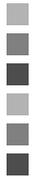
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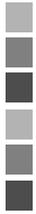
Statistical Process Control

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Statistical Process Control

For Susan, Jane and Robert



Statistical Process Control

Sixth Edition

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Preface

Stop Producing Chaos – a cry from the heart! When the great guru of quality management and process improvement W. Edwards Deming died at the age of 93 at the end of 1993, the last words on his lips must have been ‘Management *still* doesn’t understand process variation’.

Despite all his efforts and those of his followers, including me, we still find managers in manufacturing, sales, marketing, finance, service and public sector organizations all over the world reacting (badly) to information and data. They often do not understand the processes they are managing, have no knowledge about the extent of their process variation or what causes it, and yet they try to ‘control’ processes by taking frequent action. This book is written for them and comes with some advice: ‘Don’t just do something, sit there (and think)!’

The business, commercial and public sector world has changed a lot since I wrote the first edition of *Statistical Process Control – a practical guide* in the mid-eighties. Then people were rediscovering statistical methods of ‘quality control’ and the book responded to an often desperate need to find out about the techniques and use them on data. Pressure over time from organizations supplying directly to the consumer, typically in the automotive and high technology sectors, forced those in charge of the supplying production and service operations to think more about preventing problems than how to find and fix them. The second edition of *Statistical Process Control* (1990) retained the ‘tool kit’ approach of the first but included some of the ‘philosophy’ behind the techniques and their use.

In writing the third, fourth and fifth editions I found it necessary to completely restructure the book to address the issues found to be most important in those organizations in which my colleagues and I work as researchers, teachers and consultants. These increasingly include service and public sector organizations. The theme which runs throughout the book is still PROCESS. Everything we do in any type of organization

is a process, which:

- requires UNDERSTANDING,
- has VARIATION,
- must be properly CONTROLLED,
- has a CAPABILITY, and
- needs IMPROVEMENT.

Hence the five sections of this new edition.

Of course, it is still the case that to be successful in today's climate, organizations must be dedicated to continuous improvement. But this requires management – it will not just happen. If more efficient ways to produce goods and services that consistently meet the needs of the customer are to be found, use must be made of appropriate methods to gather information and analyse it, *before* making decisions on any action to be taken.

Part 1 of this edition sets down some of the basic principles of quality and process management to provide a platform for understanding variation and reducing it, if appropriate. The remaining four sections cover the subject of Statistical Process Control (SPC) in the basic but comprehensive manner used in the first five editions, with the emphasis on a practical approach throughout. Again a special feature is the use of real-life examples from a number of industries.

I was joined in the second edition by my friend and colleague Roy Followell, who has now retired to France. In this edition I have been helped again by my colleagues in Oakland Consulting plc and its research and education division, the European Centre for Business Excellence, based in Leeds, UK.

Like all 'new management fads' six sigma has recently been hailed as the saviour to generate real business performance improvement. It adds value to the good basic approaches to quality management by providing focus on business benefits and, as such, now deserves the separate and special treatment given in Chapter 14.

The wisdom gained by my colleagues and me in the consultancy, in helping literally thousands of organizations to implement quality management, business excellence, good management systems, six-sigma and SPC has been incorporated, where possible, into this edition. I hope the book provides a comprehensive guide on how to use SPC 'in anger'. Numerous facets of the implementation process, gleaned from many man-years' work in a variety of industries, have been threaded through the book, as the individual techniques are covered.

SPC never has been and never will be simply a 'tool kit' and in this book I hope to provide not only the instructional guide for the tools, but communicate the philosophy of process understanding and improvement, which has become so vital to success in organizations throughout the world.

The book was never written for the professional statistician or mathematician. As before, attempts have been made to eliminate much of the mathematical jargon that often causes distress. Those interested in pursuing the theoretical aspects will find, at the end of each chapter, references to books and papers for further study, together with discussion questions. Several of the chapters end with worked examples taken from a variety of organizational backgrounds.

The book is written, with learning objectives at the front of each chapter, to meet the requirements of students in universities, polytechnics and colleges engaged in courses on science, technology, engineering and management subjects, including quality assurance. It also serves as a textbook for self or group instruction of managers, supervisors, engineers, scientists and technologists. I hope the text offers clear guidance and help to those unfamiliar with either process management or statistical applications.

I would like to acknowledge the contributions of my colleagues in the European Centre for Business Excellence and in Oakland Consulting. Our collaboration, both in a research/consultancy environment and in a vast array of public and private organizations, has resulted in an understanding of the part to be played by the use of SPC techniques and the recommendations of how to implement them.

John S. Oakland

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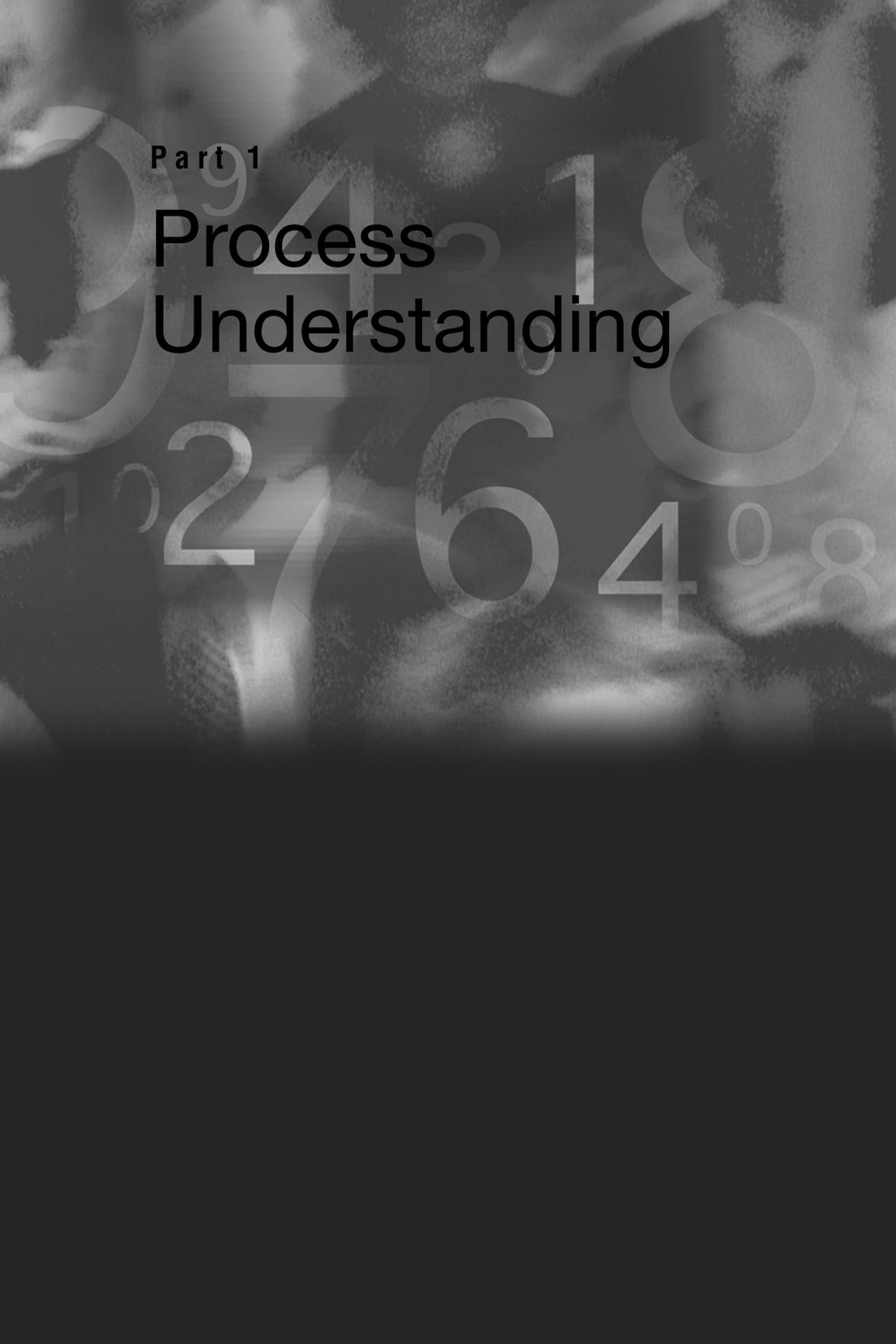
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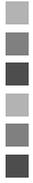
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Part 1

Process Understanding

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Quality, processes and control

■ Objectives

- To introduce the subject of statistical process control (SPC) by considering the basic concepts.
- To define terms such as quality, process and control.
- To distinguish between design quality and conformance.
- To define the basics of quality-related costs.
- To set down a system for thinking about SPC and introduce some basic tools.

■ 1.1 The basic concepts

Statistical process control (SPC) is not really about statistics or control, it is about competitiveness. Organizations, whatever their nature, compete on three issues: quality, delivery and price. There cannot be many people in the world who remain to be convinced that the reputation attached to an organization for the quality of its products and services is a key to its success and the future of its employees. Moreover, if the quality is right, the chances are the delivery and price performance will be competitive too.

What is quality? _____

The word 'quality' is often used to signify 'excellence' of a product or service – we hear talk about 'Rolls-Royce quality' and 'top quality'.

In some manufacturing companies quality may be used to indicate that a product conforms to certain physical characteristics set down with a particularly 'tight' specification. But if we are to manage quality it must be defined in a way which recognizes the true requirements of the 'customer'.

Quality is defined simply as *meeting the requirements of the customer* and this has been expressed in many ways by other authors:

Fitness for purpose or use (Juran).

The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs (BS 4778: Part 1: 1987 (ISO 8402: 1986)).

The total composite product and service characteristics of marketing, engineering, manufacture, and maintenance through which the product and service in use will meet the expectation by the customer (Feigenbaum).

The ability to meet the customer requirements is vital, not only between two separate organizations, but within the same organization. There exists in every factory, every department, every office, a series of suppliers and customers. The PA is a supplier to the boss – is (s)he meeting the requirements? Does the boss receive error-free notes set out as he wants it, when he wants it? If so, then we have a quality service. Does the factory receive from its supplier defect-free parts which conform to the requirements of the assembly process? If so, then we have a quality supplier.

For industrial and commercial organizations, which are viable only if they provide satisfaction to the consumer, competitiveness in quality is not only central to profitability, but crucial to business survival. The consumer should not be required to make a choice between price and quality, and for manufacturing or service organizations to continue to exist they must learn how to manage quality. In today's tough and challenging business environment, the development and implementation of a comprehensive quality policy is not merely desirable – it is essential.

Every day people in organizations around the world scrutinize together the results of the examination of the previous day's production or operations, and commence the ritual battle over whether the output is suitable for the customer. One may be called the Production Manager, the other the Quality Control Manager. They argue and debate the evidence before them, the rights and wrongs of the specification, and each tries to convince the other of the validity of their argument. Sometimes they nearly break into fighting.

This ritual is associated with trying to answer the question: *'Have we done the job correctly?'* – 'correctly' being a flexible word depending on the interpretation given to the specification on that particular day. This is not quality *control*, it is post-production/operation *detection*, wasteful detection of bad output before it hits the customer. There is a belief in some quarters that to achieve quality we must check, test, inspect or measure – the ritual pouring on of quality at the end of the process – and that quality, therefore, is expensive. This is nonsense, but it is frequently encountered. In the office we find staff checking other people's work before it goes out, validating computer input data, checking invoices, typing, etc. There is also quite a lot of looking for things, chasing things that are late, apologizing to customers for non-delivery and so on – waste, waste and more waste.

The problems are often a symptom of the real, underlying cause of this type or behaviour, the lack of understanding of quality management. The concentration of inspection effort at the output stage merely shifts the failures and their associated costs from outside the organization to inside. To reduce the total costs of quality, control must be at the point of manufacture or operation; quality cannot be inspected into an item or service after it has been produced. It is essential for cost-effective control to ensure that articles are manufactured, documents are produced, or that services are generated correctly the first time. The aim of process control is the *prevention* of the manufacture of defective products and the generation of errors and waste in non-manufacturing areas.

To get away from the natural tendency to rush into the detection mode, it is necessary to ask different questions in the first place. We should not ask whether the job has been done correctly, we should ask first: *'Can we do the job correctly?'* This has wide implications and this book aims to provide some of the tools which must be used to ensure that the answer is 'Yes'. However, we should realize straight away that such an answer will only be obtained using satisfactory methods, materials, equipment, skills and instruction, and a satisfactory or capable 'process'.

What is a process? _____

A process is the transformation of a set of inputs, which can include materials, actions, methods and operations into desired outputs, in the form of products, information, services or – generally – results. In each area or function of an organization there will be many processes taking place. Each process may be analysed by an examination of the inputs and outputs. This will determine the action necessary to improve quality.