Deming's System of Profound Knowledge

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1. Introduction

The purpose of this paper is describe what may seem a rather simple concept yet one that, if taken seriously and studied, can provide managers a significant advantage. That concept is Deming's system of profound knowledge. W. Edwards Deming was a statistician who lived from 1900 until 1993. In the last ten years or so of his very active life he developed this system of profound knowledge which, among his many achievements, may be his greatest legacy. One reason I've chosen to write about this system is I believe it hasn't received the attention it deserves. Even today, with America in the midst of one of its most productive eras, I believe managers still have a lot to learn from Deming and his system of profound knowledge. Furthermore, it may prove that what Deming has come up with is only the beginning of how we might tap the psychic forces that lie within each person. I will touch upon this latter point in the section 4: Going Beyond the System of Profound Knowledge.

This paper is organized as follows:

1. Introduction.
2. Who is W. Edwards Deming?
3. The System of Profound Knowledge.

   Appreciation for a system.

   Knowledge about variation.

   Theory of knowledge.

Psychology.

4. The 14 Points as a Natural Application of the System.
5. The McNary Study.
6. Going Beyond the System of Profound Knowledge.
7. A Critique of the System of Profound Knowledge.
8. Conclusion.

2. Who is W. Edwards Deming?

I was reluctant to use this title since I believe most managers *do* know who Deming is or at least have heard of him. However, there may still be some who don't. And, even for those who do, I would like to do a brief biography to fill in any details in which they may be interested. Deming's biggest claim to fame is the impact he had on Japan's industrial success that began taking market share from the U.S. beginning in the 1970s. I love to quote from humorous columnist Dave Barry (1992) to show how bad things had gotten in America and why, with Deming's help, Japan was able to begin producing products that easily bested

Dr. W. Edwards Deming

America's. Here Barry talks about the reaction of the American automobile industry when Japan began getting market share by producing dependable and inexpensive compacts:

> At first the American auto manufacturers resisted making small cars for aesthetic reasons: Smaller cars sell for less money. But finally, feeling the pinch from foreign competition, the U.S. auto makers decided that, OK, they would make small cars. But not just *any* small cars: No, they would make *really bad* small cars. The shrewd marketing strategy here was that people would buy these cars, realize how crappy they were, and go back to aircraft carriers. This strategy resulted in cars such as the Ford Pinto, the Chevrolet Vega, and the American Motors Gremlin — cars that were apparently design during office Christmas parties by drunken mail-room employees drawing on napkins; cars that frequently disintegrated *while they were still on the assembly line.* (pp. 12–13)

What did Deming do? He simply told the Japanese they *could* make quality products but they had to begin looking at their operations from a systems point of view which included both the supplier and the customer. See Appendix A for the drawing Deming used in 1950 to explain this "systems approach" which was key to Japanese success. For example, Deming told them: "You don't need to receive the junk that comes in [from the supplier]. You can never produce quality with that stuff" (quoted in Mann, 1987, page 20). Anyway, let's start at the beginning.

Deming was born in Sioux City, Iowa on October 14, 1900. Shortly after that the family moved to Powell, Wyoming and this is where he was raised. In 1921, Deming graduated from the University of Wyoming with a bachelor's degree in physics. In 1924 he got a master's in mathematics and physics from the University of Colorado. In 1928 he earned his PhD in mathematical physics from Yale University. At this time he was also working during the summers at the famous

Western Electric Hawthorne plant in Chicago[1] (W. Edwards Deming, undated).

From 1927 until 1939 he worked for the U.S. Department of Agriculture and from 1939 until 1945 for the U.S. Census Bureau. In 1946 he went into private practice as a consultant in statistical studies. He also began teaching statistics at New York University and Columbia (Britannica home page, 2000).

It was while Deming was working for the Department of Agriculture that he met Walter A. Shewhart, a statistician working at Bell Laboratories in New York. At that time Shewhart was developing his ideas about statistical process control; that is the systematic use of data about a process to determine its capability for producing a defect-free product. Shewhart did this through the use of control charts on which are plotted the results of data samples from the process. For example, if the process is to produce a steel rods that are one inch in diameter and 10 inches long, using Shewhart's method, a sample of the rods would be periodically taken and carefully measured to see how close it came to the requirement. The chart would show not only the amount of variation in those measurements but where the average was compared to where it should be. Such information could then be used to make corrections to the process. These ideas, as we shall see, became the foundation for Deming's work and formed a large part of his system of profound knowledge.

It was in 1950 that Deming, invited by the Union of Japanese Scientists and Engineers (JUSE)[2], began working with Japanese manufacturers. Deming's help,

1) This plant is where, in the late 1920s and early 1930s, Elton Mayo conducted experiments that showed worker productivity could be affected by the way managers treated their workers; more specifically, by showing interest in the worker as a person and giving him or her more of a say in the job and working conditions. Although Deming was not involved in those experiments, his observation of the poor working conditions gave him a special concern for the factory worker that was often revealed in his later work.

2) Established in 1946, JUSE's stated objective is "to promote systematic studies needed for the advancement of science and technology, whereupon to contribute to the development of culture and industry." JUSE administers the Deming Prize.

combined with the industriousness and receptiveness of the Japanese, enabled Japan to rise from the ashes of defeat to become an economic powerhouse by the 1980s. An indication of just how much Deming and his ideas were respected by the Japanese was the establishment of the Deming Prize (for quality) in 1950 by JUSE. This prize, awarded annually to companies and individuals, is highly coveted and has done much to promote quality in Japan. As if that wasn't enough, in 1960 the Emperor of Japan awarded Deming one of the country's highest awards: the Second Order Medal of the Sacred Treasure. Deming has also won numerous awards in America such as Shewhart Medal awarded by the American Society of Quality Control (ASQC)[3] in 1956 and the Samuel S. Wilks Award given by the American Statistical Association in 1983 (MIT Center for Advanced Educational Services, 2000).

Ironically thirty years would pass from the time Deming began turning around Japanese industry until he was "discovered" in America. How that discovery occurred is an interesting story in itself. Dr. Deming's coming out occurred with the broadcast in June, 1980 of the NBC White Paper "If Japan Can, Why Can't We?"; Deming was featured in the last 15 minutes of this 90 minute program. One of the coproducers of that program, Clare Crawford-Mason (1992) describes her initial encounter with the man:

> I called the man's office and set up an appointment. It wasn't difficult; his schedule was open. I recall postponing the first meeting. I was directed to go to the side of a residential house [in Washington D.C.] and come down the basement steps. I did. I knocked on the cellar door and walked into a two-room, below-ground office, filled with books and papers and overflowing desks and a blackboard covered with mathematical formulas.

This was hardly what one would expect for the man who had a major impact on Japan and then America. The impact of that NBC program was tremendous.

3) Now the American Society for Quality (ASQ).

Again quoting Crawford-Mason (1992):

> Within a week, representatives of Fortune 500 Companies were lined up outside his basement door—a slight exaggeration. But it is not an exaggeration to say that Dobyns [the reporter for the project] and I still run into people who say that they were in a cabin in Minnesota or a living room in Main, polishing shoes or flipping channels and watched "If Japan Can..." and decided to call their bosses, leave teaching, open a consulting business, contact Dr. Deming or somehow change their lives. Thousands called NBC News. We were surprised.

As the saying goes, "the rest is history." Deming began consulting for some of the biggest names in American industry, such as the Ford Motor Company, and America finally began to catch up with the Japanese juggernaut.

On December 20, 1993 Deming passed away. The article headline in the December 22 *Japan Times* said it all: "'God of quality control' W. Edwards Deming dies." Almost right up to that last day he remained very active teaching at NYU and holding his famous 4-day seminars. It is hard to imagine a person who has been more active throughout his entire life nor had a more profound effect on management, not only in Japan and America but throughout the world. Deming was truly a "giant among men" and his insights into management and quality improvement will never outlive their usefulness for mankind. Now let's look at what may have been his most valuable contribution: the system of profound knowledge.

3. The System of Profound Knowledge

Deming's system of profound knowledge consists of these four elements: (1) *appreciation for a system*, (2) *knowledge about variation*, (3) *theory of knowledge*, and (4) *psychology*. Deming's fullest explanation of these elements is in Chapter 4 of his book *The New Economics* (second edition, 1994). It is important to note

that these four elements must be used together to truly affect the transformation they are meant to affect. Let's examine in some detail each of the elements.

(1) *Appreciation for a system.* Here is Deming's definition of a system: "A system is a network of interdependent components that work together to try to accomplish the aim of the system" (Deming, 1994, p. 50). This definition does not say anything about the size of the system; it could be something as simple as a system for producing widgets or delivering some service, or the entire organization of a big company or, even, a country. Of course, as the size increases so do the management challenges. Appendix A (already mentioned) is an example of a generic production system. Here are the most important points for appreciating a system:

• *It must have an aim.* Without an aim, there is no system according to Deming. This aim is set by top management (this could be an entrepreneur or a board of directors or the CEO) but management should strive to get agreement on the aim once set. The aim should be expressed in non-specific terms; for example, for a system to teach reading: "Children have need for skills in reading, not for a certain curriculum, textbooks, or teaching technique" (Deming, 1994). Deming's Point 1 (of his 14 Points[4]) provides a good starting place for developing the aim of an organization: *Create constancy of purpose towards improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs.* It is important that the aim be known to everyone in the organization. In a recent presentation, Marsha Ludwig-Becker (1999) states: a "CEO's formula for success" includes involving people at all levels. This means that everyone knows the leader's vision (the organization's aim) and feels they are a participant in working towards that vision.

• *The performance of each component must be judged on the basis of its contribution to the aim.* This implies, as the above definition states, that the compo-

4) See section 4 of this paper.

nents *work together*. It also implies that there are interdependencies that need to be understood and managed by the system manager. Too often what is found in an organization/system is suboptimization whereby the components are focused on their own performance only, without regard for the system as a whole. Deming (1994) gives this example in his book: A woman had to attend a meeting in New York on Monday afternoon. She would be flying in from Chicago and arriving at 7 : 00 a.m. This meant she would get little sleep since she would have to get up at half past midnight. When Deming asked her why she didn't take a later flight so she could get more sleep and be better prepared for the meeting, she said her travel department got the best price on the flight she would be taking. Here the travel department "won" but the employee (and the company/ system) "lost." Another example would be a salesforce that has to "make it's monthly quota" and, to do so, makes bad sales, sales at any cost. The results are often customers who regret having been taken in and a loss for the company/ system as a whole.

• *The system must be actively managed.* As mentioned this means understanding how the system components interrelate and depend on one another[5]. Once the system's leader understands this he or she can manage those interdependencies by ensuring everyone cooperates and works for the good of the whole. This means eliminating suboptimization (just described), competition, and, even worse, components working at cross-purposes. This effort must be continual, recognizing that if one of the system's components is altered, it affects the whole system.

The system manager should also be like the character Haw in *Who Moved My Cheese* (Johnson, 1998)[6] and realize that one must anticipate change. The man-

5) A flow chart is a great way to get a handle on a system and how its components and inputs/outputs all relate to one another. See Appendix B for an example of a flow chart.

6) *Who Moved My Cheese* is a short story about how two mice, named Sniff and Scurry, and two "little people," named Hem and Haw, react to change. The simple thinking mice ↗

ager needs to think about how the organization (system) should evolve to meet future demands that may be placed on it. This means "... constant scanning of the environment (technical, social, economic) to perceive need for innovation, new product, new service, or innovation of method" (Deming, 1994, p. 54). The idea here is the "system" can begin to take charge of its own future instead of just reacting to it.

Perhaps the most important thing to remember is that a system will not manage itself. In fact, without active management, the system will soon disintegrate as each component reverts to promoting its own aims. Chapter 3 in Deming's (1994) book provides much more information on systems.

• *Recognizing the importance of the system to individual performance.* Once managers begin thinking in terms of the system they will quickly realize that it is usually the system, not the individual worker, who is at fault when something goes wrong or there is subpar performance. In fact, according to Scholtes (1999), about 85% of the problems an organization encounters is due to the system. Given that you have been careful to select good people, given them appropriate training and the chance to gain experience, and provided motivation, they will almost invariable do a good job *if the system lets them.*

(2) *Knowledge about variation.* When we talk about variation, we are usually talking about variation in a process or system; for example, the process already cited for making the steel rod with a certain diameter and length. Another example would be system for transporting people by air (airplanes, airports, airline employees who manage and operate the system, etc.). Here one variable might be arrival times. Airlines that pride themselves on having good "on-time" arrival performance will seek to reduce variation in that system. Let's look at some of

↘ have no problem "moving on" when they encounter change but the little people "analyze the problem to death" before reacting. And then it is only Haw who is able to get out of their self-made predicament and learn the importance of anticipating change in the future.

the important points for this element.

• *Variation is normal.* Variation is a normal characteristic of the world we live in whether it is the performance of individuals in a group or the output of a production process. What the "profound knowledge" manager seeks is to minimize that variation. A good example is the success of McDonalds, the ubiquitous fast food chain. This success is primarily attributable to McDonalds carefully studying each of its processes and doing everything possible to minimize variation in those processes. For example, the Big Mac: no matter where you buy it, Tokyo, New York, or Yakima, Washington, you will get the same Big Mac. Why is this important? Because people like to know what to expect; especially when it comes to something very personal like food. But this applies to almost everything: cars, air transportation, clothes, jewelry, telephone service, you name it. And, if you are the user of steel rods in your product, you want to know they will always be of a certain length and diameter!

• *There are two kinds of causes of variation.* Out of the work of Walter Shewhart, Deming's mentor at Bell Labs, came the idea of special causes of variation and common causes of variation. A special cause is one that lies outside the system as it was designed and intended to operate. For example, an untrained machine operator or a machine that has gotten out of adjustment. On the other hand, common causes are those that are due to the system itself. For example, the quality of some material used to make a product or the capability of a trained operator or properly adjusted machine. According to Castellano, et al. (1995), Deming attributes 94 percent of all variation to common causes.

• *The importance of a stable system.* By a "stable system" we mean one where the variation is due solely to common causes. As can be gathered from the just given description of common and special causes, special causes are temporary in nature while common causes will remain until the system is changed because they are inherent in the system itself. Before a manager can make meaningful

changes to the system he or she must first know just what that system is capable of. To do this the system must be allowed to run for some period of time without any adjustments while carefully measuring its variation. This measurement is done by using a process control chart, something developed by Walter Shewhart at Bell Labs in the 1920s and 1930s. Once you have decided on the attribute whose variation you want to measure, periodic samples are taken and the results are plotted on the control chart. What you will get are a series of points about an average. Using a relatively simple formula, upper and lower control limits can be determined for that particular process and drawn on the control chart. If a data point falls outside the control limits it is an indication of a special cause of variation — perhaps that particular day a new worker was assigned to run the process and didn't have enough training or experience. To obtain a stable system (or process) it is necessary to run it long enough to be sure all special causes of variation have been eliminated and there are no data points falling outside the control limits.

Now this doesn't mean the system is necessarily "good" since the spread between the control limits could be very wide meaning there is a lot of variation. However, it does mean the manager can now tell just how capable the system is and begin making informed decisions about whether it is worth changing something in the system to reduce that variation. For example, maybe spending a little more on the raw materials used in the process or on the training of those running it would result in a substantial decrease in the variation. The point is, until the system is in a state of "statistical control" (i.e., stable), management can not be sure of where it is moving *from* when trying to move to a better system.

• *Why managers should not blame their workers for poor performance.* If the workers have been carefully selected, trained, and motivated, they will perform well. Unfortunately, traditional management has tended to use the poor worker as

a scapegoat for their failure to understand and correct a deficient system. For example, the answer to falling profits is often to tell the worker to "work harder" and, when that doesn't seem to work, management says to "work harder yet." To dramatically demonstrate this failing of management, Deming devised his famous Red Bead Experiment. In this experiment, Deming has six "Willing Workers" charged with "making white beads" for the customer. Unfortunately, the beads are "made" by dipping a 50 bead paddle into a container that contains 20 percent red beads. As the Willing Workers try futilely to draw out only white beads the frustration of the manager (played by Deming himself) begins to mount. After a couple of (simulated) days of this "poor" performance which has been plotted on a control chart, the manager declares a "Zero Defects Day" — again no improvement. Then the three "worst" Willing Workers are fired and the remaining ("best") three try. Now the results are even worse. Since he can't find anyone who can perform well, the manager finally gives up and closes down the production plant. The experiment illustrates the classic problem of management: wanting a system to deliver more than it is capable of and, in the process, totally demoralizing the workers. Chapter 7 of Deming (1994) describes the Red Bead Experiment in detail.

• *Don't tamper with the system.* By tampering we mean trying to correct a common (system) cause of variation by treating it as if it were a special (non-system) cause. Deming has another experiment to demonstrate this: the funnel experiment. Again a very simple experiment that uses a funnel, a marble that can be dropped through the funnel, and a table marked with a dot (the target). The funnel is aimed at the target and the marble is dropped through the funnel 50 times. After each drop, the final resting place of the marble is marked. The following four sets of data (final marble resting place) are gathered:

- After each drop, the funnel remains in the same place.
- After each drop, the funnel is moved from its last position to compensate for

the last error (if the marble stops 10 cm south *of its last position*, the funnel is moved 10 cm north).

- After each drop, the funnel is moved as before but the target is used as a reference (if the marble stops 10 cm south *of the target*, the funnel is moved 10 cm north *of the target*).
- After each drop, the funnel is moved to where the marble came to rest (if the marble stops 10 cm south, the funnel is moved to this position).

As might be expected, the first set of data provides the least variation; the other three are tampering; that is, adjusting the system without really knowing why the correction should work. The cause of this variation is because of the *system*, not for any *special* reason. Therefore the system must be changed if you want to decrease the variation. For example, as Deming suggests, you could lower the funnel or use a fuzzier tablecloth so the marble won't roll so far. See Chapter 9 of Deming (1994) for a detailed discussion of this experiment and tampering. Now we will look at the third element.

(3) *Theory of knowledge*. For this element, Deming stresses the need for managers to both understand how knowledge is advanced and to lead such efforts within their organizations. The important points are:

• *Theories need to be developed and tested to advance knowledge*. The theory could be as simple as which of two methods is best for training certain skills (Suarez, 1992). Once that theory is developed — for example, method A will be better — it is tested by setting up an experiment (usually on a limited basis) that carefully determines which method is better (A or B). Once method A is found to be better, we have advanced our knowledge and are ready to use that knowledge to make our system better. On the other hand, should method A not prove better we have still learned something and advanced our knowledge.

• *The plan-do-study-act (PDSA) cycle should be used to systematically develop theories (predictions) and test them*. Figure 1 depicts the PDSA cycle,

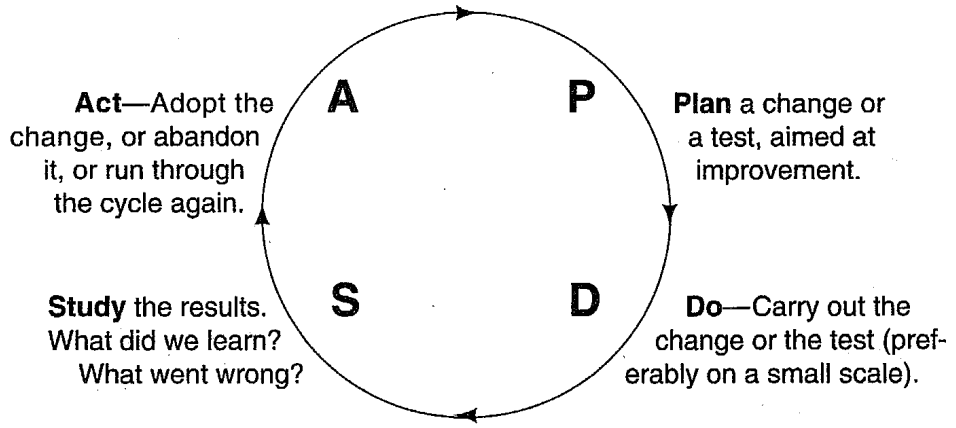

Figure 1. The PDSA Cycle (Deming, 1994, p. 132).

something originally developed by Shewhart and then enthusiastically adopted by Deming. Although simple in concept, it is a powerful tool for increasing knowledge. Let's assume we want to improve some system. During the *plan* stage we gather data on the current system[7], ensure it is in statistical control, and make some prediction based on a theory about what improvement some change will cause. Finally we devise an experiment to test our theory. As may recalled, unless the system is in statistical control we can't make meaningful predictions about how it might improve once some change is made.

During the *do* stage we carry out the experiment — usually on a limited basis. As the name implies, during the *study* stage we study our results and try to determine if, indeed, the change we made did cause the improvement predicted; that is, validated our theory. And, finally, during the *act* stage we either adopt the change or, if it didn't seem to do any good, reject it and try something else repeating the cycle. Even if the change did work, we repeat the cycle continuously striving for better quality.

The PDSA cycle can be used in many ways. For example, we could also use it to improve customer acceptance of some product/service by doing customer research in the *plan* stage, changing our product/service accordingly (the *do*

7) Especially what its desired output should be based on "customer" requirements.

stage), see how the customer likes the new product/service (the *study* stage), and, in the *act* stage, either permanently adopt the change or modify it or abandon it altogether. Again, however, the cycle should be continuously repeated. For a good explanation of the PDSA cycle, Scholtes (1999) recommends Neave (1990).

• *Learning should be continuous and organization-wide.* Deming is big on learning. Consider two of his points:

Point 6: *Institute training on the job.*

Point 13: *Institute a vigorous program of education and self-improvement.*

Although "it makes work and life itself more complex" Scholtes (1999) says: "Leaders must ... ... be leaders of a learning organization. The need for learning must be continuous and concurrent with the need to get the work done." The importance of such an organization was recently stressed by Cayer (1999). According to Cayer, a learning organization is one that provides "an atmosphere of cooperation and learning that encourages innovation within the organization that is prepared to learn from mistakes" (p. 7). She lists these as the main characteristics of a learning organization:

- *Sharing of Values and Goals* — to give you the various perspectives of the different employees working towards the same goals.
- *Empowerment* — encouraging employees to make improvements within their respective areas and within the bounds specified.
- *Participatory environment* — encouraging employees to participate in the decisions of the organization and to submit ideas, and management acting on these ideas.
- *Innovation and Risk-taking* — not punishing someone because his or her idea failed and being willing to take calculated risks.
- *Continuous Improvement* — learning from experience and, when a problem is identified, doing a root cause analysis so the root cause(s) can be elimi-

nated. This also means being pro-active in improving processes; for example by benchmarking[8].

- *Continuous Learning* — instituting a training program to overcome skill/knowledge gaps, making appropriate formal education programs available, and providing OJT and mentoring programs. This also means employees pursuing career-oriented courses and *a culture that says we learn from our mistakes*.

It is apparent from these characteristics that a learning organization is one that focuses on it people, something that we will talk more about with the fourth element: psychology.

Of course, we couldn't leave this topic without mentioning the classic by Peter Senge (1990) that brought the idea of "learning organizations" into the limelight. A couple of his basic concepts — shared vision and team learning — are right in line with Deming's idea of creating constancy of purpose by developing an aim for the organization that everyone works towards (Point 1).

(4) *Psychology*. To round out the system of profound knowledge we need to talk about people. After all, aren't they an organization's "most important asset"? In fact, it is only through people that things are accomplished. We can have the best system, know all about variation and knowledge, and still not have a successful organization if we don't understand people; particularly what motivates them to want to do a good job. These are the important points about this element:

- *People are different*. This may sound obvious but listen to what Deming (1994) has to say:

> People are different from one another. A manager of people must be aware of these differences, and use them for optimization of everybody's abilities and inclinations. This is not ranking people. Management of indus-

8) For a good explanation of benchmarking, see Austenfeld (1996a).

try, education and government operate today under the supposition that all people are alike.

People learn in different ways, and at different speeds. Some learn a skill by reading, some by listening, some by watching pictures, still or moving, some by watching someone do it. (p. 108)

Notice Deming said this is not ranking people. In fact, this was a sensitive point with Deming as expressed as part of Point 12: *Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means,* inter alia, *abolishment of the annual review or merit rating and of management by objectives*. Deming seems to be saying that ranking people, which is a very common practice, assumes everyone is essentially the same and the ranking shows who is really trying. Rather, he says, we should recognize the differences in people and take these into account when, for example, we train them or are trying to motivate them. This idea of not ranking people also implies that given good selection, training, and motivation, everyone will perform at about the same level and well.

• *Rely more on intrinsic motivation rather than extrinsic motivation.* Of course we still need extrinsic motivation. It would be unusual for someone to work without pay. However, the goal of mangers should be to take advantage of the people's innate desire to do a good job, to accomplish something challenging, to learn something new, etc. It is when the manager thinks only in terms of controls that these innate potentialities are wasted and often totally destroyed. Deming (1994) likes to tell the story of the boy who would wash the dishes after dinner every evening until, one evening, to show her appreciation, his mother gave him a quarter. He never washed another dish. Once what he had done for the sheer joy of pleasing his mother became just another job, and lost its specialness as an act of love. Perhaps this is how a prostitute feels after sex versus a married couple who do it as an expression of their loving relationship. As another

example of intrinsic versus extrinsic motivation, Deming (1994) tells the story of a brief note he enclosed with his payment to a doctor. The note expressed Deming's appreciation for the doctor's knowledge and care shown. A few weeks later Deming ran into that doctor and, guess what, he had that note in his pocket—it had meant a lot to know someone cared. Even two years later, another doctor who knew the first said to Deming: "I ran across Dr. [so and so] the other day; he asked about you." Deming said what if he had included an extra five dollars instead of the note of appreciation? Do you think *that* would have been remembered?

The works of McGregor (1960) and Maslow (1954)[9], probably more than any others, are the source of these ideas on the use of intrinsic motivation. McGregor's idea of the "Theory X" manager versus the "Theory Y" manager seems to epitomize the difference between those who would mostly rely of extrinsic motivation and those who would mostly rely on intrinsic motivation. (And, as we shall see in section 5 of this paper — The McNary Study — these two types of managers still exist.) Maslow's ideas about motivation by appealing to higher and higher parts of the human psyche fit very well into Deming system of profound knowledge. Deming seems to be saying that the ultimate goal should be to move every person into the realm of self-actualization where their maximum potential is realized. This is exactly what the ideal Theory Y manager would do by encouraging and appealing to that innate sense of wonder (always wanting to learn) and desire for perfection (always wanting to do a better job). How?:

- By giving them the training they need and opportunities for applying that training.
- By giving them the tools and equipment they need to go a good (better?) job.

9) The latest versions of these books (1985 and 1987 respectively) are available from amazon.com.

- By giving them the support and encouragement they need when they need it,
- By rewarding them not so much with monetary rewards but through praise and appreciation for doing things that have made a real contribution to the organization's aim.
- And, perhaps most important, by developing a mutual trust.

Surly this is what Deming means when he talks about "joy" in work. The opposite approach, using controls to get results, will not only extinguish any "joy" but will require ever more control as the worker begins to see the job as one where he or she does no more than absolutely required.

As a final comment it is important to reiterate here that the four elements do form a system and should be used together. This should be apparent from the considerable overlap that exists in the above discussion of these elements. Having discussed the important points relating to each of the four elements, let us now look at some guidelines for how one might implement the system; that is Deming's 14 Points.

4. The 14 Points as a Natural Application of the System

Here are Deming's 14 Points taken from Aguayo (1990):

1. Create constancy of purpose towards 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, learn their responsibilities, and take on leadership for change.
3. Cease reliance on mass 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. 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 or 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, since 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 the numbers, numerical goals. Substitute leadership.

12a. Remove barriers that rob the hourly workers of their right to pride of workmanship. The responsibility of supervisors must be changed from mere numbers to quality.

12b. Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means, *inter alia*, abolishment of the annual review or merit rating and of management by objectives.

13. Institute a vigorous program of education and self-improvement.

Deming's 14 Points:	PK element			
	S	V	K	P
1. Create constancy of purpose towards improvement.	x			x
2. Adopt the new philosophy.	x		x	x
3. Cease reliance on mass inspections.		x	x	
4. End practice of awarding business based on price alone.	x	x		
5. Improve constantly the system of production/service.	x	x	x	x
6. Institute training on the job.	x	x	x	x
7. Institute leadership.	x		x	x
8. Drive out fear.	x			x
9. Break down barriers between departments.	x			x
10. Eliminate slogans, exhortations, and targets.	x			x
11. Eliminate work standards and management by objectives.	x	x	x	x
12. Remove barriers that rob people of pride in workmanship.	x			x
13, Institute a program of education and self-improvement.	x			x
14. Put everybody to work to accomplish the transformation.	x			x

Figure 2. How the 14 Points relate to Deming's system of profound knowledge (S = system, V = variation, K = knowledge, and P = psychology).

14. Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job.

Figure 2 is an attempt to match up these 14 Points with the four elements of Deming's system of profound knowledge. Let's take a closer look at each point as part of a larger system for applying the system of profound knowledge.

Point 1: *Create constancy of purpose towards improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs* (related profound knowledge elements: SP). This point seems most closely related to the "system" and "psychology" elements: Indeed, for a system to even be a system it needs an aim that is well understood and, at least tacitly,

agreed to by all.

Point 2: *Adopt the new philosophy. We are in a new economic age. Western management must awaken to the challenge, learn their responsibilities, and take on leadership for change* (SKP). As suggested by the above discussion of the system of profound knowledge, this leadership should express itself by the way the system is managed, particularly its people. Also, as Scholtes (1999) says, leaders must be "leaders of a learning organization."

Point 3: *Cease reliance on mass inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place* (VK). This point relates to understanding and minimizing variation by, first, knowing the difference between special and common causes and, second, how to apply statistical methods to detect and monitor variation in your production/service processes. It also relates to theory of knowledge, particularly through the application the PDSA cycle to design better products and services.

Point 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* (SV). I've marked the "system" and "variation" elements for this one. As Appendix A shows, a production (or service) system must include the suppliers. Also, a key part of a "good" relationship with the supplier is to have a joint dedication to reduction of variation. This may mean, as some companies have done, requiring your supplier to learn and employ the statistical techniques necessary so what they supply allows you to meet your minimum quality standards.

Point 5: *Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs* (SVKP). Of course this point is directly related to the "system" element. However, to "constantly and forever" improve that system you must understand variation, apply the theory of knowledge (e.g., by constantly using the PDSA cycle), and

properly train and motivate your people. Regarding the latter, one of the greatest sources of cost reduction can be an active employee suggestion program. For example, according to Toyota Motor Corporation (1997), in 1995 Toyota Motors received 764,402 suggestions and *99% were adopted.*

Point 6: *Institute training on the job* (SVKP). Again, I see this point as related to all four elements. Surely an important part of creating and constantly improving a system is training. And, it is obvious that for the people in the system to understand variation and how to "advance knowledge" they must be trained in these things. Finally, to truly motivate people we must give them not only the tools they need to do a good job, but the training too.

Point 7: *Institute leadership. 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* (SKP). Similar to Point 2, the emphasis here is on leadership and this means running a good system, creating a learning organization, and knowing how to motivate people.

Point 8: *Drive out fear, so that everyone may work effectively for the company* (SP). Deming saw this as one of the biggest impediments to getting the most out of the system and people. If the system operates on the basis of control versus mutual trust, the output from your people will be the minimum required. In fact, sometimes it will even be counterproductive just for spite! Or, without necessarily wanting to harm the system, fear may cause an employee to hold back "bad news" that the manager needs to know.

Point 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 or service* (SP). Again, this relates to the "system" and "psychology" elements. As has been emphasized in the previous section on the system of profound knowledge, for a system to be effective, the components (especially the people) must work together. All to

often, departments develop a mind set of being an independent entity, responsible only for its own well being (take the travel department example cited above). For this "team" approach to take root requires a good understanding of psychology. By the way, an excellent reference for developing and using teams is Scholtes', *et al. The Team Handbook* (1996).

Point 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, since 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* (SP). This point stresses the importance of systems thinking. Once the managers realizes that the vast majority of the problems in an organization are due to the system he or she will quit blaming the worker. In effect, "zero defect" slogans are blaming the worker by saying defects are *your* fault, now quit it! From a psychological point of view, such meaningless actions will destroy any motivation that did exist — think "red bead experiment"!

Point 11a: *Eliminate work standards (quotas) on the factory floor. Substitute leadership*. Point 11b: *Eliminate management by objectives. Eliminate management by the numbers, numerical goals. Substitute leadership* (SVKP). Again, the emphasis is on leadership and all that implies for the system, for learning, and for motivating people. I've included "variation" here because, in lieu of these standards and goals, there should be an organization-wide program to improve all processes and subsystems through the intelligent use of statistics to reduce variation.

Point 12a: *Remove barriers that rob the hourly workers of their right to pride of workmanship. The responsibility of supervisors must be changed from mere numbers to quality.* 12b: *Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means,* inter alia, *abolishment of the annual review or merit rating and of management by objectives*

(SP). Although Deming isn't too clear on what these barriers are other than the "annual review," it is obvious he is talking about relying more on intrinsic motivation versus extrinsic motivation ("mere numbers"). For a system to really function smoothly there must be that mutual trust initiated by the manager. And the way that is developed is to select good people, train them well, give them the tools and support they need. This includes understanding and trying to meet their *personal* needs.

Point 13: *Institute a vigorous program of education and self-improvement* (SP). This point is closely related to the last one and the comment just made about trying to meet people's personal needs. What better way to show that a manager really does care about his or her people than to give each and every one the chance to better him or herself. This can be through educational assistance programs, in-house education programs, and giving the worker the chance to gradually take on more and more responsibility. Perhaps one of the best example of the latter is the self-directed work team where everyone on the team often knows and, on a rotation basis, does everyone else's job including that of being the "team supervisor." See Austenfeld (2000) for a complete discussion of self-directed work teams.

Point 14: *Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job* (SP). You might wonder why Deming included this as a separate point. I think the answer lies in what we've already said about systems and the need to have an aim that everyone is aware of and everyone is working towards. Too often, those people "down in the bilges" have no idea what the real purpose of the organization is and where what they do fits in with that purpose.

Admittedly, even with these points to supplement Deming's system of profound knowledge, the conscientious manager probably still doesn't have all the answers to fully understand and implement Deming's complete philosophy of

management. However, by studying these points — along with the elements of profound knowledge — and how they have been applied in other companies, surely he or she will begin to find ways to improve the organization. Another very practical way to begin improving the company's quality is implementation of ISO 9000. These standards are meant to ensure those with whom the company does business that the company has a good quality management system. See Austenfeld (1996b & 1999) for more information on these standards. Additionally, criteria such as those for the Malcolm Baldrige Award, America's national award for quality, will also provide a good basis for further understanding and implementing Deming's ideas. Finally, the ideas generated by the McNary study (see next section) are also good general guidelines for applying Deming system of profound knowledge.

5. The McNary Study

McNary (1997) did a study to see if there was a definite managerial profile among managers that claimed to be "pro-Deming." She did this by devising a two part instrument. The first part was an inventory of ten items based on the Deming system of profound knowledge. Each item had two descriptions of managerial practices, one at either end of a ten-point scale: at the "zero" end the description was for "standard managerial leadership practice" and at the "ten" end the description was for a practice that was "ideal from the system of profound knowledge." For example, the first item, based on the "psychology" element, was: With respect to employees, I believe in:

- Fostering motivation through rewards and punishment (at the "zero" end of the scale).
- Fostering motivation through pride and satisfaction in work (at the "ten" end of the scale).

The second part of the instrument was three questions:

- 1a. Do you consider yourself a manger who understands Dr. W. Edwards Deming's "System of Profound Knowledge"?
- 1b. Do you consider yourself a manger who understands Dr. W. Edwards Deming's "14 Points"?
- 2a. If you answered "Yes" to either part of Question 1, do you feel that you also practice the management theory of Dr. W. Edwards Deming?

The instrument was sent to 450 subjects, 225 from a random sample of the American Society for Quality Control (ASQC)[10] and 225 from a similar sample of the Academy of Management (AoM). This provided an overall sample of both practitioners and theoreticians. The overall response rate was 66.88 percent. Based on a cluster analysis of the responses, three groups were identified: (1) Deming managers, (2) not sure managers, and (3) non-Deming (or "traditional") managers. From this data three criteria were used to identify *true* Deming managers (called "pro-Deming") and *true* non-Deming managers (called "anti-Deming). The pro-Deming was a subject who came from group (1) and answered questions 1b and 2 "yes." The anti-Deming was a subject who came from group (3) and answered questions 1b "yes" but question 2 "no." The means and standard deviations for the responses of these subjects on the ten items were then calculated. As stated by McNary:

> A sample of 72 cases revealed that the pro-Deming managers had a grand mean [average for all ten items] of 8.824 with an average standard deviation of 1.36 compared to the grand mean of the anti-Deming at 4.825 with an average standard deviation of 2.3452. (p. 234)

In other words, there was a significant difference (as verified with an F-test for each item) between the two groups. According to McNary, this study reveals "a new managerial leadership profile which has the potential to transform organizational USA" (p. 235). To more fully appreciate the basis of this statement

10) Now the American Society for Quality (ASQ).

Appendix C is a listing of ideas embodied in the "Deming manager" side of inventory which represent the application of the Deming system of profound knowledge by the truly transformational leader. The element(s) that each idea was based on are also shown. As mentioned, these ideas can also help managers to apply Deming's system of profound knowledge.

6. Going Beyond the System of Profound Knowledge

In section 2 of this paper (about Deming), I mentioned the NBC produced TV program that, almost overnight, made Deming famous in America. I also talked about Clare Crawford-Mason who was a co-producer of that program. In 1997 she gave a very interesting speech to the W. Edwards Deming Institute[11]. Citing the work of three "20th Century thinkers," Crawford-Mason suggests that we can build on the ideas embodied in Deming's system of profound knowledge and come up with a system of "profound conscientiousness." This system draws on the ideas of Teilhard de Chardin, a French Jesuit and anthropologist; Georg Gurdjieff, a Turkish-Armenian teacher; and P. E. Ouspensky, a Russian mathematician; to wit:

- Teilhard's ideas of the continuing improvement in human conscientiousness and how this might help groups to work more as "one" versus as "individuals."
- Gurdjieff's system for understanding yourself and others called the Enneagram.
- Ouspensky's prediction that there is a higher level of logic than what we normally work with (conventional logic).

Regarding this higher level of logic, in her presentation, Crawford-Mason

11) Located in Potomac, MD, the Deming Institute's aim is "to foster understanding of The Deming System of Profound Knowledge to advance commerce, prosperity and peace."

makes the following contrast with conventional logic:

Conventional logic is:	linear	Higher logic is:	non-linear
	quantitative		qualitative
	static		dynamic
	fragmented		holistic

Deming's system of profound knowledge is an application of this higher logic. For example, as quoted in Crawford-Mason (1997), Deming's assertion that "the most important numbers being [those that are] unknown and unknowable" represents the *qualitative* aspect of his system and the idea of "variation in everything" the *dynamic* aspect.

Deming's system, as a whole, also represents another important concept, according to Crawford-Mason: *convergent integration.* Convergent integration is the idea that the whole is greater than the sum of its parts (synergy, if you will). And, Deming, by cleverly integrating the four elements into his system of profound knowledge, was employing convergent integration. Furthermore, his emphasis on a group working together to achieve a common aim is another example of his "convergent integration" thinking. A well led orchestra, is a good example to show how the outcome can be much more than the sum of the parts[12]. Note the modifier "well led"; without that leadership the parts will continue to simply add up to their sum or, more likely, due to cross purposes, add up to *less* than their sum. It is the leader who must ensure, as we've already discussed, everyone is working together towards the organization's goals. This means, as stated in the Crawford-Mason presentation: having caused "a reversal within the organization that transformed conflict into complementarily." This is what Deming means by his Point 9: *Break down barriers between departments.* Deming also advocates management and labor working together.

According to Crawford-Mason, there should be no reason to stop there and,

12) This was one of Deming's favorite examples of a system.

based on the work of Ouspensky, Gurdjieff, and Teilhard, Deming's ideas can be expanded to include not only removing organizational barriers (e.g., people working at cross purposes) but also barriers at the relational level (between persons) and, even, at the personal level (within individuals). Indeed, Gurdjieff's Enneagram is meant to help individuals better understand "conflicting internal agendas and personalities" and bring these into harmony for a happier and more productive life. At the relational level the same ideas would apply with tremendous implications for improving teamwork and problem-solving. Imagine a group so focused on its goal that there are no "biases, unnecessary speculations, and personal agendas" (Crawford-Mason, 1997).

In its ultimate form, Crawford-Mason sees this integration of Deming's profound knowledge with the thinking of the other three evolving into something she calls *profound conscientiousness*. Here the ideas of higher logic, convergent integration and inner harmony are systematically used for the "continuing improvement of people." The results could be momentous indeed:

> Of course, the implications reach far beyond the business world. We are talking about the next step in evolution and also saying that consciousness has potential control over its own success. [Operating this way] ... a group of people who have been able to achieve unified presence [inner harmony] and are practicing Deming's logic would be able to, again and again, predictably produce results greater than the sum of their parts. *Results that most of us can hardly imagine* [emphasis added]. (Crawford-Mason, 1997)

To give us some idea of just how much potential we have, at the end of her presentation, Crawford-Mason uses the metaphors of riding a bicycle or driving a car. We can't describe or even comprehend how we do these marvelous things, we only know they're possible. Such suggests that there is indeed an invisible world waiting to be discovered — that "higher logic" world — and Deming has begun that discovery with his system of profound knowledge. Crawford-Mason

and her collaborators are working on a book to further explicate the ideas of profound conscientiousness in a way that they might be employed practically[13].

7. Critique of the System of Profound Knowledge

Perhaps the biggest problem with Deming's system of profound knowledge is fully understanding it. Even where it is supposedly best explained, in Deming's book *The New Economics*, I found a lot of vagueness. Especially I found this to be true in the explanation of the "knowledge" element. Although Deming gives several examples in attempting to clarify this element, none of them are comprehensive enough to give the reader a good idea of how to apply the element in a real-world situation. It is only when the plan-do-study-act (PDSA) cycle is introduced in a later chapter that one gets a feel for how knowledge might be systematically developed.

I also thought Deming should have discussed more about how the four elements combine to form his system. His discussion seemed too piecemeal.

Furthermore, there seems to be no good mapping by Deming of the system of profound knowledge to his 14 Points. In fact, as the above discussion in section 4 reveals, there seems to be a lot of overlap between the two. It would be nice if a Deming scholar would take all of Deming's ideas and try to place them into a coherent whole. That is, take each of the four elements of the system of profound knowledge and show specific guidelines for its applications including applicable points from the 14 Points and the PDSA cycle. Such an effort should also indicate just exactly how each element contributes to an important "whole" management theory; that is, the system of profound knowledge.

The implications of what has just been written is that to fully appreciate and

13) As of this writing (October, 2000), the book apparently has not been published. I checked both the Amazon.com and Barnes and Nobel web sites. The person writing the book is Jefferson Vander Wolk.

be able to use Deming's ideas probably takes some time and study. Even Deming, according to Crawford-Mason (1997), said "it took three exposures for anyone to begin to understand his ideas." Just how much of this problem is related to the vagueness of Deming's explanations versus the esoteric nature of what is being explained is an open question. I believe the sincere manager will begin using Deming's ideas immediately and, as he or she continues to study these ideas and gains more experience with their use, gradually will be better able to employ them. In this regard, the comments at the end of section 4 of this paper are germane. A lot of what Deming says in not "rocket science" but to fully benefit from all of his "profound" thinking one must see it as a "never ending journey" of study and learning by doing.

8. Conclusion

The purpose of this paper has been to describe, in relatively simple terms, Deming's system of profound knowledge. Composed of four interrelated elements — appreciation for a system, knowledge about variation, theory of knowledge, and psychology — the system holds the promise for better management by those who truly embrace and follow its guidelines. Granted it is not always easy to fully appreciate what Deming is trying to convey but, by applying what one *can* understand and continuing to study the system, an organization can only get better; and, sometimes, *a lot* better.

The recent study by McNary shows that there is a definite profile for mangers who believe in Deming's way of managing. Such a profile might prove very useful in hiring and/or evaluating mangers.

That Deming may have been on to something really profound is suggested by Crawford-Mason. By combing Deming's profound knowledge thinking with that of Teilhard, Gurdjieff, and Ouspensky, Crawford-Mason believes it is possible to move our thinking into a higher plane that will help remove "cross purposes" not

only within organizations but at the "individual-to-individual" and "within the individual" levels. Such a breakthrough has implications for tapping human potential in the pursuit of not only more productive organizations but improving the human condition everywhere.

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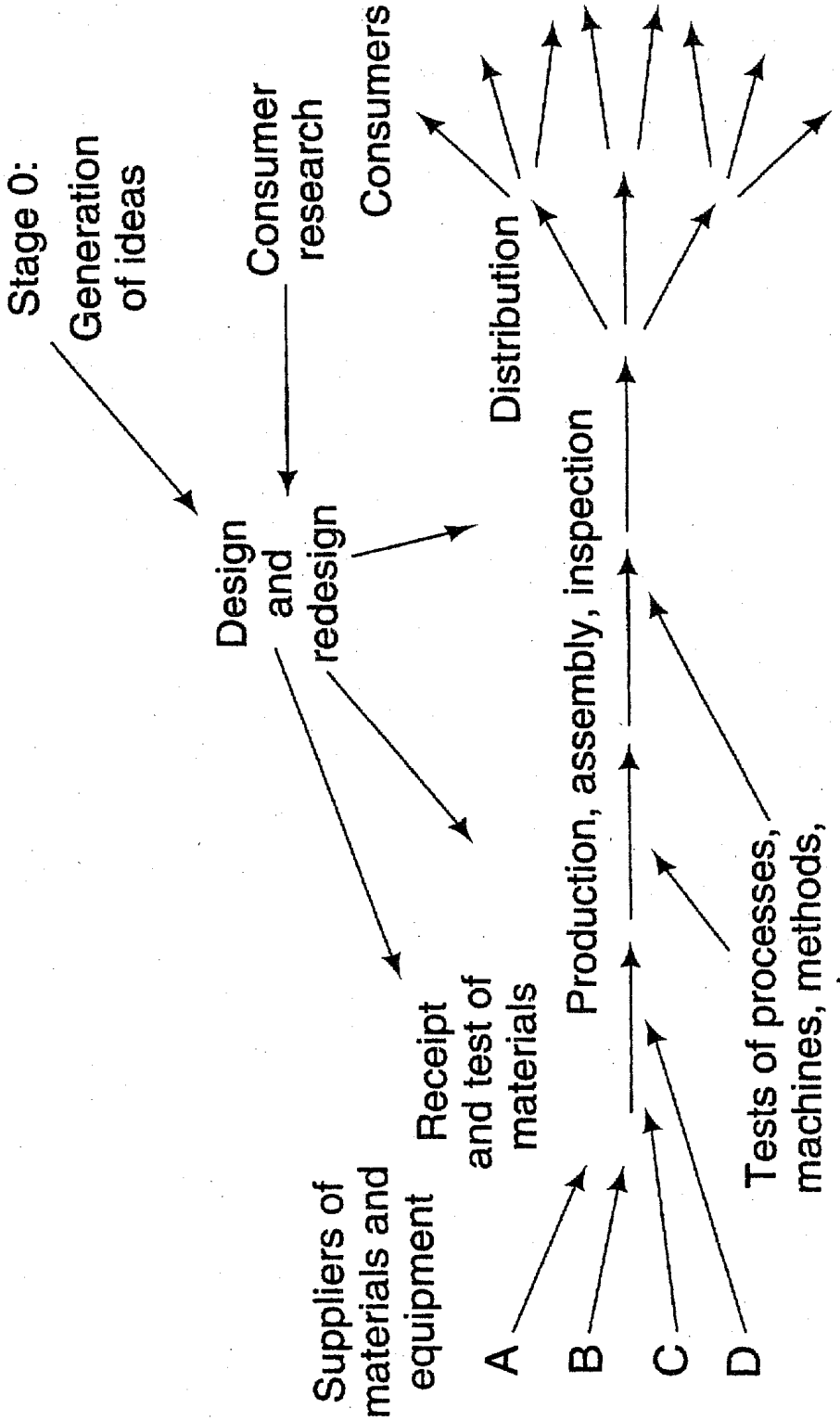
APPENDIX A

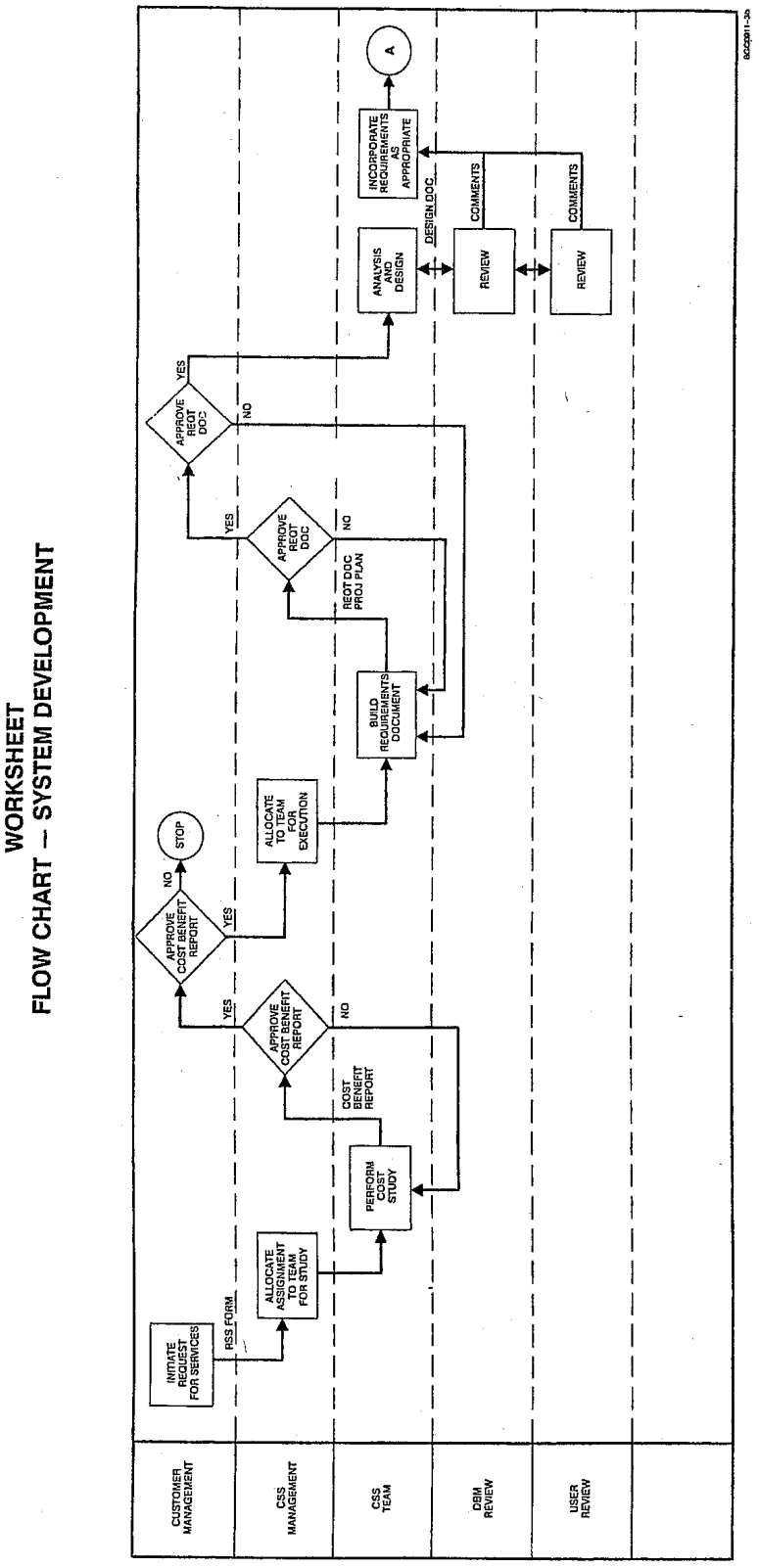
PRODUCTION VIEWED AS A SYSTEM

(Deming, 1994, page 58)



APPENDIX B - page 1 of 2

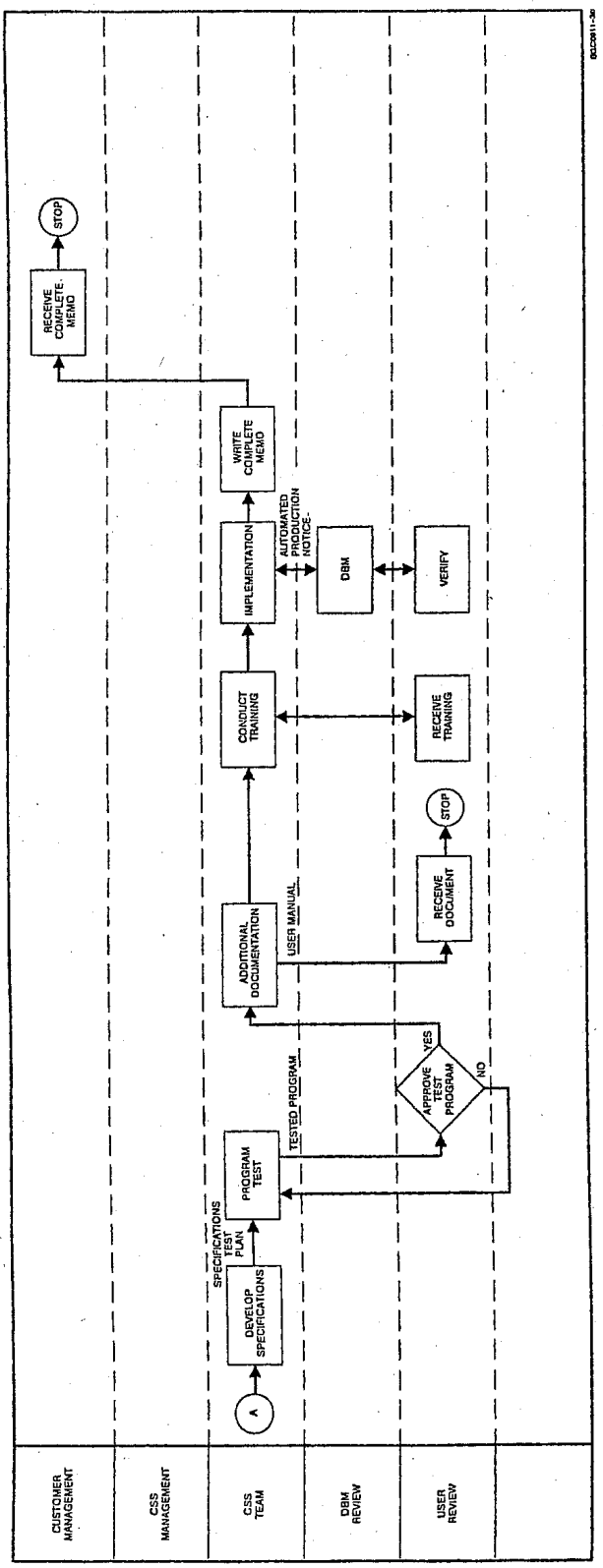
FLOW CHART EXAMPLE



APPENDIX B (continued) - page 2 of 2

FLOW CHART EXAMPLE

WORKSHEET
FLOW CHART — SYSTEM DEVELOPMENT



APPENDIX C

IDEAS FOR APPLYING DEMING'S SYSTEM OF PROFOUND KNOWLEDGE BY THE TRULY TRANSFORMATIONAL LEADER

(McNary., 1997, page 235)

Ideas For Applying Deming's System of Profound Knowledge	PK Element(s) Upon Which Idea Based*
1. Foster the intrinsic motivation of employees through pride and satisfaction in work.	P
2. Manage for the long-term by expanding the market for all.	S, V
3. Use statistical or analytical thinking in making organizational decisions by focusing on system processes to get results with an emphasis on improvement and innovation.	V, K
4. Manage with an emphasis on customer-supplier relationships, rather than the traditional hierarchical organizational chart.	S
5. Optimize the system of interdependent components through co-operation to foster organizational success.	S
6. Manage employees through informal feedback and coaching.	P
7. Base organizational decisions on operational definitions, visible figures and consider the effect of "invisible" factors which are unknown and unknowable but have an effect (e.g., employee morale).	K, V
8. Optimization of the system within an organization—move the organization towards its aim—is the responsibility of management.	S
9. Prediction is the ultimate job of management, and the concept of variation as it affects system processes and people and the interaction between them within the organization can assist management.	V, K, P
10. The concepts of management (i.e., running the organization through administrative tools) and leadership (i.e., directing the organization's mission and vision) should not be separated in organizational practice.	Interdependency of all components (elements)

*S = system, V = variation, K = knowledge, P = psychology.