Project Quality Management

Why, What and How

THIRD EDITION

by Kenneth H. Rose, PMP Retired

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Dedication

Thank you, Nancy, for your love and support over the years.

This book is dedicated to our son, Geoffrey—a good person and a good engineer.

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Preface to the Third Edition

When PMI® published the *PMBOK® Guide—Seventh Edition*, it made major changes to both format and content. Highly interlinked lists of processes within discrete knowledge areas—the hallmark of past guides—were replaced with general principles that are accepted and practiced across a broad range of projects. This new approach seems to mirror that of the Generally Accepted Accounting Principles (GAAP) familiar to the financial world.

In eschewing specific processes and embracing broadly stated principles, PMI has avoided the morass of ever-more details in ever-more dynamic domains—a path fraught with hurdles, many of them unknown and unknowable. Generally accepted principles are more universally applicable across differing domains.

But the principles-based approach leaves the practitioner with a problem: what is it exactly that I am supposed to do? The solution is simple: figure it out yourself for your own situation. That is, members of the project team must understand and apply the generally accepted principles in a way that is relevant and useful to their needs. This is the best solution because it is unlikely that distantly removed standards writers will anticipate and create specific processes and action steps for every possible situation and circumstance.

So while it is a step forward in codifying a general standard for practice in project management, the principles-based approach necessarily leaves a void of practical procedures for the project practitioner. Regarding project quality, this book fills that void. It should be viewed and used as a helpful companion

to the principles promulgated by PMI or as a firm foundation for project quality practice on its own. It is both.

Original Preface

This book is a product of frustration. Quality is clearly one of the key components of project success. Everyone talks about quality. Everyone demands and promises quality in project implementation. But in the end, it seems to be much mentioned and little employed. The reason why is not difficult to identify or understand. Many quality tools—indeed many quality books, lectures, and training sessions—seem to be oriented toward the manufacturing domain. A discussion of methods and tools may start off generally enough, but as soon as examples enter the discussion, they leap right back to some kind of manufacturing environment. That may be fine for shop supervisors, but it provides little information of relevance to project managers who work with intellectual processes more than the action details of production.

So where does a project manager go for guidance on how to integrate quality into project implementation? Many years of searching have yielded few results. There just do not seem to be any good sources that deal directly with both quality of the *project* and quality of the *product*. Project managers are busy people. They want answers, not a lot of Socratic questions or a lot of theory followed by good wishes for subsequent application.

This book delivers what has been missing. It provides a background of quality concepts and their evolution over time, but is focused on the limited information that is necessary for project managers to understand the context of quality. It summarizes concepts in a model of contemporary quality that provides a unifying, big-picture view. It provides a simple framework of specific action steps to manage project quality. It explains key quality tools relevant to the framework and presents them in a logical order of application. Finally, the book takes readers through a practical exercise in a management environment that will allow them to experience an application—to *do* something—not just read about one.

This book will not make you an expert on quality. It will not enable you to lecture long and eloquently about the history and theory of quality. It *will* give you an immediate hands-on capability to improve project implementation and customer satisfaction by making quality an integral part of your projects and the products of your projects. That is probably what really matters anyway.

About the Author

Kenneth H. Rose completed a twenty-three-year military career in high-technology development and project management as a member of the Army Acquisition Corps. His hands-on experience ranges from the first steps of initiating concepts, identifying user requirements, and evaluating technology alternatives to the culminating processes of project implementation and delivery. Subsequently, as senior research scientist with Pacific Northwest National Laboratory, he helped large government organizations to develop and apply quality improvement programs, innovative performance measurement procedures, and strategic plans. As a project manager for a not-for-profit affiliate of Virginia Tech, he led projects and performed technical work related to environmental activities, project management training and implementation, and organization development and leadership. He is currently Director, Peninsula Center for Project Management, Hampton, Virginia, USA, providing project management consulting and training services.

An accomplished author, Mr. Rose began writing articles for professional and technical journals in 1985. Known for a penetrating and engaging style, he has been published in widely read periodicals such as *Quality Progress*, *PM Network*, *National Defense*, and *Military Review*. His first book, *An Introduction to Artificial Intelligence: A Self-Study Text*, was used at the U.S. Army Computer Science School in the 1980s to provide a grounding for

students in this emerging technology. Ken's contributions to technical literature were recognized by the Project Management Institute by being selected as the winner of the 2006 David I. Cleland Project Management Literature Award for *Project Quality Management: Why, What and How* in its first edition. The PMI® David I. Cleland Project Management Literature Award recognizes the author(s) of a single publication that most significantly advanced project management knowledge, concepts, and practice in the year it was published.

For many years, he was a member of the Project Management Institute and served as Book Review Editor of *Project Management Journal*, the academic-research publication of PMI, for 18 of those years. He currently holds the PMP Retired credential.

Mr. Rose holds a Master of Arts degree in management from Ball State University and a Bachelor of Fine Arts degree in music theory and composition from the University of Wisconsin-Milwaukee. He is a former senior member of the American Society for Quality and a former ASQ Certified Quality Manager. He is a life member of the National Defense Industrial Association and past chairman of the robotics division.

This book has free material available for download from the Web Added Value™ resource center at *www.jrosspub.com*

At J. Ross Publishing we are committed to providing today's professional with practical, hands-on tools that enhance the learning experience and give readers an opportunity to apply what they have learned. That is why we offer free ancillary materials available for download on this book and all participating Web Added Value™ publications. These online resources may include interactive versions of material that appears in the book or supplemental templates, worksheets, models, plans, case studies, proposals, spreadsheets and assessment tools, among other things. Whenever you see the WAV™ symbol in any of our publications, it means bonus materials accompany the book and are available from the Web Added Value Download Resource Center at www.jrosspub.com.

Downloads *Project Quality Management, 3rd Edition*, include numerous tools for planning project quality, collecting and understanding data, comprehending and analyzing processes, and problem solving, as well as instruction materials for use in college and professional courses on the topic.

Section I

Quality Foundations

1

Understanding Quality in the Project Management Domain

What is quality? Customers know it when they see it. Suppliers promise that their goods and services embody it. Both views are often missing a clear, up-front definition of what quality is, and this leads to confusion and frustration when trying to determine just how to deliver it.

Project managers probably feel this most acutely. A customer may demand quality and an organization may promise to deliver quality, but a project manager is the one who has to do it. Failure can have devastating immediate and long-term consequences for both the project manager and the project organization.

Given its importance to project outcomes, quality ought to be a problem long ago solved. It is not. Projects continue to be plagued by imprecise quality goals and arcane quality methods most suited for a shop floor, all of this condemning the project to less-than-satisfactory results or worse.

There is a better way. From a product manufacturing or service delivery point of view, quality is, to a great degree, a problem solved. Quality tools and techniques have been developed and refined over the past 100 years to the level that they are now a matter of science, not art. Applying these proven ways to project management should be a simple matter of transference, but that is the problem. Projects come in many stripes and colors. A project undertaken by a national professional association to create a new technical

manual has little relation to the codified quality tools of manufacturing, except in the final steps of producing the book itself, and that task is usually contracted to a source outside the project team.

Definition of Quality

The key to project quality lies in making a more effective, meaningful transfer of proven quality methods to a general project management domain. The first step is to answer the question "What is quality?"

> **Exercise 1**—Consider the question "What is quality?" for a few moments. Take time to do this seriously. Put this book down, get out a blank sheet of paper, and think about the question in depth. What does quality mean to you? What might it mean to others? How do you describe quality to others? How do you know quality when you see it? What are quality's component elements? Make a few notes, then continue reading.

The results of this brief exercise probably vary among individuals. Some central themes may be common to all.

- **Products**—In some way, quality is associated with products. This may be the most obvious linkage. We define quality by our view of the features or attributes of some particular product: an automobile, an article of clothing, an electronic device, and so on. This view can lead us with confidence to the destructive "I'll know it when I see it" definition of quality.
- **Defects**—The idea of defects in a product is closely related to the view of products themselves. The perception of product quality may arise from favorable features, such as an automobile that always starts on the first attempt, or is comfortable on long trips, or exhibits efficient fuel consumption. Defects are a bit different. We expect quality products to be free of defects. When we purchase a car, the upholstery should not be ripped or soiled, all the indicator lights on the dashboard should function properly, and there should be no cracked mirrors or light covers.

- **Processes**—Now things get a little more obscure. If we manufacture a product, we probably care very much about processes. To the users of our product, the matter of processes tends to be rather transparent. Users focus more on the product and how it performs than on how it was produced. This issue is also very important to project managers. Whether they are delivering a product that results from manufacturing or purely intellectual activity, the processes that produce that product have great effect on the outcome. *What* you do may keep a smile on your customer's face, but *how* you do it will keep you on schedule and on budget—and that may make the customer's smile even brighter and longer lasting.
- **Customers**—People who sell what they make may be very product focused in their view of quality. They seek to make products that are superior to those of competitors and always strive to be the best: "This is the best DVD player on the market today." This view of quality may have short-term utility, but can be limiting, even lethal, for the organization in the long term. Consider the boasts "This is the best carburetor on the market today" or "This is the best buggy whip on the market today." Both statements may be true, but if nobody is buying carburetors or buggy whips, are they relevant? People who make what other people want to buy have a different view of quality and it is rooted in what customers want. To these people, quality is defined by customers, their needs, and their expectations.
- **Systems**—A system is a group of things that work together. At a higher level of analysis, quality may be viewed as arising from things that work together. Products, defects, processes, and customers are all part of a system that generates quality, as are suppliers, policies, organizations, and perhaps some other things unique to a specific situation.

Traditional Definitions

Several definitions of quality already exist. In the now obsolete 3rd edition of his ground-breaking *Quality Control Handbook*, quality pioneer Joseph M. Juran defined quality as "fitness for use." In this view, customers defined the use for the products (goods or services) that they purchased. It was up to the organization that produced the products to understand the needs of its customers and to design products that are fit for use. In *Juran's Quality Handbook*, 7th edition, a revised definition appears. Quality is now "fit for

purpose."[1] This new view is intended to be broader in scope and more universal in applicability, especially for service organizations that have risen to a larger role in the world economy since the appearance of the original definition.

Juran recognized the shortcomings of such a brief definition. He emphasized that the definition of quality includes two components that are critical to its management. Quality includes "*features that meet customer needs*." These features should, among other things, increase customer satisfaction, prevail over the competition, and enhance product sales. Because more or better features add to design, it is reasonable to say that higher quality costs more. Quality also includes "*freedom from failures*." These failures may be errors during production that require rework (doing something over again) or failures in the field after purchase that may result in warranty claims, customer dissatisfaction, or dire consequences to the user. Because an absence of failures means an absence of associated costs, it is reasonable to say that higher quality costs less.

Juran also made a distinction between "Big Q" and "Little Q." The concept of Big Q is a more recent development, arising in the 1980s, and is more systems-wide in its approach. It takes a broader view of quality that encompasses the goals of the enterprise and all its products. It is usually embraced by quality managers and senior managers within the organization. Little Q is more limited in scope, often focused on individual products or customers. This view is usually embraced by those in technical or staff functions.

The *PMBOK® Guide* defines quality as "the degree to which a set of inherent characteristics fulfill requirements."[2] This definition matches that of *ISO 9000:2005*, published by the International Organization for Standardization.[3] The ISO 9000-series standards are a group of international consensus standards that address quality management. *ISO 9000:2005* is a brief introductory standard that covers fundamentals and vocabulary. This definition is most complete because it is so general. The set of inherent characteristics may be of a product, processes, or system. The requirements may be those of customers or stakeholders, an important group that is ignored at great peril to the success of the project. In the current standard, *ISO 9000:2015*, the definition of quality includes the phrase "…inherent characteristics of an object…" The definition of "object" as "anything perceivable or conceivable" is so broad that it might include almost anything. The *Standard for Project Management* clarifies this scope issue by adding "…characteristics of a product, service, or result…" to the definition of quality in the *PMBOK® Guide*.

One important aspect of quality does not come out in any of these definitions. Quality is "counterentropic"; it is not the natural order of things. Entropy, from the Second Law of Thermodynamics, says that things naturally move from a state of organization to a state of disorganization. Drop a handful of mixed coins on the floor and the result is not an array lined up in rows by type. The result is a bunch of coins spread randomly across the floor. So it is with quality. However it is defined, quality is not a naturally occurring event. It is a result of hard, deliberate work that begins with planning, includes consideration of contributing elements, applies disciplined processes and tools, and never, ever ends. Achieving quality in project implementation is not a matter of luck or coincidence; it is a matter of management.

Quality and the Triple Constraint

The project "triple constraint" includes time, cost, and scope. All three elements are of equal importance to project success and to the project manager. Project managers typically try to balance the three when meeting project objectives, but they may make trade-offs among the three during project implementation in order to meet objectives and satisfy customers. Quality is a fourth among equals. It may be most closely associated with scope because scope is based on customer requirements and quality is closely associated with customer requirements. This linkage addresses quality of the *product* of the project. There is another important quality consideration: quality of the *project* itself. Quality processes, attuned to the scope specifications, will ensure a quality product. Quality processes that maintain cost and schedule constraints will ensure a quality project. Some recent project management literature suggests that quality is part of a quadruple constraint consisting of time, cost, scope, and quality. This approach is wrong-headed for one simple reason: Project managers routinely make trade-offs among the triple constraint to meet project objectives. A project manager should never, never, ever trade off quality during project implementation.

Cost of Quality

Much misunderstanding exists about quality in spite of the various definitions in circulation. Quality is many things to many people, but quality is also *not* some things that have been assumed over time.

- **An expensive process**—One of the first questions asked when a quality improvement effort is proposed is "How much will this cost?" This is always a valid question, but an uninformed view can produce an invalid answer. Conventional wisdom, perhaps better called "conventional ignorance" in this case, has it that better quality costs more. In times of cost control and cost cutting, the answer to quality improvement can be an unwise "We can't afford that." Philip B. Crosby, another quality pioneer, addressed this in a book entitled *Quality Is Free*. Briefly, his point was that quality does not cost, it pays. When you improve the quality of a process, you reduce the defects that result from that process. While the new process may be more expensive—it may be less expensive, too—the resulting reduction of defects is something that pays back over and over and over. So if the payback is more than the cost, as it often is, quality is essentially free.
- **An expensive product**—This may be the greatest misunderstanding of all because of the tendency to view quality in terms of products. An automobile with leather seats and little mechanical wipers on the headlights costs more than one without these features. A fine "writing instrument" costs more than a plastic ballpoint pen. But price does not confer quality. Review the definitions of quality. None of them mentions price. Quality arises from an ability to satisfy customer needs. If a customer's goal is to spend a lot of money, then an expensive product may be viewed as top quality. Customers generally seek the lowest price for a product that meets their functional needs, not the highest. Considering accuracy and maintenance, an inexpensive digital watch from a drugstore provides better quality than a more expensive mechanical watch from a jewelry store. A customer may want the jewelry item, but only because it serves a purpose other than timekeeping, not because it is a better quality watch.
- **Time consuming**—"We don't have time" is the response that condemns an organization to poor quality. Urgency prevails and shipping dates or field requirements rule. The reality is that we always have time; we just choose not to use it wisely. The old adage "There's never enough time to do it right, but always enough time to do it over" is not just a clever collection of words; it is the truth. Poor quality in production leads to rework. Delivery of poor quality products leads to replacement, warranty charges, lost customers, and loss of reputation. In the long run, quality saves time and much, much more.

Crosby's statement that quality is free is good theory. In practice, quality does have costs, even if those costs are subsequently outweighed by benefits. The sources of cost of quality are three: failure, prevention, and appraisal. The *Standard for Project Management* includes cost of quality as an element in the Delivery Performance Domain. It includes the three sources discussed here and includes lists of notional examples that are similar to the details discussed here. The *Standard* also suggests that early inspection and review will reduce the number of later necessary corrections. This issue will be addressed in Chapters 4 and 6.

Failure

Failure costs may result from either internal or external failure. The major costs associated with internal failures, those that occur before a product has been delivered to a customer, are scrap and rework. At the end of some process, a product may not conform to prescribed specifications. The degree of nonconformance may be so severe that the product cannot be fixed and must be discarded. Any costs associated with production to this point are lost. This is scrap. In some cases, the degree of nonconformance may not be so severe. A reasonable amount of additional effort may bring the product into conformance, so the product is re-entered into the process and any additional work adds to the overall cost of production. This is rework. The costs of scrap and rework are more than the sum of lost product and additional work. Costs associated with disposal, storage, transportation, and inventory control must be included to determine total costs.

External failures, those that occur after a product has been delivered to a customer, may generate costs for repairs in accordance with product warranty obligations. They may also generate product recalls, which can be far more expensive. Consider the potential cost of fixing a defective part during assembly versus recalling 1.2 million automobiles to replace the defective part. Recall costs are orders of magnitude higher than repeat costs.

An external failure may also generate liability costs that are far more expensive. A coffeemaker that is improperly marked or includes defective temperature controls may produce coffee that scalds unsuspecting customers. Or worse, an automobile may be so poorly designed that when struck from the rear in an accidental collision, the fuel tank ruptures and ignites the fuel, which causes immolation of any passengers in the car. The cost in human suffering and loss of life cannot be calculated, but courts will do the best

they can. Resulting awards in compensatory and punitive damages can be astronomic.

External failure costs include those associated with complaints and complaint handling. Organizations must pay specially skilled staff members to receive and respond to complaints. These employees must be empowered to offer satisfaction of various kinds, all of which have a cost. Loss of customers is a cost of nonconformance that has been characterized as unknown and unknowable.[4] Suppose a woman buys an expensive silk blouse at a high-end boutique. She wears it to a special event where a careless guest spills something on it. She has it dry-cleaned, but notices on its return that one of the side seams has opened up. She takes it back to the boutique where her money is promptly returned because the shop stands by its products. Is the woman a satisfied customer? Sure, she got her money back, but what about all the inconvenience and disappointment? Will she ever shop there again? There is no way to tell because no device has yet been invented that will count the number of customers who do not come back through the front door. And what about her friends who will never shop there after hearing about her bad experience? Again, no device exists that will count the number of customers who do not come through the front door initially. There is a bit of wisdom in retail sales regarding the buying habits of dissatisfied customers: "The goods come back, but the customers don't."[5]

Beyond costs, the effects of failure are significant and many. The effects begin with dissatisfied customers. Satisfied customers can serve as unpaid sales representatives. Without coaching or any expectation of reward, they will sing the praises of an organization and its products to all who will listen. Dissatisfied customers do just the opposite, and research shows they do so to a greater degree than satisfied customers. With a corps of complainers working against them, organizations may experience a loss of customers, which leads to loss of business, loss of revenue, loss of jobs, and eventual failure of the organization. Failure cost is not a trivial matter to be accepted or analyzed away in a spreadsheet.

Prevention

Prevention costs are fundamentally different from failure costs. These costs are related to things that an organization does rather than to outcomes of a process. Prevention costs begin with planning. One of the greatest errors a project manager can make is to leap into performance without sufficient

planning. Planning may be limited for many reasons, none of them very good. Urgency may be a reason, but if the need for the product is so urgent, the product should be right when delivered. Management's desire to cut costs may be a reason, but would management be willing to fund the effort required to do the work over and make it right if it is not when delivered? Planning generates early costs to be sure, but good planning prevents later costs that arise from changes to an inadequate plan. The cost of changes goes up as the project progresses. Changes made during implementation are far more expensive than changes made during planning. Good planning prevents later costs.

Prevention costs include both quality planning and audits, and process planning and control. Quality planning establishes the quality management system for the project. Quality audits ensure that the system works as intended. Generally, an audit is a comparison of performance to plan. A quality audit compares the performance of the organization or project quality system to the quality plan. Audits have an associated cost, which may recur with every audit. The results of quality audits show that the quality system is working or show that it is not working and must be improved. The subsequent result of either outcome is an effective quality system that reduces defects and costs associated with those defects.

Process planning establishes the steps to be taken to produce the product of the project. Process control ensures that the process performs as expected. A well-trained work force may produce defective products if the established processes are not capable of producing a high degree of conforming product. Processes tend to be rather static, but other things in the system (materials, management, working conditions, tools, requirements) change around them. Processes must be monitored and analyzed to ensure that they are current with the need of the organization and not something that is done because it seemed like a good idea at the time of implementation. Process planning will cause an organization to incur a cost for the plan and additional costs for control activities and process improvements, but these costs will pay back in reduced defects over time.

Product reviews constitute another prevention cost. Customer coordination and requirements definition, internal design reviews, and reliability engineering all generate early costs that contribute to quality of the final product.

Suppliers are a critical component of quality. Costs related to evaluating suppliers and their quality management systems are prevention costs.

A well-trained worker and a well-trained work force are more likely to produce products that conform to specifications. Less-trained workers may not possess the ability to perform according to specifications. They may not recognize nonconformance with specifications, and they may not even know what the specifications are. When a worker produces an item that is so defective that it must be discarded (scrap), the organization incurs a cost for every item discarded … again, and again, and again. When the organization trains the worker to perform better, it incurs a one-time cost for the training and obtains cost savings from the reduced number of defects produced by the worker as a result of the training. The training pays the organization back … again, and again, and again.

Appraisal

Appraisal costs begin with inspection of incoming supplies. The computer science phrase "garbage in, garbage out" applies equally here. The quality of a product is significantly affected by the quality of materials that go into its production. Supplier evaluations may have determined that a particular supplier will provide what is needed for a project, but inspection of actual deliveries is both prudent and essential. Some years ago, an army engineering center was fabricating special devices for clearing land mines in desert terrain. A supplier initially delivered inferior quality steel that did not meet specifications and would have endangered the lives of those depending on the devices.

In-process product inspection is a form of appraisal that ensures production is following the plan. Noted deficiencies may be corrected before the end of the process when scrap or additional-cost rework are the inevitable results. Final product inspection determines conformance of the result of the complete process.

Performance of well-known products may be predicted with some certainty. Buy a ream of copy paper and it is likely to work as expected in the office copy machine. New products do not enjoy the same degree of certainty in eventual performance. Testing will verify performance before the product is finished and delivered. Testing has a cost, but it is another appraisal cost that pays back over time in reduced rework of products that do not perform precisely as specified.

The effects of prevention and appraisal are simple and straightforward: better products, better processes, more capable workers, and more satisfied customers. The big difference between prevention/appraisal costs and failure costs is that failure costs are responses that occur repeatedly over time; prevention/appraisal costs are investments that provide cost benefits repeatedly over time.

Benefits of Quality

The benefits of quality in project performance are many. First, a quality project and product will yield customer satisfaction. If you meet or exceed requirements and expectations, customers will not only accept the results without challenge or ill feeling, but may come back to you for additional work when the need arises. They may well become that oh-so-important unpaid sales representative and generate additional work from new customers through referrals. A satisfied customer may perceive greater value than originally anticipated, which goes beyond customer satisfaction to customer delight.

Reduced costs are another benefit. Quality processes can reduce waste, improve efficiency, and improve supplies, all things that mean the project may cost less than planned. As costs go down, profits may go up (depending on the pricing arrangement in the contract on which the project is based) or reduced costs may mean more sales to an existing customer within existing profit margins.

Finally, better products, better project performance, and lower costs translate directly into increased competitiveness in an ever-more-global marketplace. This is the essence of a quality chain reaction described by W. Edwards Deming: improve quality, reduce costs, improve productivity, capture the market, stay in business, provide more jobs.[6]

Summary

- Quality involves products, defects, processes, customers, and systems.
- Quality is the ability of a set of inherent characteristics of a product, system, or process to fulfill requirements of customers and other interested parties.

- Quality is a fourth among equals in relation to the project triple constraint of time, cost, and scope.
- Quality is not an expensive process, an expensive product, or time consuming.
- The cost of quality may be viewed in terms of internal and external failure to conform to specifications (recurring costs) or prevention of nonconformance and appraisal (investments, recurring benefits).
- The effects of failure to conform to specifications may include dissatisfied customers, loss of customers, loss of business, loss of revenue, and failure of the organization.
- The effects of prevention and appraisal may include better products, better processes, more capable workers, and more satisfied customers.
- Quality benefits include customer satisfaction, reduced costs, increased profits, and increased competitiveness.

Points to Ponder

1. Describe several views of quality in the context of your own knowledge or experience. Include at least three of the following: products, defects, processes, customers, systems, or others.
2. Select a product (goods or services) about which you have some personal knowledge. Explain how Juran's two components of features and freedom from failures relate to the quality of that product.
3. Discuss the cost of quality considering failure, prevention, and appraisal costs. Give examples from your own knowledge or experience.
4. Explore specifically the costs of internal and external failures. Which one can be more expensive? Give examples, imagined or from your own experience.
5. From your own experience—school, work, social organizations—describe the benefits of quality in real-world situations. Give examples.

Exercise

a. Prepare a matrix that explores Juran's concept of "fit for purpose." In the first column, list at least six examples of products: two hard goods, two services, two elements of information. In the second column, describe how each example is fit for purpose. In the third

column, describe aspects of quality that may come into play in being fit for purpose. In the fourth column, describe actions that may be taken to influence the quality aspects. If so inclined, add a last column as a clearinghouse to address related matters that may have arisen in your work.

b. Prepare a presentation of the results of your matrix for class or for a collaborative work group. Lead a discussion among participants.

References

1. DeFeo, Joseph A., Ed., *Juran's Quality Handbook*, 7th ed., McGraw-Hill, New York, 2017, p. 33.
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3. *ISO 9000:2005, Quality management systems—Fundamentals and vocabulary*, International Organization for Standardization, Geneva, 2005, p. 7.
4. Deming, W.E., *Out of the Crisis*, The MIT Press, Cambridge, MA, 2000, p. 121.
5. Ibid., p. 175.
6. Ibid., p. 3.