Too Many Types Of Quality Problems

Categorizing your problems in solution relevant ways

by **Gerald F. Smith**

One of the hallmarks of expert problem solving is the use of well-founded problem types or categories when interpreting and responding to situations.[1]

Physicians use hierarchies of disease categories to organize their diagnoses of patient ailments. Similarly, attorneys classify cases in terms of the legal principles and precedents involved. Problem types or categories help direct attention to relevant past experiences and pertinent problem solving techniques.

Practitioners who lack an awareness of useful problem categories are prone to knee-jerk responses, employing popular methods simply because they are popular.

This appeared to be the case at a hospital where a quality circle used a cause and effect diagram to depict requirements for a training program for phlebotomists.[2] Faced with the task of devising a program concerning a design issue, the group unthinkingly used a method intended for diagnosis—a task rarely performed as part of design.

To avoid such mistakes, practitioners must be able to categorize problems in solution relevant ways. This presumes that appropriate problem categories have been defined and communicated to problem solvers. Well-defined categories can be organized into a problem taxonomy, a formal classification scheme that differentiates problems according to key characteristics. This article addresses these purposes. It presents an empirically derived taxonomy of quality problems that practitioners can use to better direct their problem solving efforts.

Problem taxonomies

Various schemes for categorizing real world problems have been proposed in management literature, though none has met with widespread acceptance.[3,4] Relatively informal problem types have also been noted in the quality literature, again with little apparent impact on practice.[5,6]

Among the most useful taxonomies is one proposed by Frederick Nickols.[7] Clearly recognizing the need to fit problem solving responses to the nature of the situation, Nickols differentiated

three types of problems or tasks:

- **Repair:** To restore a malfunctioning system to its intended level of performance.
- **Improve:** To improve a system so performance goals are achieved.
- **Engineer:** To design a new system or solution that will satisfy pertinent goals.

Nickols' taxonomy addresses problems with performance systems, structures and processes devised to promote human well-being. Consumer products such as automobiles, stereos and air conditioners are performance systems, as are production and accounting systems in organizations. Performance systems pose challenges regarding their design and development, as well as with their ongoing operation. These can be differentiated as design and performance problems, respectively. Nickols' categories reflect this distinction—repair tasks are performance problems, engineering tasks pertain to system design. His taxonomy includes a hybrid category (improve), reflecting the fact that performance improvement is often achieved by redesigning an existing system.

A taxonomy of quality problems

The distinction between performance and design problems was highlighted by recent research on quality problem solving (QPS). The results of this research appeared in a practitioner oriented book, *Quality Problem Solving*,[8] and in several articles published in research journals.[9,10,11] The study employed more than a thousand published cases describing quality problem solving activities conducted in organizations. A total of 719 cases drawn from 242 sources were analyzed to identify generalizable problem solving lessons.

To organize these lessons, a taxonomy of quality problems that would encompass the variety of cases in this data set was devised. The performance problem vs. design problem distinction was readily apparent and was categorized into a set of five types of quality problems.This taxonomy of quality problems is depicted in Figure 1, which also indicates its relationship with Nickols' problem types. Figure 1 has a middle level consisting of two basic problem types—performance and design. These are categorized into five specific types of quality problems, indicated at the bottom of the diagram.

The results of this research suggest that virtually every instance of quality problem solving involves one of these five kinds of quality problems. Of course, not all organizational problems are quality problems. There are, among others, decision problems, negotiation problems and resource allocation problems. But when individuals and organizations address problems

FIGURE 1 Taxonomy of Quality Problems

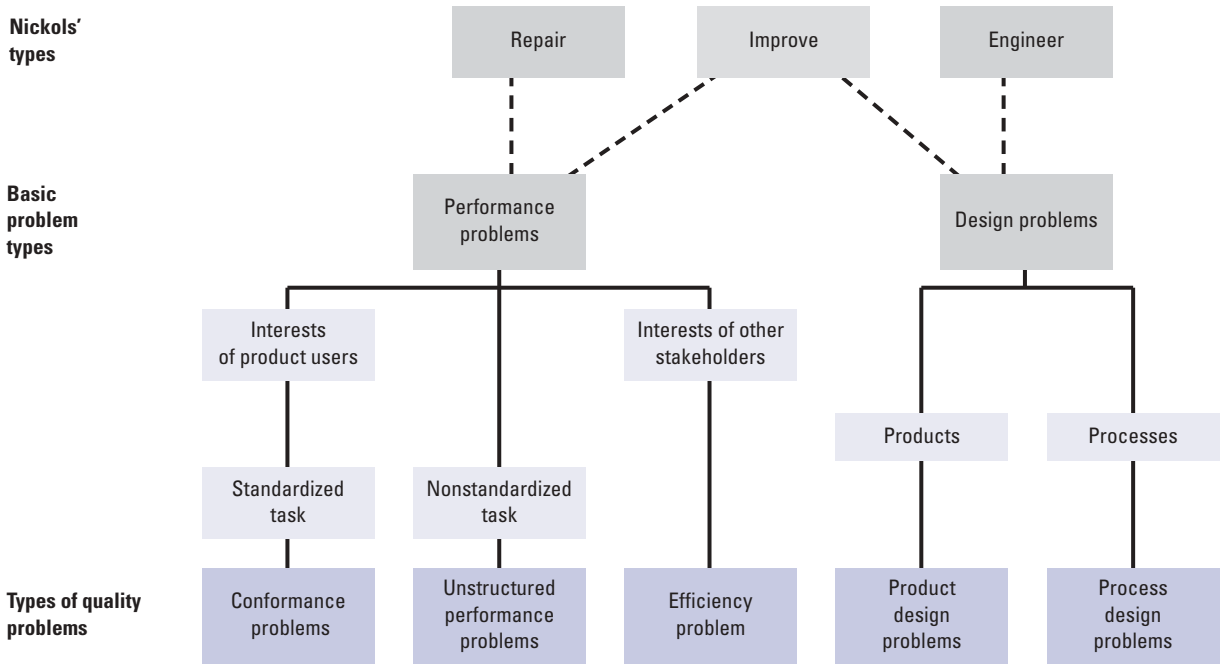

TABLE 1 Types of Quality Problems

Problem type	Defining characteristics	Key problem solving tasks	Strategies and techniques
Conformance problems	Unsatisfactory performance by a well-specified system; users not happy with system outputs.	Diagnosis; determining why the system is not performing as intended.	Use statistical process control to identify problems, cause and effect diagrams to diagnose causes.
Unstructured performance problems	Unsatisfactory performance by a poorly specified system.	Setting performance goals; diagnosis; generating viable solution alternatives.	Diagnostic methods; Use incentives to inspire improvement; develop expertise; add structure appropriately.
Efficiency problems	Unsatisfactory performance from the standpoint of system owners and operators.	Setting performance goals; localizing inefficiencies; devising cost effective solution alternatives.	Use employees to identify problems; eliminate unnecessary activities; reduce input costs, errors and variety.
Product design problems	Devising new products that satisfy user needs.	Determining user requirements; generating new product concepts and elaborating them into viable artifacts.	Quality function deployment translates user needs into product characteristics. Value analysis and "design for" methods support design activity.
Process design problems	Devising new processes or substantially revising existing processes.	Problem definition, including requirements determination; generating and elaborating new process alternatives.	Use flowcharts to represent processes, process analysis to improve existing processes, reengineering to devise new processes and benchmarking to adapt processes from others.

as part of their quality improvement activities, they almost invariably face one of these five types of quality problems.

Types of quality problems

Table 1 provides a closer look at the five kinds of quality problems. For each type, it identifies defining characteristics, critical problem solving tasks posed by such situations, and relevant solution strategies and techniques. Table 1 does not identify the many problem specific heuristics that were uncovered through the QPS research project. Heuristics—informal, quick-and-dirty methods or pieces of advice—are the key to expert performance in almost every field of practice. And as reported extensively in *Quality Problem Solving*,[12] they are clearly crucial to solving quality problems as well. The remainder of the article individually explores each problem type.

Conformance problems

A conformance problem is a situation in which a highly structured system, having standardized inputs, processes and outputs, is performing unacceptably from the standpoint of product users. These are classic quality deficiencies addressed by traditional quality control activities, such as an assembly line producing rejects or mistakes being made in the processing of insurance claims.

The key feature of a conformance problem is that there is a known right way of doing things. The system has worked before, but now, for some reason, it is not performing acceptably. One or more aspects of the system—its inputs or processing activities—have deviated from the norm, so outputs are not as they should be. Problem solving is a matter of finding the causes of deviations and restoring the system to its intended mode of functioning.

The identification of conformance problems is aided by the existence of standards. System inputs, works in process and outputs can be compared with standards—problems being identified when mismatches are observed. Statistical process control, a powerful means of identifying conformance problems, is much less useful for identifying other types of quality problems. The existence of a known right way of doing things makes problem solving relatively easy once the causes of unwanted deviation have been localized— putting the system back on track so it functions as intended.

The major challenge with conformance problems is to identify the causes of deviations or defects. This is the task of diagnosis or determining causes. Though diagnostic efforts can be aided by techniques such as

cause and effect diagrams, the Kepner-Tregoe method and why-why diagrams, there is no general procedure for determining causes. Every production process is incredibly complex. Therefore, there are literally thousands of ways for things to go wrong.

For example, when Huntsman Chemical Corp. was having trouble producing resin beads of a consistent size, an investigation led to the peroxide used as a process catalyst. Its peroxide suppliers were asked to test their products, and one found an impurity that proved to be the culprit.[13]

Due to the existence of strong standards, conformance problems are the easiest of the five types of quality problems to identify and solve. Nonetheless, the difficulty of establishing the causes of deviation in complex performance systems can make these problems extremely challenging, such that weeks or even months of production can be lost before the situation is remedied. Conformance problems often result from human error, which, in turn, can occur because workers are not adequately motivated toward error-free performance. A useful heuristic is to make sure that errors have costs or consequences for the people who make them—for instance, returning faulty inputs to their originators.

Unstructured performance problems

An unstructured performance problem (UPP) is a situation in which a nonstandardized task, one not fully specified by procedures or requirements, is not being performed acceptably. Poor performance can affect customers or the company itself—increasing costs or reducing throughput for example. But the hallmark of UPPs is that the poorly performing process or system is unstructured; it is not laid out in detail by rules and requirements.

For instance, sales shortfalls indicate unsatisfactory performance of the sales system. Since there is no one right way of selling a product, sales shortfalls cannot be cured by enforcing standards that don't exist. Why wouldn't an activity be standardized? It can be relatively new or may only be employed on occasion. Knowledge work cannot be standardized if tasks involve judgment and creativity. Many service activities aren't standardized because they must be adapted to fit varying circumstances and customer needs.

Because they are performance problems, diagnosis—determining the causes of the performance deficit—is critical when solving UPPs. Unlike compliance problems, UPPs often result from multiple causes.

Other tasks are equally challenging. Problem identification can be difficult if performance goals and criteria are not clear. Even if one knows the cause of a UPP, it can be difficult to devise an effective solution: If potential clients reject an ad agency's proposals for not being creative, the agency has no sure way of coming up with offerings that will be more appealing.

Because unstructured performance problems are so diverse, the most important tool for solving them is analysis, thinking carefully about the situation at hand. Several other strategies are also useful. Providing incentives can motivate people to find solutions. Windsor Export Supply, a division of Ford Motor Co., found that large vans used to ship parts overseas were not being packed to capacity. Adding incentives to the contract with their packing vendor resulted in significant improvements in van utilization.[14]

UPPs can also be solved if expertise is developed and accumulated with aspects of the performance being structured as appropriate. A quality circle of pilots at Hawaiian Airlines noticed that pilots flying the same route used different amounts of fuel. By analyzing verbal reports of pilot behavior during flights, the pilots identified fuel efficient flight methods and institutionalized these as standard practices. Fuel savings exceeded $2 million per year.[15] Be careful, however, not to structure such requirements prematurely. The costs to the organization and its customers of mandating ineffective practices as standard procedures can greatly exceed the costs of informally experimenting with different performance methods.

Efficiency problems

A rarely recognized anomaly in the quality movement is the fact that while quality is typically defined in terms of satisfying customer needs—Juran's "fitness for use" definition is an example—many quality improvement activities are aimed at reducing costs, increasing throughput and improving worker safety. These are matters that are of no direct concern to customers.[16]

This apparent paradox can be resolved by adopting a stakeholder perspective on quality, viewing product quality in terms of the interests of different stakeholders—a company's owners, managers, employees and customers.[17] Efficiency problems reflect this broader view of quality, being situations in which the interests of stakeholders other than customers aren't satisfied. Cost and productivity concerns are the most common issues of this kind, hence the category's name. In a typical efficiency problem, while the outputs of a relatively well-specified system are acceptable to their users, the system's performance does not achieve internal organizational goals.

Goal setting is a challenge with efficiency problems as it can be difficult to determine what level of performance is attainable. Diagnosis is a matter of localizing inefficiencies; it is not always easy to identify promising opportunities for improvement. Even when such

opportunities have been discovered, there remains the challenge of devising changes that capture efficiencies without incurring offsetting losses. One company tried to reduce order entry costs by eliminating a validation step. A surge of customer complaints about incorrectly filled orders suggested that this wasn't a viable way of reducing costs.[18]

Effective identification of efficiency problems depends on worker involvement. An organization's employees are its most valuable resource for identifying ways of reducing costs and improving safety.

Problem solving can adopt various general strategies: Focus on major cost items; reduce input costs, errors, and variety; eliminate unnecessary activities and outputs; improve inputs and activities; and increase outputs, assuming they can be sold, to exploit economies of scale.

Implementing these strategies requires detailed analysis of all inputs, activities and outputs for all organizational processes. Care must be taken so related trade-offs are properly managed. At the U.S. Army Depot in Sacramento, CA, broken steam traps, which can leak as much as $50 worth of steam a week, were not replaced until a bulk order could be issued, saving $10 per trap. Since some traps were broken for as long as a year before being replaced, the $10 savings was offset by a loss of more than $2500.[19]

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Product design problems

The problems discussed thus far have all been performance problems, situations in which an existing system isn't performing acceptably. But as indicated in Figure 1, quality improvement activities also address design problems—situations in which a new system must be created or an existing system substantially revised. Product design problems require one to create a system or artifact that satisfies user needs. These are familiar concerns, especially in competitive, technology driven industries. Most organizations have new product development departments, though product design work increasingly involves a broader set of participants.

One key task in product design is requirements determination, identifying user needs and other demands that the intended artifact must satisfy. Quality function deployment is the quality movement's primary contribution to this endeavor. The technique maps user needs into product characteristics and, from there, into production procedures and specifications. The major challenge in product design is design itself, envisioning and creating artifacts. This is a top-down process that begins with the generation of high level design concepts. A promising concept is selected for development, being elaborated into components and subcomponents until, finally, a detailed design specification of an acceptable artifact is achieved.

One reason product design involves the contributions of so many people is that a design must encompass many considerations that reflect different areas of expertise. The product must be manufacturable, reliable, maintainable, repairable and disposable, to name a few. These considerations have given rise to "design for" methods, mostly collections of heuristics. Value analysis, a technique for minimizing product costs, is a design-for-cost method, similar to design-for-manufacturing, design-for-reliability and other methods.

Effective product design reaches beyond expressed customer needs—customers don't always know what they want, much less what they can have—to consider the product's total context of use and any environment it can be expected to encounter during its life cycle. Increased competition and the faster pace of innovation in many industries has motivated companies to shorten the product design process. The experience at AT&T's Power Systems business unit is illustrative. Selling a customized product, this organization took an average of 53 days to design a prototype in response to a customer order. To reduce this time, AT&T constructed applications around standard product platforms. Dedicated design teams were established with team members working together in the same bullpen on the project. Hand-offs and meetings were eliminated. Each team member did his or her own documentation, rather than having it done by technical writers. As a result, prototyping time was reduced to five days.[20]

The quality movement's traditional concern—that products satisfy customer needs—inevitably led quality improvement activities to address product design issues. Other fields, notably engineering, have produced more significant advances in product design methodology. But the quality movement has contributed to the improvement of product design. Its major contribution, evident in the AT&T case, is the enhancement of organizational product design processes. This suggests the fifth and final type of quality problem.

Process design problems

A process is an organized set of activities aimed at achieving a goal. Process design is the task of devising processes that achieve their goals. Arguably, if all

processes were correctly designed, there would be few problems of any kind. Many performance problems can be traced to process inadequacies, so the two types of issues—performance and process design—often blend. Nickols' category of improvement tasks reflects this relationship. (see Figure 1)

Excepting physical production activities, organizations had historically ignored their internal processes. Process inadequacies were only identified as a result of serious performance problems. During the past 20 years, the quality movement has changed this thinking. It has fostered increased management awareness of organizational processes, establishing process design and improvement as ongoing requirements for organizational success. If the identification of process design problems is institutionalized, problem definition will continue to be a challenge. Effective definitional activity determines how the existing process operates, how comparable functions are performed in other organizations and what process possibilities have been created by technological advances.

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As with products, design work is the most critical activity in process design problem solving. Since processes have a start-to-finish time dimension that products lack, process design often parallels the process flow and is less top-down than product design. A major challenge is striking a balance between old and new: Designers must respond to legitimate process requirements—reflected in the existing process and those used in other organizations—without losing the ability to envision radical new processing alternatives. The danger of becoming mentally trapped in old ways of doing things is matched by the risk of reinventing the wheel or devising a revolutionary new process that doesn't work.

The flowchart is the cornerstone of most process design activities. It is a means of representing existing and envisioned processes. Benchmarking allows one to learn from processes in other organizations. The quality movement developed a collection of process design tools, collectively termed process analysis, that analyze and improve existing processes. This approach has been criticized by proponents of reengineering, who endorse a more radical, start from scratch design strategy. In reality, the achievements of reengineering derive primarily from exploitation of modern information technology, not from a powerful design methodology.

The virtues of process design methods not withstanding, process improvements usually result from heuristics. These pieces of advice exist for all aspects of a process, including process flow and layout, input screening and control, exception handling, task assignment and scheduling, setup, coordination and consolidation of activities, process triggers, and the handling of interruptions and delays.

For instance, Bell Atlantic redesigned its process for providing telephone service to corporate customers. Traditionally, service was not initiated until Bell acquired billing and other information. This trigger was safer from a legal standpoint and made things easier for Bell's accountants. However, with this group of customers there is little risk of nonpayment. Consequently, in the redesigned process, service is connected once it is technically possible, and billing information is gathered thereafter. While the old trigger for service initiation may have been safer, the new trigger makes the process, and the company, more responsive to customer needs.[21] Heuristics like this—ensuring that process triggers are responsive to customer needs—are the foundation of effective process design.

The five types of quality problems described in this article were initially identified by a research project that analyzed hundreds of published cases of quality problem solving in organizations. Practitioners attempting to solve quality problems will benefit from awareness of these problem types. They will be more likely to recognize key problem solving tasks posed by the situations they face, and they will be able to select task-appropriate tools and techniques.

Knowing the five types of quality problems will also help practitioners access the wealth of heuristic knowledge pertinent to quality problem solving. This knowledge is arguably the most valuable available resource for solving real world quality problems.

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