Preface to the Second Edition

Nearly ten years have passed since the first edition of this work was published. Nevertheless, we find our earlier work a fair attempt (and, as near as we have been able to find, the only book length attempt) at mathematically modeling the Deming paradigm (SPC) for continuous quality improvement.

Deming was an optimizer, not a policeman. Philosophically, the Quality Assurance paradigm (QA), which has dominated American manufacturing since the Second World War, has about as much in common with SPC as a horse and buggy has to a Mercedes. Both of these latter have wheels, brakes, and an energy source for locomotion, but it would be less than useful to think of them as "essentially the same," as so many managers still seem to consider QA and SPC to be the same. Both QA and SPC use control charts, but to very different purposes. QA wants to assure that bad units are not shipped. SPC wants to assure that bad units are not created in the first place, and that the units are being produced by a system in a continuing state of improvement. If this point is not understood by the reader of this book, it is not for any lack of trying on the part of the authors. Anyone who has walked into both QA establishments and SPC establishments knows the extreme difference in the sociology of the two types. In the QA establishment, the worker is being watched for poor performance. In the SPC establishment, the worker is a manager, calmly focused on the improvement of the process, and with constant recognition of his contributions.

Again, the Deming paradigm must not be confused with the touchie-feelie boosterism associated with the "Quality Is Free" movement. Although SPC is one of the best things ever to happen to making the workplace a friendly and fulfilling environment, its goal is to improve the quality of the good delivered to the customer by a paradigm as process oriented as physics. It was the insight of Deming which has led to the realization that one can use the fact that a lot exhibits a mean well away from the overall mean to indicate that something specific is wrong with the system. Using this technique as a marker, the team members can backtrack in time to see what caused the atypicality and fix the problem. As time progresses, relatively minor problems can be uncovered, once the major causes of jumps in variability have been found and removed.

For reasons of user friendliness, Deming advocated the already venerable run charts and control charts as a means of seeking out atypicality.

Thus, Deming's methodology, on the face of it, does appear to be very much the same thing as that advocated by the Quality Assurance folks or the New Age "Quality Is Free" school. Perhaps Deming himself was partly to blame for this, for he never wrote a model based explanation for his paradigm. Moreover, Deming was advocating the use of old tests familiar to industrial engineers to achieve quite a different purpose than those of the older QA school: namely, Deming used testing to achieve the piecewise optimization of an ill-posed control problem. And, as anyone who has used SPC on real problems will verify, SPC works.

This book is an updated and extended version of the first edition, with an increased length of roughly 25%. Criticisms by our colleagues and students of that earlier endeavor have been taken into account when preparing this book, as have been our own new experiences in the fascinating area of quality improvement in the manufacturing, processing and service industries. As in the first edition, we have tried to give examples of real case studies flowing from work we have ourselves undertaken. Consequently, as beyond the "production line" examples, we include an example of problems encountered when a new surgical team was brought into the mix of teams dealing with hip replacement. There is an example showing problems experienced by a company involved in the production of ecologically stable landfills. A look is given at a possible start-up paradigm for dealing with continuous improvement of the International Space Station. Thus, one aim of this book is to convince the reader that CEOs and service industries need SPC at least as much as it is needed on production lines. Deming viewed SPC as a managerial tool for looking at real world systems across a broad spectrum. So do we.

Revisions of the former book include discussions, examples and techniques of particular interest for managers. In addition, the new edition includes a new section recapitulating in Chapter 1 how properly to understand and react to variability within a company; new section on process capability in Chapter 3; on the Pareto and cause-and-effect diagrams, as well as on Bayesian techniques, on bootstrapping and on the seven managerial and planning tools (also known as the Japanese seven new tools) in Chapter 5; and on multivariate SPC by principal components in Chapter 7.

Usually, Professor Deming discussed methodologies for use with systems rather mature in the application of SPC. In the United States (and more generally) most systems in production, health care, management, etc., are untouched by the SPC paradigm. Consequently, we find it useful to look at real world examples where SPC is being used on a system for the first time. It does the potential user of SPC no good service to give the impression that he or she will be dealing with "in control" systems. Rather, our experience is quite the contrary. Startup problems are the rule rather than the exception.

Exploratory Data Analysis and other minimal assumption methodologies are, accordingly, in order. In this new edition, we introduce Bayesian techniques for the early stages of operation of a complex system. This is done in the context of a real world problem where one of us (Thompson) was asked by NASA to come up with a speculative quality control paradigm for the operation of the International Space Station. NASA, which uses very sophisticated reliability modeling at the design stage, generally does not use SPC in the operation of systems. We show how even a very complex system, untouched by SPC, can be moved toward the Deming Paradigm in its operation by the use of Bayesian techniques.

The design and operational problems of optimization are quite different. American companies frequently have excellent design capabilities, but forget that a system, once built, needs continually to be improved. On the other hand, the SPC professional should realize that a horse buggy is not likely to "evolve" into a Lexus. Design and continuous operational optimization, over the long haul, must both be in the arsenal of the successful health care administrator, industrial engineer, and manager. Deming knew how to combine design and operational optimization into one methodologically consistent whole. In this edition, we discuss his unifying approach by referring to the so-called Shewhart-Deming Plan-Do-Study-Act cycle and based on it spiral of continual improvement. We also elaborate on means to help design an innovation, namely on the so-called seven managerial and planning tools.

Because measurement statistics in quality control activities are generally based on averaging, there is a (frequently justifiable) tendency to assume the statistics of reference can be based on normal theory. Rapid computing enables us to use the nonparametric bootstrap technique as a means of putting aside the assumption of normal theory when experience hints that deviation from normality may be serious. Furthermore, rapid computing enables us to deal with multivariable measurement SPC. It is true that most companies would greatly improve their operations if they used even one dimensional testing. Nevertheless, experience shows that multivariate procedures may provide insights difficult to be gleaned by a battery of one dimensional tests. Most SPC today is still being done away from a computer workstation. That is changing.

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