Figure 11.10b. PROCESS IMPROVEMENT STRATEGIES: The Deming Philosophy

EM9036: ***Actionline*, August, 1990, pages 20-24.**

A System of Profound Knowledge

By Dr. W. Edwards Deming

The following article is Deming's personal philosophy of profound knowledge – an involving four-part system that he feels should be a fundamental concept in management.

Deming's four areas of profound knowledge are:

1. Appreciation for a system.
2. Theory of variation (statistical theory).
3. Theory of knowledge.
4. Psychology.

One need not be eminent in any part of profound knowledge in order to understand it as a system, and to apply it. The 14 points for management in industry, education and government follow naturally as application of the profound knowledge system for transforming the prevailing style of management to one of optimization – accomplishing an aim so everybody gains.

The various segments of profound knowedge cannot be separated. They interact with each other. Thus, knowledge of psychology is incomplete without knowledge of variation. If psychologists understood variation, they could no longer participate in continual refinements of instruments for rating people.

A manager, in the role of leader of people, must have some knowledge of variation and of psychology.

Managing a system is action based on prediction. Rational prediction requires systematic learning and comparing predictions of short-term and long-term results from possible alternative courses of action.

Theory of variation can play a vital part in optimizing a system. Statistical theory is helpful for understanding differences between people and the systems they work in.

Assistance to systematic learning is a specialty of the statistician. Statisticians that understand a system and optimize it, along with some theory of knowledge and something about psychology, could apply their specialized knowledge of variation toward continual improvement of methods for better prediction, and hence for better management. They could help people to retain their intrinsic motivation to learn. Statisticians that understand their unique role will no longer teach tests of significance, tests of hypothesis, chi-squared.

Statistical theory, used cautiously, with the theory of knowledge, can be useful in interpreting the results of tests and experiments, to understand cause-and-effect relationships. The interpretation of the results of tests and experiments is for future use: prediction.

If economists understood the theory of a system and the role of cooperation in optimization, they would no longer teach and preach salvation through adversarial competition. They would, instead, lead into optimization, in which everybody would come out ahead, including competitors.

Indeed, if any two or more companies or institutions put their heads together for uniform prices, they would be fools to set the price higher than what would optimize the whole system – they themselves, their customers, suppliers, employees and the communities their people work in.

The theory of knowledge helps us to understand that management in any form is prediction. The simplest plan – how will I go home tonight? – requires prediction that my automobile will start and run, or that the bus will come, or the train. Management acts on a causal system, and on changes in the causes.

What is a system?

A system is a series of functions or activities (subprocesses, stages – hereafter *components*) within an organization that work together for the aim of the organization. The mechanical and electrical parts that work together to make an automobile or a vacuum cleaner form a system. The schools of a city, including private schools, parochial schools and universities, provide an example of components that ought to work together as a system for education.

There is, in almost any system, interdependence among the components. The greater the interdependence among components, the greater the need for communication and cooperation among them.

The components need not all be clearly defined and documented: people may merely do what needs to be done. All the people that work within a system can contribute to improvement, and thus enhance their joy in work. Managing a system therefore requires knowledge of the interrelationships among all the components within the system and of the people that work in it.

The aim of the system must be clear to everyone in the system. Without an aim, there is no system. The aim is a value judgement.

The aim proposed here for any organization is for everybody to gain – stockholders, employees, suppliers, customers, community, the environment – over the long term. For example, with respect to employees, the aim might be to provide them good leadership, opportunities for training and education for further growth, plus other contributors to joy in work.

Deming's 14 Points

1. Create and publish to all employees a statement of the aims and purposes of the company or other other organization. The management must demonstrate constantly their commitment to this statement.
2. Learn the new philosophy, top management and the entire work force.
3. Understand the purpose of inspection, for improvement of processes and reduction of cost.
4. Cease doing business on price tag alone.
5. Improve constantly and forever the system of production and service.
6. Institute training and retraining of workers.
7. Teach and institute leadership.
8. Drive out fear. Create trust. Create a climate for innovation.
9. Optimize, toward the aims and purposes of the company, the efforts of teams, groups, staff areas.
10. Eliminate slogans, exhortations and targets for the work force.
11. Eliminate numerical quotas.
12. Give people a chance to take pride in their work.
13. Encourage education and self-improvement for everyone.
14. Do it!

Optimization

As previously mentioned, optimization means accomplishment of the aim, so that everyone can benefit in the system. Failure to optimize (suboptimization) causes loss to everybody in the system.

For optimization, a system must be managed. Management's responsibility is to strive toward optimization of the system, and to keep it optimized over time. An additional responsibility of management is to be ready to change the boundary of the system to better serve the aim.

(*continued overleaf*)

If the aim, size or boundary of the organization changes, then the functions of the components will change for optimization of the new system. Time will bring changes that must be managed to achieve optimization.

Growth in size and complexity of a system, and rapid changes with time, may require overall management's efforts to control the components. The number of people in top and upper management for this purpose should be kept minimal.

The components of a system could, in principle and under stable conditions, manage themselves to accomplish their aim. A possible example is a four-piece string quartet. Each member supports the other three. None of them is there to attract individual attention Four simultaneous solos do not make a string quartet. They practise, singly and together, to accomplish their aim. Their aim is challenge for self-satisfaction, and to provide pleasure to listeners.

Any system needs guidance from the outside. The four-piece string quartet mentioned above may well study under a master. The master need not be present at a performance.

A large organization will require someone in the position of aid to the president to teach and facilitate profound knowledge.

A flow diagram is helpful toward understanding a system. By understanding a system, one may be able to trace the consequences of a proposed change.

An example of a system, well optimized, is a good orchestra. The players are not there to play solos as prima donnas, to catch the ear of the listener. They are there to support each other. They need not be the best players in the country.

A business is not merely an organization chart, all departments striving for individual goals (sales, profit, productivity). It is a network of people, materials, methods, equipment, all working in support of each other for the common aim.

A system of schools (public schools, private schools, parochial schools, trade schools, for example) is not merely pupils, teachers, school boards and parents. It should be, instead, a component in a system of education in which pupils from toddlers on up take joy in learning, free from fear of grades and gold stars, and in which teachers take joy in their work, free from fear of ranking. It would be a system that recognizes differences among pupils and differences among teachers.

The performance of any component is to be judged in terms of its contribution to the aim of the system, not for its individual production or profit, nor for any other competitive measure. Some components may operate at a loss to themselves, for optimization of the whole system, including the components that take a loss.

It would be poor management, for example, to purchase materials and service at lowest price, or to maximize sales, or to minimize cost of manufacture or to minimize cost of incoming suppliers, without taking into account the effect on other stages of production and sales.

It would be poor management to save money on travelling expenses without regard to the physical wellness of the travellers. For example, it would be bad management to save $138 on a night rate for transportation, which would force the traveller to be up most of the night to take advantage of the reduced rate, but unfit for duty next day (actual example). It might be better for the travel department to ensure, at whatever cost, that the traveller arrives alert and well.

Any system that results in a win-lose structure is suboptimized.

Optimizing a system should be the basis for negotiation between any two people, between divisions, between union and management, between competitors, between countries. Everybody would gain.

A business is not merely an organization chart, all departments striving for individual goals (sales, profit, productivity). It is a network of people, materials, methods, equipment, all working in support of each other for the common aim.

Examples of suboptimization in the management of people, causing losses unknown and unknowable:

- The merit system (actually destroyer of intrinsic motivation. Emphasis is on rank, not on the work).
- Grading in school, from toddlers on up through the university.
- MBO (management by objective) and MBIR (management by imposition of results).
- Incentive pay.
- Business plans, each division with its own business plan, not coordinated towards an aim.
- Work standards for production; quotas for sales. Quotas for accidents and breakdowns.
- Competition for share of market.
- Barriers to trade.
- Anybody, team, division, establishment (management, union) gouging the other in negotiation.

Fortunately, precise optimization is not necessary. One need only to come close to optimization. As a matter of fact, precise optimization would be difficult to define. The loss function of customers will apply (as emphasized by Tenichi Taguchi). The loss function to customers will be at the bottom (minimum loss) a parabola. Curve and horizontal tangent are for practical purposes coincident over a short range. One may move away a short distance along the curve in either direction from the optimum, but rise only an imperceptible distance.

Theory of variation (statistical theory)

1. Some understanding of variation, including appreciation of a stable system, and some understanding of special causes and common causes of variation, is essential for managing a system, including leading people.
2. Variation there will always be, between people, in output, in service, in product. What is the variation trying to tell us about a process, and about the people that work in it?
3. Understanding of the capability of a process. When do data indicate that a process is stable? The distribution of the output of a stable system is predictable with a high degree of belief. A process that is stable, in the state of statistical control, has a definable capability.
4. The leadership of people (manager, leader, supervisor, teacher) is entirely different in the two states, stable and unstable. Confusion between the two states leads to calamity.
5. Knowledge about the different sources of uncertainty in the system of measurement. Is the system of measurement stable, in statistical control?
6. There are two mistakes in attempts to improve a process, both costly:

   Mistake 1. To treat as a special cause any outcome, any fault, complaint, mistake, breakdown, accident, shorage, when actually it came from common causes (tampering).

   Mistake 2. To attribute to common causes any outcome, any fault, complaint, mistake, breakdown, accident, shortage, when actually it came from a special cause.
7. Knowledge of procedures aimed at minimum economic loss from these two mistakes (Shewhart control charts).
8. Knowledge about interaction of forces. Interaction may reinforce efforts, or it may nullify efforts. Effect of the system on the performance of people. Knowledge of dependence and interdependence among people, groups, divisions, companies, and countries.
9. Understanding of the distinction between enumerative studies and analytic problems. An enumerative study produces information about a frame. The theory of sampling and design of experi-

(*continued*)

Figure 11.10b. PROCESS IMPROVEMENT STRATEGIES: The Deming Phil... (continued 1)

9. ments are for enumerative studies. The U.S. Census is an enumerative study. Another example is a shipload of iron ore. Buyer and seller need to know how much iron is in the ore on board. The interpretation of results of a test or experiment is something else. It is prediction that a specific change in a process or procedure will be a wise choice, or that no change would be better. Either way, the choice is prediction. This is known as an analytic problem.
10. Knowledge about loss functions in relation to optimization of performance of a system. Which quality characteristic has the steepest loss function and is, hence, most critical for management to work on?
11. Knowledge about the losses that come from unfortunate successive application of random forces or random changes that may individually be unimportant. Examples:
    - Worker training worker in succession.
    - Executives working with best efforts on policy, but without guidance of profound knowledge.
    - Committees, in industry, education and government, working without guidance of profound knowledge.
12. Enlargement of a committee does not necessarily improve the results of the efforts of the committee. Enlargement of a committee is not a way to acquire profound knowledge. Corollaries of this theorem are frightening.
13. As a good rule, profound knowledge must come from the outside and by invitation. Profound knowledge cannot be forced on to anybody.

Theory of knowledge

1. Any rational plan, however simple, requires prediction concerning conditions, behaviour, comparison of performance of each of two procedures or materials.

   For example, how will I go home this evening? I predict that my automobile will start up and run satisfactorily, and I plan accordingly. Or I predict that the bus will come, or the train.

   Or, I will continue to use Method A, and not change to Method B because, at this moment, evidence that Method B will be dependably better in the future is not convincing.
2. A statement devoid of prediction or explanation of past events is no help in managing a system.
3. Without theory, there is nothing to modify or to learn by comparison with experience.
4. Interpretation of data from a test or experiment is prediction – what will happen on application of the conclusions or recommendations that are drawn from a test or experiment? This prediction will depend largely on knowledge of the subject matter. It is only in the state of statistical control that statistical theory aids prediction.
5. An example is no help in management unless studied with the aid of theory. To copy an example of success, without understanding it with the aid of theory, may lead to disaster.
6. Communication and negotiation (as between customer and supplier, between management and union, between countries) requires, for optimization, operational definitions.
7. No number of examples establishes a theory, yet a single unexplained failure of a theory requires modification or even abandonment of the theory.
8. There is no true value of any characteristic, state, or condition that is defined in terms of measurement or observation. Change of procedure for measurement or observation produces a new number.
9. There is no such thing as a fact concerning an empirical observation. Any two people may have different ideas about what is important to know about any event.

Knowledge of psychology

1. Psychology helps us to understand people, interactions between people and circumstances, interaction between teacher and pupil, interactions between a leader and his people and any system of management.
2. People are different from one another. A leader must be aware of these differences, and use them to optimize everybody's abilities and inclinations. Management of industry, education and government operate today under the supposition that all people are alike.
3. People learn in different ways, and at different speeds. Some learn best by reading, some by listening, some by watching pictures, still or moving, some by watching someone do it.
4. A leader, by virtue of his authority, has obligation to make changes in the system of management that will bring improvement.
5. There is intrinsic motivation, extrinsic motivation and overjustification.

   People are born with a need for relationships with other people, and with need to be loved and esteemed by others. There is an innate need for self-esteem and respect.

   Circumstances provide some people with dignity and self-esteem. Circumstances deny other people these advantages.

   Management that denies to their employees dignity and self-esteem will smother intrinsic motivation.

   Some extrinsic motivators rob employployees of dignity and of self-esteem. If, for higher pay or for higher rating, I do what I know to be wrong, I am robbed of dignity and self-esteem.

No one, child or other, can enjoy learning if he must constantly be concerned about grading and gold stars for his performance, or about rating on the job. Our educational system would be improved immeasurably by abolishing the grading system.

One is born with a natural inclination to learn and to be innovative. One inherits a right to enjoy his work. Psychology helps us to nurture and preserve these positive innate attributes of people.

Extrinsic motivation is submission to external forces that neutralize intrinsic motivation. Pay is not a motivator. Under extrinsic motivation, learning and joy in learning in school are submerged in order to capture top grades. On the job, joy in work, and innovation, become secondary to a good rating. Under extrinsic motivation, one is ruled by external forces. He tries to avoid punishment. He knows no joy in learning. Extrinsic motivation is a zero-defect mentality.

Removal of a demotivator does not create motivation.

Overjustification comes from faulty reward systems. Overjustification is resignation to outside forces. It could be monetary reward to somebody, or a prize, for an act or achievement that he did for sheer pleasure and self-satisfaction. The result of reward under these conditions is to throttle repetition: he will lose interest in such pursuits.

Monetary reward under such conditions is a way out for managers that do not understand how to manage intrinsic motivation. □

Deming, based in Washington, D.C., is a world-renowned quality expert who has been called the father of the third wave of the Industrial Revolution. A consultant for 40 years, he is credited with revolutionizing the Japanese manufacturing industry after World War II. He is the author of several books and 170 papers.

The article EM9036 reprinted in this Figure 11.10b is also used in Statistical Highlight #96.

(*continued overleaf*)

The foregoing three pages contain much to engage the reader; notable instances are reprinted below in the order they appear.

∗ *If psychologists understood variation, they could no longer participate in continual refinements of instruments for rating people.* (page 11.57)

∗ *A manager, in the role of leader of people, must have some knowledge of variation and of psychology.*

∗ *Managing a system is action based on prediction.*

∗ *Assistance to systematic learning is a specialty of the statistician.*

∗ *Statisticians that understand their unique role will no longer teach tests of significance, tests of hypothesis, chi-squared.*

∗ *If economists understood the theory of a system and the role of cooperation in optimization, they would no longer teach and preach salvation through adversarial competition.*

∗ *The theory of knowledge helps us to understand that management in any form is prediction.*

∗ *Management acts on a causal system, and on changes in the causes.*

∗ *A system is a series of functions or activities (subprocesses, stages – hereafter components) within an organization that work together for the aim of the organization.*

∗ *The greater the interdependence among components, the greater the need for communication and cooperation among them.*

∗ *The aim of the system must be clear to everyone in the system. Without an aim, there is no system. The aim is a value judgement.*

∗ *Management's responsibility is to strive toward optimization of the system, and to keep it optimized over time.*

∗ *Any system needs guidance from the outside.* (page 11.58)

∗ *The performance of any component is to be judged in terms of its contribution to the aim of the system, not for its individual production or profit, nor for any other competitive measure.*

∗ *Any system that results in a win-lose structure is suboptimized.*

∗ *Some understanding of variation, including appreciation of a stable system, and some understanding of special causes and common causes of variation, is essential for managing a system, including leading people.*

∗ *Understanding of the distinction between enumerative studies and analytic problems.*

∗ *Knowledge about the losses that come from unfortunate successive application of random forces or random changes that may individually be unimportant.* (page 11.59)

∗ *Enlargement of a committee does not necessarily improve the results of the efforts of the committee.*

∗ *It is only in the state of statistical control that statistical theory aids prediction.*

∗ *There is no true value of any characteristic, state, or condition that is defined in terms of measurement or observation.*

∗ *There is no such thing as a fact concerning an empirical observation.*

∗ *There is intrinsic motivation, extrinsic motivation and overjustification.*

∗ *Our educational system would be improved immeasurably by abolishing the grading system.*

∗ *Pay is not a motivator.*

∗ *Removal of a demotivator does not create motivation.*

It is curious that, in Point 1 in the middle column on the lower half of page 11.59 (and in three earlier places), Deming uses 'interaction' in its *non*-statistical sense. See also Statistical Highlight #91, pages HL91.14 and HL91.3.

There is a segment about Deming's quality improvement philosophy late in Program 18 of *Against All Odds: Inside Statistics*, titled *The Sample Mean and Control Charts*, which includes footage of Deming himself. His remarks in this segment are:

- *My aim is transformation of American style of management – it'll have to take place and companies that don't make the change in style will not be here in a few years.*
- *I told the Jananese that they would capture markets within five years the world over, that they would take their place along side the prosperous nations. They have done it! They have done it! I was the only man in Japan in 1950 that believed it but I believed it and I knew it – it has come about.*
- *And do you know that? Do you know that? On what basis do you know that? Why do you take the 50 per cent and do anything, why don't you put it in the waste basket where it belongs.*
- *Improved quality automatically improves productivity. You capture the market with lower price and better quality. You stay in business and you provide jobs. So simple.*

This 26-part video series is *Against All Odds* ∗ "Lost" Annenberg Series.

Deming's quality improvement philosophy (as described in Figures 11.10a, 11.10b and *Against All Odds* Program 18) and that of Philip Crosby described in *Quality Man* (see Figure 11.9a) make an interesting comparison.