's also for original equipment manufacturers with maintenance, repair and overhaul operations that operate autonomously or that are substantially different from their manufacturing and production operations.²

 AS/EN 9120 Quality Management Systems—Requirements for Aviation, Space and Defense Distributors: This standard is for organizations that procure parts, materials and assemblies and resell these products to customers in the aviation, space and defense industries. This includes organizations that procure products and split them

Proposed AS9100 implementation schedule / FIGURE 1



into smaller quantities for resale. They should use the IAQG-developed 9120 standard.³

The expected 30-month transition period for implementation of AS9100 will not start until the publication of AS9101 Quality Management Systems—Aviation, Space, and Defense Quality Management System Audits (see Figure 1). The IAQG other-party management team (OPMT) will be publishing transition period information after the release of AS9101.

AS9101 status

AS9101, which is mandatory for use during other-party management audits, is currently being completely rewritten. This AS9101 rewrite will replace the existing version of AS9101 Quality Management Systems Assessment, AS9111 Aerospace Series Quality Management System Assessment for Maintenance Organizations (associated with AS9110) and AS9121 Stockist Distributor Quality System Questionnaire Associated with AS9120.

The current versions of these documents drive undesirable results because they inhibit the process approach, focus the auditor on completing the checklist and take time away from actual auditing. In addition, the current versions of the AS9101 series of documents are not in alignment with the newly published AS9100 series of documents and the ISO 17021 stage one and two approach.

The AS9101 rewrite goal is to provide requirements on process auditing and development of AS9100 series audit approaches and tools that focus not only on conformity, but also on effectiveness of a quality management system (QMS). The AS9101 proposal is to develop an enhanced audit process for evaluating process-based management systems that aligns with ISO 17021 and consists of:

- Process-based information gathering.
- Assessment or analysis and audit planning.
- Development of performance-based and process-oriented audit methods and techniques.
- The ability to capture objective evidence of process conformity and effectiveness.

The major proposed changes in the rewrite of AS9101 include:

- Creation of one document covering AS9100, AS9110 and AS9120.
- Elimination of scoring and key requirements designations.
- Use of data and customer feedback concerning organizational QMS performance as an input for process-oriented audits (for example, Online Aerospace Supplier Information System (OASIS) customer satisfaction or performance scores).
- Inclusion of determination of effectiveness, in addition to conformity.
- More emphasis on performance measuring.
- Introduction of the objective evidence record.

A major theme of the AS9101 rewrite is examining process effectiveness. ISO 9000:2005 defines effectiveness as the extent to which planned activities are realized and planned results achieved. The ultimate measure of QMS effectiveness is customer satisfaction.

What has not changed in AS9101 includes determining conformity to the standards, documenting discovered nonconformities and drawing conclusions on conformity of the organization's QMS based on information collected during the audit.

AS9101 is currently being **completely rewritten**.

To summarize, the gains in the AS9101 rewrite include emphasizing the process approach, shifting energies from completing the questionnaires to determining and documenting conformity and process effectiveness, and providing useful information to stakeholders concerning process performance and history.

The AS9101 rewrite is now in the IAQG ballot process, and the release will depend upon ballot comments and actions required to resolve comments.

Risk management

The new AS9100 risk management requirement has generated much interest inside and outside AS&D user community.

Risk management is one of the expanded concepts introduced into AS9100:2009. The concepts can be applied throughout a QMS, such as during management review, when assessing resource requirements and while planning and conducting internal audits.

The intent of AS9100:2009 was to introduce the risk management concept into section 7 to focus the user community on risk management during product realization. The standards writers placed this expanded requirement into clause 7.1.2 because risk management, like planning, is an iterative process that occurs across product realization and the product life cycle. The concept of risk management during product realization can be categorized by risks associated with execution of the AS9100 product realization requirements and product risks.

The concept of risk is not new to AS9100 because clause 7.2.2d already required the evaluation of risks during the review of requirements related to the product. The inclusion of clause 7.1.2 in AS9100:2009 is the next logical step to expand risk management thinking to all the product realization requirements in section 7.

Consideration of risks is a direct callout in the following AS9100:2009 clauses:

- 7.1.1—project management.
- 7.1.2—risk management.
- 7.2.2—review of requirements related to the product.
- 7.4.1—purchasing process. Product risks are applicable across

product realization with the introduction of the concepts of special requirements and critical items. Special requirements are those determined by the customer or the organization to have a high risk of not being achieved. Factors can include

HELPFUL RESOURCES

The following are helpful resources for risk management and the websites where they can be located:

- ARP9134 Supply Chain Risk Management, www.sae.org.
- ISO Guide 73 Risk Management Vocabulary, www.iso.org.
- ISO 17666 Space Systems—Risk Management, www.iso.org.
- ISO 16085 Systems-Software Engineering—Risk Management, www.iso.org.
- Risk Management Guide for DoD Acquisition, www.dau.mil/pubs/ gdbks/risk_management.asp.
- Project Management Institute, www.pmi.org.
- ISO 31000 Risk Management, under development. —*L.L.C.*

STANDARDS OUTLOOK

product or process complexity, past experience and product or process maturity.

Examples of special requirements include performance requirements imposed by the customer that are at the limit of the industry's capability, or requirements determined by the organization to be at the limit of its technical or process capabilities. The assessment of these requirements is conducted in clause 7.2 when the requirements related to the product are being determined and reviewed (see Figure 2).

Special requirements are reviewed and, if necessary, translated into critical items, including key characteristics, during the design and development process executed during clause 7.3. Critical items are items having significant effect on the product realization and use of the product. This includes safety, performance, form, fit, function, producibility and service life. Critical items require specific actions to ensure they are adequately managed. These are not new concepts to the AS&D industry, which has experience with such matters as safety critical items, fracture critical items, mission critical items and key characteristics.

These critical items are identified, and controls are put into place for transfer into the procurement contracts and inhouse production activities. These requirements are added to purchase orders, requiring suppliers to incorporate additional controls, including variation management (see AS9103) when applicable.

Lower-tier or build-to-print suppliers would rarely be creating special requirements or critical items. These suppliers typically do not have visibility to the criticality of parts they build for customers. Lower-tier or build-to-print suppliers

Product realization interrelationships / FIGURE 2

Interrelationships between special requirements, critical items, key characteristics and risk management process clauses of AS9100



would receive critical item requirements from customers in purchasing information.

The identification, monitoring, measurement and analysis of special requirements and critical items are included in the risk management process. The sidebar "Helpful Resources" provides published resources and websites related to risk management.

Not prescriptive

AS9100 is not mandating a prescriptive manner for how risk management is to be performed; only that certain aspects be established, implemented and maintained as appropriate according to the requirements in clause 7.1.2.

The risk management wording in AS9100:2009 defines the steps, sequences and interactions an organization needs to perform to ensure risks are properly handled. This risk process can be applied in various ways dependent on the business approach and integrated into key points of the organization's product realization processes.

Additional AS9100:2009 standard guidance and deployment support material is available at www.iaqg.sae.org/iaqg. **QP**

REFERENCES

 IAQG (AS/EN/JIS Q) 9100—Quality Management Systems— Requirements for Aviation, Space and Defense Organizations. IAOG, 2009.

^{3.} Ibid.



L.L. "BUDDY" CRESSIONNIE is the Americas lead for the IAQG 9100 team and is a voting member on the U.S. Technical Advisory Group to ISO/ TC 176. He represents Lockheed Martin Corp. in these roles, where he works in the aeronautics business area as a senior manager over quality and mission success processes. Cres-

sionnie is an ASQ senior member with quality manager and quality auditor certifications. He is also a certified RABQSA aerospace experienced auditor and International Register of Certified Auditors lead auditor for ISO 9001 and ISO 14001. Cressionnie has an MBA from Texas Christian University and bachelor's degree in industrial and systems engineering from the University of Florida.

NO-RISK OFFER

For another discussion of risk management and standards in the aviation, space and defense industries, read Dale Gordon's Standards Outlook column in the January 2009 issue of QP at www.qualityprogress.com.

^{2.} Ibid.

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Call: 800-561-3606; visit: www.scopes. com.

QPREVIEWS

Insights to Performance Excellence 2009-2010

Mark L. Blazey, ASQ Quality Press, 2009, 384 pp., \$84 list, \$50 member (book and CD-ROM).



Adapting Albert Einstein's explanation of the relationship between energy and mass, Blazey transforms $E = mc^2$ into a practical formula for success: Excellence

equals managing change at an accelerated rate. Thus begins the journey to explore the relationships among the seven categories of the Baldrige criteria.

During the journey, the reader will find plain-English explanations of the requirements in narrative and flowchart formats, the key links between items, explanations of potential adverse consequences if the requirements are not followed and examples of effective practices developed and used to meet the requirements.

Blazey presents research in support of the business case for using the Baldrige criteria and examines 75 high-performing organizations, with highlights from 20 of the winners discussed.

Discussion of the Baldrige criteria, as well as the seven categories and the points assigned to each, set the stage for a detailed exploration of the criteria requirements. Also included are tips for preparing the award application, an explanation of the scoring system, clarification of the scoring requirements, a self-assessment survey, an outline of how a site visit is conducted, a helpful glossary of terms and a CD-ROM that contains just about every form you would need to begin a Baldrige journey. Written and structured to serve novices and experts alike, Blazey has once again (this is the ninth update of the book) dissected the criteria and content of this critically acclaimed award. His personal insight and clear explanations simplify the complexities and reinforce the intent of the Baldrige program: to focus on the fundamental principles that drive excellence in virtually any type of organization.

The reader who follows the advice offered will come to realize why the Baldrige criteria have become a template for building and operating a successful organization, regardless of whether the organization actually applies for the award.

> Reviewed by Russ Westcott R.T. Westcott & Associates Old Saybrook, CT

Best Practices in Lean Six Sigma Process Improvement

Richard J. Schonberger, John Wiley & Sons, 2008, 290 pp., \$45 (book).



The concepts behind lean Six Sigma (LSS) have proven susceptible to cherry picking, with organizations avoiding the difficult elements that often produce the best

results. A central aim of this book is to critically discuss and sort out those elements.

Schonberger includes a wide variety of findings, including a compilation of rankings based on material from more than 1,400 manufacturers, retailers and distributors in 36 countries. For example, he ranks regions of the world and dominant industrial sectors according to their long-term commitment to lean. In the book, Schonberger discusses and attacks—the tendency to jump from one concept or acronym to another. He discusses how, in the 1980s, just-in-time (JIT) and total quality control (TQC) were all the rage, only to have JIT morph into lean and TQC renamed and watered down to total quality management, then Six Sigma. He forecasts that lean will not stay, either, since "lean's popular definition—attack on wastes—is unexciting to executives."

Pitfalls and hidden opportunities are explained in simple terms any manager could comprehend. Because of its ability to clarify concepts and bring to light the success stories of many companies, some of which surpass Toyota in long-term improvement, this eye-opening book is a must read for anyone who wants to truly understand LSS best practices.

> Reviewed by Bengt Klefsjö Lulea University of Technology Lulea, Sweden

Lean 9001: Battle for the Arctic Rose

John Guderian and Timothy Renaud, Society of Manufacturing Engineers, 2008, 315 pp., \$29 (book).



You probably never thought you could learn process improvement under the guise of a science-fiction novel. Now, thanks to Guderian and Renaud, you can.

The authors improbably pair a discussion of serious scientific process capability and lean manufacturing information with a science-fiction satire that takes place in the year 7278. There is a serious storyline to follow, and plot twists keep the reader engaged, making the book easy to read. But the book also includes comprehensive information about a company's implementation of processes to improve manufacturing and customer service.

Implementation is illustrated with flowcharts, memos and capability processing information. All of this takes place while battling pirates and fighting competition in distant galaxies—things today's companies rarely need to contend with.

While not wanting to give away any of the plot, I will say the novel successfully introduces the concept of quality management systems and implements them seamlessly into the fabric of the story. The introduction, however, is not quite as seamless, so I would probably not recommend this to a sci-fi buff who wasn't also interested in quality.

This would be a great adjunct for a class or a department that wants to introduce these quality techniques in a relatively painless way. The authors are clearly knowledgeable about quality management and have found an interesting way to present it.

> Reviewed by I. Elaine Allen Babson College Wellesley, MA

Lean Hospitals

Mark Graban, CRC Press, 2009, 280 pp., \$44.95 (book).

This book shows how lean methods can be used—and why they should be used—to improve how healthcare is practiced in all types of facilities.

The book starts by developing a case for using lean in hospitals and healthcare facilities, followed by an overview of how lean methods can be applied in these settings. Graban then covers the major areas of lean—defining waste, value streams, standard work, visual management, problem solving, error prevention and improving flow. He also discusses lean leadership, vision and implementation.



Included in the book are very thorough introductions to the major aspects of lean and how they apply to the healthcare setting, with plenty of examples provided

to show how each area of a facility (emergency department, laboratory, surgery and pharmacy, to name a few) can use lean to improve patient care.

There is enough information provided that administrators considering lean implementation in their own facilities will have a good idea of how to begin and what a successful implementation looks like in the end.

Graban comes up short in a few areas, though. It would have been nice to see more information on the use of A3 problem-solving reports in a healthcare setting, though there are other books that address this shortcoming. In addition, the book could have used more examples on how the calculations for *takt* time, *kanban* and process capacity could be applied to a hospital setting, given their importance within the lean method.

Overall, however, this is a good introduction to how lean methods can be used in healthcare. It is worthwhile reading for administrators who are considering the use of lean methods in their facilities.

> Reviewed by Brian Cocolicchio New City, NY

RECENT RELEASES

Six Sigma Marketing

Eric Reidenbach, ASQ Quality Press, 2009, 168 pp., \$40 list, \$24 member (book). **The Ultimate Improvement Cycle** Bob Sproull, CRC Press, 2009, 250 pp.,

The Rudolph Factor

\$59.95 (book).

Cyndi Lauren and Craig Morningstar, John Wiley & Sons, 2009, 168 pp., \$21.95 (book).

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21-23 Ninth Annual ENBIS Conference. Goteborg, Sweden. Visit the website of the European Network for Business and Industrial Statistics at www.enbis.org.

21-25 Achieving Results in Uncertain Times: The 2009 Fall Conference. St. Louis. Call the International Society for Performance Improvement at 301-587-8570 or e-mail info@ispi.org.

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Calibration Engineer/Assistant Facility Engineer. Calibration & validation of pharmaceutical testing & packaging equipment; QA/QC & process control; identify the process parameters; update the electronic hardware of the DAS; review & verify design criteria and set up qualification standards, environmental controls & functionality of backup power generators. Req's BS in Electronics or Electrical Engineering w/ 2 years experience. **Code #113.**

Mail résumés stating code #, to HR, EMINENT Services Corporation 7495 New Technology Way, Frederick, MD 21703

EOE

Table Talk

A simple tool can assess project effectiveness and efficiency

THERE ARE many ways to determine how successful a process or project is. These methods normally involve detailed metrics and may include cycle-time reduction, number of process steps and customer satisfaction. The more improvement projects there are, however, the more difficult it is to monitor their progress, especially in relation to one another and at a high level.

One way to monitor either a process or project is to evaluate its current level of effectiveness and efficiency. QP defines effectiveness as "the state of having produced a decided on or desired effect," and efficiency as "the ratio of the output to the total input in a process."1 ISO 9000 defines effectiveness as "the extent to which planned activities are realized and planned results achieved," and efficiency as the "relationship between the result achieved and the resources used."2

The combination of these metrics reveals the ideal result and provides a fully rounded evaluation.

Using this effectiveness and efficiency concept, a table (see Table 1) was developed to allow a simple assessment of each. The table uses customer satisfaction to assess effectiveness and resources to assess efficiency levels. This can be used to assist in determining which process to focus on for improvement in association with other tools and determinants. The table allows a group to make decisions quickly, visualize the results and compare processes simultaneously.

Each axis of the table is

evaluated individually-together the results determine the combined level of effectiveness and efficiency. The detailed comments focus on the degree to which the relevant and specific customer requirements are met, as well as the level of defects and cycle time involved. Opposite these comments are more high-level considerations that act as a guide to evaluate the efficiency and effectiveness satisfaction levels.

The table allows for a visualization of the current state of a process or project. Those that fall in the green zone are highly effective and efficient. Those in the yellow zone achieve satisfactory levels but have opportunities for improvement. Those in the red zone need significant work due to their low levels of effectiveness and efficiency, or they may be out of balance. This means a process may exceed customer expectations even though it is plagued with defects and has long, unpredictable cycle times.

In the opposite situation, a highly efficient process with zero defects and short. predictable cycle times may be ideal for the manufacturing process, but it may not meet any customer requirements. Customer satisfaction and other critical issues will fail, resulting in significant recall, rework and redesign costs.

The process of using this table for evaluation can help generate group discussion and consensus. It also creates a sense of focus and coordination with regard to a range of projects or processes and in identifying opportunities for improvement. QP

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- 1. QP Staff, "Quality Glossary," Quality Progress, June 2007, pp. 39-59
- 2. International Organization for Standardization, ISO 9000: Quality Management Systems, Fundamentals and Vocabulary, www.iso.org/iso/catalogue_detail. htm?csnumber=42180



DENIS LEONARD is the president of Business Excellence Consulting in Bozeman, MT. Leonard is the coauthor of the The Executive Guide to Understanding and Implementing the Baldrige Criteria (ASO Quality Press). He is a senior member of ASO and is an ASO-certified quality manager.

quality auditor and Six Sigma Black Belt.



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