

B4

WORKBOOK

DAYS 10–12 and OPTIONAL EXTRAS

DAY 10: A SYSTEM OF PROFOUND KNOWLEDGE, PARTS A AND B



**SECOND
PROJECT**

PART A: APPRECIATION FOR A SYSTEM

Pages 154–170 (Steps 2, 3 and 4 for Part A) come from Day 10 pages 3–19.



Step 2: Dr Deming's May 1990 version

1. What is a "System"?

A system is a network of functions or activities (sub-processes, stages—hereinafter components) within an organisation that work together for the aim of the organisation. The mechanical and electrical parts that work together to make an automobile or a vacuum-cleaner form a system. [I.e., you could substitute an "auto-mobile" or a "vacuum-cleaner" for the "organisation" in the first sentence and it's still true.] 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. [This last example is further developed at the top of page 162.]

(Remember, my writing that follows here focuses on what you might say to your interested friend:)

No messing about! We're straight in here with what I think may be the most important idea in all of Dr Deming's teaching. And it's not difficult—it's just different from the way that most people in management, or in government, or in any kind of authority, seem to think. The reason why I believe it's so important is that, when you come to some other things in Deming's teaching that you might initially think are kind of crazy, referring back to this concept soon starts helping you to see what he's driving at, and why. And all of a sudden it starts making a lot more sense. At least, that's what's been happening with me.

So this is about what Dr Deming (amongst others) refers to as a "system" and describes as a "network". To illustrate this, William W Scherkenbach (a Director in Ford of America) drew the picture on Day 9 page 9 and simply said: "This is what any organisation is!". Let's look at that page now. What do we see? Two things. Firstly, lots of boxes—representing the "components" of the system. Secondly, lots of lines joining the boxes—indicating that the components are somehow linked up with each other. Considering Deming's car and vacuum-cleaner illustrations, if any component fails or, at least, doesn't work as well as it should, that obstructs or even wholly prevents other components from doing what they're supposed to do—never mind how good they are. Thus the whole system either underperforms or stops working altogether. So that's simple enough.

Deming is mostly concerned though not with "mechanical and electrical parts" but with people. So then several, maybe all, of the "components" (represented by the boxes in Bill Scherkenbach's diagram) will be individuals or groups of people. Then what's the message from the diagram? Basically, it's just the same! What a person or group of people is able to do depends a great deal on what other people or groups do. And what other people or groups can do is greatly affected by what yet other people or groups do or have done.

I'd sum it up like this. "Conventional" management focuses on the boxes in that picture "in their own right". By contrast, Deming-guided management focuses on how the boxes are helped or hindered by each other—and that's the lines in the picture. As I said, it's not difficult—just different. But what a difference it makes!

(There will always be a little space left after each of Dr Deming's items for your notes—see the small print paragraph on the next page.)

This page comes from Day 10 page 4.

There is in almost any system interdependence between the components thereof. The greater the interdependence between components, the greater be the need for communication and cooperation between them. *[Here and elsewhere, note the implicit comparison between the vertical and horizontal concepts of an “organization chart”.]*

As you can see, after his initial “mechanical and electrical” illustrations, Deming is now immediately concentrating on human systems. The first sentence is already covered in what I wrote on the previous page. And surely it also follows that the more the people or groups depend upon each other for being able to do their jobs as well as possible, the greater is their need to be in touch with each other and to be willing and able to help each other.

(That’s the end of my sample commentaries for Part A. So over to you from now on. As discussed previously, use the blank space after each item for your reactions, comments, thoughts, questions, references to past experience, links with any of the 14 Points or Deadly Diseases, explanations for your friend—as you prefer. But don’t get carried away—keep an eye on the little clocks!)

The components need not all be clearly defined and documented: people may merely do what needs to be done. *[In other words, we should keep a sense of proportion between documentation as a real aid and documentation for documentation’s sake. I think that few people these days will disagree with that!]* All the people who work within a system can contribute to improvement, and thus enhance their joy in work. Management of a system therefore requires knowledge of the interrelationships between all the components within the system and of the people that work in it. *[Remember “all related to each other”? You’ll immediately see plenty of linkages here with Part D: Psychology.]*



This page comes from Day 10 page 5.

The aim of the system must be clear to everyone in the system. [What is the system for? What should it be attempting to do? For, without clarity on such matters, on what could decisions be sensibly based?] Without an aim, there is no system. [There couldn't be a system if neither management nor their staff really understand what they are supposed to be trying to do, nor why! On what could they "work together"?) The aim is a value-judgment. [I.e. the aim or purpose of the system is subjective. As Deming said at the 1990 presentation to senior executives: "The aim of a system is not a theorem: you don't derive it from axioms and corollaries." See Deming Speaks to European Executives, BDA Booklet A10 page 8 and DemDim page 265.]

[Notice the strong connection between "the aim" and "constancy of purpose", the latter being the main feature of the first of both the 14 Points and the Deadly Diseases.]

The aim proposed here for any organisation 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 for them good leadership, opportunities for training and education for further growth, plus other contributors to joy in work.

[Were I ever asked to select just part of one sentence from Dr Deming's writing, and paint it in big letters for all to see, it would be the opening words of this paragraph: "**The aim proposed here ... is for everybody to gain.**" It is one of those things from Deming that, at first glance, may seem hopelessly optimistic: "**everybody to gain**". But, if that in effect is **not** the aim of the system, why **should** those all-important "components" of the system—people—"work together" for achievement of whatever that other aim is? Would you, if you were going to lose out as a result?]

This page comes from Day 10 page 6.

2. Optimisation of a system

Optimisation means accomplishment of the aim: everybody to gain. *[Of course, this is unlikely to be possible in the short term. Deming is thinking long-term.]* Failure to optimise, suboptimisation, causes loss to everybody in the system. *[—again, in the long term. Some may gain in the short term, but if their main objective is to do so then optimisation and the resulting benefits to all will never happen. So even those who gain in the short term will gain less in the longer term than would otherwise have been possible—unless perhaps, as soon as they’ve made their short-term gain, they quickly move elsewhere to do the same again. Hence Deadly Disease 4 of “Management job-hopping” or, as Dr Deming more politely expressed it, “Mobility of management”.]*

For optimisation, a system must be managed. Management’s responsibility is to strive toward optimisation of the system, and to keep it optimised over time. An additional responsibility of management is to be ready to change the boundary of the system to better serve the aim. *[For example, it might be wise to include factors not previously taken into account when decision-making.]*



This page comes from Day 10 page 7.

If the aim, size, or boundary of the organisation changes, then the functions of the components will for optimisation of the new system *[need to]* change. Time will bring changes that must be managed to achieve optimisation. *[Two important points in one here which I'd combine by saying that optimisation cannot be static—it's dynamic.]*

Growth in size and complexity of a system, and rapid changes with time, may require overall management of efforts of components. The number of people in top and upper management for this purpose should be kept minimal. *[That might perhaps seem to be an unusual point. But surely there is need at the highest level for those concerned to work as "All One Team", particularly with something this major: the larger the number, the less feasible this becomes.]*

This page comes from Day 10 page 8.

The components of a system could in principle, under stable conditions, manage themselves to accomplish their aim. *[Clearly so if the components are human, but also more broadly in other well-designed systems.]* A possible example is a string quartet. Each of the four members 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. *[This was one of Deming's favourite illustrations—and indeed, who could argue against it? A larger version of the same idea appears at the top of page 161.]*

Any system needs guidance from outside. The string quartet mentioned above may well study under a master. The master need not be present at a performance. *[C.f. the final Obstacle to the Transformation on page 122. Dr Deming would often express this in such terms as: "Those within a system may understand everything there is to know about the system—except how to improve it."]*



This page comes from Day 10 page 9.

A large organisation will require someone in the position of aide to the president to teach and facilitate **Profound Knowledge**. [This was Bill Scherkenbach's role in the Ford Motor Company (remember, his was the "boxes and lines" diagram we discussed on page 154). Lloyd Nelson's role at Nashua was similar. In both cases, the "president" was the CEO: Don Petersen in Ford and Bill Conway in Nashua. Chapter 16 in Out of the Crisis is particularly helpful on this issue.]

A flow diagram [remember what he means by this term: the famous diagram on Day 9 page 2] is helpful toward understanding a system. By understanding a system, one may be able to trace the consequences of a proposed change. [—importantly including **negative** consequences that might otherwise be—and very often are—overlooked by enthusiasts for the proposed change.]

This page comes from Day 10 page 10.

An example of a system, well-optimised, 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.

[To illustrate, Dr Deming sometimes drew a little diagram like the following:



Low and high interdependence are respectively to the left and right. Paradoxically, a (ten-pin) bowling **team** can largely succeed through independent effort and brilliance of its players. An orchestra cannot: it needs a much higher degree of genuine teamwork. A business organisation needs even more.]

A business is not merely an organisation chart [of the conventional kind], 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.



This page comes from Day 10 page 11.

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 recognises *[and appreciates]* differences between pupils and differences between teachers. The reader, after study of the rest of this paper, might wish to try to construct a system of medical care. *[As you will surely remember, you used this suggestion in Day 9's Major Activity, and thus there is no need to comment on that here. So concentrate instead on the points Deming raises earlier in this item.]*

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. *[As we know, Deming sometimes spoke of the need for "transformation of management". This item is a good illustration of how necessary that is.]* Some components may operate at a loss to themselves *[from the viewpoint of the conventional style of management]* for optimisation of the whole system, including the components that take a loss. *[Think back to all that you learned in Major Activity 8–d.]*

This page comes from Day 10 page 12.

It would be poor management, for example, to purchase materials and service at lowest price, or to maximise sales, or to minimise cost of manufacture, or design of product or of service, or to minimise cost of incoming supplies, to the exclusion of 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 welfare of the travellers. For example, it would be bad management to save money 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. It might be better for the Travel Department to ensure, at whatever cost, that the traveller arrives alert and well. *[This stems from a particular experience which is related on DemDim page 354.]*



This page comes from Day 10 page 13.

Any system that results in a Win-Lose structure is suboptimised.

Optimisation of a system should be the basis for negotiation between any two people, between divisions, between union and management, between competitors, between countries. *[How sensible—yet how rare.]*
Everybody would gain.

This page comes from Day 10 page 14.

Some examples follow of suboptimisation in the management of people, causing losses unknown and unknowable: [You might find it useful to refer back to the “Optimise or maximise?” section beginning on “Preludes” page 5. Deming is simply pointing out here that these examples all indicate the existence of suboptimised rather than optimised systems. Thus they are all indicating that there is a better way.]

- 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), MBIR (management by imposition of results);
- Incentive pay;
- Business plans: each division with its own business plan, not coordinated toward an aim; [Don't just read the first two words here!]
- Work standards for production; quotas for sales; quotas for accidents and breakdowns; [If necessary, refer back to page 95 to remind yourself of more about what Deming meant by “work standards”.]
- Competition for share of market;
- Barriers to trade;
- Anybody, team, division, establishment (management, union), gouging the other in negotiation.

Fortunately, precise optimisation is not necessary. One need only come close to optimisation. As a matter of fact, the precise optimum would be difficult to define. The loss function will apply (as emphasised by Taguchi). The loss function will be at the bottom (minimum loss) a parabola. Curve and horizontal tangent are for practical purposes coincident over a short range. [You could look back at page 111 to remind yourself about the shape of the Taguchi loss function. The important sentence in this paragraph is the final one which now follows:] One may move away a short distance along the curve in either direction from the optimum, but rise only an imperceptible distance.

[It is interesting that the Taguchi loss function is introduced here in the “Appreciation for a System” part of the System of Profound Knowledge in this early version rather than in Part B: “Some Knowledge of Theory of Variation”, which is where you will find it in the 1992 version as used in DemDim Chapter 18. (See however Item 10 in Part B later today.) Placing it here in Part A to help in the interpretation of “optimisation of the system” strikes me as particularly appropriate. In The New Economics it is one of the topics that has been moved away from the main writing on the System of Profound Knowledge, in fact to Dr Deming’s final chapter: “Some Lessons in Variation”. This is an illustration of how Deming’s earlier writing that is being used here has some advantage in the way it is organised.]

There is, of course, no need to include in your comments the technical details of the Taguchi loss function: concentrate instead on what it teaches us.]



This page comes from Day 10 page 15.

That completes the items which Dr Deming included for Part A in his May 1990 version of the System of Profound Knowledge. There were rather more of them than for any of the other three parts. As mentioned earlier, that is why the relevant Activity (concerning links between Part A and the 14 Points and Deadly Diseases) is postponed to the beginning of this afternoon rather than being crammed into this morning. In all other cases, the similar Activity will conclude the relevant half-day.

Step 3: *DemDim* version

Now read through *DemDim* pages 264–270, revising your earlier comments and adding any new points below.

For your later reference (but not now!), the sections of *The New Economics* most relevant to Part A of the System of Profound Knowledge are Chapter 3 and pages 65–67[95–98] in Chapter 4.



(After the break, continue to Activity 10–a opposite.)

Activity 10-a (pages 167–170) comes from Day 10 pages 16–19.

Step 4:**ACTIVITY 10-a**

Now it's time to revisit the 14 Points and Deadly Diseases. **In light of your understanding of "Appreciation for a System", how important is it to adopt the Point or cure the Disease—and why?** You could refer back to *DemDim* Chapter 3 for fuller wordings of the Points and Diseases. Write in brief comments if you wish, but sometimes there may be no need. As implied earlier, you are not expected to always think of something new. If something new and important does occur to you, then fine! But, in many cases, what you have written concerning the 14 Points and Deadly Diseases in the First Project may well be directly relevant here also. You can use your completed copy of the table on page 149 to guide you on whether to look back. The relevant page numbers in the First Project are indicated throughout these Activities.

As mentioned on Day 9 page 27, in each case please put a number on a 0–5 scale in the box provided. Enter "5" if, from your understanding of "Appreciation for a System" (or whichever of the four parts you are working on), you feel it is *essential* to adopt the Point or cure the Disease. At the opposite extreme, you should enter "0" if you can see *no connection* between them. You may as well be honest—*I'm not there to check up on you!* Use "1", "2", "3" or "4" if your judgment lies between those two extremes. You might find it helpful to write a few words describing roughly what those intermediate numbers mean to you. These "ratings" of the connections as you see them will be used on our final day.

(You may find the brief discussion on Appendix page 39 to be helpful for this Activity.)

POINT 1. **Create constancy of purpose.** (pages 56–57)

POINT 2. **Adopt the new philosophy. We are in a new economic age, created in Japan.** (pages 58–59)

POINT 3. **Eliminate the need for mass inspection as a way to achieve quality.** (pages 60–61)

POINT 4. **End the practice of awarding business solely on the basis of price tag.** (pages 62–63)

POINT 5. Improve constantly and for ever the system. (pages 64–65)

POINT 6. Institute modern methods of training. (pages 66–67)

POINT 7. Adopt and institute leadership aimed at helping people to do a better job. (pages 70–71)

POINT 8. Encourage effective two-way communication and other means to drive out fear throughout the organisation. (pages 72–73)

POINT 9. Break down barriers between departments and staff areas. (pages 74–75)



POINT 10. Eliminate the use of slogans, posters, and exhortations. (pages 76–77)

POINT 11. Eliminate work standards that prescribe quotas for the workforce and numerical goals for people in management. (pages 78–79)

POINT 12. Remove the barriers that rob hourly workers, and people in management, of their right to pride of workmanship. (pages 80–81)

POINT 13. Institute a vigorous programme of education, and encourage self-improvement for everyone. (pages 82–83)

POINT 14. Clearly define top management's permanent commitment to ever-improving quality and productivity. (pages 84–85)



DISEASE 1. [The crippling disease is lack of constancy of purpose.](#) (pages 86–87)

DISEASE 2. [Short-term thinking defeats constancy of purpose.](#) (pages 88–89)

DISEASE 3. [The effects of performance appraisal are devastating.](#) (pages 90–91)

DISEASE 4. [Mobility of management causes instability.](#) (pages 92–93)

DISEASE 5. [One cannot be successful on visible figures alone.](#) (pages 94–95)



Continue at Step 1 of Part B on Day 10 page 20.

PART B: SOME KNOWLEDGE OF THEORY OF VARIATION (STATISTICAL THEORY)

Pages 171–183 (Steps 2, 3 and 4 for Part B) come from Day 10 pages 20–32.



Step 2: Dr Deming's May 1990 version

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 management of a system, including leadership of people.

(Again, the following thoughts are for your interested friend. Thus, clearly, some words and terms used here will need to be “translated”, which is why this commentary is relatively lengthy.)

I'll start by using some personal experience to illustrate a few of the words and terms that you will see here.

Long ago I was diagnosed as having high blood pressure, so was put on some appropriate medication and had to visit my doctor regularly for check-ups. However, being a statistician, I felt I should collect some data to find out how the medication was working, rather than simply waiting for the next check-up. Therefore I bought a blood-pressure monitor, kept a daily record of my blood pressures and pulse, and plotted the numbers on some simple charts. 35+ years later, I still do! I've learned a lot from doing so.

First, I found that my blood pressure varied quite a lot from day to day even when there seemed to be no reason for the changes: I felt the same, was doing the same kind of things, and took the readings at roughly the same time each day, etc. There were usually no trends or any kind of patterns apparent in the data: the numbers simply varied up and down, seemingly “at random”, over a certain range. A friend of mine refers to that kind of variation as “wibble-wobble”! I can't remember what that range was so long ago: nowadays my systolic blood pressure is almost always between 120 and 150.

Just now and again I get a value outside that range, usually on the high side. When that happens I can often understand a good reason for it, e.g. I'm particularly excited or stressed about something, or I'm suffering from some kind of bug. But occasionally, over the 30 and more years, I've started getting some high values that I can't explain, or even see a slow trend upwards. When that happens I've shown my doctor the graphs and she has changed my medication, and invariably that has brought the variation back to “wibble-wobble” again.

The “wibble-wobble” situation is what Deming refers to in this item as a “stable system”. There are bound to be some reasons for the ups and downs (else presumably the blood pressure would stay the same, day after day), but they are probably so many and various—and small—that nobody could identify their individual effects. These are what Deming calls “common” causes of variation: I've learned that every system has them. Causes of variation outside the usual range, or causes which actually change the behaviour of the variation from what it has been over recent readings, are what he calls “special” causes. Not all systems have them, and usually we prefer that they don't: for, without them, we can predict that the variation will continue to be very similar to what we've been seeing recently—and that's very useful in practice.

The reason why Deming says that understanding of such matters “is essential for management” is this: If the system is stable, i.e. the variation is just “wibble-wobble”, then relatively high or low values just cannot be “explained”—in particular, there is then no justification for blaming or indeed praising anybody for such values. It's the same kind of “random variation” as you get when throwing dice or shuffling and dealing playing cards. High or low is then just a matter of luck. Should you praise or blame people merely for being lucky or unlucky? I'd say you're a pretty lousy manager or leader if you do.

This page comes from part of Day 10 page 21.

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?

So we can never eliminate variation in what our processes produce. We can and should, of course, try to reduce it, particularly if the extent of the variation is really troublesome. But how do we set about that? It all depends on whether or not there are special causes affecting the results (remember, there are always common causes). If there are special causes then we need to identify them and deal with them appropriately. E.g., somebody might have been moved onto a particular job without the right kind of training: OK, then provide that training. But if the system is stable (and both theory and experience show that this is more often the case) then, as we now know, individual causes cannot be found: and, in particular, there is no justification for blaming anyone for the results that are being obtained. In this situation, results can only be improved if action is taken to improve the system within which the people are working. Such action is the responsibility of management, for the people working within that system have neither the opportunity nor the wherewithal (nor the authority) to do it themselves.

This page comes from Day 10 page 22.

(So, again, it's now over to you for reactions, comments, etc throughout Part B. Keep an eye on Step 2 in the guidance which was summarised on page 150.)

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.

*[How different, and how much more sensible, than traditional definitions of process capability that involve specifications. Deming is making the very simple point here that, when a process is in statistical control, the **control limits** indicate what it is capable of consistently producing.]*

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. *[Already touched upon, particularly near the end of what I have written for the first item—see the bottom of page 171.]*



This page comes from Day 10 page 23.

5. Knowledge about the different sources of uncertainty in the system of management. Is the system of measurement stable, in statistical control?

*[The quality of the **measurement process** itself seems to be too little considered by conventional statisticians, let alone non-statisticians. The numbers that are obtained using the measurement process are often never questioned. However, if you're wise, try carrying out repeated measurements of the same thing—e.g. the length of a piece of string (but at different times so that you don't remember what you got before)—you might surprise yourself! Or get some other people to take the measurements as well. This is even more important if that measurement process is likely to be employed under differing circumstances.]*

6. There are two kinds of 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, shortage, 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.

[This and the next item are, of course, very familiar to us from early in the course, including the fact that Mistake 1 is usually by far the more prevalent of the two.]

This page comes from Day 10 page 24.

7. Knowledge of procedures aimed at minimum economic loss from these two mistakes (Shewhart control charts). [See Appendix page 4.]

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 between people, groups, divisions, companies, countries.

*[Some clear connections with Appreciation for a System here, so why is “interaction of forces” in the “Understanding Variation” part? Working together as “All One Team” with common aims and purpose must reduce variation. The reverse statement is perhaps even more obvious: **failure** to work as All One Team is bound to **increase** variation. The analogy of a “tug of war” may be helpful for linking Parts A and B: a “tug of war” is obviously the direct opposite of “pulling together”, i.e. of “working together”, and results in unstable, unpredictable variation.]*



This page comes from Day 10 page 25.

9. [You will see some unfamiliar terms here. I'll briefly explain them in my comments below.] 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 experiments are for enumerative studies. Our Census is an enumerative study. Another example is a shipload of iron ore. Buyer and seller need to know how much iron is 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.

[If you're interested, there'll be plenty for you to read in time to come. See Chapter 7 of Deming's 1950 book: Some Theory of Sampling, and also his papers: "On a Classification of the Problems of Statistical Inference", "On the Distinction between Enumerative and Analytic Surveys", and "On Probability as a Basis for Action". The Deming Institute—www.deming.org—should be able to help you locate such papers.

It is worth pointing out that Deming's comment regarding "design of experiments" relates to traditional statistical methods. They can only have predictive power if similar circumstances prevail in the future to those in which the experiments were carried out. More enlightened approaches which include that vital matter can usefully contribute to analytic studies.

*The essential issues in this item were briefly alluded to in Obstacle 6 on page 117. I'll expand a little on them here. A "frame" is some finite collection or "population". Examples are suggested above by Dr Deming. Given the time and money, a frame can be 100% inspected, enabling complete information about that frame to be obtained (within the limits of our observational powers, etc). Traditional statistical techniques are concerned with sampling some **fraction** of the frame, and trying to infer what **would** have happened in the case of 100% inspection. In either case, the only concern is **what** is in the frame, not **why** it is there. The "**what**" is an enumerative problem; the "**why**" is an analytic problem.*

*Enumerative studies involve no temporal spread, i.e. no relevance over time except for the time during which the data were collected; in particular they imply no **predictive** ability. Yet sensible practical interest is surely on what is to come, not merely on what is past or present. In other words, most "real" problems are analytic, yet most statistical techniques are enumerative—the control chart being a notable exception.*

These matters are further discussed in Part C of the Optional Extras.]

This page comes from Day 10 page 26.

10. Knowledge about loss functions in relation to optimisation of performance of a system. Which quality-characteristic has the steepest loss function, and is hence most critical for management to work on? *[This is another neat link between the first two parts of the System of Profound Knowledge. As previously, refer back to the your work on the Taguchi loss function on and around page 111 if you need to.]*

11. Knowledge about the losses that come from unfortunate successive application of random forces or random changes that may individually be unimportant (exemplified in the Experiment with the Funnel).

Examples [all of Rule 4 of the Funnel]:

- 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.



This page comes from Day 10 page 27.

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. *[It certainly seems an unlikely way to improve understanding of variation! In any case, members of small committees are generally more able to “work together”.]*

Corollaries of this theorem are frightening.

[In later writing, Dr Deming remarks on the relevance of this comment to the fundamental plank of democracy: the popular vote. See also pages 16–17 in Deming Speaks to European Executives, BDA Booklet A10.]

13. As a good rule, Profound Knowledge must come from the outside, and by invitation. Profound Knowledge cannot be forced onto anybody. *[Note that this provides a strong link with the final member of the set of Obstacles (page 122).]*

[It is interesting that, both here and in The New Economics, this apparently very general point appears at the end of the section on Knowledge of Variation. Maybe this indicates Dr Deming’s feeling that it is in the matter of understanding variation that organisations need the greatest external help. Sadly, they will not get it from conventional statisticians. His final comment in the Knowledge of Variation section in Chapter 4 of The New Economics is “Again, a system can not understand itself. One may learn a lot about ice, yet know very little about water”. E.g. see Preludes page 18.]



This page comes from Day 10 page 28.

Step 3: *DemDim* version

Now read through *DemDim* pages 270–274, revising your earlier comments and adding new points below.

The section of *The New Economics* Chapter 4 relating to Part B is pages 67–69[98–101].
However, there is much more: indeed, all of the book's final four chapters (other than the additional final chapter in the Third Edition) are also immediately relevant.



(Continue to Activity 10–b overleaf.)

Activity 10-b (pages 180–183) comes from Day 10 pages 29–32.

Step 4:

ACTIVITY 10-b

As in Activity 10-a, but now in connection with Part B: “Some Knowledge of Theory of Variation”.

Incidentally, do not be surprised if, both here and in the similar Activities on Day 11, you find yourself coming up with some of the same thoughts and arguments as in previous Activities from within this project. This is, of course, a further indication of how the four parts of the System of Profound Knowledge are strongly interrelated.

(You may find the short discussion on Appendix pages 39–40 to be helpful.)

POINT 1. [Create constancy of purpose.](#) (pages 56–57)

POINT 2. [Adopt the new philosophy. We are in a new economic age, created in Japan.](#) (pages 58–59)

POINT 3. [Eliminate the need for mass inspection as a way to achieve quality.](#) (pages 60–61)

POINT 4. [End the practice of awarding business solely on the basis of price tag.](#) (pages 62–63)



POINT 5. Improve constantly and for ever the system. (pages 64–65)

POINT 6. Institute modern methods of training. (pages 66–67)

POINT 7. Adopt and institute leadership aimed at helping people to do a better job. (pages 70–71)

POINT 8. Encourage effective two-way communication and other means to drive out fear throughout the organisation. (pages 72–73)

POINT 9. Break down barriers between departments and staff areas. (pages 74–75)



POINT 10. Eliminate the use of slogans, posters, and exhortations. (pages 76–77)

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POINT 12. Remove the barriers that rob hourly workers, and people in management, of their right to pride of workmanship. (pages 80–81)

POINT 13. Institute a vigorous programme of education, and encourage self-improvement for everyone. (pages 82–83)

POINT 14. Clearly define top management's permanent commitment to ever-improving quality and productivity. (pages 84–85)



DISEASE 1. The crippling disease is lack of constancy of purpose. (pages 86–87)

DISEASE 2. Short-term thinking defeats constancy of purpose. (pages 88–89)

DISEASE 3. The effects of performance appraisal are devastating. (pages 90–91)

DISEASE 4. Mobility of management causes instability. (pages 92–93)

DISEASE 5. One cannot be successful on visible figures alone. (pages 94–95)



Continue on today's final page: Day 10 page 33.

DAY 11: A SYSTEM OF PROFOUND KNOWLEDGE, PARTS C AND D



**SECOND
PROJECT
CONTINUED**

PART C: THEORY OF KNOWLEDGE

Part C, Area 1: Prediction

Pages 186–189 (Steps 2 and 3 for Part C, Area 1) come from Day 11 pages 4–7.



Area 1, Step 2: Dr Deming's May 1990 version

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.

(As on Day 10, in the first two items here and opposite I will start by suggesting how you might explain these items to your interested friend. But then also keep an eye on your summary of the four-step procedure to guide you in making further notes on these topics.)

Part C starts out more straightforwardly than did Parts A and B. Any plan is surely resting on thin ice if it isn't founded on wise predictions! And this is clearly very pertinent to management. In fact, elsewhere (DemDim page 264) Deming stated more pointedly that "Management ... is action based on prediction". I'd certainly hope so! But how do people in management make their predictions? For a start, do they know anything about stable and unstable processes, common and special causes, interpreting a control chart? To put it mildly, that's all pretty relevant for figuring out what's predictable and what isn't! Or do they just depend on "experience" or citing examples of where "it worked before"? (See also Items 4 and 5 in Area 2.) Say I tossed a coin yesterday and it came down Heads. I now have some experience, I now have an example. Does it predict anything about what will happen if I toss the coin today?

So yes, of course, managers along with others need to predict successfully. But what do they know about how to do it? Deming's work can help them—a lot.

This page comes from Day 11 page 5.

2. A statement devoid of prediction or explanation of past events is no help in management of a system.

[We need to be careful about that word “explanation”: some people are skilled at finding a “reason” for anything! An observation from Dr Don Wheeler that I have often repeated is:

“Prediction requires knowledge; explanation does not.”

*Dr Deming was instead presumably referring to the kind of explanation that **does** require some knowledge! By the time of The New Economics (page 69[102]), he had avoided the problem by revising his wording to:*

“ ... a statement, if it conveys knowledge, predicts future outcome, with risk of being wrong, and ... fits without failure observations of the past.”

which is closer to the version you have already seen on Prelude C page 15.

*An important emphasis in the Theory of Knowledge part of The New Economics Chapter 4 (page 72 [106]) is that “information is not knowledge”. Indeed, a considerable part of Theory of Knowledge concerns how to **use** information to create and develop knowledge. Again you have had a good introduction to this in Prelude C.]*

Let's develop that important emphasis since it will add focus to this item. As soon as you think about it, it is obvious enough that information and knowledge are indeed different. Particularly because of ever-developing technology, information has mushroomed in recent decades. I do not believe that knowledge has increased at anything like the same rate. I'd say this suggests that not all of that information is being used very effectively to develop knowledge.

Dr Deming was particularly conscious of the difference between information and knowledge in the context of education. He spoke of it at the dedication of the Cedar Crest Academy, Washington in October 1985, referring in particular to an article titled “Why Johnny can't think” in Harper's Magazine (April 1985). Here are some brief extracts from his address:

“Johnny never had the chance to think. Children don't get a chance to think any more. Examinations are check-block [tick-box] systems. Children fill their heads with answers. If you have enough information in your head, you can mark the right answers, very simple. It is a labour-saver, because the teacher can tabulate in a flash the results of fifty pupils, bar diagram and comparisons. Neither the teacher or pupil need to think. All so simple. The Educational Testing Service grades applicants the same way; am I right?

Johnny with his head full of answers, like a dictionary, is not thinking. A dictionary is pretty important, of course. I use one frequently. But the dictionary can't think for me. The dictionary does not lay out a course of action for us. It does not contain knowledge. It contains words.

Marking the right blocks [ticking the right boxes] does not explain anything. They don't help Johnny to predict or explain what happened in the past. Science has advanced by explaining what happened in the past, as in geology, geometry, anthropology, geography, chemistry. Science is not a dictionary full of words, but is knowledge of the world, and this means temporal spread to explain what happened in the past, and what to predict in the future.^{4a}



This page comes from Day 11 page 6.

(Over to you now for your reactions, thoughts, comments for the rest of Part C.)

3. 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.

*[These last two sentences contain important emphases for statisticians in particular. Sometimes it seems that conventional statisticians act as if “knowledge of the subject-matter” should, on the contrary, be effectively **ignored** lest it bias or prejudice conclusions, i.e. as if conclusions should depend wholly on the data being analysed. Further, as regards the use of data for prediction purposes, we are again reminded that the essence of the difference between statistical control and the lack of it is respectively **predictability** and the lack of it.]*

If you are a statistician, you might prefer to remain unaware of the following paragraph! It is an extract from Chapter 7: “Management is Prediction” on page 263 of The Essential Deming^p. Here Deming was primarily (but not wholly) discussing the area in which he first became famous: sampling and survey analysis.

“The procedure of sampling, the construction of a satisfactory questionnaire, and the proper procedure for interviewing, all require thorough knowledge of the subject and of the difficulties that are to be met in carrying out the survey. That is why it has been stated that applied statistics is 90 percent knowledge of the subject-matter and only 10 percent statistics; it was Shewhart who first made this statement with regard to statistical work in engineering and manufacturing.”]



This page comes from Day 11 page 7.

Area 1, Step 3: *DemDim* version

Now briefly read through *DemDim* page 274, paragraph 1 to page 275, paragraph 4 again, revising your earlier comments if necessary and adding any further notes below.



Continue at Step 1 of Part C, Area 2 on Day 11 page 8.

Part C, Area 2: Theory and Learning

Pages 190–192 (Steps 2 and 3 for Part C, Area 2) come from Day 11 pages 10–12.

Area 2, Step 2: Dr Deming's May 1990 version

4. Without theory, there is nothing to modify or to learn by comparison with experience.

[In earlier versions, Dr Deming combined this with Item 5 and stated compactly that “Both experience and examples teach nothing without theory”. It is helpful to consider the PDSA Cycle in relation to all three items (4, 5 and 6) in this second area.

And don't be put off by that word “theory”. I'll reproduce here the whole of the quotation from Dem-Dim page 247 to which I referred earlier:

“A theory may be complex. It may be simple. It may only be a hunch, and the hunch may be wrong. We learn by acceptance, or by modification of our theory, or even by abandoning it and starting over.” (Also see Item 6 opposite.)

We are surely back to Shewhart's “dynamic scientific process of acquiring knowledge”.]

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.

*[Recall my warnings about case studies on the opening page of Day 6. Also, isn't it possible to find examples of success of just about **any** idea or proposal? The trouble is that you can often find examples of its failure as well. So where does that get us?]*

This page comes from Day 11 page 11.

6. No number of examples establishes a theory, yet a single unexplained failure of a theory requires modification or even abandonment of the theory.

[Doubtless, the people to whom Daniel Boorstin referred, relating to Pause For Thought 2-b, had countless examples to confirm that the Earth is flat]

(Continue to Area 2, Step 3 overleaf.)



This page comes from Day 11 page 12.

Area 2, Step 3: *DemDim* version

Now briefly read through *DemDim* pages 275–276, paragraphs 5 to 7 again, as usual revising your earlier comments if necessary and adding any further points below.

Continue at Step 1 of Part C, Area 3 on Day 11 page 13.



Part C, Area 3: Operational Definitions

Pages 193–200 come from Day 11 pages 14–21.



Area 3, Step 2: Dr Deming's May 1990 version

7. Communication and negotiation (as between customer and supplier, between management and union, between countries) require for optimisation operational definitions. [Otherwise there are bound to be misunderstandings and disputes.]

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. [—depending, of course, on the precision with which they are expressed.]

[Both Items 8 and 9 (overleaf) can seem very puzzling at first glance. I expect that might have been the case with you had you not recently read DemDim Chapter 7—for careful thought concerning operational definitions should help. Skim through some of Chapter 7 again if you need to.]

At least I can assure you that these versions of Items 8 and 9 are rather more helpful than when I first heard Dr Deming broach these matters. I remember the occasion well. He had the impression that the members of his audience were becoming a little inattentive and instead thinking too much about their forthcoming lunch. So he stared at them for a moment and then said: “There is no true value of anything” and, after a short pause: “There is no such thing as a fact”. He then walked off the stage in silence, leaving the audience (including me) looking somewhat dumbfounded. It had the desired effect: the conversations over lunch turned out to be rather more focused than they might have been otherwise. He was a great teacher!]



This page comes from Day 11 page 15.

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. [E.g. in obtaining some result, one person may be most concerned with how long it takes to obtain the result whereas another may be more interested in its precision.]

[Don't forget: an empirical observation depends on the operational definition by which it was obtained—and an operational definition is neither "right" nor "wrong". Of course, if no operational definition was in place on which to base the empirical observation, still less could it convey a "fact".

However, Deming's second sentence indicates that he is thinking in much broader terms than just this. That second sentence is obviously true. But why does it appear in the same item? What are the links between the two sentences?

*Many news bulletins report empirical observations on matters such as unemployment, inflation, growth, the stock market, the structural deficit, national debt, and so on. Yet what happens in interpretations by politicians? It often seems that an empirical observation provides ammunition for both those in government **and** those in opposition—because of entirely different "facts" concerning that observation! It is also very likely that the two parties may indeed "have different ideas about what is important to know about" the observation.*

It is worth pointing out that, at a trivial level, Deming's first sentence is not literally true. "We have just recorded the value 1.23" and "The value we have just obtained lies between 1.00 and 2.00" are facts—but such facts are mere information rather than knowledge (see Item 2). Deming was surely referring here to facts that might yield knowledge and aid better practice. An empirical observation cannot e.g. indicate whether the process from which it came is in or out of statistical control. So should we not question how important are our particular "empirical observations"? Further, a process can be in control with respect to some features but not others. So the choice of quantity to record and chart is also of consequence.

Would you trust apparently important "facts" deduced from unimportant or inappropriate data? I fear that many do.]



This page comes from Day 11 page 16.

Area 3, Step 3: *DemDim* version

And so, finally with Area 3, read through paragraphs 8–10 on *DemDim* page 276 again, revising your earlier comments and adding any new points below.



(Continue to the complete version of Step 3 overleaf.)

This page comes from Day 11 page 17.

Step 3 (complete): *DemDim* version

As you know, the complete *DemDim* version of Part C is on pages 274–276. So read through those three pages one more time (jotting down any final notes and revisions) to bring together all three areas into your mind before proceeding to Activity 11–a.

For your future reference, the section of Chapter 4 in *The New Economics* which relates to Part C runs from the middle of page 69[bottom of page 101] to page 73[107].



(Now, to complete your study of Area C, move on to Activity 11–a opposite.)

Activity 11-a (pages 197–200) comes from Day 11 pages 18–21.

Step 4:**ACTIVITY 11-a**

This Activity is as those on Day 10, but now in connection with Part C: “Theory of Knowledge” (check back to page 167 if need be). However, here I would recommend a widening of emphasis. Most of the System of Profound Knowledge is concerned with *why* things should be done or not done. But parts of the Theory of Knowledge are more about *how* to do things rather than *why* they should be done. As an example, the PDSA Cycle is concerned with *how* to learn and to improve rather than to *why* we should try.

Therefore, in this Activity, you could consider alternative questions linking into the Points and Diseases, e.g. how important is it to *apply* the Theory of Knowledge if we are to adopt this Point or to cure this Disease effectively?—i.e. the opposite kind of link compared with those usually considered so far. But a link is a link, in whichever direction it goes! So, in each case, allocate your 0–5 scores according to whichever kind of link strikes you as the more important and relevant.

(See Appendix page 41.)

POINT 1. [Create constancy of purpose.](#) (pages 56–57)

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DISEASE 4. [Mobility of management causes instability.](#) (pages 92–93)

DISEASE 5. [One cannot be successful on visible figures alone.](#) (pages 94–95)



After the break, continue at Step 1 of Part D on Day 11 page 22.

PART D: KNOWLEDGE OF PSYCHOLOGY

Workbook pages 201–214 (Steps 2, 3 and 4 for Part D) come from Day 11 pages 22–35.



Step 2: Dr Deming's May 1990 version

1. Psychology helps us to understand people, interactions between people and circumstances, interactions between teacher and pupil, interactions between a leader and his people and any system of management.

(As usual, I'll suggest a few possible thoughts for your interested friend:)

Like Part C, Part D starts off without anything controversial. Don't think that the only job of a psychologist is to help people who have "psychological problems". This is for you, this is for me, this is likely to be for most people that we know or with whom we have any contact. For whom might Dr Deming's teaching on Psychology be inappropriate? I suppose it could be for some who do have serious psychological problems. Using a couple of familiar adjectives, the latter need special care and consideration whereas the relevance of Deming's teaching is otherwise common to everybody.

Note also that, as you would expect, Deming concentrates in this opening statement on the interactions between people and all sorts of things—interactions: the big feature of systems. In terms of the "boxes and lines" diagram on Day 9 page 9, that diagram is too simple. The boxes representing people should have many more lines attached to them.



This page comes from Day 11 page 23.

2. People are different from one another. A leader must be aware of these differences, and use them for optimisation of everybody's abilities and inclinations. Management of industry, education, and government operate today under the supposition that all people are alike.

Some care is needed in interpreting that first short sentence. A common reaction is: "Of course, people are different"—often intended pejoratively. But, in particular, I think we must beware of confusing perceived differences in effort and in natural ability.

Dr Deming's second sentence clarifies that he is thinking of the latter. Surely it is a fact of life that there are huge natural differences between people. Should we just rue that fact, thinking it makes management more difficult? It is surely more fruitful and profitable to regard the differences positively, realising that potential for progress is greatly enhanced by recognising and combining different abilities and talents in a cooperative environment. After all, "Variety is", as we pointed out long ago, "the spice of life".

Item 3 opposite is also highly relevant to this: "People learn in different ways". Of course that's true. The frightening thing is that the way those who are trying to learn are tested and examined often means they are being assessed inappropriately. They are being assessed more on how well or badly their natural tendencies happen to fit the teaching and examination methods than on how hard they've worked or on how good they might be at using the subject-matter.

Now look at the final sentence. I'm sure most managers would deny that they were managing under such a supposition. But isn't much of what they do only justifiable under such a supposition? Consider merit ranking, financial incentives, bonuses. Aren't these intended to both encourage and reward effort? But isn't it the truth that in practice they are often just as much, if not more so, a judgment on natural ability? What's the point of rating natural abilities where, as discussed in my second paragraph, the real gains are achievable by recognising and combining them?

Finally, isn't effort greatly dependent on the way an individual reacts to, and interacts with, the "system" within which he finds himself? It isn't at all uncommon to find that a person who produces little effort in one system (environment, culture, job, etc) nevertheless makes massive effort in another system—and it isn't just a case of whether he's paid more or has the greater pressure put on him. So really, isn't it the system that should be appraised rather than the individual? Considerations of intrinsic and extrinsic motivation, to be studied in Item 5 and onward, are also highly relevant here.

This page comes from Day 11 page 24.

(Now, for the final time, I hand over to you to write your thoughts and comments in the gaps provided, with the help of my guidance for Step 2 of the four-step procedure.)

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.

[Yet again we return to the issue of the major sources of difficulty and waste being the systems (common-cause variation) within which people work, rather than the people themselves (possibly part of special-cause variation). The responsibility for improvement therefore lies with those who have authority over systems, not with those who suffer from them. Implicit in the statement is the need for managers to improve their understanding and mode of leadership. There will be some important material on improving leadership in the morning of Day 12.]



This page comes from Day 11 page 25.

5. There is intrinsic motivation, extrinsic motivation, overjustification.

["There is" is a rather innocent beginning to this substantial section (which continues all the way through to page 209!). Dr Deming placed great value on a deep understanding of these three concepts.

*Intrinsic motivation for work (of any kind) is motivation coming "from within": i.e. one approaches the work with the desire to do a good job because of **wanting to**, because of job-satisfaction, because of interest and excitement in the task, because of desire to please the customer, indeed because of "joy in work".*

*As opposed to this, extrinsic motivation is motivation for reasons unrelated to the job itself: e.g. to do with pay, or fear of being fired; external target-setting and competition also belong in this category. Dr Deming believed that we are all born with considerable natural intrinsic motivation but that management fails to recognise this; the consequence is that management concentrates on less-fruitful extrinsic motivation, regrettably simultaneously **destroying** much of that precious intrinsic motivation.*

Overjustification is concerned with the devaluing effect of extrinsic reward being given when the intrinsic reward was more than sufficient. It demonstrates to the recipient that the giver does not understand or value intrinsic motivation. This can start to change the balance between the two in the recipient's mind, and a vicious circle is likely to be generated. See also the "Life Diagram" (highly recommended) on DemDim page 389.

All that follows on the next five and a half pages concerns these matters.]

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

This page comes from Day 11 page 27.

- Some extrinsic motivators rob employees 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.

*["Wrong" can be interpreted in two ways. If I am encouraged to do what I believe to be **incorrect**, there may be some loss of dignity and self-esteem: there will certainly be loss of respect for the company and its management. If I am encouraged, or indeed required, to do what I know to be **morally wrong**, these losses become vast.]*

- 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 abolishment of grading.

[For yet more about Dr Deming's thoughts on the harm of merit rating etc, see DemDim Chapter 30; for particular arguments relating to education, see Chapter 31.]

This page comes from Day 11 page 28.

- One is born with a natural inclination to learn and to be innovative. One inherits a right to enjoy his work. Psychology [as Deming viewed the subject] helps to nurture and preserve these positive innate attributes of people.

- Extrinsic motivation is submission to external forces that neutralise intrinsic motivation. Pay is not a motivator.

*[At least, pay is not an **intrinsic** motivator; there is also considerable evidence that it is often not as important an **extrinsic** one as many people think. Some appreciation of Maslow's well-known Hierarchy of Needs is helpful for understanding this matter. For a discussion of this and other related topics, see the BDA booklet A8: Performance Appraisal and All That!]*

*"Pay is not a motivator" is worth long consideration and discussion. Note that on DemDim page 279 this is usefully qualified to "... pay, **above a certain level, is not a motivator**" (my emphasis). One might possibly add "... except to get yet more pay". And this, of course, is in contrast to motivation for doing a better job, which is what Deming is focusing on here. Recall one of the many points raised while contrasting the horizontal with the conventional vertical organisation chart—the contrast between (a) pleasing the customer and (b) pleasing the boss.*

Regarding these matters, recall also the reference to Norb Keller of General Motors on "Preludes" page 21.]



This page comes from Day 11 page 30.

- Overjustification comes from faulty systems of reward. 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.

[This is addressed with illustrations on the second half of DemDim page 279, at the end of the Psychology section in Chapter 18. Also recall "Preludes" page 25 (following the heading "Are we no better than rats?").]

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

[This, Deming's final remark in the May 1990 version of the System of Profound Knowledge, is yet one further observation that deserves much consideration and discussion.]



This page comes from Day 11 page 31.

Step 3: *DemDim* version

Now read through *DemDim* pages 277–279 again, revising your earlier comments and adding new thoughts below.

For your future reference, the section of *The New Economics* Chapter 4 relating to Part D is on pages 73–78[107–115].



(Continue to Activity 11–b opposite.)

Activity 11-b (pages 211–214) comes from Day 11 pages 32–35.

Step 4:**ACTIVITY 11-b**

Last lap! As previously, but now in connection with Part D: “Knowledge of Psychology”. In this case, there are definitely links of both the kinds (i.e. the “what and why” and the “how”) considered in Activity 11-a. That is, some parts of this Psychology section of the System of Profound Knowledge demonstrate the need to adopt the 14 Points and cure the Deadly Diseases; other parts give very helpful guidance on how to do those things successfully.

(See Appendix page 42.)

POINT 1. [Create constancy of purpose.](#) (pages 56–57)

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DISEASE 5. [One cannot be successful on visible figures alone.](#) (pages 94–95)



Continue to the "Coda" on Day 11 page 36.

DAY 12: BRINGING IT ALL TOGETHER—AND MAKING IT HAPPEN

Activity 12-a, Part 1 comes from the top half of Day 12 page 2.

ACTIVITY 12-a, Part 1

Your first task is simply to collect together all of your 0–5 scores from Activities 10a–b and 11a–b into the table on page 216 overleaf. If you haven't printed out an extra copy of that table (suggested on Day 11 page 36), it will make life easier if you temporarily detach this current sheet of paper so that you won't have to keep turning back to it. (The table is deliberately set on a left-hand page because it will be convenient for you to have the table and the radar diagram on facing pages in the third part of this Activity.)



Continue after Activity 12-a, Part 1 on Day 12 page 2.

Activity 12-a, Part 2 comes from the bottom half of Day 12 page 2.

ACTIVITY 12-a, Part 2

So now choose your 19 combinations of colours and line styles and indicate them in the KEY column on page 216 overleaf, one against each of the 14 Points and each of the five Deadly Diseases. For example, if you've decided that your four-line shape for Point 1 (Create Constancy of Purpose) is to be drawn with broken green lines: - - - - - as in the diagram on Day 12 page 3, indicate that as I've shown in the KEY column overleaf.



Continue at the bottom of Day 12 page 2.

Activity 12-a, Part 3 comes from the bottom of Day 12 page 3.

ACTIVITY 12-a, Part 3

Ready, go! Using your chosen KEYS in turn, carry out this procedure on page 217, illustrating your scores that you've recorded in the table on page 216 for all the 14 Points and five Deadly Diseases.

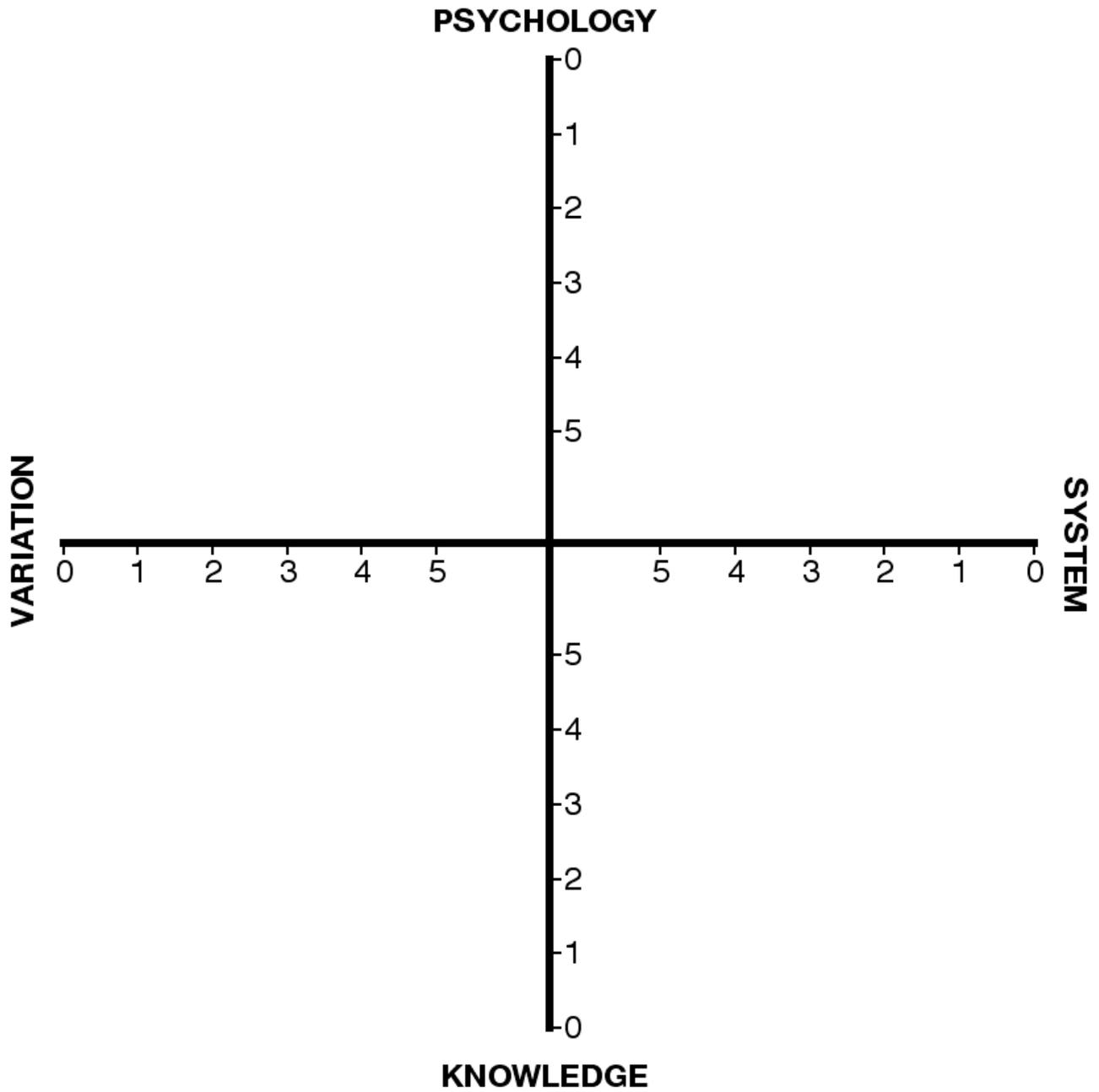


After completing Activity 12-a, continue at the "Interpretation of your radar diagram" section near the bottom of Day 12 page 5.

This table comes from Day 12 page 4 and is used during Activity 12-a: see page 215 and also Day 12 pages 2-3.

KEY		Appreciation for a system	Knowledge of variation	Theory of knowledge	Knowledge of psychology
-----	14 POINTS				
	1. Create constancy of purpose				
	2. Adopt the new philosophy				
	3. Cease dependence on mass inspection				
	4. End lowest tender contracts				
	5. Constantly improve systems				
	6. Institute training				
	7. Institute leadership				
	8. Drive out fear				
	9. Break down barriers				
	10. Eliminate exhortations				
	11. Eliminate arbitrary numerical targets				
	12. Permit pride of workmanship				
	13. Encourage education				
	14. Clearly define top management commitment and action				
	DEADLY DISEASES				
	1. Lack of constancy of purpose				
	2. Emphasis on short-term profits				
	3. Performance appraisal				
	4. Management job-hopping				
	5. Running a company on visible figures alone				

This diagram comes from Day 12 page 5 and is used during Activity 12-a: see page 215 and also Day 12 pages 2-3.



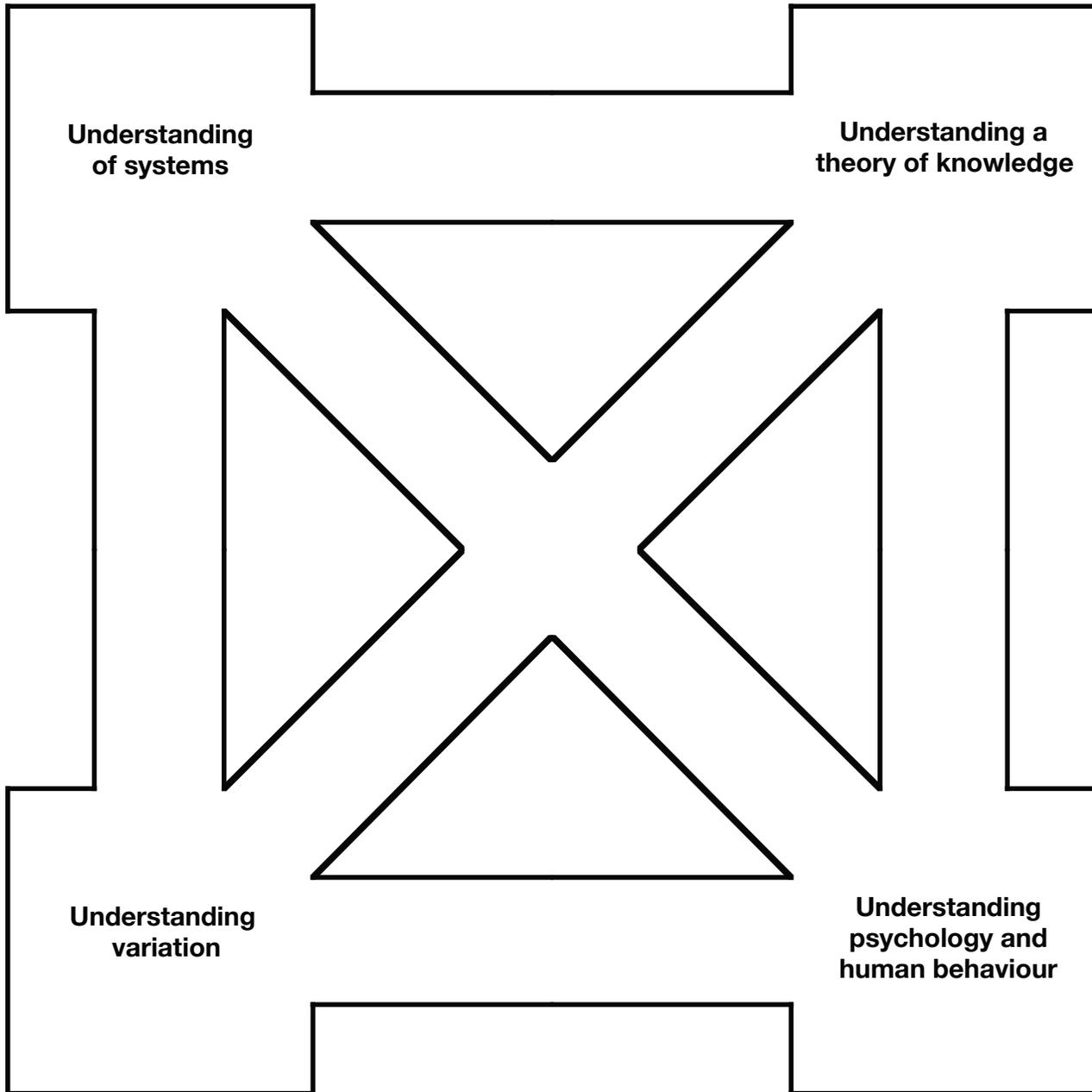
After completing Activity 12-a, continue at the "Interpretation of your radar diagram" section near the bottom of Day 12 page 5.



Activity 12-b comes from Day 12 page 9.

ACTIVITY 12-b

Following some of the guidance on Day 12 page 8—and anything else that comes into your mind—now try to identify a few of the important *connections* between pairs of the four parts of the System of Profound Knowledge and write them in on Peter Scholtes's diagram below.



Continue on Day 12 page 10.

Pause for Thought 12-c comes from Day 12 pages 11-12.

PAUSE FOR THOUGHT 12-c

What do you understand by Dr Deming's second short sentence on Day 12 page 11: "This transformation is discontinuous."?

Much understanding develops gradually—but not all. It may come "in a blinding flash"—or in several blinding flashes, usually well-separated. That has been my experience with learning about the Deming philosophy, and I know it is also true of many of my friends. I wonder if *you* have experienced any blinding flashes while studying this course. I hope so. But if not—keep at it: they'll come!



Continue under the above comment at the top of Day 12 page 12.



Guidance for Staff

The obvious one first—if your manager hasn't already seen it, show them this stuff! Invite your manager to get involved with it, and volunteer yourself for any ensuing improvement work.

[In Dave Young's context (and recall that I am now reproducing his words—see Day 12 page 13), this was probably relatively straightforward. The fact that he was working within a particular organisation presumably implied that the manager concerned knew something about what he was teaching and (hopefully!) approved of it. Similarly, the fact that you have been working on this course may imply the same about your manager. However, it might be the case that you have been studying this course for other reasons, and your manager may know nothing about it—and, if you're really unlucky, might not care anything about it either! If so then you will, of course, have to tread more carefully. You might have to cultivate interest among friends and colleagues (as I began to do well over 30 years ago!). Some of those friends and colleagues may have a manager who is more inclined and receptive to this kind of thinking, in which case it might be more fruitful for you to channel your efforts in that more favourable direction. If this is the case then naturally you will need to adapt appropriately some of the advice that follows.]

This page comes from Day 12 page 15.

You are familiar with Deming's "Organisation Viewed as a System" flow diagram. But now construct one for your own personal "system". [Of course, you are already quite well-practised at drawing such diagrams through Major Activity 9–e (pages 144–148). But this is now personally focused on **you** and therefore should probably come together rather more quickly than did your examples on Day 9. The "central track" of the diagram will now be specifically the main aspects of what **you** do.] Think hard about, and identify, who are your personal suppliers and customers within the organisation (i.e. rather than the organisation's suppliers and customers). They may or may not work in the same department as you. In other words, identify and map out what "system" you personally work in. Every one of us works in a system [in Deming's sense of the word] and that system usually crosses both departmental and hierarchical boundaries.

[It may be that you have two (or more) roles in your organisation, involving different activities and different inputs and outputs. If that is the case then, due to time-considerations, it will probably be sensible for you to concentrate on just one of those roles here. However, if so, I would strongly recommend that you return here when convenient at a later date and repeat this paragraph in terms of your other role(s). Are there any interactions between your various roles—or, indeed, any conflicts? This might lead to some interesting new understanding of your situation and perhaps to some useful improvements.]

This page comes from Day 12 page 16.

Quoting Deming from *The New Economics* page 36[50]:

“A system must have an aim. Without an aim, there is no system.”

Think hard about, and identify, the true aim of your *personal* system. [Recall that you worked on the concept of the **aim** of a system on page 156. But there, similarly as with the flow diagrams in Day 9’s Major Activity (pages 144–148), the concentration was primarily on the “system” being an organisation. Again, here we are instead concentrating on your own personal system. Also, in this current context, you may sometimes (as previously) find it useful to interpret “aim” as “purpose”.] Hopefully, the true aim of your system should have less to do with meeting targets and more to do with pleasing your customer(s).

When you have identified your system and its aim, think hard about, and identify, what can tell you whether or not you are successfully working toward that aim, i.e. your “system measure(s)”. You may discover something important that is not currently being measured by your organisation; what will you do if you find this to be the case? Is it possible to control-chart your key measure(s)? If you can (a) get a good picture of your system, (b) identify its aim, and (c) if possible, examine its key measures on control charts, necessary improvement actions are likely to start becoming obvious. At this point, you may wish to check back to pages 94–95 on the fifth Deadly Disease; also, Dr Deming wrote about “[running a company on visible figures alone](#)” on *Out of the Crisis* pages 103–107[121–126]. If you believe that “unknown and unknowable figures” apply to you (as they do to most people) then *both* they and visible figures need to be taken into account. Something that can always be done is to maintain a continuing conversation with your internal suppliers and customers [for mutual help, cooperation and improvement—see Dave’s next item].

This page comes from Day 12 page 17.

When you have identified your internal customer(s), talk to them. Ask them:

- What do you need from me?
- What do you do with what I give you?
- Is there anything you need from me that I am not giving you?

Areas for improvement may become obvious—and you may get a few surprises!

Are there any people in your organisation whom you perceive to be your competitors? Given what you have learned during this course, what do you want to do about this? Would it make a difference if they (or their manager) had also been working on the course?

This page comes from Day 12 page 18.

Identify what power to act you possess. What can you do by yourself or with the help of your colleagues, and what would you need permission to do? Identify which of Deming's teachings you can apply yourself, and where. Where you haven't the authority to act, try to involve your manager—but be careful that you don't leave your manager feeling threatened or belittled in any way.

This page comes from Day 12 page 19.

Guidance for Middle Managers

[As I have already pointed out, middle managers are effectively at staff level in relation to the senior management, and so the preceding pages have relevance to them as well. In addition, Dave has also provided some useful thoughts about what they should try to do to help their own staff; these follow on this and the next two pages. But those in middle management need to tread carefully: as already observed, they can well be in the unenviable position of “between the Devil and the deep blue sea”. To cultivate some friendships with “those in high places” can be helpful for all.

So spend a little time thinking about each of these six issues that Dave raises here, and jot down any thoughts and reactions that occur to you about how they could apply to you and what actions you might be able to take.]

Encourage and help your staff to get involved with this stuff.

Set up a study programme for your staff, wherever they are in the organisation.

This page comes from Day 12 page 20.

Give them time to study.

Give them time and support to apply what they have learned.

This page comes from Day 12 page 21.

Institute a regime/culture of continual improvement by your staff, throughout the organisation.

If you want this stuff to work in your organisation, you will need to make a serious commitment in time and resources to it.

Continue on Day 12 page 22.



Pages 228–239 come from Day 12 pages 23–33: see Day 12 page 22.

Modern principles of leadership

“Modern principles of leadership ... will replace the annual performance review. The first step in a company will be to provide education in leadership. The annual performance review may then be abolished. Leadership will take its place. This is what Western management should have been doing all along.

The annual performance review sneaked in and became popular because it does not require anyone to face the problems of people. It is easier to rate them; focus on the outcome. What Western industry needs is methods that will improve the outcome. Suggestions follow.”

1. Institute education in leadership: obligations, principles, and methods.

2. Ensure more careful selection of people in the first place.

This page comes from Day 12 page 24.

3.
 - After selection, ensure better training and education.
 - A leader encourages his people to study.
 - He tries to optimise the education, skills, and abilities of everyone to improve.
 - He provides, when possible and feasible, seminars and courses for advancement of learning.
 - He encourages continued education in college or university for people that are so inclined.

4.
 - A leader understands that all people are different from each other.
 - He creates trust. He is aware that creation of trust requires that he take a risk.
 - He tries to create for everybody interest and challenge, and joy in work.



This page comes from Day 12 page 27.

9.
 - Ranking of people (outstanding down to unsatisfactory) that belong to the system violates scientific logic and is ruinous as a policy.
 - The people of a group that form a system will all be subject to the company's formula for raises in pay. This formula may involve (e.g.) seniority. It will not depend on rank within the group, as the people within the system will not be ranked No. 1, No. 2, ... No. last. (In bad times, there may be no raise for anybody.)
 - The day is here when anybody deprived of a raise or of any privilege through misuse of figures for performance (as by ranking the people in a group) may with justice file a grievance. [*I certainly wish that our legal system encouraged this.*]

10.
 - Figures on performance should be used not to rank the people in a group that fall within the system, but to assist the leader to accomplish improvement of the system.
 - A leader will study results with the aim to improve his work.
 - These figures may also point out to him some of his own weaknesses.

This page comes from Day 12 page 28.

11.
 - In the absence of numerical data, a leader must make subjective judgment.
 - He will hold a long interview with every one of his people, three or four hours, at least once a year, not for criticism, but for help and understanding on the part of everybody. They will know what kind of help they need.
 - There will sometimes be incontrovertible evidence of excellent performance, such as patents, publication of papers, invitations to give lectures.

12.
 - A leader has three sources of power: (1) Formal; (2) Knowledge; (3) Personality.
A successful leader develops (2) and (3); does not rely on (1). He has nevertheless obligation to use (1), as this source of power enables him to change the system—equipment, material, methods—to bring improvement, such as to reduce variation in output.
 - He understands a stable system. What to do about mistakes and failures of people, how to help them. What to do about accidents and breakdowns in a stable system is entirely different from action to take in an unstable system.



This page comes from Day 12 page 29.

13.
 - Everybody must be on a team to work for improvement of quality in the four steps of the Shewhart Cycle.
 - Improvement of the system will help everybody, and will decrease the spread between the figures for the performances of people.

14.
 - A leader and his people understand the meaning of a system, and how the work of his group may support its aim.
 - A leader works in cooperation with preceding stages and with following stages toward optimisation of the efforts of all stages. He sees his group as a component in a system.
 - He understands the benefits of cooperation and the losses from competition between people and between groups.

Continue to Activity 12-d which begins on the next page.



Activity 12-d (pages 235–239) comes from Day 12 pages 30–33.

Section 5: **ACTIVITY 12-d**

This Activity builds upon the sections that you have just read through, particularly on the parts that are most relevant and of most interest to you. You will have highlighted some already. Here I'll make some general and natural observations about what to choose.

If you are in senior management, or indeed you are the Chief Executive, then have no doubt that Dr Deming's "Modern Principles of Leadership" will be more than adequate to keep you busy for far longer than the rest of this morning! Indeed, that is likely to be true of just those items which you have already highlighted. So be guided by them.

If your position can be described as "staff" then, equally obviously, your focus will be on the "Guidance for Staff" section (pages 220–224). However, "staff" covers a wide range. Some staff are relative newcomers whereas others have been around for quite a while and thus have a lot of knowledge about, and experience of, the organisation. The latter are therefore likely to be given some additional responsibilities from time to time. Consequently, it could well be that some of the guidance for middle management (pages 225–227) will also be important.

If you are already in middle management then that term also covers a wide range: from "lower middle" to "upper middle". So, in addition to the half-dozen items that Dave has provided in his "Guidance for Middle Managers", "lower middle" managers may also find some of the "Guidance for Staff" of relevance whereas "upper middle" managers may similarly find some of the "Modern Principles of Leadership" to be of importance.

So then, how to tackle the items that you want to pursue? As we have previously seen from time to time, a good way to proceed is to ask yourself lots of questions. Perhaps most important of these are:

- Why is this item in the guidance?
- What will happen if I succeed in doing this?
- What will happen if I don't?

Maybe the answers will be obvious to you. Even if so, you are likely to have to explain the pros and cons to others.

- So what would you say to them?

If you are going ahead, there are bound to be plenty of practical questions that need answering:

- Do I need to do other things before embarking upon this item? If so, what?
- Will I need to get somebody's support in order to proceed with this? If so, whom?
- What shall I say to them?
- Will I need anybody's help with this? If so, whom?
- How can I get them involved?
- What plan of action would make sense? I.e., what is Step 1, Step 2, Step 3, ... ?

By that stage, doubtless you will have created yet more questions that need answers!

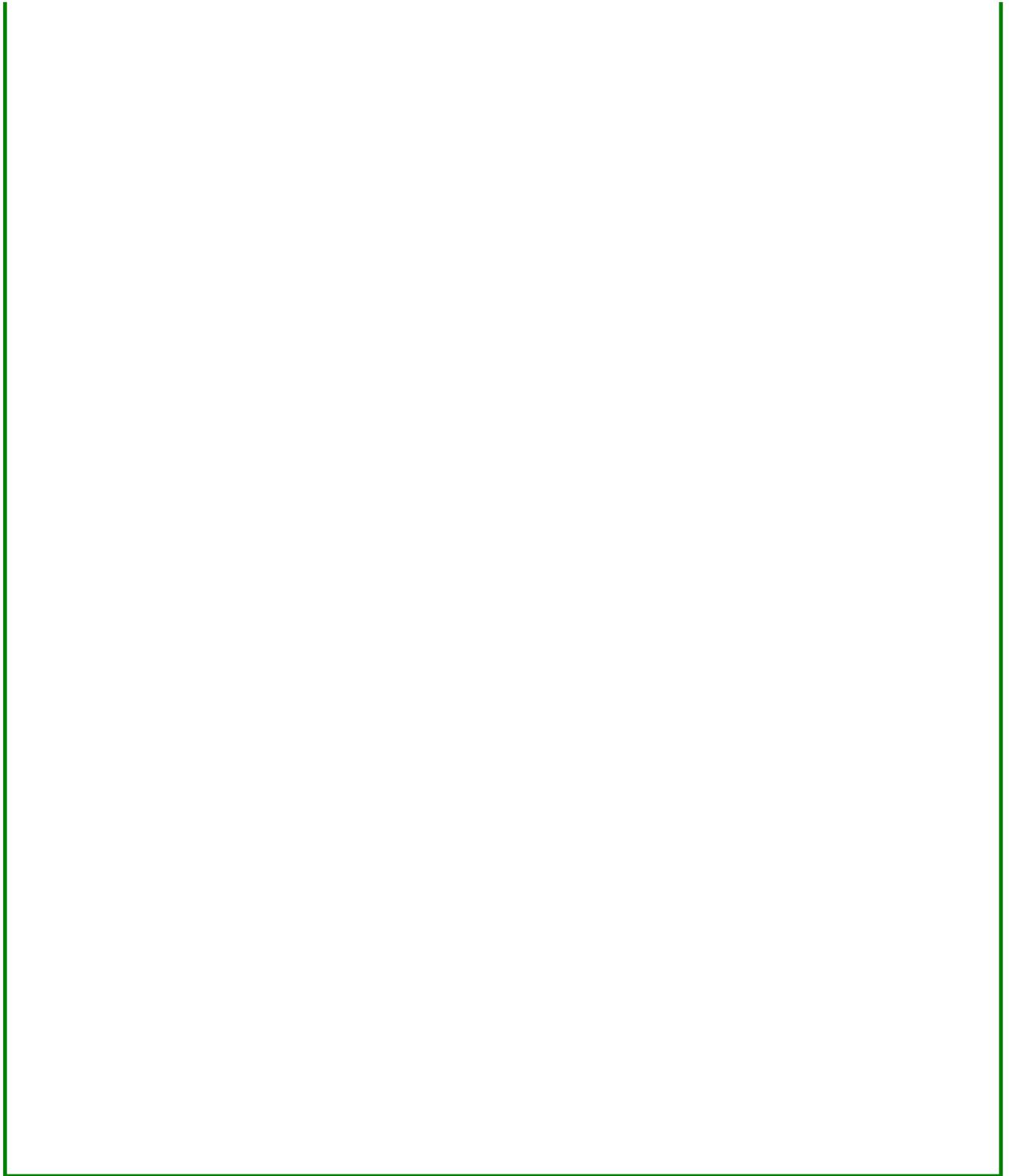
Jot down your answers to some of these questions and other notes either in the space following the relevant items or on the following blank pages, as you find convenient. Also include any general notes about your work in this Activity, in particular why you have chosen your particular selection of topics on which to concentrate.

(You will note that my guidance allows you plenty of time for this Activity. You may well need yet more.)

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(continued overleaf)

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(After the break, continue straight on with the course's final Major Activity which begins overleaf.)

Major Activity 12-e (pages 240–247) comes from Day 12 pages 34–41.



Section 6:

MAJOR ACTIVITY 12-e

This final Major Activity of the course is in two parts. The first part is for everyone. The second part is in two versions: choose which version is the more appropriate for you. The choice will largely depend on the position you hold in your organisation. Divide your time that remains today fairly equally between the two parts.

As you will soon see, you may find it helpful to read through “Leadership for the Transformation” (pages 228–234 along with Day 12 page 22) one more time before embarking upon Part 1.

Part 1

Again you may not have the time to produce anything like a complete version of what will be requested here. That does not matter. What does matter is to summarise (perhaps just as brief notes—see below) the major issues as you now see them. If you can afford to spend more time on this after completing the course, first study Chapters 5 (“Questions to help managers”), 14 (“Two reports to management”) and 16 (“Organisation for improvement of quality and productivity”) in *Out of the Crisis*. And then revise this first attempt—I have left you plenty of space.

During this course you have read a great deal of both Deming’s writing and his spoken word. Hopefully you may also have seen something of him on video. But now it’s your turn!

Let us imagine that Dr Deming has accepted an invitation to spend time in your organisation. He has permission to go anywhere, to look at anything, and to speak with anybody that he wishes, from all levels in the company, in order to learn how the organisation is managed. (He would not have accepted the invitation otherwise.)

And now imagine that *you* are Dr Deming. Draft his subsequent report, addressed to the organisation’s Chief Executive (or whoever is the “top box” in the vertical organisation chart). You do not have to try to imitate Dr Deming’s unique style of writing (although you may do so if you wish!). But you are, of course, welcome to use his terminology and phraseology with which you have become familiar. In practice, you would, of course, need to make yourself available to explain any language with which the addressee might be unfamiliar.

Dr Deming’s reports to management were often written in note form, the notes being numbered 1, 2, 3, ... and subdivided into a, b, c, ... when appropriate. The individual notes were often quite short.

If you would like to see a couple of examples of such reports, and have available a copy of *Out of the Crisis*, turn to Chapter 14: “Two Reports to Management” beginning on page 339[397].

(The following three pages have been left blank for Dr Deming’s draft report.)

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(continued overleaf)

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(Part 2 of this Major Activity begins overleaf.)



Part 2

Your choice of option here largely depends on your position in your organisation. If you are the Chief Executive, or are part of the small top management team around the Chief Executive, then Option 1 is appropriate. Otherwise, Option 2 would generally seem to be the more appropriate. Both options follow straight on from Dr Deming's report (that you have just written).

Option 1

Formulate your plans for change in your organisation in order to implement the points raised in Dr Deming's report. You will need both a short-term and a longer-term plan. The short-term plan needs to contain some detailed proposals of what to do during the next 6 to 12 months, and the longer-term plan needs to paint the general picture of change in your organisation over at least the next five years. As emphasised both by Dr Deming and by Dave Young in his "Guidance for Middle Managers", one of the earliest priorities will surely be to develop appropriate education for your people: indicate some of its main content.

OR

Option 2

Since you have now nearly completed this course, assume you have been promoted to the position referred to by Dr Deming on page 160 as "aide to the president", "the president" being interpreted as your Chief Executive along with the most senior management team. Members of the senior management team have not embarked upon this course (yet!), and thus the first task in your new role will be to work through Dr Deming's report, point by point, with them. Explain where necessary the points and recommendations that he has made, and then help them to formulate their plans to implement appropriate change. During the Second Project you have had plenty of practice at interpreting Dr Deming's guidance in the System of Profound Knowledge for your interested friend, and so the experience gained there should be helpful for this current task.

(The next three pages have been left blank for your thoughts and ideas.)

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(continued overleaf)

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Finally, continue on Day 12 page 42.

OPTIONAL EXTRAS

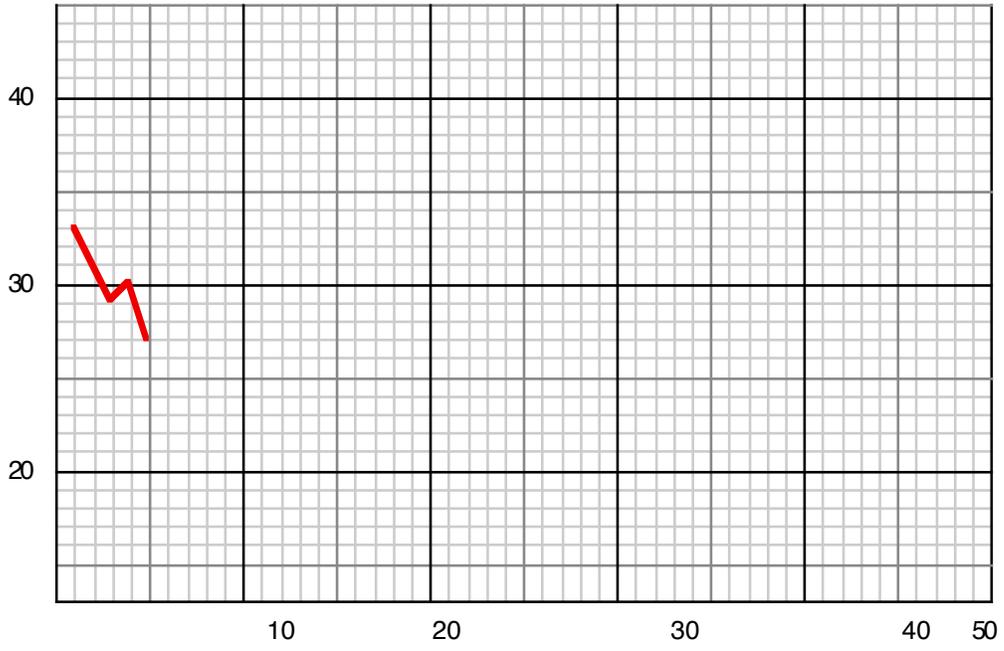
Pages 249–251 come from Optional Extras pages 5–7.

2. Rules 1 and 2 of the Funnel

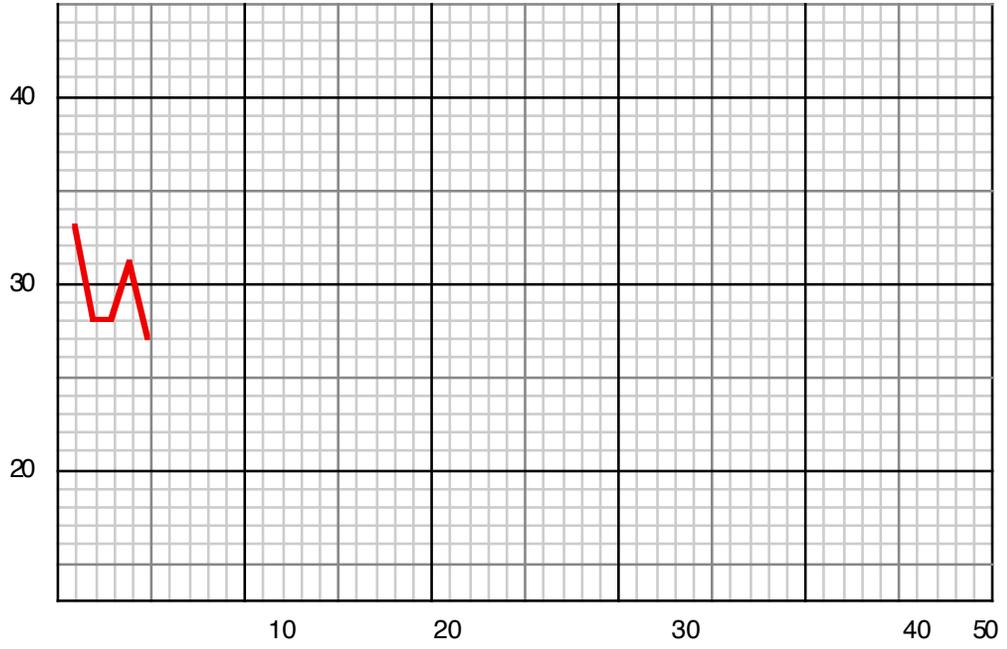
So now go ahead with Rules 1 and 2 using the data you generated on Day 3. Again, your Rule 1 (Ford's Second Strategy) data are on page 40 and the data from Rule 2 (Ford's First Strategy) are on page 43.

Seeing that you have not drawn the run charts of these data previously, I suggest it would be a good idea for you to develop the charts for Rules 1 and 2 "live". That is to say, reflect the more usual and better practice of first (a) drawing the run chart over your chosen baseline, *but no further*; then (b) computing the positions of the Central Line and the control limits from those data; (c) inserting these three lines on the graph-paper throughout the baseline and then somewhat further into the future if all seems to be well at that stage (i.e. if the process currently appears likely to be in control); and finally (again if all seems well) (d) continuing the chart *one point at a time*. Imagine that you were seeing these data for the first time, so that you don't know beforehand what you learned when generating them and constructing their histograms back on Day 3. There is room for your computations and whatever notes you care to make under the graph-paper on the next two pages. In both cases, describe what you feel the control chart is telling you *as and when you are developing it*: a kind of brief running commentary.

Rule 1



Rule 2



Continue on Optional Extras page 8.

Pages 252–253 come from Optional Extras pages 24–25.

Now, returning to the chart on Optional Extras page 22, you will see the note at the top pointing out that the new control limits were computed after the 15 October subgroup had been recorded. To save you from having to try to decipher the writing above the chart, here are the data that were used for the computation:

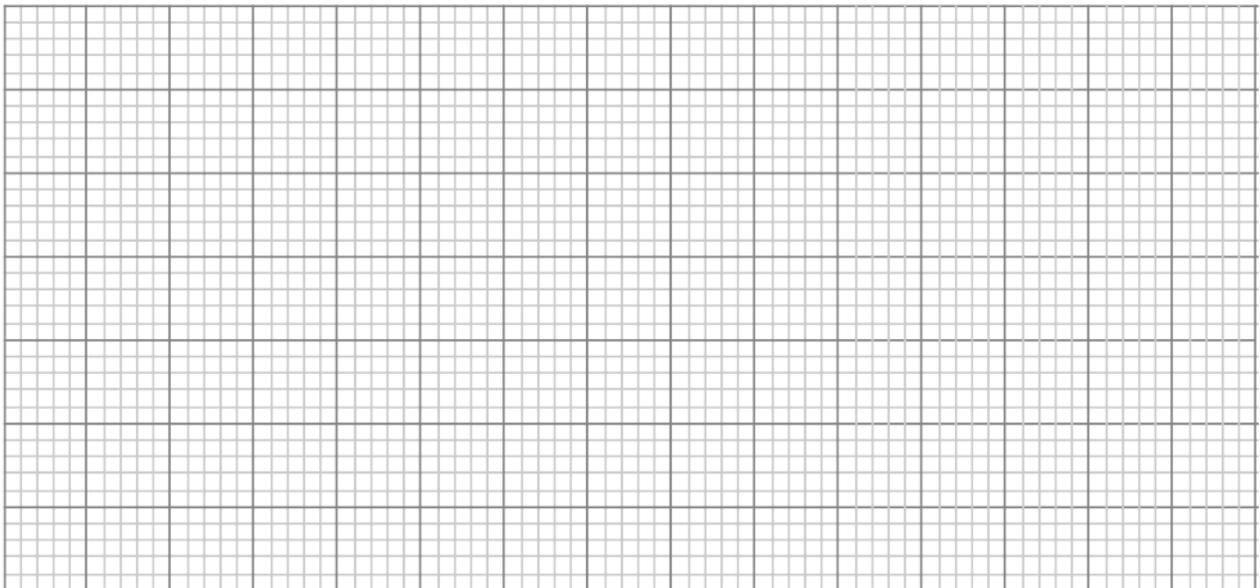
	¹⁰ / 1	2	3	6	7	8	9	10	13	14	15
	15.90	15.90	15.89	15.90	15.90	15.91	15.90	15.90	15.90	15.90	15.90
	15.90	15.91	15.90	15.91	15.90	15.90	15.91	15.90	15.90	15.90	15.90
	15.90	15.90	15.90	15.90	15.91	15.91	15.90	15.90	15.91	15.90	15.90
	15.91	15.90	15.91	15.91	15.89	15.90	15.90	15.90	15.90	15.90	15.90
\bar{X}											
R											

So, go ahead and write down the values of \bar{X} and R for each subgroup—not very difficult with these data! And yes, you will soon see a few of those zero ranges that I mentioned on Optional Extras page 21. Next compute the values of $\bar{\bar{X}}$ and $\bar{\bar{R}}$. Finally, compute the control limits for both parts of the chart as described earlier and check that they agree (approximately) with what the Japanese workers had drawn as reproduced on Optional Extras page 22. My answers are on Optional Extras page 27 if you need them—but first try it yourself here:

As you have seen on Optional Extras page 22, all remained well until the out-of-control signals which began on 27 October. You have read at the top of Optional Extras page 24 what then happened. After the repair had been carried out during the weekend of 15–16 November and some subsequent data had been collected, new control limits were drawn on the chart from 17 November onward. Meanwhile, someone had checked through the data from 27 October to 14 November and had computed control limits for that period using that whole set of data. If you would like to try out the computations one more time, here are the data recorded over that period (I don't know the reasons for the apparent six-day week followed by a three-day week):

	27	28	29	30	31	¹¹ / 1	4	5	6	10	11	12	13	14
	15.87	15.88	15.87	15.86	15.87	15.88	15.89	15.90	15.89	15.89	15.87	15.89	15.89	15.88
	15.88	15.90	15.88	15.87	15.87	15.89	15.90	15.91	15.87	15.89	15.90	15.89	15.88	15.89
	15.88	15.89	15.88	15.89	15.89	15.89	15.88	15.88	15.88	15.90	15.89	15.89	15.89	15.88
	15.89	15.89	15.89	15.87	15.90	15.88	15.89	15.89	15.89	15.90	15.89	15.88	15.88	15.88
\bar{X}														
R														

If you'd like to examine this period by drawing the \bar{X} - R chart on the graph-paper below, you will see that the process remained in control during this time, albeit with the lower mean and with increased variation. However, you will also see that, despite the problem that had been discovered, it is highly unlikely that any piece manufactured even during this period was anywhere near going outside the specifications of 15.90 mm \pm 0.10 mm. This is, of course, an illustration of the value of having improved the process way beyond the minimum that had appeared to be necessary: despite the current perturbation, everything produced *still* remained "fit for purpose" (as conformance to specifications is often described).



Continue on Optional Extras page 26.

Approvals, Acknowledgments and Information

- ^a (page 187) This quotation from *Dedication of the Cedar Crest Academy, Washington in October 1985* has been reproduced with the approval of the Cedar Crest Academy.
- ^b (page 188) This quotation from *The Essential Deming: Leadership Principles from the Father of Quality* has been included with the approval of the W Edwards Deming Institute and McGraw-Hill Education.