

## W. Edwards Deming, Quality Analysis, and Total Behavior Management

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During the past 10 years, the inclusion of the word "quality" in descriptions of production methods, management approaches, educational systems, service system changes, and so forth, has grown exponentially. It appears that no new approach to any problem is likely to be given much consideration today without overt acknowledgment that some improvement in quality must be the outcome. The origins of the importance of quality are primarily rooted in the awakening recognition of the influence of W. Edwards Deming in the post-World War II restoration of Japanese industry. We provide a brief overview of Deming's approach to modernizing management methods and discuss recent criticisms from the field of organizational behavior management that his approach lacks emphasis on the role of reinforcement. We offer a different analysis of Deming's approach and relate its evolution to the contingencies of reinforcement for the behavior of consulting. We also provide an example of problem solving with Deming's approach in a social service setting familiar to many behavior analysts.

*Key words:* statistical process control, total quality management, quality, systems change, reinforcement, organizational behavior management, human performance

### W. EDWARDS DEMING AND THEORY D

W. Edwards Deming, an American mathematical physicist, traveled to Japan in 1950 to aid the Allied government in conducting the first post-World War II census. At the time of his arrival, Japanese industries were producing low-quality goods and struggling in the global marketplace. Japanese business managers were desperate to develop methods to increase product quality and achieve an international standing. During his visit, the Union of Japanese Scientists and Engineers invited Deming to speak on the topic of statistical methods in business management. On July 26, 1950, he addressed 50 leading industrialists at the Industry Club of Japan (Ringle, 1981). Although some managers disagreed with Deming, many corporations began making systematic and comprehensive changes based on his proposals, integrating them with their own approaches to improving quality. Within 5 years, Ja-

pan was emerging as an economic superpower with a reputation for producing high-quality goods; as a result, an annual quality control award was established in Deming's name (the first of several). Deming also won many such awards and was formally recognized by Japan in 1960 when he was awarded the Second Order Medal of the Sacred Treasure by Emperor Hirohito (Ringle, 1981).

Although Deming has been widely credited with revolutionizing Japanese business practices, only in the early 1980s did he begin to influence American industry (Dobyns, 1990; Ringle, 1981). Deming began consulting with a series of corporations facing serious difficulty, including Xerox, Ford Motor Company, and Florida Power and Light (Dobyns, 1990; Dusky, 1990; Gabor, 1988, 1990). Although he worked as a consultant, Deming selected potential clients on one important criterion: Deming agreed to work only for those corporations in which the highest levels of management were willing to participate in change. Deming believed that the successes of his proposals are contingent on total commitment at the pinnacle of management (Ringle, 1981). To facilitate continuity in

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organizational change, corporations were instructed to establish a single goal—quality—and to implement an array of changes in pursuit of that goal. Organizations that maintained multiple goals, partially implemented Deming's recommendations for change, or focused on modifying the behavior of a single group of employees failed (Deming, 1986). Organizations that maintained a single goal and made comprehensive changes consistently survived and prospered (e.g., Dobyns, 1990; Dusky, 1990; Gabor, 1988, 1990).

As a consultant, Deming's primary emphasis was on the implementation of effective measurement systems. Although he recommended a variety of techniques, his system of measurement and analysis is referred to most often as statistical process control (SPC). SPC is based mostly on the work of Shewhart (1939). The purposes of SPC are (a) to distinguish processes reflecting normal variance in outcome from those reflecting irregular patterns of variance and (b) to monitor the influences of system changes on the patterns of variance. Control charts, a common analytical tool of SPC, consist of graphed data with horizontal lines representing upper and lower limits of control. Upper and lower control limits are set at plus or minus three standard deviations from the mean. Data points located outside one or more of the control limits and certain patterns of data between the control limits are statistically inferred to be due to sources of variance not assignable to the same causes as those that produce the normal or expected variance of the process under study (see, e.g., Mawhinney, 1992; Pfadt, Cohen, Sudhalter, Romanczyk, & Wheeler, 1992; Wheeler, 1991, 1993; Wheeler & Chambers, 1992).

In Deming's method, when a process such as the manufacture of some mechanical part is said to be in statistical control, the variance in the characteristics of the product are roughly the same from day to day. Achieving quality, defined as *customer satisfaction*, means refining the process so that all of the vari-

ance observed remains within the parameters of quality set by the customer; that is, within the product specifications (e.g., Wheeler, 1993). Variance within the specification limits can be ignored partly because it cannot be brought entirely under control and because it has little or no effect on customer satisfaction. A process is not in statistical control when the variance is not consistent. Such variance is assumed to be not a function of the process under study and, therefore, must be assignable to some other source that can be identified and manipulated (Wheeler, 1993). When the uncharacteristic variance indicates unexpected improvement in outcome, attempts are made to control the sources of the variance to put these sources to work permanently and more broadly. When detrimental sources of variance are located, efforts are made to remove them from the system (Mainstone & Levi, 1987). By continually monitoring variance in a system and reacting appropriately to it, customer-satisfying, high-quality production can be maximized (Deming, 1986).

Deming viewed the lack of SPC-type data collection and statistical analysis in organizations as being central to problems of management and decision making. He describes corporations in which managers cannot detect the sources of variance affecting success and failure as having in large part outdated, inappropriate, and poor-quality data (Deming, 1986). In response to organizational failure, managers without data usually place contingencies on production outcomes. Such actions strongly imply that management often blames production problems on production workers and holds firmly to the notion that substantial improvements can be made if the worker works harder or better. In contrast, Deming believed that production workers are rarely the direct source of variance and poor quality (Deming, 1986). Further, the observed results of applying contingencies of reinforcement and punishment on production behavior often are incorrectly interpreted, leading to further problems (Notz, Boschman, & Tax, 1987). Statis-

tically speaking, in a series of data in statistical control, a datum that is well away from the mean is most likely to be followed by a datum closer to the mean. Thus, the behavior of non-SPC managers who provide reinforcement for workers for an event or cluster of events above the mean (e.g., high levels of production within specification limits) often will be punished when the managers observe that the subsequent events are closer to the mean. Conversely, punishment at low points often is followed by apparent improvement. Thus, managers may learn to include punishment in their attempts to control behavior (Notz et al., 1987). Both of these scenarios are most likely when the difference between the momentary event and the mean of such events is not related to changes in human performance based on changes in motivation.

For many organizations, SPC methods allow managers their first opportunity to analyze correctly the variables affecting corporate performance and to assess the appropriateness of contingencies placed on production workers. Deming is credited with having developed a theory of management that assists managers in developing management techniques based on SPC data. Deming's Theory D, as it has come to be called (Gruska, 1981), can be summarized in five basic points: (a) a product of high and invariant quality will be more competitive in the long term than products of lower or variable quality, sometimes even when these may be less expensive; (b) thus, quality is defined largely by what the customer wants and will pay for; (c) building quality in is less expensive than monitoring every item produced in an attempt to eliminate defective units after the fact; (d) sampling outcomes throughout the production cycle permits precise analyses of new efforts to build quality in; and (e) efforts to build in quality should primarily be addressed by that part of the overall "system" with the most flexibility or room for change—management. To offer corporations an opportunity to test this theory, Deming (1982, 1986) provided a set of 14 management practices for adoption. His "14

points" for transforming management (Deming, 1986) are:

1. Create constancy of purpose toward improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs.
2. Adopt the new philosophy. We are in a new economic age. Western management must awaken to the challenge, must learn their responsibilities, and take on leadership for change.
3. Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.
4. End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust.
5. Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs.
6. Institute training on the job.
7. Institute leadership (see Point 12). The aim of supervision should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers.
8. Drive out fear, so that everyone may work effectively for the company.
9. Break down barriers between departments. People in research, design, sales and production must work as a team, to foresee problems of production and in use that may be encountered with the product of service.
10. Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system, and thus lie beyond the power of the work force.
- 11a. Eliminate work standards (quotas) on the factory floor. Substitute leadership.
- 11b. Eliminate management by objectives. Eliminate management by numbers, numerical goals. Substitute leadership.
- 12a. Remove barriers that rob the hourly worker of his right to pride of workmanship. The responsibility of supervisors must be changed from sheer numbers to quality.
- 12b. Remove barriers that rob people in management and in engineering of their right to pride in workmanship. This means, *inter alia*, abolishment of the annual merit rating and of management by objective.
13. Institute a vigorous program of education and self-improvement.
14. Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job. (pp. 23-24).

Unfortunately, Deming's two publications on his management theory (Dem-

ing, 1982, 1986) provide little more in the way of detailed instructions for implementing these practices. These publications are composed primarily of brief descriptions of organizational problems and potential solutions using SPC methods, through which Deming continually clarifies and elaborates the 14 points. Nevertheless, the 14 points remain in many ways relatively broad and seemingly contradictory rules that only hint at the specific steps a company must undertake to produce the principal goal of Deming's approach: an increase in the share of the available market for the product produced by the company. His publications are also short on an analysis of why application of these practices should be successful. They do more to expose the results of poor managerial practices than to explain how following certain points will modify those practices. In fact, over half of the 14 points exhort managers to either end, cease, remove, eliminate, break down, or drive out some current practice. The specific steps to take in addressing specific bad practices, beyond these general statements, are not provided. The remaining, positive points only recommend having a common philosophy, using teamwork, improving training, and remaining dedicated—hardly recommendations not heard previously by managers and employees alike!

In recent years, followers of Deming's management methods, and others promoting singular focus on quality outcomes, have become part of a loosely organized field called total quality management (TQM) (Berry, 1991). Much like Deming's original work, the TQM literature has generally focused on applying and modifying methods to improve specific organizations, but often without clearly describing the relationship between method and outcome, except to assert that they are related. TQM methods have been widely applied in businesses (e.g., Gabor, 1990; Hiam, 1992), social service agencies (e.g., Hiam, 1992), and educational programs (e.g., Miller, 1991). Such applications do not mean that Deming's particular approach or TQM

methods in general, however, have been universally embraced or incorporated into the study of organizations in general. For example, the 17 articles in the 1991 *American Psychologist* special issue on organizational psychology, with sections on the changing work place and developing and maintaining competitiveness, contain no citations of Deming's work.

### BEHAVIOR-ANALYTIC APPRAISALS OF THEORY D

In contrast to Deming and TQM proponents, behavior analysts have been contributing to the organizational and management literature with more precise descriptions of their methods and analyses of the relationships between their methods and the outcomes produced. Generally referred to as research in organizational behavior management (OBM), these studies have dealt almost exclusively with manipulations in reinforcement and feedback systems. This research has primarily targeted the behavior of production workers and middle managers (Balcazar, Shupert, Daniels, Mawhinney, & Hopkins, 1989). The results of this research have generally indicated significant increases in productivity and/or savings in costs (Merwin, Thomson, & Sanford, 1989), but the interventions have not been of the scope often attempted by TQM proponents.

In a recent issue of the *Journal of Applied Behavior Analysis*, devoted largely to performance management issues, Mawhinney (1992) provided a comprehensive review of Deming's work, relating it to the total quality field in general and contrasting it with OBM approaches. In addition, Redmon (1992) contributed a discussion of opportunities to improve quality interventions through the lessons learned from our applied behavior analysis research base. Pfadt et al. (1992) reciprocated by illustrating the application of SPC methods to analysis of clinical data. These authors have concluded that TQM and OBM are complementary approaches and may benefit from greater sharing of specific components and assumptions (see also Notz et al., 1987).

There is also general agreement, however, that Deming's approach and related TQM methods lack an emphasis on careful analysis and do not acknowledge the importance of reinforcement contingencies. For example, Mawhinney (1992) reiterated Redmon and Dickinson's (1987) observation that the 14 points are exclusively devoted to antecedents, suggesting that Deming (and presumably other TQM advocates) mistakenly ignore the role of consequences in interventions designed to improve organizational performance. Mawhinney (1992) provides a detailed discussion of the pitfalls of such an omission in the context of critiquing Deming's 14 points. Mawhinney suggests that

Deming does not analyze the contingencies that maintain behaviors in terms of reinforcement. With respect to what is wrong with behavior in many American corporations, Deming (1986) provides clear insights. With respect to the contingencies that maintain these behaviors, Deming's analysis is incomplete. There is no reason to believe that action will be taken to correct the problems identified until contingencies of reinforcement are changed to make powerful reinforcers depend on addressing the problems. Interventions aimed at implementing TQM should be much improved when effective and reliable contingencies of reinforcement support them. (p. 534)

Luthans and Thompson (1987) apparently agree with this appraisal, stating that

Theory D still seems too narrow in its scope on the one hand and is too general in its treatment, on the other hand. It does not deal with the full gamut of behaviors and outcomes that the manager is faced with in a day-to-day situations. As a result, Theory D cannot really be considered a comprehensive approach to performance management. (pp. 119-120)

Redmon (1992) also shares the view of Theory D or TQM as insufficiently comprehensive, noting

Thus, applied behavior analysis could add a powerful management technology to large-scale quality programs by facilitating the adoption of existing contingency-management technology by quality control engineers and managers. However, this will require greater emphasis on factors that influence adoption of behavioral technology. (pp. 547-548)

Although few passages in Deming's works (1982, 1986) address reinforcement issues directly, the above statements seem to be odd conclusions to draw in the face of Deming's (and perhaps oth-

er TQM consultants as well) apparent success without direct assistance from behavior analysts. Why does Theory D need to add an OBM emphasis on arranging reinforcement contingencies when apparently it can be successfully applied without doing so? Moreover, given what we and other behavior analysts believe about the importance of reinforcement contingencies in the development and maintenance of important behaviors, how could Deming's methods succeed if such contingencies were ignored? How can an analysis be incomplete if the methods derived from it often result in success?

### THE BEHAVIOR OF CONSULTING AND THEORY D

We believe that finding answers to our questions begins with recognizing that the 14 points are a set of general management practices stated as instructions to managers—rules reflecting past successful practices gathered from the preceding 36 years of consultation to businesses. It is a list that probably emerged gradually, shaped by the contingencies of reinforcement for Deming's consulting behavior. We do not believe they represent either a complete management theory or the keys to Deming's success. Thus, to determine whether Deming's method addresses issues of reinforcement and to understand his analysis of management, we must look elsewhere.

In the preface to *Quality, Productivity, and Competitive Position* (1982), Deming indicates that management has a new job in the present economic climate, but he says that what the job entails cannot be learned by experience on the job or in the classroom. Deming goes on to state that his book is not meant to convey technique; good books on technique are already abundant, he observes. So what is Deming going to relate through this text that cannot be learned on the job or in the classroom? We think the answer can be found on the first page of the text. What the manager needs to know is what the production worker already knows: Quality and productivity can rise con-

currently only when management addresses variables in the system that contribute to high rates of errors that subsequently must be corrected (i.e., reworking defective units). Thus, this book is about acquiring knowledge and learning how to change based on this knowledge. We believe that Deming knew that the difficulty in sharing the workers' knowledge in classrooms or through his text is that the knowledge of which he speaks is different in every company.

Thus, Deming's analysis of what is wrong in most businesses is that managers ignore or lack access to important knowledge and are paying for it with loss of business and loss of profit, leading inexorably to a less competitive position. His design for reversing this process is to get the appropriate messages from the factory floor (and from customers) to the board room and for those at the highest levels of the company to commit to acting on these messages. His task as a consultant was to produce the initial behaviors of change in managers in a way that they would come into contact with its consequences. The introduction of SPC methods provides data—the "knowledge" Deming (1982) refers to in his preface—that can reinforce (or punish) initial efforts by managers to deal with system variables. This early feedback is essential, because changes in the quality and marketability of the company's products depend on the cumulative (and delayed) effects of numerous such efforts.

It seems clear from reading Deming's illustrations and examples that he did not simply instruct the managers of those first companies that workers had important information, exhort them to go out and listen, and then return and make better management systems. Instead, his texts indicate that what plausibly he might have done was to observe their workers at work, talk with them himself, learn some of their secrets, and then find ways of showing management how fixing what the workers had observed could lead to better quality. In other words, he created illustrations specific to that company and shared them with management. Next he

might have shown them how SPC methods could be used to inform them which workers to talk to for which problems, which problems were not problems at all, and, therefore, how to conserve and focus effort. He might reasonably have then guided them through some problem identification and problem solving with SPC methods that reinforced their participation. Next, with their own examples of problem solving, he showed them how few problems were "people problems" and how many were system problems. In this new approach, problem identification is systematic, scientific, and reinforced. Problem solving is likewise systematic, scientific, and reinforced.

Next, it was important that the managers learn that they had applied some basic scientific principles in their exercises with Deming and that successful change would require generative application of these principles at every level in the company. With successful application of these principles, the management system would solidify gradually and remain relatively impervious to deterioration because the cumulative effects would begin to alter the profits of the company. With the first companies Deming assisted in Japan, we think the 14 points (or some early version of them) entered the equation at this point; that is, they emerged concurrently with his successful application of SPC-based methods. Deming likely learned that as important as his statistical methods were for success, convincing managers to adopt them was impeded by certain existing practices. Thus, the 14 points emerged as steps that were essential if his statistical methods were going to be adopted and used throughout the company. As rules stated later by a demonstrably successful consultant, their influence on other companies should have been greatly enhanced by his reputation for success. Nevertheless, the operative methods at the core of the important changes he is credited with producing must certainly have been the application of SPC methods—observe, analyze, modify, observe, and so forth.

### AN ANALYSIS OF THEORY D

As we read Deming (1982, 1986) from a behavior-analytic perspective, we conclude that instituting change through SPC methods (changes that later can be said to reflect adherence to Deming's 14 points) results in bringing workers and managers into more direct contact with the reinforcement contingencies operating on the manufacturing process. Specifically, based on our reading of the texts, a different list of 14 premises and steps emerges. Our inferences appear to describe a fairly straightforward way of getting the worker's knowledge to the managers and for evaluating the utility of responding to that knowledge. Our 14 points are:

1. Consultants do not, and will not, control the reinforcement contingencies operating on the upper levels of management. Management is already subject to powerful contingencies of reinforcement established by social and economic systems and to contingencies of punishment through bad management practices. Thus, the only relevant reinforcement contingencies in business are already in place; what remains is to teach managers how to bring all employees in contact with the contingencies and to remove punishment contingencies that interfere with the process of change.

2. The collective behavior (making and implementing company policies) of the manager(s) that precede changes in the market share of the company's product should receive consequences from the effects of those changes. The consequences are delayed, however, and follow so many different managerial behaviors that the relevant consequences often are not differentiated.

3. The company's managers must be able to see the relationship between their behavior and its consequences through a new and precise data collection and data analysis system.

4. The managers do not make the product sold by the company, however; workers do.

5. Although individual workers may

be aware of the consequences of changes in market share, each of them contributes such a small proportion of the total behavior required to make the product that their behavior is not altered directly by such changes.

6. Managers must use the new data collection and analysis program (i.e., SPC) to observe the effects of the interaction of the workers' performance with system characteristics and other operational variables and to show workers and supervisors the direct effects of their performance.

7. The monitoring system must be comprehensive and sensitive. It must be used at all levels and be capable of detecting specific sources of variation. Changes observed at one level that produce local improvement but that have broad but subtle negative effects elsewhere should be detectable.

8. Accept as a given that most workers work most of the time when at work. That is, there is a ceiling on worker behavior (in terms of rate) and usually it is not far away. Thus, changes in worker behavior that can influence the data lie mostly in modifications in the topography of their behavior and, thus, in efficiency (the ratio of quality units to defective units per unit of time) and not in absolute rate. Note that this a priori assumption is not necessarily true, but adopting the assumption focuses managers on potentially more powerful systems variables first. Any subsequent series of successful systems changes then has the effect of gradually differentiating precisely which human performance issues are involved in any continuing lack of statistical control or in any discrepancy between in-control variance and the customers' specifications. The differentiating process also facilitates distinguishing between types of human performance variables, such as lack of motivation versus lack of knowledge or skill. The more an organization can benefit from systems changes, the more unlikely are the prospects of correctly identifying human performance problems. Thus, human performance problems

should be addressed in otherwise efficiently operating organizations.

9. Accept also as a given that human error cannot be eliminated because human behavior is always susceptible to the influence of unexpected events, both environmental and physiological. Accept instead that other systems changes can either eliminate the context or conditions under which the error has occurred (e.g., adding a copilot to the cockpit of commercial aircraft) or that other systems can detect and override human error (e.g., midair collision warning systems). These assumptions are critical in minimizing unrealistic expectations regarding performance and again focusing managers on other solutions.

10. Sustained improvements in efficiency occur through one primary mechanism: Whenever a source of variance is detected (in equipment, raw materials, or method, for examples), no matter by whom, someone responds to that discovery with steps that control or eliminate the influence.

11. Changes in the data (from the new data collection system) at the level of the system change, and adjacent level above, are the consequences of the discovery and the response to it. That is, if the discovery was an accurate analysis, the workers who work most of the time when at work will be more efficient and the data will confirm it. As Deming emphasizes repeatedly, this outcome has a major positive impact on worker morale. Creating more efficiency sends the worker the message that his or her time and effort is no longer undervalued and wasted. Thus, "pride in workmanship" is not the originating cause of improvements in performance; it is the outcome of system changes. Subsequently, of course, pride in workmanship may well become a human experience associated with observable behaviors that set the occasion for additional problem solving.

12. At some point, system changes should create the condition in which workers can maintain a higher proportion of quality units to defective units while simultaneously increasing somewhat the total number of units per unit

of time. This will be the first moment when individual performance (except the performances of analysis, discovery, problem solving, and so forth) should be permitted to come under the control of the contingency of positive feedback (changes in the data, awards, raises, and so forth). If it occurs any sooner, the absolute rate of defective units would have increased also (because until now the proportion of defective units was uncontrolled). Often misunderstood as reflecting "pride in workmanship," this actual increase in work rate is probably the most expected outcome of data-based system change.

13. Positive changes in the data will reinforce, or set the occasion for, others to correctly reinforce increases in individual performance. These conditions will occur simultaneously in all feedback loops at all levels, and market share will increase. Aggressive adherence to the policy of reinforcing analysis and discovery will maintain the conditions in which individual performance is also an appropriate variable.

14. The preceding points are interactive and interdependent; all of the changes must be incorporated into the company's reorganization at all levels.

Although our inferences are derived from Deming's material, we do not know whether Deming would have agreed with them, and we have no data to support their accuracy with respect to actual practice. Nevertheless, Deming was an active and successful consultant. Irrespective of whether our interpretation of how he effected the rearrangement of reinforcement contingencies is correct, we conclude that his consultations in many cases probably resulted in such functional changes, even if he was not aware that his recommendations were leading to such outcomes. Deming was not a behavior analyst by training, and the fact that he neither explained his approach as we have, nor recommended the inclusion of a contingency-management technology is understandable—his strength was statistics-based system analysis. Nevertheless, if a consultant tailors our 14 points to a particular company by con-



sulting in a manner that reinforces employing the consultant and brings the company's work force into contact with appropriate contingencies, the consultation should produce outcomes that independent observers will conclude reflect many of Deming's 14 points.

### SPC AND THEORY D OUTSIDE THE MANUFACTURING PLANT

Consider the case of a program manager employed by a community agency for adults with developmental disabilities. Following a recent program evaluation by an external review agency, this manager is informed that significant problems were detected in the two six-bed residences for which the manager is responsible. These problems are most easily summarized as inconsistent implementation of the generic and individualized habilitation programs planned for the consumers living in the homes. Although these conditions were found in other locations operated by the agency, this manager's area was the most extreme instance, falling below the review agency's criterion for acceptable performance. The agency director might expect the program manager to employ some combination of counseling, remedial training, and improved performance feedback to rectify the agency's current poor evaluation. Certainly, a performance-management intervention, incorporating reinforcement for acceptable outcomes, also could be an effective addition.

If performance-related interventions do not affect the variables actually impeding smooth, consistent program delivery, however, the problems will not be solved or will quickly surface again. We believe that one of the reasons that this might occur is that counseling, retraining, feedback, and incentives may have little impact on the level of difficulty inherent in producing acceptable outcomes. When difficulty level is extremely high, similarly poor performance outcomes may emerge even if the most highly rated staff members from throughout the facility are assigned to these homes (see Rummel & Brache, 1990). Thus, the success of performance-related ap-

proaches will be a function of the size of the gap between current employee performance and possible employee performance, given that the basic system remains unchanged (see Gilbert, 1978). When no gap exists, performance-related interventions can have no effect on the identified problem, but may have significant negative impacts on worker morale.

In contrast to depending only on performance-related approaches for solving the agency's problems, we might attempt first to evaluate the influence of other variables, such as those affecting task difficulty. Using statistical sampling methods, we might determine, for example, that the complexity of responding appropriately to consumers in these two homes is far greater than in other pairs of residences operated by the agency. Our inference from these data would be that consumer characteristics can produce variability that is not controlled by characteristics of staff performance. In response, changes in the assigned residence of only a few consumers, resulting in the equalization of complexity across homes, might produce measurable improvement in the consistency of acceptable outcomes. Other forms of statistical sampling can be used to confirm these predictions and to monitor for similar conditions arising elsewhere in the agency.

Another likely source of variance in our hypothetical agency could be its staffing system. For example, suppose the current approach is to ensure that two staff members are on duty in each residence during both the day and evening shifts. This is currently accomplished by scheduling at least four staff members for each shift across the two residences from an assignment pool of eight staff members per shift. This relatively common method can make staff scheduling less complex, but unfortunately, it also creates as many as 28 possible combinations of two staff members per shift in each residence. That is, across two shifts, as many as 56 different pairs or teams of personnel could work in a residence across a period of several months. Thus, every employee must become familiar with the

needs of 12 individuals, be competent with respect to implementing their individualized programs, and frequently coordinate their respective duties with a new work partner. This combination of expectations may be a direct cause of the noted inconsistency in program implementation (Saunders & Spradlin, 1991). If inconsistency leads to less appropriate and less predictable consumer repertoires, as we suspect it might, the agency managers will likely respond by designing more complex behavioral interventions to address them, further adding to the difficulty of consistent implementation. Alternate methods of staffing with the same resources, however, can reduce the number of different staff teams from 56 to as few as four. This change will not only reduce the number of consumers that each staff members must serve but will also reduce the complexity of staff teamwork. Such changes also facilitate the identification of an individual employee who, despite the reduction in task difficulty, is not performing as effectively as other employees. By isolating the performance-based source of variance, it becomes easier to determine which of the performance-related interventions is needed. Statistical sampling methods would be particularly useful for evaluating the effects of different staffing patterns and the relative effectiveness of individual teams.

Our example suggests that behavior-analytic consultants to similar organizations should consider engaging in comprehensive systems analysis and restructuring prior to engaging in contingency analysis of performance problems. This is not an easy process. In the business of consultation, the primary independent variable is the consultant's verbal behavior; the variable in a dependent relation to this verbal behavior is the managerial behavior of the company; and dependent to that behavior are the contingencies of reinforcement that operate as a function of that managerial behavior. A consultant to the agency in our example must somehow disabuse the facility's management of the notion that fixing the identified problems should be tackled by more counseling, training, documentation, and so forth, and

obtain sufficient support from management for "experimenting" with consumer groupings and staff assignment before introducing a contingency-management system to close the gap between current employee performance and employee performance potential.

The degree to which the verbal behavior of the consultant results in major organizational improvement is likely to be heavily dependent upon the degree to which the company's leadership has observed that following the consultant's rules was productive for others (see Skinner, 1969). We also believe, however, that success will depend upon whether, in addition to sharing various premises and rules, the consultant has available an empirical approach to problem solving through which important relationships can be demonstrated (Rummler & Brache, 1990), the observation of which reinforces the company's leadership for listening to the consultant and experimenting with the methods. Deming began with such an approach and later, we believe, developed and disseminated his 14 points to facilitate acceptance of his empirical methods. We believe proponents of Theory D, TQM, or other quality-enhancement approaches are likely to be on loose footing if they are not aware that Deming's 14 points are facilitators of a core approach and are themselves not the core. Similarly, managers' attempts to apply Deming's 14 points without including SPC or similar evaluative methods may not fare well; as a result, managers may conclude that Deming's methods are ineffective. We agree with our colleagues that behavior analysts can add an important component to quality-improvement efforts, a component Deming could not offer. SPC methods and Deming-style analysis, however, are important tools for determining whether the conditions exist in which contingency-management approaches can be most successful, or for creating the conditions when they do not exist.

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