



Always Applicable

Deming's system of **profound knowledge** remains relevant for management and quality professionals today

by Ronald D. Moen and Clifford L. Norman

W. EDWARDS DEMING was truly one of the quality giants of the 20th century. A pivotal event in quality history occurred during one of his four-day seminars in Houston in 1990 when he introduced his system of profound knowledge.¹ “My aim is to provide a foundation or system of theory for continual change of practices for management to keep up with the changes that are taking place in this world. Even, perhaps to guide the changes to come,”² he said at the seminar.

Exactly what is his theory all about and how did it evolve? More than 25 years after its unveiling, does the theory still have meaning for management and quality professionals? Is the theory actually being used today to, in Deming's words, “guide the changes to come”?

In 50 Words Or Less

- W. Edwards Deming's system of profound knowledge essentially bundles four theories that address variation, psychology, knowledge and systems.
- Having evolved during Deming's 50-plus year quality journey, the theory continues to be essential for management and quality professionals to understand the messiness of the business world and develop productive paths forward.

Deming's journey of quality learning lasted more than 50 years. In short, the journey started with statistical quality control (SQC) for industry that he developed with his friend and mentor, Walter A. Shewhart, and taught in the United States during World War II. The journey continued with Deming teaching SQC to managers and engineers in Japan. Japanese managers listened and went to work on quality. Managers elsewhere did not. This led to his 14 points for management. Finally, Deming developed his system of profound knowledge to improve current management practices for industry, government and education.

Of course, quality giants and scholars such as Joseph M. Juran, Kaoru Ishikawa and Taiichi Ohno made other significant contributions to quality in the 20th century. Deming's system of profound knowledge, however, is unique to the quality profession.

Still, many don't seem to understand this system as well as they should, and it's not universally practiced today as might be expected. To get management and quality professionals reacquainted with the system so they can apply it more in today's business environment, you must look back and understand Deming's

quality journey—divided here into three major eras (see Figure 1)—and the quality thought leaders who influenced Deming and how he developed the system.

Before 1980

In April 1942, Deming received a letter from W. Allan Wallis, a member of Stanford University's statistics faculty. Wallis was writing on behalf of himself and some of his statistician colleagues (including Eugene L. Grant) who wanted to contribute to the war effort by offering statistics training.

These efforts and collaboration resulted in intensive eight-week courses that began in early 1943. Within two years, almost 2,000 men and women from nearly 700 industrial concerns had been trained. SQC—based on work of Deming and Shewhart—was a core feature of these courses. Deming taught 23 of the courses himself. This intensive workshop would prepare him for his later work in Japan and laid the foundation of the American Society for Quality Control (ASQC, now ASQ) in 1946.

In July 1950, Deming first taught SQC in Tokyo during an eight-day course, which 600 people attended.

Evolution of W. Edwards Deming's work / FIGURE 1



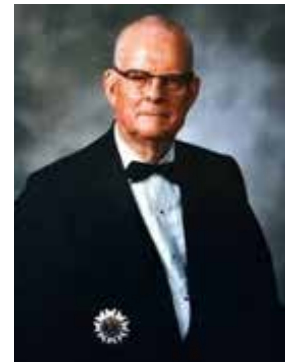
Before 1980

- 1942 – Statistical quality control (SQC)
- 1950 – SQC for management
- 1953 – “On the Distinction Between Enumerative and Analytic Problems” article.
- 1975 – “On Probability as a Basis for Action” article.



1980-1988

- 1980 – NBC white paper
- 1981 – 14 points of management
- 1986 – Deadly Diseases of Management
- 1986 – *Out of the Crisis*



1989-1993

- 1989 – Profound knowledge
- 1991 – System of profound knowledge
- 1993 – Application of system of profound knowledge: present practice to better practice
- 1993 – *The New Economics or Industry, Government and Education*

“Years of study and experience are required to become an expert. Yet, you will get a good start here in eight days,” he said.³

Deming’s audience included many Japanese managers. The key concepts in the course included:

- The customer is the most important part of the production line.
- Quality is determined by management.
- The consumer is most important. What will help him or her in the future? The customer cannot tell you what he might need and buy in the future. This responsibility lies with the producer’s management.
- Your supplier is your partner. Develop a long-term relationship with the supplier in a spirit of mutual trust and cooperation.
- There is a chain reaction from improvement of processes.
- There is a need for trust and cooperation between organizations.
- Variability is a rule of nature.
- The Shewhart control chart is the statistical tool that helps an engineer or foreman to separate the two types of variability.
- The red bead experiment shows the fallacy of basing the ranking of personnel on their previous performance.⁴

These lectures led to a 1950 Union of Japanese Scientists and Engineers brochure, “Elementary Principles of the Statistical Control of Quality” and a Japanese book *Guide to Quality Control* by Kaoru Ishikawa in 1968 (later translated into English by the Asian Productivity Organization in 1971).

Deming visited Japan again in 1951 and 1952. His seventh visit to Japan was in 1965. Deming’s popularity was clearly growing around the world. His business card read “Consultant in Statistical Studies” to reflect how much of his work involved applying statistical methods to a variety of applications. But his quality message was not being understood that well—especially by those in managerial roles.

1980-1988

Before 1980, Deming lived a paradox. In Japan, he was revered as the man who helped the Japanese believe in their country’s ability to be a world-class competitor. He remained largely unknown in the United States, however.⁵

NBC introduced Deming to the United States

Evolution of the 14 points / TABLE 1

Point	Early 1982 (handout)	1986 (Out of the Crisis)
1	Innovate and allocate resources to fulfill the long-range needs of the company and customer, rather than short-term profitability.	Create constancy of purpose toward improvement of product and service.
2	Discard the old philosophy of accepting defective products and defective workmanship.	Adopt a new philosophy.
3	Eliminate dependence on mass inspection for quality.	Cease dependence on mass inspection.
4	Reduce the number of suppliers for the same item. Demand and expect suppliers to use statistical process control and to furnish evidence thereof.	End the practice of awarding business on the basis of price tag alone.
5	Use statistical techniques to identify the two sources of waste: system 85% and local faults 15%; constantly strive to reduce this waste.	Improve constantly and forever the system of production and service.
6	Institute better job training with the help of statistical methods.	Institute training.
7	Provide supervision with the use of statistical methods. The aim of supervision should be to help people to do a better job.	Adopt and institute leadership.
8	Reduce fear throughout the organization by encouraging open, two-way communication.	Drive out fear.
9	Reduce waste by putting together as a team the people who work on design, research, sales and production.	Break down barriers between staff areas.
10	Eliminate use of goals and slogans in an attempt to increase productivity.	Eliminate slogans, exhortations and targets for the workforce.
11	Examine closely the impact of work standards. Do they consider quality or help anyone do a better job?	Eliminate numerical quotas for the workforce. Eliminate numerical goals for people in management.
12	Institute rudimentary statistical training on a broad scale.	Remove barriers that rob people of pride of workmanship.
13	Institute a vigorous program for retraining people in new skills to keep up with changes in materials, methods, design of product and machinery.	Encourage education and self-improvement for everyone.
14	Make maximum use of statistical knowledge and talent in your company.	Take action to accomplish the transformation.

through a televised “White Paper” episode in June 1980 titled, “If Japan Can ... Why Can’t We?”⁶ This program clarified some of the problems faced by U.S. industries and introduced Deming to U.S. viewers, something that changed his life irrevocably.

Almost a year later, Deming went on to teach again in the United States at a two-day seminar in March 1981 at Hewlett-Packard (HP) titled, “Productivity Goes Up With Quality.” There were 450 members of HP management and 75 others from various Silicon Valley organizations in attendance. Bill Mohr, a long-time HP manager, summarized what Deming advised top management must do:⁷

- Innovate—plan product and service for the future.
- Learn the new philosophy—you can no longer live with hitherto accepted levels of mistakes, defects, material not suited to the job, handling damage, failure to understand the problem of your products in use, antiquated methods of supervision, training and purchasing.
- Discard dependence on mass inspection.
- Recognize the new economics. Purchases at the lowest prices may be unwise for important supplies.

- Reduce the number of suppliers.
- Institute massive training programs in simple statistical methods.
- Institute supervision to reduce insecurity (for example, fear on the job and fear to ask questions or report trouble with equipment and materials).
- Recognize there are two sources of trouble—the system is trouble 85% of the time, and the worker 15%.
- Constantly improve the system.
- Realize the new direction for purchasing managers. Sample inspection is a thing of the past.

Deming added four more “must do’s” for management later that year. The entire list became his 14 points of management. The wording of the 14 points changed several times from his handout in 1982 to his published version in 1986’s *Out of the Crisis*⁸ (see Table 1, p. 49). For instance, the 1982 version mentioned the word “statistic” six times. These mentions

Components of the system of profound knowledge / TABLE 2

<p>Knowledge about variation</p> <ul style="list-style-type: none"> • Awareness that there will always be variation. • Appreciation of a stable system and capability. • Some understanding of special causes and common causes of variation. • Some understanding of the costly mistake of tampering. • Use of data requires knowledge about the different sources of uncertainty. • Use of data requires understanding of the distinction between enumerative studies (information about the framework) and analytic problems (results of a test or experiment must be inferred to the future—prediction). 	<p>Psychology (psychology of individuals, groups, society and change)</p> <ul style="list-style-type: none"> • Psychology helps the understanding of people and interactions between people. • People are different from one another. • People are born with a natural inclination to learn. • People learn in different ways and at different speeds. • People are born with a need for relationships with other people and a need for love and esteem from others. • There are intrinsic and extrinsic sources of motivation. • Total submission to extrinsic motivation leads to destruction of the individual. • All people are motivated to a different degree extrinsically and intrinsically.
<p>Theory of knowledge</p> <ul style="list-style-type: none"> • Management is prediction. • Knowledge is built on theory. • Information is not knowledge. • Rational prediction requires theory. • Interpretation of data from a test or experiment is prediction. • There is a need for operational definitions. • Enlargement of a committee is not a reliable way to acquire knowledge. 	<p>Appreciation for a system</p> <ul style="list-style-type: none"> • A system must have an aim. • A system includes the future and competitors. • The aim is a value judgment. • A system must be managed—it will not manage itself. • Left to themselves in the Western world, the components become selfish, competitive and thus destroy the system. • The bigger the system, the more difficult to manage. What are the boundaries of the system? • A system cannot understand itself and needs guidance from outside. • The greater the interdependence between components, the greater the need for cooperation among them. • Management must manage the interdependence between components toward the aim of the system.

had disappeared by the 1986 version.

There was much confusion on the role of statistics as defined by Deming. In *Quality, Productivity and Competitive Position*, he writes, “Too many teachers of statistics look backward, still teaching and applying the theory of enumerative problems to analytic problems that they do not understand. It’s time for statisticians to awaken to the needs of science and industry of today.”⁹ Deming was frustrated by the profession’s entrenched position not to understand analytic problems. He believed the theory of statistics to be right, but the application to be mostly wrong.

“The teaching of statistical methods in Japan did not confuse statistical estimation, nor Shewhart charts, with statistical test of hypothesis,” Deming said.¹⁰

Some of the obstacles listed in chapter three of Deming’s 1982 *Quality, Productivity and Competitive Position*¹¹ were then promoted as deadly diseases of management in chapter three of Deming’s 1986 *Out of the Crisis*.¹² The diseases are:

1. Lack of constancy of purpose to plan product and service that will have a market and keep the company in business and provide jobs.
 2. Emphasis on short-term profits: short-term thinking (the opposite of constancy of purpose to stay in business) fed by fear of unfriendly takeover and by a push from bankers and owners for dividends.
 3. Evaluation of performance, merit rating or annual review.
 4. Mobility of management—in other words, job hopping.
 5. Management by using visible figures with little or no consideration of figures that are unknown or unknowable.
- Deming added two additional diseases unique to U.S. industries:
6. Excessive medical costs.
 7. Excessive costs of liability, swelled by lawyers who work on contingency fees.

Deming covered the 14 points and seven deadly diseases during the first two days in his popular four-day seminars, which were conducted globally through 1988. Deming was creating dissonance with the prevailing system of management.

Some managers became disciples, while a few actually walked out of the seminars on the first day. Dissonance was not always welcomed by those who had become accustomed to being told they were doing

things right. For these people, the seminar was a tough challenge. Deming was asking managers to change. There were other soothing voices in the quality movement that were not requiring managers to change their behavior or the prevailing style of management.

1989-1993

Deming started working on a paper to be delivered in Osaka, Japan, in July 1989 that introduced profound knowledge. He identified the 15 basic elements of profound knowledge as:¹³

1. Knowledge about the statistical concepts of variation.
2. Knowledge of the losses from tampering with a stable process and from missed opportunities for improvement of an unstable process.
3. Knowledge of procedures aimed at minimum net economic loss from mistakes one and two.
4. Knowledge about interaction of forces in a system.
5. Knowledge about losses due to demanding performance that lies beyond the capability of the system.
6. Knowledge about Genichi Taguchi’s loss function and problem prioritization.
7. Knowledge about instability and loss that result from successive application of random forces.
8. Knowledge about the losses from competition for share of market.
9. Knowledge about the theory of extreme values.
10. Knowledge about the statistical theory of failure.
11. Knowledge about the theory of knowledge.
12. Knowledge of psychology and motivational theory.
13. Knowledge of learning and teaching styles.
14. Knowledge of the need for transformation to the new philosophy.
15. Knowledge about the psychology of change.¹⁴

The Osaka paper became a basic handout at his four-day seminars in 1989 and grew in content with each seminar.

A year later, three University of Minnesota professors presented a paper “Profound Knowledge: Exploring Theoretical Foundations” at the Forum on Leadership, Theory and Practice on May 21-22, 1990.¹⁵ This paper took Deming’s Osaka paper of 1989 and grouped Deming’s 15 elements of profound knowledge into four foundational areas:

1. Cognitive psychology (elements 11 and 13).
2. Organizational theory and behavior (elements five, 12, 14 and 15).

Faulty practices and better practices / TABLE 3

Present practice	Better practice	Relationship with profound knowledge (Why is it a better practice?)
Lack of constancy of purpose. Short-term thinking. Emphasis on immediate results. Think in the present tense; not future tense.	Adopt and publish constancy of purpose. Do long-term planning. Ask the questions: Where do we wish to be five years from now? Then, by what method?	<p>System: System has an aim. Stay true to the aim. The aim is a value judgment. The system includes the future.</p> <p>Variation: Understand the distinction between enumerative and analytic problems.</p> <p>Psychology: Constant change confuses people who work in the system; working to a common purpose facilitates relationship building and trust.</p> <p>Knowledge: Common purpose focus enables better theory building. No number of successes in short-term problems will ensure long-term success.</p>
Ranking people, salespeople, teams, divisions; reward at the top, punish at the bottom.	Abolish ranking. Manage the whole organization as a system. Study and understand how every component contributes toward optimization of the system. Ranking does not help anyone improve or help the system improve.	<p>System: The system is responsible for most of the observed variation; common cause; people deliver samples of the system.</p> <p>Variation: Ranking people within the common cause system is misleading. There will always be variation.</p> <p>Psychology: Debilitating and perceived to be arbitrary. Pygmalion effect* begins and destroys cooperation. People are different from one another.</p> <p>Knowledge: Ranking is a snapshot and does not take into account temporal spread.</p>
Management by results. Take immediate action on any fault, defect, complaint, delay, accident or breakdown. Act on the last data point.	Understand and improve the process that produced the fault, defect and system.	<p>System: Most results belong to the system.</p> <p>Variation: Understand the distinction between common and special causes to understand the kind of action to take.</p> <p>Psychology: People take credit or get blamed; attribution error.</p> <p>Knowledge: Consistently making mistake one or mistake two.</p>

*The Pygmalion effect means that expectations influence performance.

3. Statistical theory (elements one, two, three, six, nine and 10).
4. Systems theory (elements four, seven and eight).

Deming was invited but did not attend the University of Minnesota forum. He did, however, revise the list of 15 elements in his Osaka paper¹⁶ on Sept. 1, 1990 into four parts—all relating to one another:

1. Appreciation for a system.
2. Theory of variation.
3. Theory of knowledge.
4. Psychology.

He called this the system of profound knowledge.

By 1993, the handout had expanded to 10 chapters with tabs. The handout provided Deming a draft for his last book, *The New Economics for Industry, Government and Education*, which he began, “This book is for people who are living under the tyranny of the prevailing style of management.”¹⁷

Chapter one asks “How Are We Doing?” and chap-

ter two covers “The Heavy Losses (Present and Better Practices).” Deming later said chapter two actually could have been called “How to Increase Your Costs.”

In chapters three and four, Deming describes his system of profound knowledge. The four parts all related to one another:

- Appreciation for a system.
- Knowledge about variation.
- Theory of knowledge.
- Psychology.

He says, “One need not be eminent in any part of profound knowledge to understand it and to apply it. The various segments of the system of profound knowledge cannot be separated. They interact with each other. For example, knowledge about psychology is incomplete without knowledge of variation.”¹⁸

Table 2 (p. 50) includes a description of the four parts taken from chapters three and four of *The New Economics for Industry, Government and Education*.

In developing each of the four parts, Deming was influenced by experts. His major contribution was to look at each of these theories as a system and use this system as a lens to understand organizations.

Deming said the 14 points follow naturally from his system of profound knowledge.

In chapter two of *The New Economics for Industry, Government and Education*, Deming wrote that the present style of management is the biggest producer of waste, the magnitude of which cannot be measured.¹⁹

Some of the faulty practices of management, with suggestions for better practice, are listed in Table 3. The last column in Table 3 offers insight on why it is a better practice to use the system of profound knowledge.

A new lens

Deming started his quest in developing the system of profound knowledge by understanding Shewhart's theory of variation. Shewhart was both his mentor and colleague. Through the lens of that theory, Deming began to appreciate the need for the theories of systems, psychology and knowledge.

When these four streams of theory are used together, they provide a new lens for looking at theory to keep up with the changes for management that are taking place in the world. This lens can be used for industry, government and education.

Quality professionals and managers should learn to look through this lens. Table 3 is an effective way to assess current practices and provide better practices. Leaders who use this lens are uniquely armed to understand the messiness of today's business world and will gain insight to help them develop a productive path forward.

Years ago, a manager in one of Deming's seminars asked, "Isn't this common sense? Why isn't everyone adopting Deming's ideas and moving on?" As the seminar progressed, the manager often would remark, "This is hard." By the end of the workshop, he realized he had answered his own question.

Learning the theory of variation does take work and study. Understanding the system by which you accomplish an organization's purpose requires new learning and understanding. Appreciating how people learn and the important role of theory in learning requires more study and work. Psychology is a lifelong endeavor leading to understanding yourself and others, and how you create the environment conducive to intrinsic motivation.

This is all hard, but it also contributes to joy in work. **QP**

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EDITOR'S NOTE

Ronald D. Moen worked with W. Edwards Deming for several years: From 1972 to 1975, Moen participated with Deming at the American Society for Testing and Materials (ASTM) E-11 committee. From 1982-1986, Moen managed Deming's monthly trips to General Motors. From 1982 to 1993, Moen assisted Deming at 70 of his four-day seminars. During that time, Deming reviewed several papers and a book Moen co-authored.

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