THE EFFECTIVENESS OF QUALITY CONTROL SYSTEMS IN AUSTRALIA AND JAPAN: A COMPARATIVE ANALYSIS

Valerie McGown

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Centre for Strategic Economic Studies
Faculty of Business and Law

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Declaration

I, Valerie McGown, declare that the PhD thesis entitled *The Effectiveness of Quality Control Systems in Australia and Japan: A Comparative Analysis* is no more than 100,000 words in length, exclusive tables, figures, appendices, references and footnotes. This thesis contains no material that has been accepted for the award of any other degree of diploma in any university or institution. To the best of my knowledge, this thesis contains no material previously published or written by another person, except where due reference has been given.

VALERIE MCGOWN **DATE**

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Abstract

This thesis undertakes a comparative analysis of quality control practices in Japan and Australia in the 1980s and the 1990s. The methodology employed consists of two main components. The first is a comparative analysis of the literature in Japanese and in English, to highlight the differences in the interpretation of quality management systems. The second is the analysis, through extensive interviews, of five case studies (including Japanese firms in Japan, Japanese subsidiaries in Australia and Australian firms) to identify the differences in actual practice in the two countries.

One aim is to define the characteristics of the 'mature' system of Japanese quality control in place around 1990, as a basis for comparative analysis. Three important aspects of the Japanese approach are a reliance on formal structures, procedures and data, the key role played by engineering staff and an emphasis on the technical rather than the social aspects of quality control systems in Japan. By contrast the Australian practice focused on people issues, labour-management relations and achieving cultural change, but formal structures, data and the role of engineering staff were generally inadequate. Some evidence is found of a 'reverse effect', that addressing technical production problems contributes to a positive experience of work, but the converse is unlikely to be an effective approach to installing a quality management system.

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List of Acronyms

4W1H	What, When, Where, Why and How
5W1H	What? Why? Where? When? Who? How?
ABPDP	Australian Best Practice Demonstration Program
AFR	Australian Financial Review
AMC	Australian Manufacturing Council
AOQ	Australian Organization for Quality
AOQC	Australian Organization for Quality Control
AQA	Australian Quality Awards
ASQC	American Society for Quality Control
AT&T	American Telephone & Telegraph
BPP	Best Practice (BP) Programme
CCS	Civil Communications Service
CEO	Chief Executive Officer
CPM	Critical Path Method
CPS	Canon Production System
CS	Customer Satisfaction
CSA	Canadian Standards Association
CCS	Civil Communication Section
DPCA	Defective Product Corrective Action
EA	Enterprise Australia
EIG	Employee Involvement Group
EQA	European Quality Award (hereafter
EQCDS	Environment, Quality, Cost, Delivery, Safety
FCAI	Federal Chamber of Automotive Industries
FMEA	Failure Mode and Effect Analysis
FMS	Flexible Management System
GATT	General Agreement on Tariffs and Trade
GHQ	General Headquarters
GMH	General Motors Holden
GMHAL	General Motors Holden Australia Limited
HEO	Holden Engine Operations
HO	Head Office
IE	Industrial Engineering
IMF	International Monetary Fund

ISO	International Organization for Standardization (
JIS	Japan Industrial Standards
JIT	Just In Time
JITA	Japan Industrial Training Association
JMA	Japan Management Association
JORS	Japan Operational Research Society
JPC	Japan Productivity Centre
JPC-SED	Japan Productivity Center for Social and Economic Development
JSA	Japan Standards Association
JSQC	Japanese Society for QC
JUSE	Japan Union of Scientists and Engineers
KPI	Key Performance Indicators
LH	Leading Hand
MBNQA	Malcolm Baldrige National Quality Award
MTP	Management Training Program
NEC	Nippon Electric Company
NHK	*Nippon Hōsō Kyōkai* (Japan Broadcasting Corporation)
NIES	National Industry Extension Service
NZ	New Zealand
OECD	Organisation for Economic Cooperation and Development
OEM	Original Equipment Manufacturer
OR	Operations Research
PAC	Performance Analysis and Control
PCP	Process Control Plan
PERT	Programme Evaluation and Review Technique
PFMEA	Process FMEA
PM	Phenomenon-Mechanism Technique
PM	Preventive Maintenance, Productive Maintenance
PQAC	Product Quality Assurance Centres
PRWS	Problem Resolution Work Sheet
QA	Quality Assurance
QAFC	Quality Assurance Flow Chart
QC	Quality Control
QCC	Quality Control Circles
QCD	Quality Cost Delivery
QCDSME	Quality, Cost, Delivery, Safety (Service), Morale and Environment

QE	Quality Engineer
QISS	Quality Information Sharing System;
QM&D	Quality Management and Development Department, NEC (Aus)
QPR	Quality Problem Report
QSA	Quality Society of Australasia
QZD	Zero Quality Defects
SA	Statistical Analysis
SA	Special Attention
SECJ	Social Economic Congress of Japan
SGAs	Small Group Activities
SMWT	Self-managed Work Teams
SPC	Statistical Process Control
SQC	Statistical Quality Control
SZD	Small Zero Defects
TAFE	Technical and Further Education
TPM	Total Productive Maintenance
TPM	Total Productive Maintenance
TQC	Total Quality Control
TQM	Total Quality Management
TQMI	Total Quality Management Institute
TWI	Training Within Industry
UAAI	United Australian Automotive Industries
VA/VE	Value Analysis/Value Engineering
VE	Value Engineering
WF	Work Factor
ZD	Zero Defects

CHAPTER 1. Introduction

Background

The quality control movement in Japan in the period after the Second World War has been widely regarded as successful and as one of the major factors in the emergence of Japan to world leadership in manufacturing production processes. While, until the 1970s, Japan had largely been regarded as catching up to the major industrialized countries, Japan's unexpectedly rapid recovery from the Oil Crises of the 1970s – while the other industrial countries continued to languish in a state of 'stagflation' – focused attention on the reasons for, or secrets of, Japan's success. In the context of continuing de-industrialization in the USA and industrial restructuring in Australia under the pressures of an increasingly global economy, Japanese-style quality programs were widely regarded as offering a solution to the perceived loss of competitiveness of industries in these countries. However, the success of the introduction and adaptation of Japanese methods into the West in the form of total quality management (TQM) has remained a highly debated and contentious issue – being both highly acclaimed as a panacea and condemned or dismissed as an "embarrassing failure" (Basu 2001: 32).

This thesis traces the largely indigenous development of Japanese quality control systems during a period of some 50 years following the Second World War. In the early postwar years, the quality control movement in Japan involved to a substantial degree a Japanese adaptation of Western concepts drawing on the work of Deming, Juran, Feigenbaum and others (for details see Chapter 2). But once imported, these concepts were studied, interpreted and modified by the Japanese largely in isolation from the original source,[1] so that much of the Japanese development was truly indigenous (Iizuka, et al. 1998). Despite the "learn from Japan" fashion of the 1980s and a sudden realization in Japan that they might be a world leader rather than a follower, this reliance on largely indigenous quality control processes in Japan did not really change until the 1990s.

During the 1990s Japan's new-found confidence was again punctured by the collapse of the "bubble economy" and by the emergence of the ISO9000 series (in which Japan had played no

[1] Tsutsui (1998) discusses this point but his position is rather ambivalent. His view seems to be that imitation eventually led to innovation and that Japan took its own distinctive path in the development of quality control. He also makes the point that the flow of information has now become two-way (from Japan to America or the West general not just to Japan) but in my view the flow from Japan remains severely restricted not least because it relies on the English language ability of Japanese which is still quite limited in terms of number of persons and individual levels of fluency.

significant part) as the world standard for quality management.[2] By the mid-1990s, the Japan Union of Scientists and Engineers (JUSE), one of the key bodies driving quality control in Japan, decided to formally change the title of its quality programs from 'total quality control' (TQC) to 'total quality management' (TQM), and a working group was established to examine and explain what was new in the conception and practice of TQM compared to the former TQC. Around this time, there was also an increasing amount of literature on the relationship between TQC/TQM and the ISO9000 series and how to use the latter as a basis for developing a TQC/TQM system.[3] In 1995, the Japan Productivity Center for Socio-Economic Development (JPC-SED) established the Japan Quality Award which had much more in common with the "quality of management" emphasis of prizes in 'Western' countries. This shift within Japan seemed to reflect a perception that TQC had largely ceased to be used overseas, so there was concern that Japan would be seen to be out-of-date (Iizuka, et al. 1998), as well as the penetration of Western ideas that the process of achieving quality needed to concentrate more on, or relate more strongly to, management issues than was current in Japan at that time.[4]

In recent years there has been renewed debate about the ongoing effectiveness of Japan's quality control methods, culminating in the Toyota crisis in 2010. While the current issues are beyond the scope of this thesis, it is hoped that a detailed analysis of the indigenous process of quality control as developed in Japan after 1946, and of the alternative views of quality control as developed in the West (exemplified in the case of Australia) which came later to influence Japanese approaches, may be of value for subsequent analyses of the current situation.

In Japan, in the aftermath of the Second World War, quality <u>together with</u> cost and delivery were regarded as critical to changing the image of Japanese products as *yasukaro, warukaro* (cheap and nasty) and to the ability of Japanese products to compete in world markets. They were therefore seen as indispensable to Japanese economic recovery and growth. Moreover, as the Japanese economy developed, new pressures emerged which continued to reinforce this orientation – or to make this orientation a necessity rather than a choice. These included trade and financial liberalization in the 1960s, the introduction of floating exchange rates and the Oil Crises in the 1970s (the so-called "Nixon Shocks" and "Oil Shocks" in Japan), and the trade wars and sharp upward revaluation of the yen (associated with the Plaza Accord) in the 1980s,

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[2] See, for example, Ayano (2002) and Kano (2001). Japan's lack of interested in the establishment of the ISO9000 series in the late 1980s is often attributed to Japan's confidence in the superiority of its own methods at the time.

[3] See, for example, Iizuka (1997), Iizuka, et al. (1998), Iizuka (1999), Kano (2001); Iizuka, et al. (2003), Nakajo and Yamada (2006) and Iizuka (2007).

[4] For example, see the description (in English) of the Japan Quality Award on the JPC website; www.jpc-net.jp/eng/award/index.html. Also see TQM Committee (1998).

followed by the collapse of the so-called "bubble economy" and the subsequent protracted recession.

It is also important to stress that, immediately after the War, Japan lacked "modern industries" – not only modern technology but also modern management methods. Japanese industries were neither efficient nor cost effective. It was perhaps fortuitous that quality was the first issue to become the focus of attention in this situation, but Japan's "state of underdevelopment" meant that as it adopted modern (machine) technology, it also had to acquire modern methods of operating that machinery (production management) and modern methods of corporate management in the broadest sense, as its industrial organizations grew in size and complexity. The existence of this "methodological vacuum" encompassing all facets of modern industry may have been one of the factors that allowed quality control to play such a central role and resulted in the particular configuration of Japanese management methods that emerged (Ishikawa 1989; Tsutsui 1998).

Australia, in the 1980s, also faced a survival crisis of sorts. In Australia, the crisis surrounded the view that Australia needed to reduce protection, open its markets and expose its companies to foreign competition – that Australian industry needed to become internationally competitive. But Australia's situation differed in two important respects from that of Japan. The crisis was vastly less severe than that which faced Japan in the early postwar period and the practices of Australian management had evolved with what were accepted as the modern management methods of the time. In view of the latter, the need for new methods of quality control or quality management may not have been so keenly felt and, conversely, an accommodation with existing management methods more difficult to achieve.

In Australia, improving quality performance and installing successful quality control systems was regarded as depending critically on changing organizational culture. The advocacy and introduction of quality control (QC) programs were surrounded by a great deal of "hype and fervour" and sweeping claims were made for the efficacy of these programs. However, they never enjoyed the acceptance in Australia that they had in Japan, either in industry generally or in the management ranks of individual companies. Moreover, the results of such programs have been even more contentious and contested. Despite some apparently outstanding successes, the benefits were often found to be quite short-lived and most assessments or guesstimates conclude that the benefits of successful programs were limited to only a small proportion of companies – both here and in America. A number of authors have pointed to the fact that a strong sense of 'management fad' surrounded the introduction of quality programs (Nohria and Berkley 1994; Jacob 1993; AFR 1989). On the influence of management fads and fashions generally, also see

Woodward 1965) There have been many criticisms of the failure of TQM programs to deliver results in the West.[5]

In Australia, and in the English language literature generally, improved quality performance and successful quality programmes were regarded as essentially "people issues" dependent on organizational and cultural change. The main focus of this cultural change was production workers or management-worker relations. In Australia, the perceived need for this cultural change was reinforced by ideas then being strongly advocated about the need for a new workplace culture. The objectives were flatter structures, more autonomy and decision-making powers for production workers, participation in management (ABPDP 1995; Mathews 1994).

This thesis will investigate the relative effectiveness of quality control systems in Japan and in Australia, and the reasons for the widely perceived relative ineffectiveness of these processes in Australia. A major theme will be that quality control in Japan is a rigorous, well-documented process strongly oriented to the technical and engineering aspects of production and of production processes, whereas in Australia it has been interpreted primarily as a process focused on human relations management and organizational culture. This focus on social and cultural rather than technical aspects may be a major reason for the limited success of quality control initiatives in Australia.

Objectives

In this context, the major objectives of this research are:

1. To develop a framework – through the study of the history of, and the literature on, quality control in Australia and Japan – as a basis for analyzing and comparing quality control systems in practice in the two countries.
2. To make a detailed study of quality control systems as actually practised in selected Japanese firms and to compare that to quality control practices and systems in selected firms operating in Australia.
3. To explore in some detail the differences between Australia and Japan in the conception and practice of quality control.
4. To assess as far as the evidence allows the relevance of the different conceptions of quality control in Australia and in Japan to the perceived failure of quality systems in Australia.

[5] For a discussion of these issues, see Chapter 8.

Methodology and Structure

The methodology employed to explore these objectives consists of two main components. The first is a comparative analysis of the two bodies of literature, concentrating on conceptual issues and highlighting the differences between the Japanese and the Australian/English approach. The second is an empirical study of a small number of cases studies to ascertain to what extent prescriptions and issues raised in the literature were reflected in actual quality control practices and to compare the actual practices employed by Japanese and Australian firms. It was hoped by a combination of these methods to arrive at a clearer delineation of what constitutes an effective quality control system in manufacturing industry.

Comparative Analysis of the History and the Literature

The literature review begins with an outline of the historical development of the quality movement in Japan (Chapter 2) and Australia (Chapter 7) in the postwar period. This is followed by a detailed analysis of the Japanese language literature (Chapter 3), with reference to the literature on production management and production systems. One of the major tasks here is to attempt to extract from the Japanese literature a specification of the technical variables by which systems at the individual firm level can be compared. An analysis of the English literature, including empirical studies, is presented in Chapter 8 in order to highlight the limitations of existing studies in terms of the concept, definition and analysis of quality management practices in Australia.

The analysis of the two bodies of literature seeks to clarify the differences in approach to and interpretation of quality control between the Japanese and English literature and also to indicate the limitations in the English literature with respect to the technical aspects of the quality control system and the relationship between the quality control system and the production system. In order to clarify the relationship between the technical and social aspects of quality control systems, other relevant literature, such as industrial organization, technology and the organization of work, is also canvassed.

The Case Study Approach

The case studies are limited to manufacturing industry because it is felt that special problems apply to the study of quality control systems in the service industries.[6] For example, not least of

[6] Although general claims are made by major Japanese authors such as Ishikawa about the application of quality control to the service industries, it was widely acknowledged in the 1990s that one of the failures of Japanese QC had been that quality control was not seen as relevant to the service industries. (See, for

these is the definition of "product" and what constitutes "quality" of the "product". The case study method was chosen because of the need to collect detailed data as a basis for testing and refining an analytical framework which will enable comparisons to be made of the organization and operation of quality control systems in manufacturing firms – both nationally and internationally. The case study method is appropriate for this task because what is lacking is a detailed understanding of how quality systems are organized and operate, particularly the technical aspects of those systems in manufacturing situations. For arguments in support of the case study approach to the study of quality management and quality control systems, see Simon, Sohal and Brown (1996) and Sohal, Simon and Lu (1996).

Data was collected in the form of observation, documentation and semi-structured interviews. Semi-structured interviews were considered most appropriate because:

- terminology, the meanings attached to various terms and actual practices relating to quality control vary considerably;
- they provide the flexibility to identify actual practices and variations in practices which a more rigid questionnaire format would fail to do, as this format has a tendency for similar, even only slightly similar practices to be forced into predetermined categories or conceptions; the objective was to identify the actual quality management practices employed on a routine/daily basis; and
- yes/no answers to a standardized questionnaire cannot provide an assessment of the adequacy or effectiveness of the quality control system or practices in place.

The problem of form without content is well illustrated by Wood and Preece (1992). In a study of the utilization of statistical process control (SPC) techniques or what they refer to more broadly as the "measurement-based approach to quality" (MAQ), they found that:

- mistakes were being made in the application even of relatively simple techniques and were not being detected even by, for example, software providers or company staff;
- certain techniques were unsuitable for the purpose for which they were being used;
- SPC techniques were being used because senior management had taken a decision to do so or to comply with the requirements of major customers. So employees were under pressure to "be seen to be using" a technique even though it was being incorrectly used or being put to little or no practical use; and
- particularly in the case of computerized systems, the output and screen displays were often too technical and difficult for the intended users.

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example, Kano 2001.)

In the light of findings such as the above, questions such as "Has your company introduced SPC?" (yes/no) or, even worse, "Does your company use Taguchi techniques?" (yes/no) become virtually meaningless as indicators or "measures" of the viability or efficacy of quality management or practices.

The Case Studies

Two companies in Japan and three companies operating in Australia (two Japanese subsidiaries (one a subsidiary of a company studied in Japan) and one non-Japanese company) were selected and interviewed for the case studies. The rationale for the three way comparison was based on the view that, on the one hand, Japanese subsidiaries could be expected to have the advantage of the knowledge and experience of the parent company in operating quality control systems while, on the other, lack of familiarity with the socio-cultural and institutional milieu in Australia might inhibit their ability to implement programs effectively.

All are major, large scale manufacturing enterprises. Only one of each company's production facilities was chosen for the study. Each case study involved: detailed inspection tours of the factory/plant, collection of extensive documentation on all areas of interest, observation of quality control and other related meetings wherever possible.

Interviews of 1.5-2.0 hours duration were also arranged with the following staff:

- at the factory/plant level:
    - manager/senior engineer, quality control and/or inspection;
    - manager, major production area;
    - supervisor/foreman, in same production area;
    - group leader/leading hand, in same production area;
    - manager/senior engineer, engineering;
    - manager/senior engineer, maintenance;
    - manager, education and training;
    - manager, personnel;
- and, where the positions exist:
    - organizer/coordinator, QC circles;
    - coordinator, plant QC centre;
- and, at head office, where practical:
    - manager, quality control.

The interview schedule sought detailed information in relation to:

- the organizational structure and activities of the company and the role of the particular factory/plant in relation to the whole;
- composition of the workforce;
- the production process and production management;
- the organization and operation of the QC system;
- education and training programmes (QC-related, other);
- QC-related and other meetings; and
- QC circles and other group activities.

The companies in question (Canon, Bridgestone, NEC and General Motors Holden) were all very cooperative, and the interviews were conducted over 1998-2001. For each company multiple visits to the plant were required, and a vast quantity of material was collected for analysis. The material is interpreted in the light of the historical and literature analysis (Chapters 2 and 3 for Japan and Chapters 7 and 8 for Australia), and results of this analysis are summarized in Chapters 4, 5, 9, 10 and 11 below.

Specification of Conceptual Framework

There are three key aspects of the conceptual framework of this thesis. The first concerns the conceptualization of industrial organizations. For the purposes of this thesis, industrial organizations (and subsystems such as the management system and the quality control system) are identified as socio-technical systems. The relationship between technology and other aspects of organizations has long been an issue of interest to social scientists however failure to adequately specify the technical dimension has continued to be a problem, even for socio-technical systems theory. As Woodward wrote many years ago, "the technical variables on which the differences in structure and behaviour depend have not been isolated. (So) the concept of a socio-technical system remains largely an abstraction" (Woodward 1965: 37). An attempt will be made to develop a clearer conception of the technical dimension of quality systems as socio-technical systems. For reasons that will be discussed later, this study of quality control systems is limited to manufacturing industry.

As part of a socio-technical system, the social, the technical and the management system are defined as follows.

The technical side of the organization refers to the production system or the production process or as Hitomi (1979) puts it the physical transformation process and in the case of the quality control system, those aspects which are directly concerned with controlling and improving that process.

The social refers to the organization of the people carrying out the work in the firm, covering both the formal and informal organization. While the main concern here is with the formal organization as embodied in the management system, other aspects raised in the literature will also be considered.

The management system must control both the technical and social aspects of the industrial organization. As Woodward has pointed out, a management system has two functions; one, "to produce a design or mechanism for the coordination of the work" (technical) and two, "to identify the source of authority, establishing a network of relationships to enable people to work together" (social) (Woodward 1965: 122). Many activities of the enterprise – such as training or even small group activities – can be regarded as having both a social and a technical aspect. While it is often difficult to draw a sharp line in practice, the conceptual distinction is important.

The second aspect is the conceptualization of "process". Following Hitomi (1979), the "process" is regarded as the physical transformation process. From a production systems engineering perspective, Hitomi divides the production system into a transformational aspect (the production process itself) and a procedural aspect (the management system) and maintains that full integration between the two is essential to an effective operating production system. By making a clear distinction between the two, we can examine the relationships between QC and the production process and QC and production management. These relationships are only touched on briefly here but are important to delineating the structure and function of the quality control system within the organizational whole.

The third aspect is the relationship between quality control and the production process. Following Hartz (1974), quality control is identified as fundamentally one of the control systems of the production process or the physical transformation process. Again this allows us to consider more clearly the relationships between quality control and the production process and quality control and the other control systems of the production process. The fact that the approach to quality control in Japan had much broader ramifications for the organization of production and production management does not change this fundamental nature.

Finally, a few points need to be made about the scope of this study. Firstly, this study of quality control systems is limited to manufacturing industry. Secondly, it concentrates on large scale companies. Thirdly, it is concerned with the company's own internal operations (rather than for example relationships with suppliers) and fourthly, it focuses on the production function (rather than for example the product development process).

The final issue which needs to be mentioned here is the problem of definition. There are a number of issues. In the English literature, there is no widely agreed definition of quality control, quality management or any of the variants.[7] Thus, as Dawson so succinctly put it, "... while there are characteristics of TQM, part of its attractiveness stems from its ambiguity – in meaning different things to different people" (Dawson 1994: 57). Despite this many authors discuss quality control as if the definition is known and agreed. Finally, there have been few systematic attempts in the English literature[8] to compare the definitions and interpretations used in the English and Japanese literature. Indeed, the "ambiguity" in the understanding of Japanese quality control is even greater – not least because that understanding is usually drawn from interpretations of the writings of those (notably Deming and Juran) who are thought to have "taught" Japan about quality control.[9]

One of the consequences of the difficulties of finding an agreed definition of quality control is that quality control systems are discussed in terms of "core concepts" or "critical factors" and so on. However, it is argued that existing analyses in terms of "critical factors", "key dimensions" or "quality activities" are inadequate and incapable of providing reliable guide to effective quality control practices which can be applied to the solution of the practical problems encountered by industry. Instead what is required are tools which enable quality control to be assessed as a system which is both technical and social and is integrated and interdependent with the production system.

For the purposes of this thesis, a quality control system is defined as:

> A comprehensive and practical framework linking quality, cost, delivery and productivity by eliminating waste and improving product quality and the process by which the product is manufactured.

[7] While it may appear that this problem has been resolved, at least to some extent, by the dissemination of the ISO9000 series, it can also be argued that the 8 quality principles are a compromise which resulted from failure to reach an agreed definition.

[8] Though not necessarily systematic, comparisons are made in the Japanese literature about the ideas and concepts in Japanese and English. In English, Schonberger (1984), Sprouster (1987) and Blakemore (1989) comment on the differences between the Japanese approach and 'conventional wisdom' in the West/ Australia.

[9] For a critical assessment of Deming's role in the development of Japanese quality control, see Tsutsui (1998: 197-8).

Key Findings

In conclusion, the main findings of this research can be summarized as follows.

1. The quality management system and practices which developed in Japan over a period of decades focused on the production process and the technical aspects of quality control.

   This involved removing waste in all aspects of the system. The approach to the analysis of the production process was comprehensive and pursued vigorously in terms of all four Ms – with no bias towards one particular aspect such as "man" (or "people"). In particular, the focus was on improving process capability (the dismantling and reconstruction of the production process) which is an engineering task. A vitally important proviso which governed the approach to process improvement was that improvements should "make it easier to do the job well". This task was not left only to shop floor workers or even production departments, but informed and underlay the activities particularly of production engineering staff but also other support staff as well. Importantly, interaction and cross-fertilization between engineering staff and production workers and supervisors is a learning experience for both parties which in turn facilitates process improvement and ultimately feeds into manufacturability of design. This interaction is not limited to teams or cross-functional teams but occurs in a range of contexts and forums.

2. The system was thorough and rigorous relying on formal documented procedures and scientific and statistical methods to collect and analyze data as the basis for both control and improvement of the production process/system.

   Programmes were preceded by careful preparation and planning and systematically implemented over a period of years – typically at least three years. Over a period of about 50 years, the level of performance and the sophistication of the system were raised by successive, cumulative programmes and the introduction and refinement of new methods and techniques. The emphasis was on management control and effective policy deployment and coordination across all levels and areas of the organization in relation to both the quality system and management in general. Japanese stressed management by policy (in contrast to management by objectives) and crossfunctional management – the use of formal structures to ensure consistency, coordination and cooperation. There was a stress on the need to prioritize objectives, to ensure that resources were allocated to the greatest effect but at the same time on the importance of a strict regime of day-to-day management of operations – the distinction between prioritized and routine management which was based on the interrelationship between process improvement and process control. For this purpose, objective data obtained by the rigorous application of scientific and statistical methods was essential. While personal experience was acknowledged as valuable, personal opinion and guess work were considered unproductive and unacceptable.

3. In Australia, on the other hand, the focus was on the social aspects of quality control – dealing with people issues or trying to achieve cultural change – and the role of engineering staff was limited at best.

   According to the literature, management had to change old habits of laying the blame for all problems at the operation and expecting workers to simply take orders. They needed to drive out fear by instituting non-punitive two way communication and encouraging participation and they needed to provide security of employment with the objective of developing greater trust and cooperation between management and workers. Otherwise quality management programmes would not be successful.

   In reality, despite the preoccupation with and the effort expended on people issues, "ownership" and cultural change, NEC and GMH failed to achieve significant impact at either the shop floor or in management ranks. Failure to convince management was due in no small part to failure to demonstrate substantive results (except for some brief initial gains) and this in turn was linked to the fact that there were too few people with too little knowledge. This situation was not remedied by training programmes which were inadequate in terms of both content and coverage. The widespread use of the word "people" obscured both a clear differentiation of the roles of different categories of employees and therefore of their different training needs – a problem which was further exacerbated by the fact that "people" was often a euphemism for operators.

4. It was found that the differences among the three Australian companies were related to the model which each had adopted. The most successful (Bridgestone) had adopted the Japanese model while the two which were largely unsuccessful (NEC and GMH) had adopted the Australian model.

   The differences among the Australian firms were not, as expected, related to whether or not they were subsidiaries of Japanese companies. NEC adopted the Australian, not the Japanese model. Nor were the differences related to the industry to which the firm belonged – the two firms which belonged to the car industry (Bridgestone and GMH) had adopted different models. Moreover, although Bridgestone had obtained and GMH was working towards QS9000 accreditation, this too was not sufficient to impose similarities in the systems and practices adopted.

5. The results of this research suggest that there is a "reverse effect" of the technical on the social aspects of organization; that is, concentrating on the systematic implementation of the technical aspects of the quality system and improving process capability in the sense of "making it easier to do the job well" will encourage and facilitate the participation, involvement and commitment of shop floor operators and other employees.

   The view was widely expressed in the Australian/English literature and in the Australian case studies that the success of quality management programmes in terms of obtaining measurable improvements in quality performance depends first on addressing and resolving the social aspects, the cultural and people issues – that changing the social aspects of the system will have a beneficial effect on the technical aspects. Here it is argued that the effect works in the opposite direction from the technical to the social aspects of the system – the reverse effect. It is necessary to establish formal procedures and techniques to control and improve the production process and this requires the full involvement of engineering departments and close interaction between engineering and production – with the important proviso that improvements must make it easier to do the job well. Otherwise, the effect of changes to the social aspects of the system on quality performance and the changes themselves are likely to be short-lived.

6. It may be the case that the shift away from and the dilution of Total Quality Control in Japan by the inclusion of Western approaches after the mid-1990s has contributed to the quality problems being experienced by some Japanese companies in 2010.

   The results of this research give rise to the speculation that the spate of quality problems which is currently afflicting some Japanese companies may have a lot to do with the importation after the mid-1990s of Western interpretations of TQM which have distracted attention from the core of Japanese TQC – an unequivocal focus on the analysis and improvement of the production process. It may also be that the adoption of Western approaches to TQM by overseas Japanese subsidiaries has similar implications for the level of quality delivered by overseas operations and suppliers in increasingly global supply chains. But this remains only speculation. Detailed analysis of this hypothesis is beyond the scope of this thesis, but is an important area for further research. This study provides an important benchmark against which to examine the effects of subsequent attempts to reorient Japanese quality control and integrate TQC as it developed in Japan with TQM as it developed in the West.

CHAPTER 2. The Development of Quality Control in Japan: An Historical Introduction

The Context for the Emphasis on Quality Control

The introduction and dissemination of quality control followed diametrically different paths in Japan and Australia. In Japan, the movement started in the early postwar period and has continued to this day – a period of over 60 years. In Australia, quality control began to attract attention in the late 1970s and gathered momentum in the 1980s but by the mid-1990s had been swept aside by the "best practice" program, having lasted for a period of barely 20 years. In a sense, the impetus for the movement in both countries sprang from a sense of crisis. But the crisis which faced Japan in the aftermath of the Second World War was far more serious and "life threatening" than that which faced Australia in the late 1970s and 1980s. The history of TQC/TQM in Australia is outlined in Chapter 7. In this chapter, we look briefly at the history and dissemination of quality control in Japan.

The socio-economic context of the introduction of quality control[10] was one of economic devastation and turmoil following defeat in the Second World War. By the end of the war, a large technological gap had built up between Japan and other industrialized countries because of the increasing isolation leading up to and during the War and the major advances in technology and management methods made by the Allies during Japan's period of isolation. There were many in Japan who regarded the backwardness of Japanese industry and the poor quality of its products as a major cause of its defeat in the War. While Japanese industry benefited enormously from special procurement for the Korean War (which in some ways put the Japanese economy back on its feet), the Korean War again reinforced the awareness of the poor quality of Japanese goods. As a condition of economic recovery, Japanese were acutely aware of the need to shake off the prewar reputation of their products as 'cheap and nasty' (*yasukaro, warukaro*) in order to compete successfully in international markets (Udagawa 1995; Ishikawa 1989).

It goes without saying that the rebuilding of Japanese industry was the most important issue facing the wreckage of war-devastated Japan – to feed, clothe and re-house its people. This task was made more difficult by the loss of overseas territories, which not only meant a flood of

[10] Here "quality control" is used as a generic term to describe all forms of quality management systems and practices – as are "quality assurance" and "quality management system". In the interviews, "quality control" was often taken to mean an old-fashioned approach which had been superceded by TQC or TQM.

returning expatriates and military personnel, but also the loss of sources of raw materials and overseas production capacity as well as markets. It has been estimated that by 1945 domestic production capacity alone had been reduced to nearly half its prewar level, while Japan's population increased by more than 6 million (over 8%) in the two years from November, 1945, as both military and civilian personnel returned from the overseas territories (Katsumata 1995; Gordon 2003).

It is no secret that during the early postwar years, many thought it would be decades before the Japanese economy recovered, if at all. In addition to the devastation of the economy, Japanese business was dogged by considerable uncertainty arising from the possible prosecution of business leaders (some were banned), the planned dissolution of the zaibatsu (which was never completed) and demands for reparations (which did in fact see some production machinery and equipment shipped abroad, though these plans too were abandoned at a fairly early stage). However, despite the hardship and confusion, some business organizations recovered surprisingly quickly.[11]

The fact that recovery began so quickly was due in no small part to the so-called "reverse course" in Occupation policy which saw a shift from punishment to rehabilitation; the associated "Dodge Line" which finally brought rampant postwar inflation under control; and the Korean War boom, and subsequent procurement for US forces based in Japan, which provided vitally needed foreign exchange. This enabled the purchase of raw materials, machinery and equipment essential to the revival of Japanese industry – purchases which would not have been available for many more years if Japan had been forced to rely on exports to generate the foreign exchange to finance its imports. Following the "reverse course", US patronage and support were also important in smoothing the way for Japan's reintegration into the world economy and its admission to the GATT, the IMF and the OECD – the organizations administering the world economic and trading system.

Another set of pressures were brought to bear on Japanese industry in the 1960s in the form of trade and capital liberalization. Japan joined the General Agreement on Trade and Tariffs in 1955 but the pace of trade liberalization was slow until 1960. In 1960, the government announced a three-year trade liberalization plan and thereafter the rate and level of liberalization proceeded well ahead of plan.[12] The leaders of the quality control (QC) movement adopted the

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[11] For an overview of early postwar economic history of Japan, see Katsumata (1995), Nakamura (1994) and for a more general history, see Gordon (2003).

[12] Exceptions were made for some categories of products, particularly agricultural products and leather goods for example. The latter had been the exclusive occupation of the outcaste group, *eta* or *burakumin*,

catch phrase "quality control to meet the challenge of trade liberalization" and promoted quality control as the means to achieve the cost and quality necessary to export to overseas markets. (Ishikawa 1989) In fact, in 1963, the then Managing Director of JUSE, Ken'ichi Koyanagi, published a major paper on "Quality Emphasis in Japan's Postwar Trade" prepared for the 13th CIOS International Management Congress in New York. Japan was admitted to the OECD in 1964 but was not immediately required to comply with the organization's capital liberalization codes. However, when the government did formulate a basic policy on capital liberalization in 1967, Japanese companies had to prepare themselves for the possible entry of American or European multinationals into the Japanese market[13] (Koshiro 2000).

The Introduction of Quality Control in Japan

Initially, the Civil Communications Section (CCS) of the Occupation Forces played a key role in the introduction of QC, particularly SQC (statistical quality control), in postwar Japan. A reliable communications system was essential if the Occupation Forces were to exercise effective control over the country. Because of serious problems with the telephone system, and particularly the high failure rates of valves and delays in effecting repairs, the CCS decided to undertake direct inspections of the telephone and radio communications equipment makers. In May, 1946, a group of CCS staff led by Coombs inspected NEC's valve factory at Tamagawa and advised that the company should introduce statistical quality control. Starting later in the year, engineers from NEC met regularly with Magill (a quality engineer from Western Electric who was the most experienced QC person at CCS)[14] for advice on how to solve their production problems. CCS planned to use NEC as a model for the introduction of SQC. The advice of CCS engineers was not limited to NEC. Between 1946 and 1950, CCS staff visited all five major communications equipment makers (NEC, Toshiba, Matsushita, Fuji, and Oki) and even small companies employing as few as 6-30 workers in Tokyo's Shinagawa area. In fact, inspections were not limited to the Tokyo area but included Shizuoka, Nagano, Osaka, Kyoto and Kyushu (Sasaki and Nonaka 1990).

Domestically, a number of organizations which played a key role in the introduction and

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and so import restrictions were continued to protect their livelihood.

[13] Udagawa et al. describe the case of Komatsu which, in the period 1961-64, was faced with the full liberalization of trade and the challenge of dealing with the entry of Caterpillar into the Japanese bulldozer market. This case is very revealing of the state of development of Japanese industry at this time and of the sort of forces which propelled the adoption of quality control in Japan. (For details, see Udagawa, et al. 1995: ch. 4.) On the postwar modernization of Japanese industry, also see Tsutsui (1998: chapters 5 and 6).

[14] Magill was one of a number of engineers seconded to CCS, GHQ from AT&T (Sasaki and Nonaka 1990).

dissemination of QC were established in rapid succession after the War. These included the Japan Standards Association (JSA) (*Nihon Kikaku Kyokai*), established in December 1945; the Japan Union of Scientists and Engineers (JUSE) (*Nihon Kagaku Gijutsu Renmei* (*Nikagiren*)), established in May 1946; and the Japan Productivity Centre (JPC) (*Nihon Seisansei Honbu*)[15], which was established in February 1955. These, together with the Japan Management Association (JMA) (*Nihon Noritsu Kyokai*), which had been established during the War in 1942[16], were the major organizations concerned with the dissemination of quality control in Japan. In 1949, a group was founded at JUSE, the QC Research Group (QCRG), and commenced the study of quality control. Also in 1949, Nishibori (a former employee of Toshiba) joined the JMA and began work as a consultant in quality control. In the same year, it was the JSA that offered the first seminar on quality control for two days in Tokyo and, later in the year, took up quality control as a major issue at its National Conference for Production Engineers (*Seisan Gijutsusha Taikai*). In the same year, JUSE also offered its first Quality Control seminar series (for a total of 190 hours), which later became known as its Basic Course.

In 1950, JSA set up its Committee for the Study of Quality Control Methods, with 5 specialist sub-committees (that is, control charts, tools, diagnosis, implementation and sampling inspection). In 1951, The Iron and Steel Institute of Japan (*Nihon Tekko Kyokai*) established a Sub-Committee on Quality Control and started the study and introduction of quality control. However, it was JUSE – the union of scientists and engineers – which emerged as the main organization concerned with the study and dissemination of the ideas and techniques of quality control. It was not until 1970 that the Japanese Society for QC (JSQC), which had been discussed since the 1950s, was established. The JSQC was essentially an academic association unlike its American counterpart, the ASQC, whose members were largely practitioners. (Ishikawa 1989) Other early inputs to the fledgling Japanese quality control movement were the translation of the American wartime Z1 standards[17] published by the Japan Standards Association in 1950 and serialized in the journal *Quality Control* (*Hinshitsu Kanri*) in 1951-52. The Japanese translation of Deming's first lectures in Japan was also released by JUSE in 1950.[18] From the first number of the first volume of the journal *Quality Control*,[19] a lecture

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[15] The JPC changed its name to the Japan Productivity Center for Social and Economic Development (JPC-SED) in 1994 as the result of a merger with a sister organization, the Social Economic Congress of Japan (SECJ) formed in 1973 but subsequently changed its name back to JPC in 2009.

[16] JMA was formed by an amalgamation of two organizations – the Japan Efficiency Federation *(Nihon Noritsu Rengokai*) (formed in 1927) and the Japan Industrial Association (*Nihon Kogyo Kyokai*) (formed in 1931).

[17] The Z1 standards had earlier been used by Sarasohn of the CCS as the basis for advising on the implementation of QC at NEC's Tamagawa Plant in 1948.

[18] The following historical survey draws on a number of chronologies published in *JUSE's Quality Control,* issues 5 (11), 1954; 9 (6), 1958 and 21 (3), 1970.

series entitled "How to learn QC" (*Hinshitsu Kanri Nyumon*) commenced and although the title has changed, has continued to be a feature of the journal.[20] Both the content of the journal *Quality Control* and the courses serialized in its pages dealt in detail with the technical content and techniques of quality control. This journal was a journal for engineers with high levels of expertise not only of engineering, but also mathematical and statistical skills. As noted later, this journal proved too difficult for shop floor supervisors, and especially workers, and this led to the publication of another journal to address their needs at a more appropriate level.

In 1950, W.E. Deming[21] gave an 8-day course on quality control for an audience of managers and engineers in Tokyo and Osaka under the auspices of JUSE. In 1951, JUSE again invited Deming to lecture in Japan and the inaugural Deming Prize was awarded.[22] In 1954, JUSE invited Juran to Japan to give lectures on quality control to executives, senior managers and middle managers. At this time Juran visited and advised a number of companies. On the basis of his observations, he suggested that the Japanese were placing too much emphasis on control charts and the mere collection of data, and were not paying enough attention to what data was needed or what it was to be used for; in other words, there needed to be more attention to actively utilizing QC as a "management tool" (Udagawa, et al. 1995; Kogure 1988; Ishikawa 1989). Udagawa et al. make several important observations about Deming's early lectures and his contribution to the development of quality control in Japan.[23] Firstly, the 8-day course Deming delivered in Japan was exactly the same as the course he had delivered in America since 1942 but which had had virtually no impact in America – a situation which continued until the 1980s. Secondly, while Deming did refer to the importance of 'building in quality', he provided no advice as to how this could be achieved. In other words, the particular approach to

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[19] JUSE changed the title of its journal from *Hinshitsu Kanri* (Quality Control) to *Kuoritei Manejimento* – the katakana for the English words, with the English subtitle "Quality Management" in 2002.

[20] The first two courses serialized in the journal *Quality Control* running from 1950 to 1951 and 1952 to 1954 concentrated on the use of control charts, statistical methods and sampling inspection. In 1955, the course was divided into two parts – one concentrating on statistical methods with a particular emphasis on distribution, dispersion and correlation and the other on the role of the various levels of the management organization and on some particular groups such as engineers or QC sections. In 1956, the emphasis returned to process-related matters.

[21] Actually, Deming first visited Japan in 1947 as part of a delegation to advise the government bureaucracy on the use of statistics and public opinion surveys.

[22] Udagawa et al. claim that the original intention of the Deming Prize was as an award for an individual publication which made a major contribution to the theory or application of statistical quality control. But when the first prizes were awarded, two separate categories had emerged – a prize for an individual publication (*Demingusho Honsho*) and a prize for companies implementing quality control (*Demingusho Jisshisho*). (In the first year, 4 companies were awarded the implementation prize.) Other categories were added in 1957, the Small-Medium Enterprise Prize (C*husho Kigyo-sho*) and in 1965, the Divisional Prize (*Jigyobu-sho*) for individual divisions of large companies but both were abolished again in 1995 (Udagawa, et al. 1995: 10-11).

[23] For a critical view of Deming's role in the development of quality control in Japan, see Tsutsui (1998: 197-201).

the analysis, control and improvement of processes was largely developed by the Japanese themselves. Thirdly, Deming made no reference to quality control circles, so these appear to have been an entirely Japanese development (Udagawa et al. 1995). Udagawa et al. believe that one of the most important contributions of Deming and Juran was to convince top management of the importance of quality control. Whereas Japanese engineering staff rapidly became experts in quality control, neither they nor the experts attached to key Japanese organizations may themselves have been able to wield enough influence to convince senior management[24] (ibid; Ishikawa 1989).

The Deming Prize mentioned earlier came to play a very important role in promoting excellence in quality control in Japanese industry. As a competitive prize, it was awarded only to the best performers in quality control. At a time when there were no other such national prizes nor any international standards for quality control systems (such as the present ISO), the role of the prize cannot be underestimated. In 1970, the Japan Quality Prize was established to reinforce high standards. Only companies which had won the Deming Prize at least three years earlier were eligible to apply for the Japan Quality Prize. In other words, one of the main objectives was to test whether companies were able to sustain high levels of quality performance over the longer term.

The close association between the introduction and dissemination of industrial standardization and the development of the quality control movement, together with the direct involvement of the JSA (Japan Standards Association) in quality control training, is also regarded as having made a major contribution to the success of quality control in Japan. In fact, the implementation of statistical quality control and quality assurance was one of the conditions for obtaining permission to display the JIS (Japan Industrial Standards) mark (Ishikawa 1989; Udagawa 1995). In 1953, JSA held its first Quality Control and Standardization course (*QC to Hyojunka*); and the prize for Excellence in Industrial Standardization (*Kogyo Hyojuka Yuryo Kigyo-sho*) was established.

Also of major significance was the Productivity Movement which was launched as a national campaign with full government support in 1955. The movement, prompted in part by an offer from the U.S. government of technical aid for productivity improvement, was initiated by the four leading business organizations in Japan (Federation of Economic Organizations (*Keidanren*), Japan Federation of Employers'Associations (*Nikkeiren*), Japan Chamber of

[24] However, Tsutsui (1998) points out that the founding chairman of JUSE, Ishikawa Ichiro (Ishikawa Kaoru's father), was also the first chairman of *Keidanren* and took considerable trouble to establish strong links with the big business community.

Commerce and Industry (*Nihon Shoko Kaigisho*), Japan Committee for Economic Development (*Keizai Doyukai*). The Japan Productivity Center (JPC) was established as a tripartite organization and the First Productivity Liaison Conference, attended by representatives from government, labour and management, was held in May, 1955[25] (JPC 1990).

One of the JPC's main activities was the organization of overseas study missions, which played an important role in the development and dissemination of modern technology and management methods, including quality control, in Japan. The JPC organized its first mission, the Iron and Steel Industry Study Mission to the United States, in 1955. Although the objectives were more general, this mission also looked at quality control. Subsequently, groups from all sectors of industry were sent on study tours while American management experts and business leaders were invited to Japan. In the early days, programs such as management development seminars and consulting activities were heavily dependent on American experts, who were invited under the US-Japan Technical Exchange Program. Even after the termination of US aid in 1961, the JPC maintained the study tour program sending about 60 teams a year to the US, Europe and other countries. In a period of 35 years after its establishment, over 28,000 participants took part in overseas missions (ibid.). The main contribution of the study tours, especially in the early stages, was in the introduction of modern management techniques in areas such as top management, marketing, industrial engineering, materials handling and so on as well as quality control.

The first specifically Quality Control Study Mission organized by the JPC was in 1958. JUSE organized its first overseas Quality Control Study Mission to the United States in 1963. These missions continued on an annual basis to either the USA or Europe. Generally reports of JUSE's missions were published in its journal *Quality Control*. These missions provided a wealth of information which was critically appraised and compared to the Japanese situation: they provide an interesting contrast to the benchmarking approach later adopted by Australian industry.

Training and Dissemination

In part as a result of the activities of CCS GHQ, which had focused particularly on the training of managers, training received a high profile in the quality movement virtually from the outset. While management training received considerable attention, a much more extensive array of training courses in the techniques and technical aspects of quality control was developed. In

[25] For a review of the productivity movement in Japan, see Shiozawa, Yoshinori (2001) *Seisansei Undo no Kino, Kyo, Ashita*. (The Productivity Movement – yesterday, today and tomorrow), Tokyo: Seisansei Shuppan.

1949, the CCS conducted a management training course for about 20 top executives of the major communications equipment makers (Sasaki and Nonaka 1990). The CCS management course continued until 1953 when it was taken over by *Nikkeiren* (Japan Federation of Employers' Associations). On the advice of GHQ, the Ministry of Labor started TWI (Training Within Industry) courses in 1949. In April-May, 1950, the American Far East Air Force Supervisor Training Course was made available to Japanese supervisors on all American bases. By October of the same year, Japan's Ministry of Trade and Industry decided to introduce this course as part of its Workplace Development Program (*Shokuba Shinko Hosaku*). The American Air Force renamed this course MTP (Management Training Program) and it became established as a course for middle management in Japan. In 1955, the Japan Industrial Training Association (JITA) (*Nihon Sangyo Kunren Kyokai*) was established and took over the TWI courses (ibid.).

In addition to these management development courses, a large number of quality control courses and seminar programs were introduced starting in 1949. The first QC Seminar was a two day seminar held by JSA in 1949 but later in the same year JUSE organized its first major quality control course, which was the forerunner of its Basic Course. The Basic Course was held for three days a month over a period of twelve months, for a total of 36 days. JUSE commenced market research seminars and an operations research (OR) seminar series in 1952-3. In 1953, the JSA launched its Quality Control and Standardization courses. During 1954, 64 QC seminars and seminar series were held around the country attended by 7000 people. In 1956, JUSE commenced its 6-day Introduction to QC Course. There were also specialist courses such as JUSE's Design of Experiments (*Jiken Keikaku*) course introduced in 1955, a short introductory course for Design of Experiments introduced in 1961 and a Computer Course for Quality Control in 1966. The JSA also offered a range of quality control courses (including separate courses for managers and supervisors) in addition to its major 'Quality Control and Standardization' (Basic, Advanced) courses. (For a list of some of the courses offered by JUSE and JSA and the year in which each commenced together with the duration of the courses and the cumulative number of participants, see Table 2.1 in Kogure 1988: 34.)

In terms of QC courses for management, following the visit of Juran in 1954, JUSE commenced its QC Course for Middle Managers (*Bukacho*) in 1955 and, in 1957, organized a three day Special Course in Quality Control for Executives (*Juyaku*) at Karuizawa. These were followed by the introduction of a Special Course in Quality Control for Top Management (*Keiei Kanbu*) (1962) and a Quality Control Seminar for Foremen and Group Leaders (1967) (ibid.).

Another important factor in the widespread dissemination of quality control was the use of courses broadcast on radio and later television. In 1956, the first series of broadcasts on short-wave radio was organized by JUSE. In 1957, the first radio courses on quality control were broadcast by NHK. Ten courses were broadcast during the next five years, in addition to five courses broadcast on short-wave radio between 1957 and 1959. During 1960 and 1961, quality control courses were also shown on NHK's educational TV channel. The radio programmes lasted about 15 minutes and in some cases, were broadcast directly on the factory floor and represented the first exposure of supervisors and factory workers to quality control. It is notable that these courses predate the development of quality control circles by six or seven years (Sasaki and Nonaka 1990; Udagawa et al. 1995).

In 1960, the Month of Quality was inaugurated and became an annual event held in November. Each year, as part of the activities associated with the Month of Quality, JSA published a number of texts which were targeted at different audiences – top (executive) managers, departmental and section managers, staff,[26] lower management and supervisors, and QC circles or different combinations of the above.

Quality Control Circles

Despite the existence of the radio and television courses, the first moves to establish QC circles did not begin until the early 1960s. In 1962, JUSE commenced publication of the journal *The Workplace and QC* (*Gemba to QC*) and the editors advocated the formation of QC circles in the inaugural edition.[27] The First National QC Conference for Foremen and Group Leaders (*Daiikkai Shoku/Kumi-cho Hinshitsu Kanri Taikai*) was held in 1962 but it was not until the following year that JUSE established the National QC Circle Headquarters and held the First National QC Circle Conference (*Daiikkai QC Sakuru Taikai*) in Sendai. For the first few years only a trickle of QC Circles was established. Both these National Conferences were in addition to the National Quality Control Conference (*Hinshitsu Kanri Taikai*) first held in 1951, which was pitched at engineers and academics and considered too difficult for shop floor workers and supervisors. In 1963, JUSE held its first National Top Management Conference, which also became an annual event. In 1965, JUSE held the First National QC Symposium (*Daiikkai QC Shimupojiumu*), which was subsequently held as a biannual event. In 1966, JSA held its first National Q-S (quality and standardization) Conference (*Q-S (Hinshitsu Kanri to Hyojunka) Taikai*).[28] What is noticeable is that separate publications, courses and national conferences and symposia were organized to cater for the different needs of particular audiences and the content

[26] The Japanese word 'sutaffu' refers to all university educated employees, including engineering staff.
[27] The events surrounding the call for the establishment of QC Circles are discussed in Chapter 3.
[28] For a list of the different national conferences set up by JUSE and JSA, see Table 2.2 in Kogure (1988: 36).

– especially in terms of level of difficulty – tailored to the needs of the audience.

It is significant that the promotion of Quality Control Circles did not begin until at least 12 years after the introduction and dissemination of quality control. Moreover, despite widely held views in the West, the findings of Udagawa and his colleagues show that great difficulties were experienced in instigating and sustaining these groups in the early years.[29] The fact that Quality Circles attracted so much attention in the West may not only be because, as Sprouster (1984: 31) suggests, "quality circle activity is the most visible aspect of TQC", but also because the Western interest in QC, and particularly Japanese QC, happened to coincide with a second major wave of diffusion of Quality Control Circles in Japan that occurred in the 1980s and saw their number and participation more than double[30] (Sugiura 1995).

Quality Control and Other Production Management Techniques

The dissemination of QC also proceeded in parallel with the introduction of other production management techniques such as IE (industrial engineering), OR (operations research) and PM (productive maintenance, preventive maintenance). All of these techniques continued to develop over the years and new methods and disciplines were developed and added. (Kogure 1988: 26, 56) In 1952, preventive maintenance (*yobo hozen*) was introduced. In 1953, JUSE commenced its OR seminars and OR was a major issue at the Fifth QC Conference in 1955. The year 1953 also saw the introduction of the work factor (WF) method. JUSE launched the journal *Operations Research* in 1956 and the Japan OR Society was established the next year. Although industrial engineering (IE) had a tradition dating back before the War, the widespread dissemination of industrial engineering began with a seminar held by JMA in 1956 and was further promoted when JPC invited M.E. Mandel to Japan in 1958 to give seminars on IE. In 1959, the Japan IE Association was established and began publication of the journal *IE Review*. The JMA also launched its journal *Industrial Engineering* in 1959. By 1964, PERT (Programme Evaluation and Review Technique) and CPM (Critical Path Method) had been introduced and were becoming more widespread and management-by-objectives was introduced by major corporations such as Japan Telephone and Telegraph and Sumitomo Metals and Mining but apparently soon fell out of favour.[31] In 1965, the Japan Value Engineering Association was

[29] For a discussion of the difficulties encountered in the early stages of the introduction of quality control circles in Japan, see chapter 3.
[30] There would seem to be a number of reasons for this second wave; the need to respond to the difficulties posed by 1) the two Oil Crises in the 1970s (given the country's extreme dependency on imported petroleum as an energy source) and 2) the rising value of the yen during the 1980s – both of which were a serious threat to the continuing international competitiveness of Japanese industry.
[31] Japanese authors criticize 'management-by-objectives' (MBO) as only concerned about outcomes or results and not how those results are achieved. They stress that it is important to know HOW outcomes

formed and commenced publication of its journal *Value Engineering*.

There were lively debates within the pages of the journal *Quality Control* about the relative merits of QC, IE and OR and of the role and importance of specialists in the respective fields.[32] Explanations of operations research appear in the early editions of *Quality Control* and there is considerable discussion of the application of OR in the mid-1950s. Discussions about the relationship between QC and IE (and sometimes also OR) became prominent in the late 1950s and the beginning of the 1960s, probably stimulated by the visit of Mandel and the founding of the IE Association. In essence, the advocates of quality control claimed that QC engineers had taken the lead in introducing and applying the techniques of IE and OR, so there was no need for separate specializations or groups of specialists. This did not, however, prevent the development of IE and OR as separate disciplines in Japan.

Conclusion

Clearly, the range and intensity of the public effort in Japan – the supporting structures available to any firm which decided to introduce a quality management program – fully justified the claims of Ishikawa and others (Ishikawa 1989; Kogure 1988) that the introduction and dissemination of quality control was a major national movement. These structures included a number of organizations involved in the promotion of quality control, specialist journals, an extensive range of courses and seminar programs, radio and television courses, a range of specialist conferences, national quality prizes, the national Quality Month and the national QC Circle Headquarters. They provided information targeted to the needs and abilities of specific audiences from the most simple to the most technical and sophisticated. What is striking is that private consulting firms played little or no role in this movement. Most consulting services were provided by the major organizations or by key academics. Even the role of government was limited and generally indirect – in the form of promotion or endorsement of some of the major organizations or of activities such as the Quality Month.

While many, even most of the ideas in their raw form were imported from abroad, the Japanese continued to develop, refine and modify, and particularly to work out how to apply these ideas; that is, how to turn the ideas into practical, operating systems. The Japanese approach was eclectic and agnostic and proceeded by a process of trial-and-error. All ideas were scrutinized,

(whether good or bad) are achieved in order to know which methods or measures are effective and which are not and therefore to be able to prevent recurrence of the same problem or to take preemptive action (Kogure 1988; Mizuno 1984; Ishikawa 1989).

[32] See, for example, "Quality Control" vol.9, nos.2 and 11 (1958), and vol.10, nos.2, 3, 5 and 7 (1959).

trialed and re-trialed – tried in different combinations and configurations by different firms or even by different facilities of the same firm. Above all the approach was pragmatic. Ideas or rather applications that proved effective were retained and became common practice. Those that were not effective were likely to be revamped and tried again – perhaps many years later and perhaps even by the same firm. When the circumstances of a firm or factory or even part of its operations change, it is not unusual for Japanese firms to revisit and recycle older ideas and operational techniques or methods. In this way, quality control systems have continued to evolve and develop in Japan for more than 60 years[33] and, for this reason, there was perhaps never a sense that the Japanese had perfected a system of quality control.

The next four chapters of this thesis are devoted to delineating further the Japanese quality control system as it developed after the Second World War into a mature system by the mid 1990s. In Chapter 3 the Japanese literature on quality control is reviewed, and Chapters 4 and 5 provide case studies of quality control systems in operation in two Japanese companies (Canon and Bridgestone), based on visits to specific company plants and detailed interviews with company personnel. An interpretation of the mature quality control system is provided in Chapter 6.

[33] As noted in Chapter 1, the concern of this thesis is with the period up to the mid-1990s (a period of about 50 years) at which point a major revamping of the quality movement began in an attempt to "harmonize" (reconcile and integrate) Japanese TQC with the development of TQM overseas.

CHAPTER 3. The Japanese Approach to Quality Control

Japanese QC (TQC): Emphasis on 'the Technical'

The Japanese approach to quality control is comprehensive and requires that quality be addressed at every stage of the manufacturing operations – from product development and design to purchasing of parts and materials (frequently referred to as relations with suppliers or supplier-customer relations), engineering of production processes, production, maintenance, sales and service, and handling of complaints and product returns. Faults or weaknesses in any part of the system have repercussions for all other stages of the operations, so that quality is only as good as the weakest link in the chain.[34]

Nevertheless, the unambiguous objective of quality control in Japan was to improve product quality and the focus in pursuit of this objective was clearly on the production process/system. All other aspects of the company's operations were relevant in so far as they affected the ability to achieve this objective. For example, Mizuno states:

> It is desirable for administrative and management areas of the organization to participate in QC but it is not unusual from them to concentrate only on improving the work of their own respective areas and **to carry out very little of the work** necessary to ensure the quality of the product such as, for example, providing the documentation of standards for manufacturing or developing the human resources necessary to ensure quality. (emphasis added; Mizuno 1984: 21-22)

In other words, the importance of non-production departments and specifically administrative departments is the extent to which they either facilitate and support or alternatively impede the work of production (interpreted broadly as the production function not just the 'shop floor'). The focus is not on their own "business processes" as such except in so far as changing those processes would facilitate the work of production.

In Japan, quality control is not pursued in isolation or regarded as being in competition with other management objectives such as cost, meeting production schedules (delivery) or productivity. Japanese authors refer to product quality itself as the "narrow definition" of quality, and to the combination of quality, cost and delivery/time management (QCD) as the "broad definition" of quality.[35] (See, for example, Ishikawa Kaoru *"Hinshitsu Kanri Nyumon"*; Ishikawa actually refers to the combination of quality, delivery, cost and service but "S" is also

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[34] For a discussion of the five areas of quality assurance, see Asaka, et al. (2nd edn, 1988: 192-197).

[35] Over time, the original QCD trilogy has been expanded to QCDSME; quality, cost, delivery, safety (or sometimes service), morale and environment.

used for "safety" and even "society" (Ishikawa 1989: 28-29).)

Moreover, quality control and the production system, or more particularly, process control (*kotei kanri*) are regarded as interlocking, interdependent systems. For example, Mizuno asserts (quoted in Tasugi and Mori 1960: 67): "Quality includes not only the physical and chemical properties of the product but also those aspects of quality related to cost, such as yield, unit cost and operating rate".

In other words, the definition of quality includes elements usually considered to be part of process control. The Japan Management Association (*Nihon Noritsu Kyokai* – literally the 'Japanese Efficiency Association') – definition of process control (*kotei kanri*) states in part "to manufacture products of a given quality and quantity by a specified date" (quoted in Tasugi and Mori 1960). In other words, conversely, the definition of process control includes quality. Logically this relationship is not difficult to explain. Once the emphasis moves from "inspecting out" defective products to "building in" quality (*kotei de tsukurikomu*), it follows that the production process must be capable of delivering the desired or target quality.

The key role accorded to process analysis and control is apparent in the work of the key figures in the Japanese movement. Ishikawa, for example, devotes two whole chapters to "Process Analysis and Improvement" and "Process Control" respectively (see *"Hinshitsu Kanri Nyumon"*, ch. 4, 5 (Ishikawa 1989)). This involves much more than statistical process control (SPC) or whether or not a process is in or out of control. Specifically, Ishikawa states that the study of process capability is the basis of quality control. According to Ishikawa, the determination/design of quality (*hinshitsu sekkei*), process design (*kotei sekkei*), planning and control/management of machinery and equipment (*setsubi no keikaku to kanri*), process control and improvement (*kotei kanri ya kaizen*) (which he refers to as the whole range of quality control activities (*ichiren no QC katsudo*)) is not possible without a thorough, detailed knowledge of process capability; the starting point for which is the current actual operating performance of the process (ibid.).

The same is true of Mizuno (1984) and Asaka (1988) who also address process analysis and process planning, control and improvement[36] in detail. Asaka is the most technically inclined concentrating on the collection and collation of data, correlation, process analysis, design of experiments, inspection and quality assurance with a lot of statistical content. Although,

[36] This stress on the importance of process analysis and control is also apparent in the content of the courses serialized in early years of JUSE's journal, *Hinshitsu Kanri*. See *Hinshitsu Kanri*, vol.1 (1950), vol.5 (1954) and vol.7 (1956).

compared to the other two, Mizuno gives more attention to the management aspects of quality control looking at the role of senior and middle management and the quality control activities of the various sections/departments of a company, he concentrates on organizational planning issues in the sense of the allocation of quality control responsibilities throughout the organization, policy deployment and management control rather than abstract notions of leadership common in the English literature. (On process issues, see Mizuno (1984), chapters 10, 12 and on management aspects, see chapters 2, 11, 12 and 13.[37]) However, the importance of statistical analysis is also stressed by Mizuno. Mizuno specifically refutes the view that statistical quality control (SQC) is outdated and has been replaced by total quality control (TQC):

> It is not unusual to find cases where only the administrative work of preparing documents and paper work is carried out and **there is no analysis at all of rejects and other problems using statistical techniques** on the grounds that there has been a shift from SQC (Statistical Quality Control) to TQC. I wish to stress that the use of statistical methods is **even more important** in the case of TQC. (emphasis added; Mizuno 1984: 22)

Chapter 9 on implementation also devotes a major section to production and statistical methods.) In other words, TQC is an elaboration and extension of SQC, not its replacement with something different.

Process Control and Process Improvement

As noted above, process analysis and control, identifying and improving process capability[38] are central to the Japanese conception of TQC and are encompassed within the broad definition of QC expressed by the concept of the QCD trilogy.

An important point here is the distinction between control (or analysis and control) on the one hand and improvement on the other. Ishikawa refers to the "confusion between control and improvement" (*kanri to kaizen no konran*) (Ishikawa 1989: 201) and uses "improvement", in the strict sense, to mean achieving a higher level of process capability. He also makes a distinction between control/management (*kanri*)[39] (in the broad sense) and simple "maintenance of the

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[37] In fact, it is noticeable that a) Mizuno refers to the development and design stage and the production stage rather than area – which does not preclude the involvement of other areas; and b) the main sections in the chapter on the production stage all deal with the process; process analysis, process design, process control, process improvement and quality assurance in the manufacturing process.

[38] Unless otherwise stated, throughout this thesis, "process" means specifically the production process or part thereof.

[39] As is so often the case with the translation of words between Japanese and English, the word "kanri" is problematic. Japanese authors devote some time to the problems of translation and determining which are the most appropriate words to correspond to "control", "management" and "administration". However,

status quo" (*genjo iji*). He points out that, where the emphasis of control/management (*kanri*) is on "prevention of recurrence" (*saihatsu boshi*), it will include some degree of improvement. However, "improvement" in this sense only involves making "full use" of the existing capability of the process. In other words, if control/management is being properly exercised, it can and should result in improvements in performance, including operational performance, but this is different from improvement in the strict sense of improvement in process capability.

Importantly, Ishikawa discusses a number of different ways of categorizing 'improvement'; 'proactive' versus 'reactive', 'localized' versus 'prioritized', and 'improvement of ends' versus 'improvement of means'. The differences between these respective types of improvement are explained as follows. 'Proactive' involves the development of new products and systems to improve quality and process capability whereas 'reactive' only takes full advantage of existing process capability. 'Localized' improvement deals with the small problems in each worker's immediate vicinity which can be resolved with a little ingenuity. In contrast, 'prioritized' improvement requires decisions at the organizational level about which are the most serious problems and which are to be selected as a matter of policy as the most important problems at the company, divisional or factory level. According to Ishikawa, this is the most important type for achieving major improvements in quality performance (Ishikawa 1989).

Ishikawa also stresses that it is important to make a clear distinction between 'improvement of ends' and 'improvement of means' or between objectives and methods. Objectives or targets must be clearly established before the appropriate methods for achieving those objectives can be determined. Concentrating only on changing methods will have little or no effect. But in order to set objectives or targets, particularly concrete, practical targets for each workplace, technical and statistical analysis is essential. Once the objectives or targets are clear, it is necessary to determine the methods and techniques by which the improvement/s can actually be implemented – by which improvement in the process can be achieved (ibid).

The most important distinction is probably between 'localized' and 'prioritized' (*shinkinteki, jutenteki*) improvement – widely referred to in the Japanese literature as small and large improvements (or problems) (*chiisana kaizen/ mondai, ookina kaizen/ mondai*). Ishikawa

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they agree that the meaning of the word "*kanri*" is broader than control and includes the sense of both control and management (Ishikawa 1989; Kogure 1988; Mizuno 1984).
Therefore, throughout this thesis, "*kanri*" will be translated as "control/management". However, in specific instances where there is an established terminology in English, that terminology is used; e.g. "process control" for "*kotei kanri*" and "production management" for *"seisan kanri"*. The translation "control/management" should not be confused with the expression "management control" which I use specifically in contrast to the stress on leadership in the English literature.

regards the latter as more important and mainly the province of engineering staff and departments. Small improvements, on the other hand, are mainly the province of the shop floor and quality control circle activities. Ishikawa stresses that the importance of small improvements is rather to accumulate large numbers, commenting that "if you accumulate enough grains of dirt, you can build a mountain" (ibid.: 203).

While Ishikawa insists that a clear distinction must be made between (process) control and (process) improvement, he notes that the two are highly interdependent. In order to achieve process improvement, the process must first be under control; that is major improvements only become possible when adequate control is being exercised over the process as currently designed. Conversely, improvement cannot be regarded as successful or complete until it has been institutionalized as part of normal practice; that is, has become part of the normal control systems – or, alternatively, until the process has been shown to be reliable after the removal of a control mechanism. Ishikawa stresses that:

> … if improvement proposals are not thoroughly investigated, implemented as part of control/management and effort is not continued until they become institutionalized as part of normal control/management, then even the best attempt at improvement will end in 'froth and bubble'. (Ishikawa 1989: 201; Koura 1990)

In other words, process improvement, in the strict sense, necessarily includes process re-design – to which reengineering later attempted to lay exclusive claim but which, from a very early stage, has been an integral part of Japanese QC/TQC (Hammer and Champy 1993).

An important aspect of analysis of process capability and process improvement is that significant gains in performance (and directly or indirectly in quality performance) are not dependent on the introduction of new machinery and equipment or new technology in the conventional sense.[40] Rather, improvements can be achieved by better process design, that is, more effective combinations of the 4 basic component inputs (4Ms); improved operational efficiency of individual components of the system such as change to a different material (material), changes to the operating regime of machines (machines) or to work methods (methods, man); additional or different training regime (man); or better "accessories" such as jigs and tools, computerization (methods, machines) and so on. The introduction of new modern machinery may even result in a reduction in performance and, in any case, will necessitate a whole new round of learning and modification in order to realize the full potential of the new

[40] Tsutsui (1998) mentions the fact that QC offered Japanese business an alternative to the American approach of reliance on technological innovation and large scale investment in machinery (Tsutsui 1998: 186, 240).

machinery and to achieve a new higher level of performance.[41]

Ishikawa warns about the dangers of seeking solutions to quality problems by introducing 'hi-tech' machinery and equipment.

> With increasing automation, robotization and computerization, the production process is speeding up. If standard work procedures and engineering standards have not been firmly established, if there is insufficient process capability and if a reliable and effective system of process control is not in place, <u>the result will be the rapid production of even larger numbers of defects</u>.[42] ... the first step therefore is to undertake a thorough analysis of process and consolidate the system of process control. (emphasis added; Ishikawa 1989: 297, also see Seishi 1999)

The means by which improvement in process capability and thus quality performance is achieved is the elimination of waste. Importantly, elimination of waste is pursued in relation to the each of the key inputs of the production process – the 4Ms.[43] This means that the production process must be disaggregated into its component parts (the 4Ms) and each part examined for problems or improvements. No single one of these components is sufficient to deliver high levels of improvement in quality. (For example, concentrating only on aspects related to "man" will bring only limited benefits.)

The Japanese concept of waste is a complex and multifaceted one. Firstly, waste does not refer only to rejects or defective product, rework or machine breakdown (that is, waste which results from failure to implement the process/system as planned/designed[44]) but to waste in the sense of

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[41] Ishikawa stresses that process analysis and control and production of QC Flow Chart are necessary preconditions to reap the benefits of automation and robotization (1989: 404).

[42] This appears to have been the experience of one Australian manufacturer (South Pacific Tyre) which as a major plank of its new quality system, decided to commission the development of new, high-tech machines. The results however, were found to be less than satisfactory with the new machines operating at only 75% of capacity (below world best) several years after their introduction and the staged replacement of old by new machines delayed by on-going operating problems (Terziovski, Sohal and Samson 1996). One possible explanation is, as Ishikawa argues, that failure to analyze and understand the existing process, to identify and systematically remove problems meant that these problems were simply "carried over" to the operation of the new machinery and obstructed the full utilization of the new equipment.

[43] Ishikawa refers to the 5Ms – because he wishes to stress the importance of developing appropriate measuring instruments. Here measurement will be treated as part of methods and the more conventional 4Ms used. This is in no way intended to diminish the critical importance of appropriate measuring instruments and systems (see also Asaka, et al. 1988: 4-5).

[44] Better ways to achieve the same result could in most cases be assumed to require less inputs but for conceptual purposes it is useful to draw a distinction even if in reality it is very difficult to draw a clear dividing line.

'Failure to implement the system as designed' can take a number of different forms; a) to all intents and purposes a system does not and never has existed; b) a system has been developed in the past but not up-dated and current practices have increasingly diverged from or grown up independently of the system the use or consumption of any unnecessary or excessive inputs (time, effort (by man or machine), materials, energy, etc) to the process (which is stable and operating at full current capability), the elimination of which results in a new improved process (i.e., less inputs for the same output or the same or less inputs for more output – in terms of quality or quantity or both). Secondly, waste can take three basic forms; i.e., *muda* (waste), *mura* (unevenness, distortion), *muri* (extraordinary effort/force) in Japanese.[45]

From a quality control point of view then it is clear that process analysis and control and improved process capability are essential to improved quality performance and that the primary means by which this is achieved is the elimination of waste – interpreted in the broadest possible way; that is, the elimination of all unnecessary inputs to the process.

Moreover, and most importantly, elimination of waste is the link between quality, cost and productivity. Elimination of waste not only improves the stability and control of the process thus improving quality but also lowers cost and/or increases productivity. Pursuing and achieving simultaneous improvements in quality, cost and productivity is one of the distinctive features of Japanese quality control and production systems which not only ran counter to conventional wisdom in the West (Blakemore 1989; Schonberger 1984) but has also proved difficult for firms in other countries to emulate. Womack and his colleagues observed in their study that non-Japanese firms rarely achieved high levels of <u>both</u> quality and productivity simultaneously (Womack, et al. 1991).

In Japan, the centrality of the production process and the use of statistical methods are expressed in the concept of "*gemba, gembutsu, genjitsu*".[46] Simply put, it means that the actual problem

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as previously described; or c) a system does exist but for whatever reason is not observed by workers. Ishikawa (1989) notes that until a systematic description of current practices is developed, it is not possible to say whether problems result from failure to comply with the process/system or because the process/system itself is faulty.

[45] *Muda* means the output is not commeasurate with the amount of input; i.e. some part of the input is wasted (using an excessive amount of resources or inputs). Unevenness is quite a good translation of *mura* which means that the outcome is not even in the sense that for example, there is unevenness in the thickness of steel plate or unevenness in the "painting" of a drink can where the colour goes on thickly in some parts and thinly in others. *Muri* means excess in the particular sense that an unnecessary or excessive amount of force or effort is required to make something work or to complete a task; for example, having to use a mallet to force a component into the cavity provided for it in another component.

[46] The original idea of "*gemba, gembutsu, genjitsu*" has been expanded into "5-*gen-izumu*" ("Five-gen-ism"). This is a sort of play on words. The "gem" or "gen" is written using the same hiragana but the first three and the last two use different characters which have a fundamentally different meaning. The first three "gem" or "gen" mean something like "the actual" (i.e. the actual site, the actual object, what actually happened) but the second two mean principle or general rule. That is, the two aspects of "*genri, gensoku*" (general principles and basic rules, respectively) have been added to the original 3

(defective product, machine breakdown) (*genbutsu*) must be analyzed in the context of the actual production site and circumstances (*gemba*) at the time of occurrence and in the light of what actually happened (*genjitsu*, *genjo*) not what is supposed to have happened or someone assumes to have happened.

Liker, Fruin and Adler (1999: 6) list 'gembashugi' as one of the "generic features" of 'Japanese Management Systems' however I disagree with their interpretation in two respects. They note two features: 1) many staff, especially engineers, are deployed to support shop floor activities, and 2) there are many tools to enable shop floor employees can be involved in improvement. While this is true, in my opinion, these are not the essence of 'gembashugi' which, as explained above, is a much more fundamental and comprehensive concept which does not centre on the activities of shop floor workers but on process analysis and improvement. Secondly, as explained below, Japanese authors argue the reverse; that is, that it was engineering, especially production engineering staff, who played the crucial role and operators or the shop floor which played a supporting role by taking responsibility for dealing with small problems. This sort of misconception which is common in the English literature has two unfortunate side effects; it exaggerates the importance of what can be achieved by operators, the shop floor or production and grossly undervalues the role of engineering staff.

In other words, the actual production operations should be the focus of attention for all departments in the manufacturing enterprise and engineering staff, in particular, should be familiar with the actual conditions on the shop floor and understand the practical requirements of production when addressing the resolution of problems or designing products and, most importantly, production processes. It does not mean, however, that the 'shop floor' is the only or even the main source of quality problems or has the primary responsibility for resolving those problems. Problems may occur as a result of faulty or unsuitable materials, malfunctioning machinery, poorly conceived processes or lack of effective management control – none of which are the responsibility of the shop floor and most of which are beyond the capability of the shop floor to resolve. In addition, it means that the resolution of problems must use a scientific approach and objective data to investigate what actually happened.

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aspects of "*gemba, gembutsu, genjitsu*". This means that, in addition to investigating and resolving the particular incident or problem, one should attempt to derive (or identify) the general principles and basic rules which generalize the solution or knowledge thus gained and guide or govern its application in the future (so that it is not necessary to 'reinvent the wheel' each time). The most comprehensive and systematic exposition of these ideas is given in a series of seven books by Kobata Tomozo published by JUSE between 1989 and 1998. The final volume in the series is Kobata, Tomozo (1998) *Gogenshugi: monozukuri kaikaku no jissen*. (Five gen-ism: reforming manufacturing operations in practice.), Tokyo: Nikagiren Publishers.

Viewed in this way, it is apparent that the quality control system or the resolution of quality problems is not only or even mainly the concern of production as such – or even less production interpreted as the shop floor or the activities of operators – but is critically dependent on the involvement of all engineering departments, particularly production engineering (Ishikawa 1989; Ono and Negoro 1990).

Thus the quality control system – and achieving a high level of quality performance – is not confined to the application of quality control techniques in a narrow sense but involves the utilization of an extensive range of techniques – industrial engineering (IE), work factor (WF), operations research (OR),[47] programme evaluation and review technique (PERT), value analysis/value engineering (VA/VE), preventive maintenance/ productive maintenance (PM) or total productive maintenance (TPM) and so on to improve process performance. The focus here is on production engineering or production technology (*seisan gijutsu*) as distinct from the development of new products (*shinseihin kaihatsu*) or the introduction of new machinery and equipment as such (*atarashii kikai/sochi no donyu*).[48]

QC and the Production Process

The fundamental nature of the relationship between quality control and process control or the production process as a whole is also apparent if we look at the Japanese literature on production systems and production management.

As in the case of other Japanese authors, Ono and Negoro give high priority to quality control within the overall production management system but go further to identify quality control or quality performance as one of the keys to the competitive strength of Japanese industry (for example, see Figure 7.1 in Ono and Negoro 1990: 162). Ono and Negoro note that the typical policy of Japanese firms was to import basic technology and begin with simple products at the lower end of the market and gradually build up their know-how and expertise until they could compete at the top – in the technologically most sophisticated segment of the market. They give the example of motor bikes but note that the same pattern applies to a wide range of products from radios and televisions to household appliances, watches, production machinery, cars and semi-conductors.

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[47] Concerning the debates about the relative importance and role of QC, IE and OR, see Chapter 2.

[48] For an overview of the introduction and development of some of these techniques, see Figure 2.2 in Kogure (1988: 26, 56). Also see Ishikawa's definition of "quality control" and his Table 1.3. (1989: 2, 87)

However, most importantly, they also point out that:

1) this strategy applied not only to product technology (*seihin gijutsu*) but more particularly to process (or production) technology (*kotei gijutsu*).[49] This ranged from simple modifications such as the development of jigs and tools to improvement to 'standard' machines and the development of new specialized machinery. Further, these improvements contributed to the stabilization of product quality and reduction in cost.
2) the key players in this strategy of improving process technology were production engineers （*seisan gijutsusha*）.

They point out that the work of production engineers in particular was ably and strongly supported by two other groups of actors:

3) cooperative materials makers and machinery & equipment makers[50] who were prepared to develop products better suited to their corporate customers' needs
4) operators who played an important but still supporting role in being able to adopt and master new production methods and machinery with a minimum of difficulty and by taking on the task of dealing with relatively simple production problems.

According to Ono and Negoro, the importance of the latter is that it enabled engineering staff to concentrate on and achieve major improvements in quality and performance (ibid.). (This distinction is essentially the same as Ishikawa's large and small improvements.) It is notable that although aspects on which the English literature has concentrated – the role of production operators[51] (the "shop floor"), small group activities and subcontracting relations – are treated as important supporting factors by the authors, they are not regarded as playing the key role in Japan's competitive advantage.

Ono and Negoro point out that it was the combination of improvements in process technology and investment in modern machinery and equipment which contributed to a high consistent

[49] Ishikawa also stresses this point (Ishikawa 1989: 84-5). He comments that Japanese have been particularly dedicated to developing methodologies and technologies for <u>making</u> things (*monozukuri*) and have made real progress in this area but were relatively weaker in product technology. Even a basic sociology text such as Inuzuka (2003) makes this point.

[50] Importantly, this means that there is a need to distinguish between two distinct groups of suppliers:

1) makers/suppliers of materials, machinery and equipment – usually major national/international corporations in their own right. Typically, there is technical <u>cooperation</u> between these suppliers and product makers (their customers) to improve the technological capability of the latter.
2) the myriad layers of subcontractors supplying components and other materials. Typically, technical <u>support</u> is provided to these suppliers to ensure a satisfactory level of quality and overall performance – although some first-tier subcontractors may closely resemble the Type 1 suppliers.

[51] As far as possible, the word 'workers' is avoided because it is ambiguous. Though in most cases, it appears to be used in the sense of 'operators', sometimes "workers" is apparently used to mean all employees of a company irrespective of status. The problem is that often it is difficult to determine which is which. Here, the words 'operator', 'engineer', 'staff', manager or supervisor are used instead to clearly indicate the status and work role of those discussed.

level of quality and improvement in quality. They also make the important point that improvements in process/production technology and in quality were closely linked and mutually reinforcing (ibid. 163-4). Improved process stability and reliability frequently produce more consistent and higher levels of quality and the elimination of quality problems frequently results in more reliable and efficient processes.

Another Japanese author who develops in more detail the central importance of process technology makes similar observations. Seishi (1999) maintains that it is impossible to make an assessment of the Japanese production system on the basis of labour management relations, subcontractor/supplier relations, organization of labour/work or the management structures and management techniques of the company. It is precisely because this is the approach usually taken that the result has been diametrically opposing views; one that takes a very negative and critical view of the Japanese production system or management system and the other which evaluates it very highly to the extent that it is regarded as a revolutionary and far superior production system.[52]

Moreover, according to Seishi, it is impossible to explain Japanese quality control without exploring Japanese production technology. Seishi claims that what lies behind the differential in quality between Japan and 'the West' is a differential in technological capability – which refers principally to production technology.[53] He argues that the development of production technology (or the Japanese production system) resulted from a complete dismantling and reconstruction of the production process. The production process is dismantled down to a very fine level of detail and only those parts absolutely necessary to the production of the product are retained and incorporated in a reconstructed process – which is in no way fettered by the original configuration.[54]

Further, Seishi also argues that there were two important corollaries of this dismantling and reconstruction of the production process; one, the in-house development of purpose-built

[52] Negative views of Japanese production (management) systems include Dohse, et al. (1985) who argue that the Japanese system simply represents intensification of labour, the UAW who claim that it is simply "management by stress" (Womack 1991) and, in certain respects, Tsutsui (1998). Highly positive views include Womack, et al. (1991) and Dore (1973) who once claimed that Japan had leap-frogged the West and developed a more advance form of labour management so that rather than Japan converging to the West, the West would converge to the Japanese pattern. For a review of the many interpretations in the English literature, see Liker, Fruin and Adler (1999) and Keys and Miller (1984). For one attempt to synthesize the different interpretations into a single "Japanese corporate model", see Porter (2000).

[53] Seishi includes design technology but his analysis/discussion is overwhelmingly concerned with production technology and the production process.

[54] As mentioned earlier, this is completely contrary to the claims of Hammer and Champy (1993) who claim that Japanese TQC was limited to only small, incremental improvement.

machinery and equipment and two, the development of high performance and sometimes even "custom-made" materials. As a result of process analysis, manufacturers became so familiar with the requirements of their own processes that they were able to develop machinery and equipment superior to that available from machinery makers and so themselves became producers and sellers of this machinery. (This was true of both Japanese firms in this study.) Further, it became apparent that the quality of the products of the final producers and their suppliers depended critically on the quality of materials. The largely positive response to pressure from the users (particularly the large corporations) to improve the properties and performance of materials resulted in close collaboration between suppliers and users and in some cases even the development of 'custom-made' materials to meet particular needs (Seishi 1999; Ono and Negoro 1990).

In this sense, one could argue that what the Japanese engaged in was precisely a process of unveiling the 'physical limitations of the production process' and pushing back those limits as far as possible; that is addressing the key issues identified by Woodward – not just increasing, but maximizing prediction and control of the production process (Woodward 1965). Thus the attempt to identify the causes and potential causes of quality problems became part of a much broader effort to control and improve the production process which, in turn, had a major positive impact on quality performance.

Thus it can be seen that the full extent and depth of the relationship between quality control and process control is a relationship between quality control and the design and operation of the production process as a whole. That is, major improvements in quality performance are dependent on process control and improvement (in the sense of improvement in process capability), and the improvement of process capability is in turn dependent on the application of a vast range of techniques which influence the performance of any one of or any combination of the individual components (4Ms) of the production process. All of the 4Ms were regarded as equally important and each was subjected to careful scrutiny in the search for ways to improve process (and quality) performance. In other words, a high level of quality performance cannot be achieved by the quality control system in a strict (narrow) sense but depends on the operation of the production system as a whole. Conversely, the pursuit of improved quality performance has benefits for the production system in terms of increased control and predictability of the production process and the outputs.

Quality and Cost

Related to improvement is the issue of quality cost. Although the concepts and interpretations of quality cost in the English literature were known and discussed in the Japanese literature (Kogure 1988; Mizuno 1984), in Japan, cost tended to be treated in the context of QCD – in Japanese, *hinshitsu, kosuto, noki* or *hinshitsu kanri, genka kanri, ryo kanri* (literally, quality, cost, delivery or quality control, cost control and volume control). Cost referred to production costs rather than specifically quality cost (see Ishikawa 1989; Kogure 1988; Asaka, et al. 1988). For example, Ishikawa explains the 'C' of 'QCD' as any characteristics related to cost, price or profits and as related to cost control/management (*genka kanri*) and profit control/management (*rieki kanri*). The related characteristics include yield, productivity, materials costs, production costs, defect rate, selling price and so on (ibid). Ishikawa stresses the importance of Juran's distinction between quality of design and quality of conformance in two respects. The first is the relationship among quality, cost and productivity. Whereas raising the quality of design will, in general, increase cost, raising the quality of conformance will lower cost and increase productivity. Secondly, he points out that unless due consideration is given to process capability in determining the quality level of the design, it will cause problems for both cost and productivity (ibid.; also see Mizuno 1984).

The fact that a small number of quality problems account for the vast majority of quality costs (particularly in the sense of failure costs) was stressed and, consequently, the importance of identifying and acting on "major quality problems" or improvements which would deliver the greatest reductions in cost ("cost down" in Japanese) (Mizuno 1984; Ishikawa 1989). In general, the stress was on raising quality while also lowering production cost and the test for any improvement was whether the savings obtained would outweigh the costs involved in implementing the improvement or achieving the improvement in quality. Overwhelmingly, the pursuit of quality was regarded as a means of reducing production costs and this pervaded the quality control literature rather than being treated as a discrete issue of quality cost.

Policy Deployment

Another aspect which has received a lot of attention in the quality control literature in Japan is policy deployment. There are a number of general principles which recur in the Japanese literature. All management and supervisory staff should present clear policy and objectives or targets in line with company policy. Policies should become increasingly detailed and concrete at successively lower levels of the organization. Similarly, policy time horizons should become progressively shorter at lower levels of the organization; ranging from 5-10 years or more at the senior management level to about 3-5 years for middle management to 1 year for first-line supervisors (Ishikawa 1989). In all cases, overall policy should be broken down into yearly, monthly or weekly performance plans and targets as appropriate and actual performance tracked against these plans/targets. Results should be evaluated and plans adjusted to compensate for underperformance. Overall policy should be reviewed and revised in the light of performance on a regular basis – even during the term of the current policy. Policies should be consistent vertically across all levels and horizontally across all departments and areas of the organization. There is particular stress on the need for prioritization as the basis for policy formulation and deployment – distinguishing the "vital few" from the "trivial many". (This was of course linked to the importance of identifying the "vital few" in terms of cost.) Finally and most importantly, there is an insistence that objective data is essential to effective policy formulation – objective data obtained by scientific methods and which is thus an accurate reflection of actual operations (Ishikawa 1989).

These general principles form the basis of *hoshin kanri* (management-by-policy) and *kinobetsu kanri* (cross-functional management). The development of *hoshin kanri* and *kinobetsu kanri* are usually dated in the early to mid-1960s which some also regard as the period of transition from SQC to TQC in Japan (Kogure 1988: 162-3, also see Figure 2.2, p.26, 56; Akao 1988). Major Japanese references devote considerable time to both of these approaches to policy and management.[55]

Management-by-policy was contrasted with 'management-by-objectives' which was imported from America but did not become established in Japan. Management-by-objectives was criticized on the grounds that it only set objectives and was only concerned with outcomes/results but said nothing about how these objectives were to be attained. Management-by-policy, on the other hand, was particularly concerned with how the outcome is to be achieved – the means by which it is to be achieved. It was pointed out that it is possible to achieve the "right" outcome in the "wrong" way. An apparent solution to a problem might result in negative side-effects or create problems in other parts of the system. Moreover, it was considered just as important to know how good results were obtained as how and why bad results occurred and to consider whether standard work procedures should be modified accordingly (Kogure 1988; Mizuno 1984; Ishikawa 1989).

The main objectives of cross-functional management were twofold. The first was to ensure that various management functions and policy objectives which were not confined to or could not be addressed satisfactorily by a single department or area were properly addressed and the

[55] For example, see Mizuno (1984: 48-54, chpt.6) and Kogure (1988: chpts.7 and 10). Also see JSA publications, "*Hoshin Kanri Katsuyo no Jissai*" (Using Management-by-Policy in practice) (Akao, Y. (ed), 1989) and "*Kinobetsu Kanri Katsuyo no Jissai*" (Using Cross-functional Management in practice) (Kurogane, K. (ed.), 1988).

responsibilities of each department/area spelled out. The key cross-functional policy objectives were usually given as the QCD trilogy – quality, cost and delivery. Second point was, as is implicit in the above, to ensure consistency of policy across the organization. Japanese authors are particularly concerned about the need to breakdown barriers between departments and to overcome the narrow interests of individual departments and considered that formal mechanisms were necessary to ensure that this happened. Cross-functional management was regarded as one such mechanism (Mizuno 1984; Ishikawa 1989).

Another aspect of policy formulation or development was what the Japanese refer to as the "top-down, bottom-up" approach. That is, while policy is deployed from the top of the organization down to the bottom, the formulation of effective policy relies on the information passed up from the bottom of the organization. As pointed out, there was an insistence that this information should be based on objective, scientific data and not on opinion.

Leadership and strong leadership are mentioned (Ishikawa 1989; Kogure 1988) however the stress was overwhelming placed on effective policy development and deployment and on how policy objectives were to be achieved. See, for example, Asaka (1988) who mentions strong leadership but then moves on immediately to a discussion of cross-functional management and management-by-policy.

Information and Communication

The insistence on accurate, objective information which is widely communicated throughout the company is one of the most outstanding and pervasive features of Japanese quality control. Information and communication are regarded as both crucial to and dependent on effective policy formulation and deployment. On the one hand, accurate information is considered essential to effective policy formulation and on the other, effective policy deployment itself provides information which directs ongoing operations and at the same time provides the framework or guidelines for the collection of relevant information for policy adjustment and future policy (re)formulation.

There is an insistence that information (particularly technical information about the production process) must be based on objective data which is obtained by scientific methods (including but not limited to statistical quality control methods) so that the information accurately reflects the actual state of operations (Ishikawa 1989; Kogure 1988; Mizuno 1984; Asaka, et al. 1980, rev. 1988). The importance attached to objective, scientific data is clearly apparent in the criteria for the Deming Prize. Of the 10 basic criteria of the Deming Prize, six include items referring to the utilization of statistical thinking, methods or techniques and another refers to statistical analysis (for example, see Table 9.2 in Mizuno 1984: 189).

Secondly, there was an insistence that information should be widely available and particularly that it should be available to all effected or related parties who should be involved in examining the information and making decisions. Thirdly, it was regarded as essential that all parties receive the same information (*joho no ichigenka*) – that different parties did not have different information or only some parts of the information. High levels of shared information ensured that there was a common understanding (*kyotsu shita ninshiki*) of the nature of the problem being addressed and of the relative importance of different problems. The Japanese set up structures (horizontal and vertical) to ensure that the related parties meet and exchange information – regular meetings, coordination committees or review committees (*renrakukai*, *kentokai*) and study or research groups (*kenkyukai*) of one kind or another – most of which were permanent structures.[56] These committees or groups are established to review procedures or progress of activities, to explore new proposals, or to investigate the feasibility of new technologies, methods or procedures. The objective was to ensure that all concerned parties are kept informed and have the opportunity to indicate potential problems from their own perspective and also that all relevant information is considered. In other words, in Japan, rather than cross-functional teams, the stress was on incorporating cross-functional objectives in the formal management structure (cross-functional management) and setting up permanent structures to ensure that information was gathered and transmitted throughout the organization.

The presentation of data in an easily accessible format (which may be highly technical depending on the user) was another important aspect – and was not limited to display boards on the production floor which constitute only one part of a much larger flow of information.

QC and the Production Management System

Another fundamental aspect of the Japanese approach is the very high priority given to quality control within the overall production management system.

As has been noted, quality in Japan is not treated as a separate issue but is firmly imbedded in the trilogy of quality, cost and delivery and, secondly, quality control is accorded a very high priority, is treated as a central aspect of the overall production management system. Kai (1987)

[56] Teams and particularly cross-functional teams have attracted a great deal of attention in the English literature but a great variety of structures – often formal, permanent structures – are employed by Japanese companies.

identifies the QCD trilogy as the three primary (*daiichiji kanri*) as opposed to secondary (*dainiji kanri*) control/management methods. Sugamata and Tanaka (1986) identify quality control as one of the 'three pillars' of production management, the other two being production technology and production planning and control. Tasugi and Mori treat quality control and time control as 'direct control/management' in contrast to cost control which they regard as 'indirect control/management'. They argue that the merit of cost control is as a common measure or indicator of performance which allows otherwise disparate aspects of management to be compared but that no amount of manipulation of cost data can lower costs. In their view, the only way to lower cost is by the rationalization of production activities through quality and time control (Tasugi and Mori 1960; also see Ishikawa 1989).

Others accord quality control an even more prominent position. Ishikawa (1989) goes so far as to claim that the quality control system is more or less equivalent to the management system as a whole (*keiei kanri*). More specifically, he comments that quality control provided the organizing framework for the introduction of otherwise disparate modern management methods and techniques which occurred so rapidly after the War. Tsutsui (1998) takes a similar view. In particular, he credits the postwar quality movement – and not the vaunted "lean production" regime (Toyota model) – with providing "an organizational structure and strategy that could effectively disseminate new management models throughout industry"; that is, it stood in the "vanguard of Japanese efforts at managerial modernization" (Tsutsui 1998: 190).

Koura (1990), in a more detailed study, traces the parallel development of TQC, control/management thought (*kanri no kangaekata*) and management practice (*jissenteki keiei kanri*). He focuses on two aspects; the transformation of the Deming Circle/Cycle[57] into the management circle/cycle[58] and the use of control items (also see Kogure 1988). Koura points out that the basic plan, do, check functions had long been a part of scientific management but that around the mid-1950s, the 'check' step was divided into check and act (take corrective action) and the importance of feedback to quality control came to be stressed. The other aspect which Koura traces is the development of ideas about control points (*kanriten*) and control items (*kanri komoku*) and the application of control items to both ongoing management (*iji*

[57] As is often the case, the vagaries of translation resulted in 'cycle' being rendered as 'circle' (*sakuru*) in Japanese.

[58] This represented a transformation from task functions to element functions (see Woodward 1965: 97-8). The essential distinction is that task functions are directed towards specific and definable end results and to a considerable extent can be carried on independently of each other whereas element functions are an intrinsic part of the management process and it is rarely possible to separate them in time and space. This distinction is important. Being a cycle of intrinsic functions means that the PDCA cycle can be applied as a general methodology to any control or management task or problem solving activity.

kanri) and improvement or breakthrough management (*kaizen, genjo daha no kanri*). He identifies Komatsu's "flag system" (*hata hoshiki*)[59] as an important stage in this development. (On the importance of control items, also see Kogure 1988: chpt.9.) Koura sees the development of these ideas as culminating in the distinction between routine or 'daily management' (*nichijo kanri*) and management by policy (*hoshin kanri*) or crossfunctional management (*kinobetsu kanri*) for which separate control items must be set.

Thus the parallel development of TQC and a wide range of other modern management methods seemed to have had two major effects. Firstly, with respect to the relationship between quality control and process control, process analysis, control and improvement came to be regarded as fundamental to effective quality control. In addition, a clear distinction was not drawn between the techniques of quality control and the techniques of process control and a range of other production management techniques so that a broad range of techniques were applied to achieve and maintain high levels of quality and process performance. Secondly, the fact that historically quality control, production technology and modern management methods developed in parallel seems to explain why quality control became such a prominent and highly integrated part of management practice in Japan – as expressed in the QCD trilogy.

Quality Control Circles

Quality circles (or Quality Control Circles as they are called in Japan) have been widely regarded overseas (and also by some in Japan) as a major, if not decisive, factor in the success of Japanese quality control systems and as a distinctive or unique characteristic of Japanese management in general. In a detailed historical study of the introduction and development of quality control in Japan,[60] Udagawa, et al. attach great importance to the role of QC circles. They take the view that the development of QC/TQC constituted a central feature of a distinctively Japanese (*Nihongata*) production system and that, though not an essential part of the production system, the development and spread of the quality control circle movement was an indicator of the development of that system (Udagawa, et al. 1995).[61] Nevertheless, they also draw attention to a number of facts which are generally absent from the English literature. In all

[59] For a brief explanation of Komatsu's *hata hoshiki*, see Udagawa, et al. (1995 : 146-8).

[60] This study points to the importance of both detailed historical studies and detailed case studies in laying to rest widely held preconceptions and misconceptions – often based on cultural explanations – about what is different or "unique" about Japanese management practices.

[61] Also see Tsutsui (1998). According to Tsutsui, the postwar quality movement provided a reformist agenda in the form of QC circles "that could credibly fuse respect for humanity with economic rationality" or, put another way, that could realize "a credible 'humane' Taylorite regime on the shop floor". In this sense, he concludes that, "in the thirty years after World War II, quality control would emerge … as the definitive manifestation of what makes 'Japanese style management' unique…" (Tsutsui 1998: 190-1, 239).

five companies in this study, attempts to introduce QC circle activities did not occur till more than 10 years after the companies first began to develop quality control programmes – in one case, about 20 years later. Despite the popular view that quality control circles were more successful in Japan because they were compatible with Japanese cultural traits[62], four of the companies experienced considerable difficulty in introducing and sustaining quality circle activities. Indeed, in two cases, the first attempt was unsuccessful. In addition, the researchers note that initially attempts to introduce quality control circles and problem solving activities concentrated on supervisors and foremen and further that these early attempts relied heavily on the support and back-up of engineering staff. Indeed, in some cases, it was factory engineering staff who selected and solved the problem and prepared a presentation in simple language. They then helped one or more foremen/supervisors to learn it for presentation at one of the national meetings (ibid.). However, over time first engineering staff and then supervisory staff withdrew from direct involvement in QC circles although supervisory staff continued to play a key role in organizing and monitoring circle activities.

It is notable that the initial attempts to incorporate the "shop floor" in QC activities focused first on training supervisory personnel – ensuring that they understood QC techniques and were competent to organize and lead QC activities. The first major attempt to incorporate the shop floor in quality control activities began with a roundtable discussion for supervisory staff organized by JUSE in 1961 and published in its journal, *Hinshitsu Kanri.* The discussion was to consider the problems faced by supervisory staff in dealing with quality control and the participants put forward two major suggestions. One was the publication of a journal (originally titled '*Gemba to QC*' and later '*FQC*' (1973) (where 'F' stood for foreman) and '*QC Sakuru*' (1988)) which dealt with QC issues at a level more suited to their needs and the other was the establishment of a separate national QC conference specifically for supervisory staff (both of which commenced in 1962). The call for the establishment of QC circles was made in the editorial of the inaugural edition of the journal, '*Gemba to QC*' and the National QC Circle Headquarters (a national centre for the registration of QC circles) and the National QC Circle Conference were established in the following year (Udagawa, et al. 1995).

[62] About Japanese management in general, see Abegglen, James C. (1958) The Japanese Factory: Aspects of its Social Organization. Glencoe, Ill.: Free Press; Levine; Solomon B. (1958) Industrial Relations in Postwar Japan. Urbana: University of Illinois Press; and Dohse, et al. (1985). For a useful but not entirely convincing attempt to sort myth from reality, see Odaka, Kunio (1986) Japanese Management: A Forward-looking Analysis. Tokyo: Asian Productivity Organization. A central concept which is used in these arguments is "*shudanshugi*" (usually translated as groupism). Also see Hazama, Hiroshi (1971) *Nihonteki Keiei: shudanshugi no kozai.* (Japanese Management: The Merits and Demerits of Groupism) (Tokyo: Nihon Keizai Shimbunsha).

Historically, QC circles have fulfilled three main functions: 1) to provide training in QC methods and techniques; 2) as a means for disseminating understanding of and ensuring adherence to standard work procedures and modern management methods more generally; and 3) to engage in problem solving and improvement activities (including reviewing and revising standard work procedures). Historically, and often in terms of the development of QC circles within individual companies, the relative importance of these functions tended to shift over time from training to problem solving (for example, see Udagawa, et al. 1995). While the possibility of major improvement emerging from these activities exists, the benefits of QC circle activities were seen to lie mainly in the cumulative effect (which can be substantial) of large numbers of small improvements.[63] While Ishikawa makes frequent reference to the role of QC circles, he also warns against the misconception that TQC or a QC programme and QC circle activities are one and the same.[64] On the contrary, he explicitly accords them only a minor role in the total quality system, declaring that quality circle activities constitute only one quarter to one fifth of a quality management programme (Ishikawa 1989; Kogure 1988).

In Japan, QC circles are regarded as '*jishu kanri katsudo*', literally, 'self-managed activities' which means that they were often conducted outside working hours. This does not mean however, that the activities were voluntary. On the contrary, it is usual for all operators to be organized into circles in their own work area (based on 'natural work groups' as they became known in the English literature). Thus, while participation and 'respect for humanity' are emphasized as characteristic of QC circles, some hold the view that peer group pressure to "pull your weight" and personnel assessment (*satei*)[65] by the immediate supervisor served to reinforce active participation in circle activities. For example, Dohse et al. (1985) argue that Japanese management uses peer group pressure, the social pressure of the work group as a "functional part of production control" and that this performance pressure is relatively high. They also comment that while lifetime employment offers security of employment, this must be balanced against the costs of the system in which they include dependence on the subjective

[63] The 'productivity' of circle activities in terms of solving problems especially in the earlier period roughly up to the Oil Crisis is unclear. There are a number of factors here. Firstly, as Udagawa and his colleagues pointed out, the priority in the early stages was on training rather than problem solving. Secondly, in so far as circle activities were largely unpaid, companies could afford to allow circles to work at their own pace in resolving problems. However, this must be balanced against the fact that activities were monitored and records kept at both the company and national level and meetings to compete for the best presentation held both internally and externally. Over time, however, the emphasis increasingly shifted towards coordinating QC circle activities with company policy and objectives (Udagawa, et al. 1995).

[64] In the English literature, Sprouster (1987) makes reference to this point. Ishikawa (1989) attributes the importance attached to quality circles in the West in part to the fact that the abbreviation widely used for quality control in Japan – QC – was mistakenly taken to refer to quality circles.

[65] For a discussion of *satei* in personnel assessment, see Tachibana, Toshiaki (1992) *Satei, shoshin, chingin kettei* (Personnel assessment, promotion and wage fixing) (Tokyo: Yuhikaku).

evaluation of the supervisor. Also see Tsutsui (1998) who agrees with Dohse that quality control circles were not genuinely participative because the form and limits of participation were defined by management.

Support Structures (Internal)

Another critically important aspect of QCC activities in Japan was and is the existence of extensive support structures both inside and outside the individual factory or company. As Kogure notes, QC circles did not develop spontaneously, rather their success depended on the efforts of many people belonging to national organizations and the creation of committees and bodies at different levels within individual companies to promote and support TQC programmes in general and QC circle activities in particular. (Kogure 1988) Internally, there is usually a QC circle office separate from the QA/QC department both at the factory level (possibly located in the personnel area or administration) and at corporate level which provides training support, supplies materials and maintain and circulates reports of activities. In large companies, there are usually presentation meetings at the section, department, factory and corporate level – with the most successful presentations at each level going on to participate at the next. The presentations at the corporate level are likely to be published as a booklet each year. Some large companies also hold presentation meetings for their associated companies and suppliers not only within Japan but also internationally. In addition, there are the extensive training programmes in QC techniques and QC circle activities which occur regularly on an annual basis with each intake of new recruits and as employees progress through the career structure.[66] Given that the shop floor cannot resolve all problems themselves, Udagawa et al. (1995) regard the help and support by engineering staff as essential to the success of QC circle activities.

Support Structures (External)

Externally, as noted, a national registration scheme for QC circles was established at the outset and there are QC circle conferences/presentation meetings at both the regional and national level.[67] The reporting and discussion of QC circle activities occurs in the journal "*QC Circle*" which was specifically designed initially for foremen and then later for shop floor workers. Indeed, a deliberate decision was made that the journal should be A5 size so that it could be folded in half and put into the pocket of overalls (Udagawa 1995). For circles registered with the national centre, the journal will arrange meetings with circles from other companies to learn

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[66] Large companies typically have a single intake of new school and university graduates at the beginning of April each year. The new recruits are put through a common initial training programme.

[67] As noted, there is a range of different types of national conferences and symposia related to quality control and targeted at specific groups of employees (for details, see Chapter 2).

from each others experiences. There are also activities organized in association with the Quality Month held annually in November, including publications aimed specifically at circles, circle leaders and supervisory staff. It should also be remembered that for several years before QC circle activities commenced, radio courses had been broadcast throughout Japan, that the "QC Text for Foremen and Group Leaders" (A & B)[68] had been published in 1960. In addition, there is a vast array of 'how to' books[69] which explain various aspect of QC techniques and circle activities in simple terms and which are widely available in general bookshops. So there was a lot of groundwork in place and information circulated well before any attempt was made to introduce QC Circles. Even so the introduction and dissemination of circle activities was a slow and difficult process as Udagawa, et al. (1995) have shown. At the national level, the figures show that the number of circles remained small for the first few years up to the mid-1960s. (For the trend in the number of QC circles registered with the national center between 1966 and 1994, see Figure 5 in Sugiura (1995: 11).)

There was a surge in QC circle activities in Japan in the 1980s when the number of circles and participants more than doubled compared to their previous peak in the early 1970s (ibid.). One of the major reasons for the renewed and even more intense interest was undoubtedly because, having just struggled through the two Oil Crises, Japanese industry was again under severe pressure, this time from the rising value of the yen which was beginning to force even small manufacturers off-shore. Companies were looking for any and every possible source of cost reduction to offset the revaluation of the yen. It is interesting to note that this occurred just when Western countries were taking a keen interest in quality control as one of the reasons for the success of Japanese manufacturing. Although QC circles had first attracted attention overseas in the 1960s as one of the distinctive or unique features of Japanese management practices , these circumstances probably served to exaggerate the profile of QC circle activities in the perception of overseas observers interested in quality control practices.

Training Programmes and Japanese QC/TQC

A critically important part of Japanese quality control is undoubtedly the extensive QC training courses which are part of broader comprehensive in-house company training programs. Training

[68] This was also the work of Ishikawa Kaoru. The A text was a basic introduction to quality control for those who lacked either the time or inclination to undertake more detailed study and the B text was for those interested in further study (Udagawa 1995).

[69] This is a ubiquitous phenomenon in Japan. These books cover everything from basic engineering technology, to the latest developments in information technology to personnel management, book-keeping or international finance. Often the material is presented in a comic or part comic format.

is provided throughout the employees' careers (remembering that the regular employees[70] of large firms are recruited as school/university leavers and employed until retirement), courses are targeted to specific categories of employees, and are graded with respect to level of difficulty. Training covers both technical job skills and management skills, including specific skills and knowledge such as quality control.

The same principles apply to training in quality control with a comprehensive range of courses targeted at specific categories of employees and graded according to difficulty. Ishikawa stresses that all employees should have a knowledge of statistical methods and distinguishes three main levels of education and training for this purpose; basic, intermediate and advanced. Basic courses are for all employees from top and middle management to operators and are mainly directed at raising awareness and understanding of the importance of QC and giving a basic understanding of the seven tools of QC. Intermediate courses are directed to (general) engineering staff and young assistant managers at the operational level and advanced courses to selected senior (specialist) engineers and QC engineers. Each level assumes a mastery of the content of preceding levels. For the purposes of quality related training generally, he distinguishes among eight categories of employees[71] (Ishikawa 1989).

Other Japanese authors also stress the importance of targeting and grading training courses in quality control. Mizuno discusses education and training in relation to six different groups of employees; top management, middle management and staff, QC staff, operators, administration/office staff, research and development staff. However, though grouped together, a distinction is made in the content of courses for middle management and general staff (by which Mizuno means general engineering staff). For the former, Mizuno lists the concept of quality control, control charts (less than 10% of allocated time), statistical methods (about 15% of time) and implementation of QC (to which more than half the total time is allocated). For the latter, in addition to the above four, Mizuno lists under statistical methods testing, estimation,

[70] The major divisions in the workforce of large Japanese corporations are not between professional, skilled, semi-skilled and unskilled but between regular (*seishain*) and non-regular (*hiseishain*) employees. Regular employees are further divided according to their final education level (middle school, high school, college (2 years), university) with separate career paths and pay scales for each level. All graduates in the same category join the same career path with the same training and promotion opportunities. They are recruited immediately on graduation from school or university and generally remain with the same company for the whole of their working life. Non-regular employees include part-time, seasonal and casual employees whose numbers fluctuate depending on the business circumstances of the firm and who are hired and fired on a needs basis. The former enjoy a range of benefits and higher wages, bonuses and retirement benefits which are not available to the latter.

[71] The eight categories are senior management, middle management, general engineering staff, senior engineering staff, administration staff, supervisors/foremen, operators, statistical engineers (Ishikawa 1989).

correlation analysis and analysis of variance and adds a fifth item, analysis and experimentation (1984: 140-148). Asaka distinguishes between four groups of employees for the purposes of education and training and relates education and training to different stages of the development of a quality control system (introduction, development and consolidation). The four groups of employees are top/senior management, specialists, first-line supervisors and operators. Asaka gives examples of course content for the second and third groups in which the stress is even more strongly on statistical methods and technical content generally (1988: 141-5).

As mentioned, quality circles themselves played a significant role as institutions for training operators in QC. According to Udagawa and his colleagues:

> People who do not know a lot about QC circles, think that they are groups for carrying out improvement but this is a mistake. They are first of all groups for the purpose of study and for implementing control/management (*kanri*) to prevent the recurrence of problems (*saihatsu boshi*). (1995: 33)

The ability of quality circles to perform training as well as a problem solving function depends to a considerable degree on the existence of veteran workers who not only have years of experience in circle activities but also a high level of technical skill and experience.

In-house training is supported by an extensive range of courses provided by organizations such as JUSE, JSA, JMA and JPC. As with in-house training programmes, such courses are targeted for level of difficulty and relevance to different groups/categories of employees. There are also numerous conferences, symposia and seminars (regional and national) which provide an important venue for exchanging and disseminating information and learning about quality control. Similarly, the various professional journals play an important education and training role at the individual level. The emphasis on self-improvement (*jiko keihatsu*) is one reason for the vast quantity of "how to" books mentioned above.

Moreover, QC training courses must be viewed in the context of an even more comprehensive in-house programme of training courses in both job skills and management skills. Graded courses in technical skills are available to workers at each stage of their careers, some of which are in effect 'compulsory' and others which are optional.[72] In addition to scheduled training programmes, special training courses will be planned and delivered in conjunction with the

[72] For any skill or knowledge that is considered non-essential, Japanese companies also rely heavily on the individual worker's interest in self-improvement (*jiko keihatsu* in Japanese). However, this aspect of training is probably not very different from Australia where workers, especially production workers, interested in a better job have to go to 'night school' in their own time. The real difference is the extensive range of in-house training programmes provided to all workers in the same category throughout their career.

introduction of new methods or new machinery and equipment. There are also courses in management responsibilities and techniques that are generally provided to all new appointees before they take up their positions.

Japanese QC (TQC): The Social Aspects of Quality Programmes

While reference to the 'social' aspects of quality control programmes can be found in the Japanese literature, their importance should not be exaggerated. Firstly, there are often qualifications attached and, secondly, the rhetoric is not necessarily reflected in reality.

Some extravagant claims have been made about the people or social aspects of TQC programs. For example, Ishikawa makes some sweeping statements about the social aspects of organization and the social role of companies and their management.

> The objective of management … ultimately is the happiness of people; that is, in a narrow sense, of those people related to the company, including all employees (everyone from top management down), consumers, and shareholders or, in a broader sense, all related companies and all members of the society. (Ishikawa 1989: 86)

Koura claims that the philosophy or thinking behind quality control or TQC can or should be regarded as an expression of the ideas of industrial democracy put forward in Sweden (Koura 1990). Claims are also made that TQC provides meaningful and satisfying work (*ikigai no aru shigoto*), a pleasant or "bright" workplace (*akarui shokuba*) and improves human relations at work (*ningen kankei wo kaizen suru*) (Kogure 1988; Mizuno 1984; Ishikawa 1989).

While Kogure notes that in the West, quality circles were often adopted as a discrete device – quite separately from quality control or TQC – to improve worker motivation, in Japan, QC circles were proposed and adopted as one aspect of an integrated TQC system. While he agrees that QC circle activities may have the effect of promoting "self-realization" (*jiko jitsugen*) and improving motivation, Kogure considers that this is unlikely to happen (certainly on a long-term basis) if quality circles are divorced from a wider TQC program (Kogure 1988). In a similar vein, Mizuno contrasts the ZD movement in America which he regards as essentially a psychological campaign to QC circles which provide concrete, practical methods for implementing control/management and achieving improvement (Mizuno 1984). In other words, the success of QC circles is seen to depend on the fact that practical techniques for achieving improvement are provided and that circles are able to make a real and substantive contribution to improving the operations and increasing the prosperity of the company. Improved motivation, satisfying work or better human relations are a by-product of such planned, systematic and practical activities.

The most commonly used expression in the Japanese literature is *zen'in sanka*; participation by everyone. However, to interpret this in the sense in which participation, involvement or empowerment is used in the English literature is somewhat misleading. 'Z*en'in sanka'* is usually paired with '*zenbumon sanka'* (participation by all departments and areas). What is important here is that every area and every person is required to fulfill their role – to make their contribution in order to obtain the maximum benefits from a quality control program The concern is as much – or more – to make the system work as to make employees more satisfied.

Another widely used phrase is *ningensei no soncho* (respect for humanity) – it is this phrase which has probably been most widely repeated in the English literature. This is contrasted to European or American situation where managers and supervisors set the standards and give orders to the workers who grudgingly perform only the work they are directed to do during the specified working hours (Mizuno 1984; Ishikawa 1989). Autonomy/ self-reliance (*jishusei*) and self-improvement (*jiko keihatsu*) (often also grouped with "mutual improvement" (*sogo keihatsu*) in the sense of learning from each other) are frequently discussed as related to or as aspects of "respect for humanity". These characteristics are usually associated with QC circle activities but are also regarded as basic principles (or objectives) of TQC (see, for example, Kogure 1988; Ishikawa 1989). Another characteristic, fully utilizing workers' abilities and potential (*noryoku wo hakki suru*), tends to be associated with TQC programmes generally (Kogure 1988; Ishikawa 1989).

But in all cases it is argued that specific systems and structures are necessary to make these things happen. While Kogure regards participation as a basic principle of TQC, he argues that "simply participating" is not enough. It is also necessary to develop and utilize statistical and scientific methods and to establish control/management systems and to operate them effectively in order to carry out quality control activities effectively and on a continuing basis (Kogure 1988). Ishikawa argues that it is not enough for management to adopt a position that people should be able to realize their human potential and find satisfaction at work. In order for this to happen, there must be a comprehensive and ongoing program of education and training which covers both the principles and techniques of quality control and practical work and management skills. as well as systems and structures which allow employees to utilize those abilities (Ishikawa 1989; Mizuno 1984; Kogure 1988). Ishikawa also contends that people (which may include everyone from top management down) and people's attitudes are often the main obstacles to improvement efforts in a quality control programme but at the same time insists that:

1) What is required is not motivational or psychological campaigns (*seishin undo*) and

everyone "doing their own thing" (*mute katsuryu*) but rather the application of engineering technology (*koyu gijutsu*)[73]and statistical techniques (*tokei shuho*) to analyze processes in order to understand the actual operating conditions and then use scientific methods to improve the process (ibid.).

2) Managers and supervisors must not only present clear policy and objectives but also indicate how – the methods by which these objectives can be achieved and provide the organizational structures and resources necessary to achieve them (ibid.).

Ozawa (1988) also points to the limitations of 'psychological campaigns' in achieving better quality outcomes (see Chapter 8).

Others are much more skeptical and critical of the supposed social aspects or benefits of quality programs. In his study of manufacturing ideology in Japan, Tsutsui states, "in Japan (as in the West), managerial commitment to the humanization of work has remained shallow and, for the most part, rhetorical rather than practical". He goes on to say that "even QC circles – held up as models of democratic and compassionate management – were born of the perennial drive to Taylorize the shop floor"; that is, extract, formalize and standardize the production knowledge of production workers (Tsutsui 1998: 226-9, 243). Nakamura in his study of the 'Japanese production system' from the perspective of the workplace（*shokuba*）or the organization of work (*sagyo soshiki*) makes a similar observation. He argues that the particular organization of work that emerged in Japan was not the result of job redesign aimed at improving QWL (quality of working life) but rather chosen in order to achieve rationalization of production in the particular circumstances that prevailed at the time (Nakamura 1996).

Engineering Staff

As is apparent from the preceding discussion, engineers were the leaders and drivers behind the introduction and development of/ the quality movement at both the national and individual firm level. This applied to engineering staff generally, not just to those directly involved in quality control. As we have seen, engineering staff were accorded a central role in the success of quality control in Japan both in the quality literature and in the literature on production management and production systems. The first journals and conferences were directed to engineering staff, those for other groups of employees both management and supervisors and operators were only introduced later. Udagawa et al. (1995) point out that, in the early years of the quality movement, the vast majority of those who attended external training courses on quality control were

[73] This term is also difficult to translate but broadly '*koyu gijutsu'* means mechanical and electrical engineering technology and more specifically the technical knowledge necessary to make a particular kind of product or operate a particular kind of production system- whether that be chemicals, plastics, steel-making, etc.

engineering staff attached to production departments, not the staff of quality control departments. They also note the vital historical role that engineering staff (not management staff) played in supporting the early development of problem solving and QC circle activities (see above, p. 47). Interaction and cooperation between engineering and production particularly in the form of cross-functional teams engaged in product development has received considerable attention in the English literature (see for example, Fujimoto and Clark 1991; Liker, et al. 1995). However, in the Japanese literature, it is the interaction between production engineering and production which is stressed and this interaction and cooperation is not limited to cross-functional teams but is a normal part of work activities and occurs through a range of structures and forums which control and monitor production activities. Kobayashi (1996, 1994) who reports on a number of studies of the relationships between research and development, production engineering and production, has pointed out that the knowledge and experience of these groups is complementary – one is not a substitute for the other. This is particularly true of the latter two between whom interaction is fairly intense. He observed that whereas research staff, for example, may offer a theoretical explanation for a problem, they may rely on experience of veteran/skilled workers to determine the parameters for practical application. Kobayashi (1996: 71-72, 1994) and Ono and Negoro (1990) argue that one of the benefits of this interaction was that it enabled engineering staff to hand over relatively simple process improvement and maintenance tasks to production operators and so freed up engineering staff to concentrate on high level improvements in production technology. They consider this to be one of the major reasons for the high levels of quality and productivity achieved by Japanese manufacturers.

This interaction provides a mutual learning experience for both parties. It enables engineering staff (particularly process and methods engineers) to acquire knowledge of what causes difficulties for operators in real production situations and thus to design "worker-friendly" processes. It is also important as a means for operators and supervisors to improve their skills and technical know-how by exposure to the expertise of engineering staff – a sophisticated form of OJT or self-improvement. In this way, it ensures that engineering staff are exposed to the interests and needs of production workers at the various stages of developing (or reviewing and revising) production systems. And it also ensures that there is a 'shared understanding' between engineering staff and production about what 'works best' in production situations. Importantly, the knowledge of actual production conditions is fed back from production engineering to product design so that manufacturability is also considered in product design. This cross-fertilization – and the dissemination of the information thus gained among engineering staff and in engineering practices – is facilitated by rotating engineering staff among the various facilities of the company; including departments at corporate and divisional headquarters, R&D facilities and factory operations.

Another group of workers who played a vital role in the success of quality programmes in Japan is veteran workers. As noted, all regular workers have access to the same extensive range of training programmes; OJT and Off-JT, "compulsory" and optional. The term, "veteran workers" (*beteran rodosha/ sagyosha*), which is widely used in the Japanese literature, refers to older, highly experienced and knowledgeable operators who have worked for the company for many years[74] and have had the benefit of the extensive training programmes provided by the company.[75] They have a detailed knowledge of the company's production system and many years experience of problem solving and circle activities.

The results of Kobayashi's research throw some interesting light on the significance of 'veteran workers".[76] He notes that, in the case of one company's decision to introduce continuous casting to produce precision flat steel plate, "a veteran of water cooling <u>was assigned to each work group</u> and took the lead in investigating the method of water cooling" (emphasis added; 1994). In other words, every work group does not necessarily have the expertise to carry out the improvement tasks required of them from time to time. Instead, in such cases, highly experienced veteran workers will be selected and assigned to the group/s. Moreover, Kobayashi notes that, as the result of a reorganization, some of the veteran/skilled workers[77] were later replaced and the proportion of workers who were skilled in all tasks dropped from 80% to 40%. In order to raise the skill level of the replacement workers as quickly as possible, "self-managed activities" (*jishu kanri katsudo*) were organized around the remaining veteran skilled workers to develop an OJT manual to train the newly assigned and less experienced workers. Kobayashi's examples indicate that 'veteran workers' are used as an important reserve of expertise that is available to assist small group activities and to deal with production problems in general. This in turn highlights two issues. One that talks about loyalty, commitment and job satisfaction ignores

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[74] The point at which a worker would be considered a "veteran worker" would vary depending on the industry and the job. Ten years would generally be an absolute minimum and in many cases, it would be 20 years or more. But this is an ongoing process – workers continue to accumulate knowledge and experience until they retire.

[75] See, for example, Watanabe (2000: 316). Watanabe uses the term '*tanoko*' which he translates as 'polyvalent workers' but the argument is essentially the same. I prefer to use the term 'veteran workers' because I do not wish to become involved in the issue of multi-skilling.

[76] Unfortunately, there is a degree of ambiguity in Kobayashi's use of the term "skilled worker" (*ginoko* in Japanese). From the context and the discussion, there is little doubt that, though not in all cases, in most cases, Kobayashi is referring to what are called "veteran workers" (*beteran rodosha/sagyosha*), not just operators in general (*sagyosha*) which is the other sense in which "*ginoko*" is used.

[77] "…skilled worker" is not used in the Australian sense of a group of workers who are distinguished as a separate occupational category by their qualifications or status as in unskilled, semi-skilled, skilled, technical, professional. "Experienced" might be less confusing but does not necessarily convey the sense that they are in fact highly skilled and not just experienced 'unskilled' production workers in the Australian sense. Veteran workers are not to be confused with skilled workers in the Australian sense which draws a distinction between skilled, semi-skilled and unskilled workers as separate categories.

these very important institutional underpinnings of shop floor problem solving and improvement activities. Two, it indicates the difficulties of simply extrapolating the Japanese experience to the Australian situation, particularly with regard to the conditions for successful and productive QC circle or small group activities.

The corollary of this situation is that there is no real equivalent of "unskilled workers" in the Japanese system. There are new recruits – new employees recruited directly from school or university with no work experience. But all of them are "veteran workers" in the making, not a separate category of employee in the sense that 'unskilled', 'semi-skilled' and 'skilled' workers are. All operators (who are regular employees) are part of the same promotion system and all take part in the same training programmes.

Conclusion

In Japan, quality control (as part of the QCD trilogy) became established as a central element of the approach to production management. The focus in pursuit of quality was on the production process and the analysis, control and improvement of the process. This involved analysis of the process in terms of all 4Ms. Improvement (meaning improvement in process capability) involved the dismantling and reconstruction of the production process principally by eliminating all forms of waste – again in relation to all 4Ms. Quality control and process control were seen as interlocking and mutually reinforcing – so that improvement in one usually resulted in improvement in the other. There was an unequivocal insistence on the use of statistical, scientific methods to gather objective data by which to monitor, control and improve the process/system. Consistency and coordination across the organization were considered imperative and were to be achieved by systematic policy formulation and deployment and the establishment of formal structures and procedures.

The key players were engineering staff – in terms of both the historical development of the movement and of activities within individual companies. QC circles and activities at the shop floor level were an important but still minor part of the system and their viability depended on extensive support structures both internal and external. Veteran workers played an important role in the viability of quality control circle activities and the dissemination of knowledge about QC generally at the shop floor level. One of the keys to the success of quality management programmes in Japan was the interaction between production and production engineering in terms of making it easier to do the job well. The recognition of a hierarchy of difficulty and the distinction between responsibility for large and small problems and improvement was an important part of the system and applied not only to the relationship between engineering and production at the factory level but also to the relationship between corporate headquarters, divisions and the factory level.

CHAPTER 4. Case Study 1: Canon

Introduction

Canon had experienced difficulties in its early attempts to establish a quality management system in the 1950s and early 1960s. After some market failures at the turn of the decade and a failed attempt to win the Deming Prize, the company decided that a more planned and comprehensive approach was required. What happened during the 1960s is not clear but by the mid-1970s, the company's products (Canon cameras) certainly had a worldwide reputation for high quality and relatively low cost (compared to say its German rivals). In 1970, the company began introducing a series of programmes to improve performance leading up to the introduction of the Canon Production System (CPS) and the Premier Company Plan (*Yuryo Kigyo Koso*) in 1976.

The Ami Plant commenced operations in 1981 – the final year of the development of the productivity improvement system (N-PAC) and also the end of the second phase of the Canon Production System. Small group activities (called Ami Groups) were introduced to the plant in 1984. Reorganization of product lines and activities at the site over subsequent years culminated in the establishment of the three separate operations on the site. In 1991, the plant started preparing for ISO accreditation, underwent formal assessment in 1992 and gained ISO9002 accreditation through the Japanese office of Lloyd's Registry in 1993 (Jan). It was one of the first operations in the Canon Group to gain accreditation.

Within the factory, there are six sections responsible for quality control. One is the Quality Assurance Office (*QA Shitsu*) which has central overview of the quality control activities of the factory. There are four sections – each attached to one of the production departments, and another responsible for the quality control of externally supplied parts and materials (Materials QA Section, Materials and Components Engineering Department; *Shizai Gijutsu-bu, Shizai QA-ka*). There are a total of about 300 employees in all QA sections combined, including receiving inspection, and about 10 QA section managers (*kacho*) in the plant. (Considering that this is only an assembly operation, this is a very substantial number.)

The central section at the factory level, the Quality Assurance Office (*QA Shitsu*), is located organizationally directly below the factory manager and is responsible for seeing that the other five sections operate effectively; for various factory-wide activities such as ISO conformance activities and ISO and other external inspections/audits (e.g., by major OEM customers); and for collating and formatting various quality control information for dissemination particularly through the computer information network. The QA Office also has responsibility for overseeing major quality problems and quality problems which are common to a number of production departments and/or external suppliers. However, even in areas such as ISO where the QA Office has primary responsibility, much of the actual work is delegated to production QA or other sections.

The four Quality Assurance Sections located within one of the Production Departments are primarily concerned with the direct control of quality in production.

1. QA Section, No.1 Production Department.
2. QA Section, No.3 Production Department.
3. Area responsible for QA within the Computer and Information Equipment Management Section in the same department.
4. Area responsible for QA within the Administration Section of the No.2 Production Department.

However, by the second visit, the various QA sections had been removed from the Production Departments and amalgamated into a separate QA Department. Detailed information was obtained from the QA Office and the QA Section (Communications Systems QA Section) in No. 1 Production Department.[78]

This QA Section had a total of 51 staff who were divided into 4 groups (called *ku*) responsible for administration, product quality assurance planning (with separate groups for new and existing product), process assessment and receiving inspection, and reliability assessment. More specifically, the work of the QA Section was detailed as consisting of five main activities:

1. Management of the departmental quality system and the actual product quality assurance system.
2. Developing quality assurance plans for individual products (including issuing of Mass Production Trial (MT) Assessment Request (*MT Kento Shijisho*), development of QA Flow Chart (QA FC)).
3. Product assessment (assessment at MT stage, reliability assessment, VE assessment, confirmation of the effectiveness of corrective action procedures).
4. Shipping assurance inspection (sample inspection, patrol inspection).
5. Auditing (process auditing (machinery and equipment, jigs and tools, work procedures, static electricity), ISO internal audits).[79]

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[78] At the time of the second visit, this section had become part of the new QA Department, but the responsibilities and the manager of the section remained the same.

[79] Matters related to the maintenance of ISO9001 and product quality assurance are handled in conjunction with the appropriate Product QA/QC Centre and other matters relating to ISO9002

According to one interviewee, "Probably most people in the plant feel that the respective QA Sections are familiar with all aspects of the operations of the plant. QA staff are always present, moving around the production area. So if a problem occurs, they are probably first on the scene".

The AQMS Committee (*AQMS Iinkai*)[80] is the ultimate decision-making body in the factory with respect to matters related to quality. The Committee consists of all department managers and the chairman is the factory manager. The QA Office acts as the secretariat and the QA Office manager as the secretary. This committee is responsible for debating and approving the organization of the quality control system and any changes to the system as well as proposals for internal quality auditing. The committee also reviews the reports on internal audits and reports on the results of corrective action for major quality problems and considers whether any changes to the quality system are warranted on the basis of these reports. Scheduled meetings are held 4 or 5 times a year but additional meetings are called as required. Reports on the results of external inspections – whether ISO or safety related, including compliance with individual country regulations – are prepared by the QA Office and presented to the Committee.

The above six sections at the factory level were supported at two higher levels of the organization; the quality control/assurance centre responsible for company-wide control of each major product category (hereafter Product Quality Assurance Centres (PQAC)) and the Quality Management Headquarters (*Hinshitsu Honbu*) at corporate headquarters. The range of products at Ami meant that the plant had association with three of these PQAC – office imaging products, peripherals and B products.[81] Unlike the QM Headquarters, the product-specific Quality Assurance Centres (software, cameras, office imaging equipment, peripherals, B products, chemical products) are likely to be located at one of the factory sites. In other words, the factory's QC system is not a self-contained system.

AQMS: Ami Quality Management System

The factory had produced a Basic Work Flow chart (*A-QMS Kihon Gyomu Furo*) of the quality management system which showed the complete flow of the quality assurance activities of the plant in relation to all of its organizational units. The main components of quality assurance were seen to include use of the QA FC and the standard assembly procedures to specify the

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accreditation in conjunction with the factory QA Office.

[80] Here "A" is the initial of the name of the factory.

[81] The mix of products produced at a particular plant determines the Product Quality Control Centres with which each interacts.

quality characteristics to be checked and the method to be used at each step of the assembly process; handling of defective product and rejected lots and associated corrective and preventive action; regular checking and calibration of measuring instruments and scheduled machine maintenance; and, finally, process auditing to check compliance with procedures. A large part of the assembly process itself consisted of inspection; receiving inspection, in-process inspection, electrical safety inspection, final inspection as well as sampling inspection of packaged product by QA. The last was classified as product shipping assurance and was the responsibility of the QA department. The others (excluding receiving inspection) were classified as process assurance.

The quality assurance system at the production department level showed quality control and "worker control/management"[82] (*sagyosha kanri*) as the two components of process control (*kotei kanri*). In turn, quality control was shown as consisting of 11 components ranging from work control/management to data management, process change control, control/management of jigs, tools and measuring devices, corrective measures, quality records and process auditing. (*FAX Kumitate Hinshitsu Hosho Shisutemu*)

Introduction of New Product and Development of the QC Regime

The product development process is a 6 stage process. A quality assurance plan is drawn up during the first two phases (planning and concept development, and component prototyping stages) and quality targets set. Consultation with production engineering can occur as early as the component prototyping stage. During the third phase (functional prototyping), the specific product quality standards are determined and finalized. Evaluation of product quality occurs during the following product prototyping and mass production trial phases. In the latter phase, particular attention is paid to production related issues and consultation occurs with production areas to ensure the manufacturability of the design.

The engineering sections at the factory become involved in the development process virtually as soon as the product concept is decided. An engineer is allocated to the product and attends the development meetings as appropriate to ensure that the needs of production are reflected in the development process. As the production department manager pointed out, it is very difficult to effect changes to represent the interests of production after product development is completed. The engineering sections are responsible for drawing up the Process Chart (*Koteizu*) which is a complete description of the factory's production process for each product. The factory becomes

[82] Worker control/management consisted of only two components; control/management of manning levels (*yoin kanri*) and education and training.

fully involved at the mass production trial (MT) stage which is a critical phase for production operations. An MT Review Team (*MT Kento Chiimu*) consisting of the assembly, engineering and QA sections involved with the product is put together during the MT phase and a Review Meeting (*3-ji Teireikai*) is held every afternoon at 3:00 o'clock during this phase.

The QA Flow Chart (*QA Koteizu*) (QA FC) which is the core document controlling product and process quality is drawn up by the QA Section of the relevant Production Department during the MT phase. The QA FC follows the same order as the Process Chart (*Koteizu*) and covers the whole of the production process, including the work of the inspection group in the QA Section, the assembly section/s and the Materials QA Section. In the case of the last, the Materials QA Section, although the section does perform some quality assurance activities itself on purchased parts and components, the relevant section of the QA Flow Chart is used rather to specify the quality assurance activities required of suppliers. Members from production are involved in the process of drawing up the QA FC so if production considers that there are any problems or want any changes, they are handled at this stage. If problems do occur after production starts, production notifies the QA Section of the nature of the problem and QA make the changes. The QA Flow Chart may be amended 20-30 times during the lifetime of a product. Although copies of the QA Flow Chart go to the Production Department and to the shopfloor, they are not usually used directly by production but rather as the basis for drawing up Standard Work Procedures (*sagyo hyojun*) and other documentation for the use of production.

The standard work procedures (*sagyo hyojun*) are developed in parallel and coordinated with the development of the QA Flow Chart and both are derived from the Process Chart (*Koteizu*). The standard work procedures incorporate the content of both the Process Chart (*Koteizu*) and the QA Flow Chart (*QA Koteizu*). The standard work procedures are drawn up by the production sections but are checked by both the engineering and QA sections.

Another critical activity for the QA Section during this phase are requests for data collection (*kento shijisho*) to identify and set limits for specific quality characteristics (*hinshitsu tokusei*). Although quality characteristics are identified prior to this phase because of the small numbers of product samples produced at earlier stages, it is not always possible to quantify the limits for each, so this is one of the major tasks for QA Section during the MT phase. The limits thus established are then incorporated in the QA Flow Chart.

Once mass production is approved and commences, there is still a Start-up phase (*tachiage* *kikan*)[83] during which intensive work to eliminate any remaining quality problems continues. A special management regime is put in place during this period, not only by quality control but also engineering section/s. A pilot run of several 100 products (the number varies depending on the nature of the product) is evaluated by Production QA[84] and if passed, a report is sent to the QA Office. The QA Office examines the report and if they agree, the Factory manager will approve the product for shipping. During this period, the regular daily three o'clock meetings (*3-ji Teireikai*) continue to review problems and decide on action. By the end of the Start-up phase, the production department is supposed to have achieved the planned output levels and to meet the specified quality and other performance criteria (e.g. right-first-time, 98%; etc.).

Normal Operations

Quality assurance activities were divided into 4 main categories – receiving inspection/quality assurance,[85] quality assurance for electronic units (PCBs), process assurance, and shipping assurance. Only the latter two are internal to the production department. In addition to assembly and adjustment/tuning, there is in-process inspection, testing for electrical safety, and final inspection before packaging. All of the above are conducted by operators of the production department and constitute in-process inspection or process assurance. There is an accreditation process for operators engaged in final inspection. The items for and methods of inspection are specified in the standard work procedures. Each of the above in-process inspections applies to every product, i.e., 100% coverage. It was pointed out that inspection actually constitutes about 60-65% of the assembly process and assembly itself only 35-40%. Moreover, if the different forms of testing and inspection carried out at various stages during the production or assembly process are "added" to final inspection, "inspection levels" may reach as high as 300%.

A Product Check Sheet (*seihin chekku shiito*) accompanies every single product from the start to the end of the line and the appropriate section is filled in as the product and document pass through each work station. The Sheet is checked and signed-off by final line inspection. The Ami Production Management System (APMS)[86] is based on a bar code system. This includes a bar code classification for likely defects. When a new product is introduced, a bar code is

[83] The Start-up Phase generally lasts for about 3 months and has a lower right-first-time target level and includes a Pilot Run of about 300 (200-500 depending on the product) which is not included in the calculation of right-first-time and other performance data.
[84] In the case of new product or where a new function has been added to a product, on average the first 100 after the start of full production are subjected to extensive rough handling to see whether any problems occur or whether they can be released onto the market with confidence.
[85] Since the Ami Plant produces almost no componentry in-house, receiving inspection and relations with suppliers are a major part of QA activities. However, the focus of this study is on the internal quality system so supplier QA will not be discussed in detail.
[86] The APMS is the Ami plant's version of the company CPS.

assigned to each likely defect and these codes are used on the Check Sheets.

After packaging, sampling inspection is conducted by the QA Section as the basis for shipping approval. Basically, sampling inspection is completed and approval for shipping issued on the same day as production. The number sampled varies depending on the product. Shipping assurance was explained as both a discrete activity which takes the form of sampling inspection at the end of the line and as the cumulative result of receiving inspection/assurance, process assurance and final shipping assurance.

Daily quality performance is monitored by collecting and collating data on right-first-time, incidence of TSS (explained below) and rejects. This information is incorporated in the Daily Quality Report which is displayed on the computerized quality information system. A key distinction in the reporting of the data is whether the cause of a problem was the responsibility of one's own or another process. Rejects are also classified according to the unit/component found to be faulty. The active monitoring and review of action takes place at the Morning Quality Meeting and/or the Morning Q Check (*Asaichi Q Tenken*) Meeting. (For further discussion, see following section on abnormal occurrences.)

There was a very strong emphasis on "change control" which was a very important issue for the supervisor (*shokubacho*). It was explained that if something is changed, whether man, material, machine, method, or measurement, it is likely to cause variation, so any planned change should be notified in advance and there was a special document for this purpose. For production, change control had at least three aspects. One was ensuring that the correct materials and components and the correct documentation are in place for a change of model. For this purpose, a Change-over Check Sheet (*Kirikae Chekku-Shiito*)[87] was prepared by the supervisor (or sometimes by the Support Workers). This clearly showed any individual differences in work tasks, inspection tasks, accessories and parts/components and was used by the Support Workers to check the line at the beginning of a new run. Two, deciding on what changes will be treated as a separate variation which requires new numbering and identification in terms of product model, product drawings, component identification and so on. Three, ensuring that all changes are promptly notified and also reflected in corrections to all relevant documentation. Of course, many of these changes originate from other sources such as engineering or QA sections which must ensure that they are observing the change control rules and providing the necessary information to the production department.

[87] The Change-over Check Sheet covers change to the work; change to inspection; change of accessories (e.g. for different national markets) (which was reported to cause the most headaches); and change to components/parts.

Key Role of Supervisor (Shokubacho)

An important point which emerged from the interviews was the critical and pivotal role of the production supervisor (*shokubacho*). The supervisor has extensive responsibilities which place heavy demands on him. Under the overall responsibility for "Work Management" (*sagyo kanri*), the supervisor's tasks are broken down into 5 main areas; CPS planning (*CPS keikaku*), line control/management (*rain kanri*), process control (*kotei kanri*), employee/worker development (*buka no ikusei*)[88] and attendance[89] control/management (*kintai kanri*). Of these, line control/management and process control were specified in more detail.

Line control/management was broken down into line formation/organization (*rain hensei*), data management, PM (Productive Maintenance) management, change-over control (*kirikae kanri*), stratification control (*sobetsu kanri*) and output management (*dekidaka kanri*). Throughout the QC system, there was an emphasis on change control as important to avoiding various production errors and problems and at the work place level, the related issue of stratification was also stressed. Thus, the management of change-over, the proper communication of change-over and strategies to avoid and reduce "work misses" (*sagyo misu*) (or mistakes) associated with change-over were mentioned. With respect to stratification, not only differentiation of models but also differentiation of specifications and other documentation, management of numbering systems (for documents and product variations) and management of records of numbers of each model/variation coming onto and leaving the line were listed as key points for attention. The control and recording of product entering and leaving the line was also mentioned under other headings. Other items of interest were the recording and feedback of data relating to PAC and management of the TSS system. As well as maintenance and coordination with the Machinery and Equipment Section, line control/management, guidance (*shido*) for 5S (*seiri, seiton, seiso, seiketsu, shitsuke* (arrangement, orderliness, cleaning up, cleanliness, discipline)) activities and the management of information displays were also mentioned under PM management.

Process management included control/management of work-in-progress (*shikakehin kanri*), contro/management of damaged product (*jikohin kanri*), data control/management (*deta kanri*),

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[88] There were three categories of employee development (literally, development of subordinates; *buka no ikusei*); education/training for new recruit/s, education/training for operators and general education and training. (In Japanese, the word *kyoiku* (education) is used rather than *kunren* (training).) CPS plans were drawn up on an annual, 6 month and 3 month basis.

[89] The word *'kintai'* can be translated as 'diligence and indolence' so it suggests that what is intended is a little more than simple attendance management (or absenteeism).

quality action/countermeasures (*hinshitsu taisaku*)[90], and control/management of specification changes (*zutei kanri*). Data management included collection and feedback of data on hand repair and right-first-time as well as "work misses" and extraction of problem points from data. Control/management of occurrence of TSS, measures to deal with trouble and make improvement, coordination and meetings with other sections, and measures to deal with "work misses" and make improvement were also listed as aspects of quality control. In association with management of specification changes, control/management of the QA Flow Chart and standard work procedures were also listed.

The *shokubacho* also appeared to be the pivot on which the "bottom-up, top-down" approach turned, controlling/ensuring the distribution of all necessary information to the line and gathering – or overseeing the gathering – and collation of information about line output and performance to pass back up the system. In other words, the supervisor not only transmits management plans and intentions to the shop floor and ensures that production is implemented in accordance with management plans and company procedures but also acts as the critical gatekeeper for the collection and transmission of accurate information about actual production conditions from the shop floor to higher levels of the organization.

Abnormal Occurrences

The Ami Plant had a comprehensive system for handling and following-up production problems which did not end with the resolution of the immediate problem but involved the exhaustive investigation of the possible implications of the problem and its resolution. The features of this system were the filtering and referral of serious problems to higher levels of the organization and close coordination between all departments and sections within the factory (and beyond). (See the 'FAX/GP Genre Current[91] Products Trouble Follow-up Flow Chart' (*FAX/GP Janru Genryuhin Toraburu Foro Furo Chato*).)

The general problem handling procedure distinguishes between the area where the problem occurred *(toraburu hasseimoto*), the area responsible for overseeing the resolution of the problem (*kanrimoto;* usually either the production area or the QA section) and the section or sections responsible for actually investigating and resolving the problem(*sekinin bumon*). Problems are differentiated in terms of severity and also scope (Rank A, B, C) – each requiring a different level of treatment. The determination of rank is finalized after the problem has been

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[90] It is difficult to convey the meaning of the word *taisaku* but it means something like "to take action or countermeasures to deal with" quality problems.

[91] Meaning products currently in production (as opposed to stages prior to full production).

investigated. In terms of scope, a distinction is drawn between problems which only effect one department and on which action on an individual basis is sufficient and problems which are occurring in different parts of the organization, structural problems related to the organization as a whole and on which limited local action is not sufficient. In general, it is the relevant Production QA Section which is responsible for making decisions about the prioritization of problems and the action to be taken but if a problem affects other departments or if similar problems are occurring in several departments, the QA Office will become involved. The required action is specified in the Flow Chart of Corrective and Preventive Measures (*Zesei shochi/ yobo shochi gyomu furo*).

As mentioned, the handling of problems varies depending on ranking. Rank A is regarded as a discrete problem with only requires resolution of the immediate problem. Rank B requires that the corrective action be checked in some way (sampling inspection, process audit) and the results recorded. Rank C requires consideration of whether systems or procedures need to be changed and if so a further confirmation of such changes and recording of results is required.

The main document for reporting and following the resolution of problems is the Investigation of Problem Cause Form (*Fuguai Gen'in Chosahyo*). This form is divided into three main parts. The first gives details of the problem and the circumstances of its occurrence, the immediate action taken to deal with it, and any investigations or suggestions. The second is completed by the section and person/s requested to resolve the problem (which may be in-house or an external supplier) and includes explanation of the cause, interim and permanent measures to deal with the problem and timing for implementation of the measures. The final section gives details of the range of actions required which includes, for example, checking the process or changing procedures and confirmation and signing off by all parties involved.

The factory has a line stop system referred to as TSS (***T****omete,* ***s****ugu* ***s****hochi o suru*; "stop (*tomete*) (the line) and immediately (*sugu*) take action (*shochi o suru*)"). In the line stop system, a distinction is drawn between cases which only require the correction of the immediate problem and disposal of the faulty product and cases which require the responsible parties to attend and determine an interim solution to allow restart of the line and then to investigate and determine a long-term or final solution to the problem. In the case of conveyor lines, the stop is registered and the length of the stoppage recorded. The general principle is not to allow defective product to be passed down the line and to prevent repetition of problems.

An interesting feature of the line stop system at Ami is the existence of a group of "Support Workers" (*sapoto-in*) who provide the first-line response to line stoppage. These are highly experienced workers with a high level of technical knowledge who are able to quickly repair simple problems or make a quick diagnosis and call for additional help from QA or engineering if necessary. These workers have a broader role of assisting the supervisor in various ways. Although each line stop is recorded, not every incident generates a formal record or investigation report.

Some interviewees considered that the line-stop system was particularly important because of the large numbers of contract workers. They stressed that it was important to encourage contract workers to stop the line even if they were not sure whether there was a problem or not because they lacked the experience to make an accurate judgement. On the other hand, there was mention of greater or lesser degree of reluctance on the part of some supervisors to use the system (for example, some supervisors reportedly set a long time lag between pressing the button and the line actually stopping so as to minimize stopping) and some disagreement about how often the system was actually activated. Moreover, the shift to cell production meant that the TSS system was no longer appropriate in these areas and a new mechanism had to be devised.

Problems are initially reported in handwritten form to the morning quality meeting and then the information is recorded on a Morning Quality Information Sheet (*Hinshitsu Asaichi Joho Shiito*) which is a separate report on each individual problem and, if necessary, the Urgent Report on Serious Quality problems (SQP) (*Juyo Hinshitsu Mondai Sokuho*).[92] The former not only gives details of the problem and the immediate/interim action taken to deal with it but also records the cause of the problem, both the corrective measures taken and the proposed preventive action and, importantly, whether or not the resolution needs to be implemented by other sections/ departments or applied to similar machinery and equipment and so on (*suihei tenkai*). Where problems require further investigation, the form mentioned above, the Investigation of Problem Cause Form (*Fuguai Gen'in Chosahyo*) is used**.**

The daily records of line stop (TSS), defective product and other problems are collated in a Quality Status (*Hinshitsu Jokyo*) report compiled by each production section. This is one of the reports available on the new QISS system but was previously kept in handwritten form. In addition to planned and actual input[93] to the line, the report covers 19 items including RFT and process RFT, rate of "work misses", details of TSS and details of defective product removed

[92] This was not quite clear but one explanation was that SQPs were only used in instances where a problem resulted in smoke or actual combustion/flame.
[93] The number of "products" input to the line is then compared to output in terms of the number of completed products and the number of good products.

from the line (classified as waiting to be returned to the line, waiting for repair, under investigation). For the purposes of this report, a distinction is drawn between line stop which is the responsibility of assembly, those which are the responsibility of other processes (which usually means external parts suppliers) and those which are caused by jig or tool problems. Similarly, defective product which is the responsibility of the local process and of other areas is counted separately. Defects are classified according to their source and by the particular product, unit or component involved. In addition to the 19 items, there is a graphical presentation of right-first-time (in percent) and number of incidents of defects differentiated by origin ('own process' and 'other processes') and another graph showing the percentage distribution by main type of defect.

As mentioned, as far as possible engineering tries to anticipate and eliminate problems before full production starts. A bar code is allocated to each likely defect during the MT phase and this bar-code is used on the check sheets which accompany each product through the assembly process. However, interviewees commented that new problems inevitably arise after full production starts or it may be decided that the level of 'manufacturability' or ease of assembly (*kumitatesei*) is too low and needs to be raised.

Although some interviewees stated that "Production" plays the key role in addressing problems, this is potentially misleading for a number of reasons. Firstly, the Production Departments at Ami include both QA and Engineering Sections. Secondly, it was reported that engineering receive frequent requests to deal with problems or to make changes and that a large part of the time of production engineering at the factory is taken up dealing with current problems and analyzing the cause. Thirdly, it is QA and Engineering that have ultimate responsibility for resolving problems (changes to the QA Flow Chart can only be made by QA and to the Factory Process only by Engineering). Finally, one of the principal roles of QA is to oversee the investigation and resolution of problems and ensure that they are followed through to a satisfactory conclusion – although as noted earlier, QA is not always the section responsible for overseeing the resolution of a problem. In other words, production in the strict sense of production sections and production workers is not expected (nor do they themselves expect) to resolve all problems. On the contrary, depending on the nature of the problem, resolution is assigned to an appropriate section and production itself may call on engineering or QA to deal with a particular problem.

Improvement Activities

Requirements for improvement in quality and efficiency were written into the heart of the company's *"Premier Work Center"* (*Yuryo Shokuba*) concept. Improvement targets are part of the manager's and supervisor's annual and three-monthly plans. In some cases, numerical targets (such as 3% improvement in efficiency) are set for both the section as a whole and for the individual block[94]. Most targets however are set as maximum levels of allowable failures or minimum levels of acceptable performance. In addition, the activities which are to be the focus for achieving these targets are also specified. For example, in the case of quality, actions include consolidating the "work miss" prevention system, utilizing the results of the process audit system and shortening the production start-up phase by improving accuracy at the mass production trial phase. The supervisor's plans also nominate (though only in general terms) the sections or areas from which cooperation will be sought in achieving the targets.

With respect to engineering's involvement in process improvement, as noted above, a large part of engineering's time at the factory level is taken up by responding to current problems. This was particularly true of Sections 1 and 2 (electrical and mechanical) although Section 3 had a particular brief for process improvement and technical/engineering standards. It was stressed by both mechanical and electrical engineering that the technology then in use was at a mature stage which presented few technical, especially novel, problems so there was less potential for improvement. One of the problems which caused the most difficulty was associated with the handling of paper – jamming or not feeding squarely. This posed problems at both the design and the manufacturing phases. From an engineering point of view, what generally happens is that improvements that arise from the resolution of problems with the current model are incorporated in the next generation/version of the product.

It is important to see factory operations in the context of the multi-level structure of the company as a whole. Improvements in quality practices and quality technology and importantly also in process and production technology are addressed at two higher levels of the organization – the Product Quality Assurance Centres within the operating divisions and the Quality Management Headquarters and Production Technology Headquarters[95] at the corporate level. The centres and headquarters are involved in research into quality control/assurance methods

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[94] At this factory, each production section is divided into blocks each of which has a supervisor (*shokubacho*) and each of which varies in size from as few as 2 to as many as 30 regular workers. In some blocks, there may be twice as many non-regular or contract workers as regular workers. The blocks seem to be divided on the basis of work tasks. In addition, this section had three assistants to the manager (*sennin shunin*), one of whom was responsible for quality and in charge of 26 regular employees. The other two were responsible for budgeting and manpower and for cooperation and coordination.

[95] The Production Technology Headquarters consists of seven centres – one of which (the Production Technology Centre (PTC)) was located on the Ami site. The PTC was involved in the development of machinery and moulds – particularly machinery and equipment to manufacture high precision products and which was not readily available from outside sources.

and systems and production techniques and technology respectively. In fact, at the time of the study, there was a major corporate level review and examination of existing production methodologies to determine whether Canon operations were employing the optimum available technology.[96] The ongoing reassessment of production technology and systems to adjust to changes in product technology, product life cycle and market conditions is illustrated by the change many years earlier at the Ami Plant to highly automated systems using robots for packaging and so on, then a return to manual operations using a conveyor belt system (on the grounds that it was more flexible than using robots) and later again, the switch to cell production but only for some product lines.

At the factory level, there is also an ongoing requirement to find ways to reduce costs – this is referred to as VE (value engineering) activities. The engineer responsible for a particular product is the person who has the main responsibility for VE activities related to that product because, it was explained, he is the person who knows most about the product. The view was expressed that the workload would be too much for Engineering to handle alone so it is necessary for other departments to become involved but overall coordination is the responsibility of Engineering Section No.3.

The distinction between different levels/parts of the organization (particularly between production and engineering departments) and the differentiation of roles is evident in the approach to VE activities and in the associated training programmes. According to company publications, VE activities are described as having a layered structure with O(zero)-Look VE for the design stage, First-Look VE for the product trial stage and Second-Look VE for the production stage. The training programmes not only show the principle of increasing levels of sophistication and specialist knowledge but also of different courses for different categories of employees. Thus, there are specialized VE courses for engineering staff and simpler courses for production employees whereas courses for management staff are based on the need to ensure that they have sufficient understand to be able to lead and control such activities. (JMA 1987) More broadly, there is an ongoing requirement to pursue process elimination/ reduction (*hyojun kosu no teigen*): that is, to find any non-productive (*muda*) processes or operations and eliminate them so as to reduce time and/or cost. This was the responsibility of engineering staff. This is central to both the PAC system and the Canon Production System itself.

Market task (*shijo tasuku*) is a more recent innovation and involves meetings between

[96] This was a personal communication from one of the company's Directors. The review was looking at virtually the whole range of existing production technologies. Almost certainly one of the outcomes of this review was the introduction of cell production at the Ami plant.

manufacturing and technical people and the sales companies, particularly the servicemen. A major/priority product (*juten seihin*) is selected and regular meetings are held (about once a week) for a period of 2 or 3 months. The members include the relevant QA and engineering staff and a representative of assembly from the factory and representatives of the design and development and quality divisions at the corporate level.

Ami Plant also has an active programme of small group activities referred to as Ami Groups (AG) which involves staff sections and departments as well as production. These activities are discussed in a later section.

Quality Cost

As indicated above, cost reduction is an integral part of CPS (as part of the QCD trilogy) (including VE activities) and is a basic requirement of the Premier Work Center structure but attention was also given to reduction of quality cost or failure cost as such. Between the first and second visits, there had been a major revision and upgrading of the approach to quality cost referred to as "Internal Failure Cost" (*Naibu Shippai Kosuto*) and development of extensive supporting structures. The old system centred around the idea of "mis-production" (*gozo*) and the time spent on hand repairs calculated as actual time and as a percentage of total production time. Cost was regarded as the total of labour cost spent on repair or rework, the cost of material/parts scrapped and the cost of replacement material/parts.

Under the new system, specific cost reduction targets were set for each department and section and actual progress plotted against the planned trend line. The new system provided for detailed recording and analysis of quality cost. Cost was analyzed separately for each major product line (in the case of Ami, five) and according to six to eight major categories of defects/failure; that is, processing defects, hand repair, non-routine processing, retro, specification changes (2 types), control/management failures[97] and disposal of work-in-progress. There was an elaborate structure for the reduction of 'Internal Failure Cost' that included six separate teams – each of which dealt with one or two of the major sources of 'failure cost'.[98] Specific numerical cost reduction targets (in yen) were set for each of the teams. The teams consisted mainly of section managers, assistant managers and supervisors.

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[97] Note that "control/management failures" constitute only one of eight categories; i.e. system is not interpreted simply as the management system nor system problems as virtually the sole responsibility of management.

[98] The two types of specification changes were handled by one team and both control/management failures and disposal of work-in-progress (unfinished product) were the responsibility of another team making six teams for eight categories of cost.

The supporting structures included an Internal Failure Cost Reduction Committee located under the factory manager and below this an Internal Failure Cost Review Committee. The latter held monthly meetings to monitor progress in cost reduction. Actual activities were coordinated with quality assurance and there was a group which drew up annual activity plans and reported results to the Review Committee. The factory Review Committee was also linked to a corporate-level Internal Failure Cost Reduction Review Committee located within the G-CPS Promotion Office. The factory committee reported results to the corporate-level Review Committee and the corporate Committee's deliberations and decisions were passed back to the respective cost reduction teams.

Quality Policy

Quality policy is enunciated each year but the same policy statement may be continued over a number of years especially at higher levels such as corporate or factory manager. Policy is cascaded down through the organization and is interpreted and released as explicit, stated policy at each level by the manager/supervisor of each organizational unit. A general policy statement is issued by the President (CEO; *shacho*) and then by the General Manager/Managing Director (*honbucho*) of each product division, the factory manager, each department and section manager (including the QA Department) and so on, right down to Assistant manager in the case of administrative/ staff departments and supervisor in the case of production/line departments.

At the Production Operations Section (*Kacho*) level, policy is detailed and comprehensive, with explicit (often numerical) targets set for specific items, and clearly shows the combined QCD (EQCDS)[99] approach. Each production supervisor is also required to draw up annual and quarterly G-CPS plans with specific activities under each of the EQCDS headings as well as 5S activities and general work environment (*hudo*).[100] Month to month variation of achievement targets are specified and actual performance tracked. The example sighted included 11 items (and a total of 14 items and sub-items) of which 3 (5 sub-items) related to quality and 2 (3 sub-items) to productivity. It is interesting to note that only one of the total of 14 items and sub-items was promotion of small group activities – the other two items under improvement of work environment being promotion of improvement suggestions and promotion of participation in training programmes.

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[99] Canon has added E for environment and S for safety to the basic QCD trilogy.
[100] Again translation is difficult – the literal translation is "climate". Here work environment does not mean *sagyo kankyo* which is more like the physical environment but refers to the experience of work and the workplace more generally. "Workplace atmosphere", on the other hand, seems too vague and abstract.

At higher levels, policy statements tend to be more general setting the direction or parameters. For example, the QA Department Manager's policy statement included; "Total cost reduction and development of a system for tracking cost" or "Consolidating the system of 'same-day response' and 'same-day resolution' of problems". The department manager's statement consisted of a slogan, policy statement, action guidelines and priority issues. The last was the most specific and in the example sighted, consisted of 10 items. At the section level, however, explicit targets were set such as 'internal failure cost=less than 0.85%' or 'market rework=zero'. The section manager's statement included a slogan (different from the Department Manager's), quality objectives and priority implementation items (some of which were different from the Department Manager's priority issues).

The transmission, coordination and actual implementation of policy throughout the organization were facilitated by the general principle of overlapping 3-level meetings. The coordination of policy and activities was further enhanced by the existence of specialist committees at the department (*bu*) and section (*ka*) levels. There were 17 specialist committees at the section level, most of which were duplicated at the department level,[101] and at least 5 were directly related to quality control issues (i.e., quality improvement (*Hinshitsu Kojo Iinkai*), promotion of ISO/BS (*ISO/BS*[102] *Suishin Iinkai*), reduction of lost product (*Sonpin Sakugen Iinkai*), improvement suggestions (*Kaizen Teian Iinkai*), and AG activities (*AG Katsudo Iinkai*)).

Information and Communication

There is a comprehensive system for capturing, recording, analyzing, reviewing and disseminating information, particularly information relating to operational activities. There is ongoing collection of a range of quite detailed data to monitor performance. This data is analyzed on a regular basis to inform management decisions and establish management priorities right down to the supervisor level. Data and information is circulated widely within the factory and beyond and there are numerous opportunities for exchange and sharing of information – as outlined in the next section. A great deal of stress is placed on the "single streaming" of information (*joho no ichigenka*) – to ensure that everyone receives and is therefore acting on the same information. Even though a wide range of information is available in the workplace, this represents only a small part of the overall flow of information.

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[101] Differences in the range of committees at different levels tend to reflect differences in responsibilities at the various levels.
[102] BS= British Standards.

At the production workplace level, in relation to the annual and quarterly G-CPS Plans, the supervisor tracked process performance, for each product each month on a daily basis and quality performance and productivity improvement for each six month period on a weekly basis. In general, the indicators that were tracked to ensure the production of a "good product" were right-first-time, failure cost (*huguai kosuto*), operating rate (up-time),[103] process throughput and state of rework. In the case of quality performance, targets were specified for right-first-time, occurrence of "work misses" and defects found by QA sampling inspection. Targets set for productivity improvement were worker performance and overall performance (as defined by the N-PAC system), operating rate (up-time), and improvement rate. In both cases, the targets vary on a month-by month basis. In each of the work areas, there was a CPS Management Board which displayed information for the major CPS categories (environment, quality, efficiency[104], delivery/output, safety and 5S, and work environment) relative to the targets for the month as well as the progress of specific activities.

The on-line computer system (Quality Information Sharing System; QISS)[105] which was in place by the second visit was based on the principles of speed, integration and open access. Whereas in the past, computer systems seemed to have largely operated within each facility, the new system connects not only each of the production operations but also the Canon sales company and its overseas sales subsidiaries. At the local factory level, this carries up-to-date information compiled by the QA Office in the form of the Morning Quality Report (*Hinshitsu Asaichi Joho*), the Quality Status Report (Daily/Monthly) (*Hinshitsu Jokyo Nippo/Geppo*) for each production department showing cumulative day-by-day data for the current month, a report on Serious Quality Problems (*Juyo Hinshitsu Mondai Sokuho*), and Morning Q Check (*Asaichi Q Tenken*).[106] However, the system also carries a much larger range of other information including, for example, market claims/complaints, service information (hardware, software), repair reports, minutes of quality meetings, and an engineering/ technology resources guide.

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[103] In Japan, up-time – the time machines are actually operating is used rather than down-time as is common in Australia.
[104] This is categorized as C, cost of the QCD trilogy but the actual items relate to efficiency as defined by the N-PAC system except for the statement of the general goal of achieving minimum cost.
[105] Reference is made in publications about the company to the development of earlier information system called GINGA (Global Information System for Harmonious Growth Administration) over a five year period starting in 1988. This system was completed early in 1993 but already by the later part of the same year, planning had begun for a new generation information system. Reference was also made to the GINGA system in the documentation received from the plant (Canon Inc. 1994).
[106] At the time of the first visit, there were no less than 17 separate reports on some aspect of quality performance – some of which were summaries (e.g. monthly report) of the information provided in daily or individual incident reports. It appears that there may have been some consolidation of reporting with the development of the QISS.

The system of overlapping 3-level meetings[107] was regarded as an important mechanism to ensure the dissemination of information throughout the organization and also to ensure that all parties received the same information. These meetings were also regarded as a key aspect of the "top-down and bottom-up" approach to information gathering and sharing, consultation and decision-making. The pivotal role of supervisor/foreman in this structure has already been mentioned.

Although the difficulty of gathering and collating data on a large scale was acknowledged, the dangers of relying on individual memory (*kojin no kioku ni tayoru*) were considered more serious. The fact that it is inevitably piecemeal and information is overlooked or missed (*more ga deru*) was stressed. It was also commented that speaking only from personal recollection is not convincing and thus does not have much impact. In addition, the need to accumulate a sufficient body of data in order to detect and analyze trends was also considered important. (This is of course consistent with the ideas of a scientific approach to management and basing decisions and actions on fact not guess work, supposition or opinion.) These comments were made on the first visit prior to the introduction of the new QISS which presumably simplified the handling of large quantities of data.

Meetings

There was a large range of meetings at different levels of the organization to monitor and/or examine various aspects of the quality control system and activities. The meetings ranged from regular daily meetings to weekly or monthly meetings to meetings associated with particular activities such as the Start-up Phase of production of a new product. Perhaps one of the most important functions of the various meetings is to share information about the problems that are occurring in each area and to ensure that the same problems do not recur in other areas. The following are some of the main quality-related meetings.

There is a Morning Quality Meeting everyday at 7:45am attended by the managers of all the production QA sections and convened by the QA Office. The problems that are occurring in the various production departments and how they are being resolved are discussed. At this meeting, the most up-to-date information is presented in hand-written form (*sashizusho*). The idea is to share the information with all the other production departments (*suihei tenkai*), to get advice from others or to look at the information from others and see if it is relevant or applicable to one's own department and to be forewarned about possible problems. This information is then

[107] This system ensured that some members of every meeting were also members of the meeting at the next higher level of the organization and some of the meeting at the next lower level of the organization.

processed and released on the computer network (as the Morning Quality Meeting Information Sheet (*Hinshitsu Asaichi Joho Shiito*)) by the QA Office usually by the beginning of the same afternoon. So everyone can see at a glance what is happening in all of the production departments. The Quality Status report (*Hinshitsu Jokyo*)[108] for each of the production departments is available on the computer network by 10:00 the next morning. The data for this report is formally the responsibility of the supervisor (*shokubacho*) but usually it is the QA staff who enter the data. Each of the QA Sections also holds its own morning meeting.

The Morning Production Meeting (8:00-8:30) is attended by the Factory manager and the Department and Section managers and the QA manager goes to report on results of the earlier quality meeting. This meeting reviews the on-going daily quality performance of the production departments, information on market complaints, corrective and preventive measures, identifies and notifies major quality problems and reviews the Urgent Report on Major Quality Problems. The Assistant Section Managers (*Kacho Dairi*) also convene a morning meeting within their own sections to review current production issues.

There are also other "regular" meetings which by their nature are only held for limited periods of time. These are meetings to make major decisions about production activities, such as the decision to move to full, mass production of a new product. In these cases, it is usually the QA Office which is responsible for calling all the related parties together. In the case of the move to mass production, this would be mainly the members of the Mass Production Trial Team. However, the final approval for the start of mass production rests with the relevant Product Quality Assurance Centre which may be located at another plant site. The manager of the QA section of the relevant production department is responsible for coordinating the report to be presented to this meeting. Another example is the "Regular 3:00 Meeting" (*Sanji Teireikai*) between production, QA and engineering (and other parties as necessary) which is held during the MT and Start-up phases.

Another important mechanism for disseminating and coordinating information and activities is the committee system mentioned earlier (see pp.77-78). Most committees at the Section level are duplicated at the department level and where relevant horizontally in other sections and departments.[109] The chairmen of these committees at the section level are usually supervisors or

[108] For details of the content of this report, see p. 71 above.
[109] Some notable differences were that the education & training committee existed at section level only and budget committees (machinery and equipment and administrative) at department level only. Whereas the department level had a committee responsible for quality cost, the section level committee concentrated rather on reduction of product loss. The range of committees in the QA Section was more like that of the department level.

foremen. In addition, at the plant, department and section level, there are a number of committees – referred to as "follow-up bodies" (*foro kikan*) – which have an overseeing or coordinating role. At the factory level, there is the Productivity Improvement Committee (PIC) (*seisansei kojo iinkai*) which meets 4 times a year and an ISO Secretariat Liaison Committee (ISO-SLC) which meets monthly. At the department level, there is a G-CPS Review Committee (*CPS kento iinkai*) (monthly) which has an overall coordinating role, a Development, QA, and Factory Engineering Liaison Committee (monthly) and a Serious Quality Trouble Follow-up Meeting (weekly). At the section level, there is a Specialist Committee Review Meeting (fortnightly) and an AG (Ami Groups) Meeting (monthly) as well as an AG Activities Committee. The factory PIC has a counterpart at the section level that meets once a month. The supervisors report to this meeting on progress against the targets set in their annual and quarterly plans. The productivity improvement committees are part of the larger range of CPS activities and the IE Promotion Department (established in 1996) acts as the secretariat for the factory level committee. The factory ISO-SLC also has counterparts at both the department level, (ISO Committee which meets weekly and is coordinated by the QA section) and the section level (ISO-BS Promotion Committee).

Auditing

There is a range of auditing activities to ensure that operations are being conducted in accordance with the required standards. Process evaluation (*kotei hyoka*) consists of two main activities – process auditing and sample inspection. Sampling inspection is used as an indicator of process operation on the basis that if the product conforms to requirements, the process is considered to be operating correctly. However, since the numbers involved in sample inspection are small, this alone is not regarded as a sufficient check on process performance. So process audits or process patrols are conducted by QA to provide a more direct and intensive scrutiny of whether work is being performed according to the standard work procedures, whether the machinery and equipment and jigs and tools are in good working order, whether the management system for static electricity is being observed and so on. There are also comprehensive internal audits conducted on a factory-wide basis based on the ISO9000 criteria. In addition, major customers conduct spot audits or inspections.

Small Group Activities

Canon uses the term Small Group Activities (SGAs) not Quality Control Circles – probably because Canon has mainly used the consulting services of the JMA which refers to their programme as SGAs. However, the nature of the activities, the tools and problem solving techniques are basically the same. At Canon, both direct production employees and indirect staff engage in small group activities and separate records are kept for the activities of each.

At the Ami Factory, small group activities are referred to as AGs, Ami Groups. In terms of SGAs, the first year of full production at the factory (1983) was devoted to preparation and actual group activities did not begin until February, 1984. During the first few years, there were large annual intakes of new school leavers who were of course unfamiliar with group activities so the first 3 to 5 years concentrated on educational or study group (*benkyokai*) type activities. Then as workers became familiar with what group activities entailed and with the techniques of problem solving, they began to take on issues related to quality, efficiency and so on.

The groups are formed by dividing the employees under each foreman (line) or deputy section manager (staff) into groups of about 3 to 10 members (20 is usually considered to be too large to allow effective participation) – the typical method in Japan. Contract workers do not take part in SGAs. At the time of the study (late 1990s), there were just over 160 groups at Ami. Numbers operating at any one time vary between 160-210 due to changes in the organization, major increases or decreases in production, or suspension of activities during the start-up phase of a new product or the lapse between the completion of projects and the formation of new groups and so on. Four hours of group meeting time per month are treated as paid working hours – some of which may be within normal working hours. These are regarded as part of formal work activity not as informal, free activity. Whether additional time may be spent on group activities is decided by the foreman or the section manager. On the first Monday of every month, there is a factory-wide 30 minute meeting which is timed to coincide with the factory manager's monthly broadcast addressing current issues for the plant and urging everyone to "do their best".

There are basically three broad sources of problems for group activities; workplace policies and targets (determined in accordance with factory, department and section managers' policies), corporation-wide activities or campaigns such as ISO accreditation, environmental accreditation or development of the company's computerized information network, and problems which arise from the day-to-day operations of the workplace. In principle, a specific problem or issue which is consistent with the experience and ability of the group is selected from these three broad categories and formally registered. The problem is also selected on the basis that the group can either use data regularly collected at the workplace or are able to collect data themselves.

There are two kinds of activity reports; "report of completion" (project has achieved its stated objectives (*tassei hokoku*)) and "report of results" (stated objectives not achieved but meetings were held and some results achieved (*jisseki hokoku*)). The reporting format for group activities actually consists of two parts; an activities registration form and an activities report form. The former is to register the group, its name, members and leader, the objective and a measurable target as the outcome, the intended length of the project and a detailed plan of activities. This registration must be acknowledged by the chairmen of both the section and department committees and the respective secretariats. The activities report gives details of the results achieved and a calculation of the economic benefits of the outcome. It also gives a record of the meetings held and the number of participants in terms of total man hours and provides comments by the committee chairman and a committee member. The report follows the same route as the registration.

At Ami, small group activities (SGAs) in engineering areas occur outside regular working hours. Generally two problems or issues are taken up each year. In one section, the two issues were problems associated with paper cutting (*kamikiri*) and with the different requirements of different market destinations (*shimukechi*). Basically, members suggested problems in which they were interested and the group decided which one to take up. In recent years, the view was that the problems taken up should be closely related to the work of the section (presumably as set out in the policy statement). It seems that engineering staff rarely receive requests from production for assistance with SGAs. (The manager could only remember one instance and that had been from the Production Management Section not from production.) In any case, it was thought that such a request would go directly to the engineer responsible for the particular product rather than formally to the engineering section/department.

Records for Ami plant for 1996 show that there is a difference in emphasis in the activities of the groups in direct production areas and indirect staff areas. Quality (32%) was the largest category in direct line areas and standardization (35%) in the case of indirect staff areas followed by performance/efficiency in both cases (line 21%; staff 19%). Quality (13%) only rated third in staff areas but study was higher in staff than line areas (8% compared to 4%). In total, groups in staff areas undertook more projects than those in line areas (177 compared to 105). Figures for the company as a whole showed a roughly similar pattern. It is likely that even where categories are the same, the nature of the problems addressed would be different in the case of production line and staff groups.

Support Structures and Activities

Within the factory, the supporting structure of committees for the promotion of group activities is duplicated at each of three levels – factory, department, section. The factory manager (department manager, section manager) acts as chairman and the department managers (section managers, assistant managers or supervisors/foremen) are the members. There is also a secretariat in charge of SGAs located in the Factory Manager's Office. Each of the Section managers holds a meeting every month attended by the Assistant manager/s or foremen and the group leader/s and where group progress is reviewed and advice offered. As well as the annual company-wide All Canon Presentation Meeting, there are more frequent presentation meetings held at the factory, department and section level. Groups also make presentations to regional or national conventions such as the JMA's national ZD Convention.

While small group activities are considered to be an important avenue for participation by the non-supervisory workforce, they do not have much in common with self-managed groups. Rather they are highly controlled activities which are integrated into the overall management structure. Thus targets for SGAs are set in the foreman's policy statement and the foreman is responsible for seeing that groups operate effectively and carry through their planned activities. In particular, decisions about the formation of groups, the selection of the leader and the problem on which the group will work are made by the foreman. If a group does select its leader or project, the decision must still be approved by the foreman. It was explicitly stated that groups cannot just be allowed to "do their own thing" both in terms of achieving results and because what they do has implications for the preceding and following processes. The organization of group activities was also referred to as a combination of the "top-down and bottom-up" approach.

Training for SGAs

Initial training for new recruits lasts for a week and includes, among many other things, introduction to SGAs but orientation training only covers the very basics. The rest is learned on the job, in group activities working together with older, experienced workers. Leader training is conducted twice a year at the factory for newly appointed leaders and consists of 15 hours over 2 days. In 1996, the course was offered twice for a total of approximately 25 leaders. (There is a Leader's Manual which for example contains several pages of formulae for calculating the cost benefit of projects.)

Other courses on simple improvement methods, how to conduct meetings (which is available 2 or 3 times a year) and so on are part of the universal training programmes mentioned below and interested persons can apply through their supervisor. Leaders would normally take these courses too. There are also many other quality-related courses in addition to those specifically related to group activities.

From the company's point of view, the objectives of SGAs are regarded as both direct and indirect. Direct objectives or outcomes include improvements in quality or safety, the economic benefits thereof, and so on. The indirect outcomes that occur in the process of problem resolution activities include individual/personal growth, growth of the group, developing leadership skills and so on. Both of these in turn contribute to the ultimate objective which is comprehensive organizational improvement (*taishitsu kaizen*)[110] of factory operations and performance.

Despite the considerable effort and organizational support that goes into SGAs, their importance either to the quality control system or in general should not be exaggerated. As indicated by the Section manager's interpretation of the CPS system for his section, AGs are only one of five activities contributing to improvement in work environment (*hudo no kojo*). The other four are the suggestion scheme, 5S activities, education and training and social activities. In turn, work environment is only one of a range of factors which contribute to the creation of the "Premier Work Center". It is clear that substantial improvements do flow from the work of these groups, but from the point of view of the overall quality management system, they only constitute a minor part.

Four other points should be noted. The first is the time taken to introduce and consolidate small group activities – which was counted in years (not weeks or months as often seems to have been the case in Australia). Second is the fact that group activities themselves are used as a training venue, not only for group activities per se and problem solving methods but also for other company programmes. Thirdly, there was a time lag between the renewed emphasis placed on quality assurance as a key aspect of CPS which was launched in 1976 and attention to the development and diffusion of SGAs – which did not begin until the second phase of CPS in 1979. Finally, it took many years for SGAs to become widely established throughout the company's operations. The first groups were established in 1972-3 in three of the company's four operations (well after the launching of the quality circle movement and well after the establishment of these plants) but widespread dissemination did not begin until 1979.

Education and Training

Training in QC is not an isolated activity but part of a comprehensive training programme not only in work skills but also in supervisory and management skills. Moreover, training in QC

[110] This term is frequently used in Japanese. "*Taishitsu*" literally means "physical constitution". When applied to business, the sense of "*taishitsu kaizen*" is more comprehensive and thoroughgoing than the most obvious translation 'restructuring'. The English word, 'restructuring', is used directly as a borrowed foreign word in Japanese (*risutora, risutorakucharingu)*.

itself (as in other skills) offers courses tailored to the needs of different groups of employees and also provides a progression in level of difficulty.

In 1996, the Ami plant put 108 new recruits through initial training, a further 243 employees through various regularly scheduled courses and 140 through a wide range of CPS training courses in small numbers of less than 5.[111] The CPS training courses ranged from IE and WF to Group Creation, Strategic Management Games and trainer courses for QC and VE. The only large numbers were 12 and 14 participants in two Basic QC Techniques courses but there were 6 participants in Intermediate QC and 1 in the course for trainers of Basic QC.[112] There were no participants in the QC Advanced Course. All of the above is in addition to ongoing OJT in all departments.

It was admitted that participation in training programmes can be obstructed by the demands of production. However, there is a committee at the section level responsible for planning training programmes (*kyoiku kenshu iinkai*). Moreover, 100% implementation of training plans is set as a section target (in the case of the Assembly Section, No.1 Production Department) and the view was that the necessary steps must be taken to reorganize the work and personnel of the section to allow the release of workers for training.

There are two other aspects of training at Ami which are of particular interest. One is the provision of support and guidance for suppliers and the other is the issue of training for contract labour. With respect to the former, of the three production departments, only No.1 Production Department has set up a special block of 5 members to advice suppliers and provide training for their workers. But when a new product or model is being introduced, this group also enlists the assistance of a foreman and others from the block responsible for that particular product.

In the case of contract workers, a group arrives in the morning and starts work in the afternoon. (These workers may only stay for a month or less.) As a result, the production manager pointed out that regular workers were required to play a major part in the teaching contract workers how to do the job. Accordingly, training courses in how to teach the job were increasingly important

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[111] A direct comparison is not available but figures for the company as a whole for fiscal year 1992 were 21,000 participants and 680,000 hours for a cost of 2.3 billion yen (Canon, Inc. 1994).

[112] Courses attended by Ami employees included the Canon Simple Approach to Improvement, Development Course for Meeting Leaders, TWI-JI (job instructor for job training), TWI-JR (job relations for human relations (sic)), Introduction to Accounting, Introduction to Personnel Management and Air Spin. Air Spin was a course for employees in their 40s and was described as thinking about the flow of time and events and developing a future life plan. It emphasized change and adaptation to change – changing one's perspective and way of thinking. It was offered 6 times for a total of 49 participants.

and in the preceding year or two it had become necessary to have female workers attend these courses and become involved in training. Otherwise, according to the manager, it was "no longer possible to ensure the flexibility necessary to keep operations running smoothly".

Factory-level training is only part of an even more extensive company-wide education and training programme[113] consisting of 4 major components; a universal component for all employees of the same status or position; function-specific training divided into 7 streams; local training by each plant or facility; and personal development training. Each of the categories contains a range of individual programs. The universal component (*zensha kenshu*) alone is made up of seven programmes containing a total of 46 individual courses.

At the company level, for the purposes of training programmes, a distinction is drawn between administrative staff, technical staff and production operators (*shokushu*; type of work) as well as between new recruits, experienced employees, supervisory staff and managers (*kaiso*: status/level). The target "audience" as well as the objectives of each courses is clearly specified. For example, in the case of universal training courses, the objectives are selected from a total list of 14 (position/ function, problem selection and resolution, development and training of subordinates, strategic thinking, comprehensive organizational change, management "mind", creativity, planning and improvement ability, persuasiveness and negotiating ability, leadership, communication, adaptation to internationalization, specialist/technical knowledge and skills, life planning and occupational consciousness).

Courses in quality control are one of the seven streams[114] of function-specific education and training and are also included in the production operations stream as well as local plant training programmes. The corporate-level training courses include Basic QC Techniques, and Intermediate and Advanced QC as well as a course for trainers of Basic QC. There is also a separate training course for SGA facilitators. These are only some of 20 elective (in addition to 'compulsory' universal courses) quality-related courses which are targeted at particular categories of employees, have pre-requisites for participation and eligibility criteria. So completion of the basic course is a prerequisite for the intermediate courses and so on. In terms of categories, supervisors or employees in research and development or in quality areas are eligible to undertake the 'Design of Experiments' course, for example.

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[113] For an indicative listing of the range and types of education and training available, see Canon, Inc. (1994: 258-62, Appendix K).
[114] The other six are internationalization, R&D engineering, intellectual property and product law, materials, production technology and skills, production-division-related programmes.

It is interesting to note that Canon regards the extensive training programmes as performing a number of functions in addition to training as such. Firstly, Canon shares the widely held view in Japan about expertise and skill as expressed in its human resource development (*jinzai ikusei*) philosophy. "Company-specific skills (knowledge and experience) are vital ingredients of productivity. <u>Graduates</u> ... <u>do not come equipped with them</u>. They can only be learned gradually" (emphasis added; Canon, Inc. 1994: 177). In other words, companies are generally not looking for specific technical expertise when they recruit graduates of universities or other training institutions. Secondly and most importantly is the role of training as a means of communication, dissemination of information and shared understanding. As stated in "The Canon Handbook", "In-house training also serves as a most important information channel through which management policy can be communicated to members of the company" (ibid.).

The Social

There were only occasional references to the social aspects of plant organization or of company organization generally and, unlike the other Japanese plant, such references were usually within the context of actual work activities. As outlined above, even at the shop floor level, in the concept of workplace organization (the Premier Work Center), the element with the most obvious social overtones, improvement of work environment, is only one aspect of a complex structure and even this is regarded as dependent on specific activities and programs such as 5S activities, education and training, the suggestion scheme and Ami Group activities. The only other specifically "social" aspect of workplace organization is the HELPA scheme of social activities.

In company publications about its operations and the Canon Production System, there are comments such as "Production is more than highly automated machines, sophisticated control equipment and computer-aided design. It is people working together to take ideas from the drawing board to the marketplace …" (Canon, Inc. 1994: 98). However, these comments are qualified by such remarks as these men and women are "joined in a rational organizational effort" where the "Accent is on production efficiency and the ability to bring innovative products to market in record time" (ibid.). Similarly, a scan of a table showing the history of CPS activities reveals very few items of a "social" nature. For example, the objective of the second phase is to "Construct a quality, delivery time and cost assurance system and invite the participation of all workers" (ibid.). In other words, there is a clear recognition of the need to construct systems in which to invite workers to participate. In this second phase, "workplace vitalization" (*shokuba no kasseika*) activities, small group activities and presentation meetings and commendation awards appear for the first time but this phase is also to concentrate on target setting and implementation plans as well as techniques or programs such as PAC, HIT, QAFC, VE and PM.[115]

Conclusion

Canon was a 'late-starter' in adopting quality control. However, after some early difficulties, quality (as part of the QCD trilogy) was adopted as a key element of the CPS which was launched in 1976. In terms of conception as well as practice, quality management was clearly focused on the production system. A great deal of attention was paid to collecting accurate data and ensuring that information was disseminated to all related parties. This relied on formal procedures for recording and analyzing data and a network of formal meetings and committees and culminated in the development of the on-line QISS system.

References to the social aspects of quality control were quite rare. Work environment was included in the conception of workplace organization but was only one part of a complex structure centred around improved efficiency, quality and on-time delivery (basically the QCD trilogy), and supported by management policies, the specialist committees, and the supervisor's G-CPS plans. Improvement of the work environment was itself seen to depend on specific activities such as education and training, 5S activities, small group activities and the suggestion scheme.

A striking feature of the development of quality control in this company was the time taken to plan and then introduce new systems and programmes. The introduction and consolidation of CPS occurred in three stages over a period of nine years which could be roughly characterized as establishing, consolidating and upgrading the system. This was followed by further development and upgrading of the system with New CPS (1985-87), G-CPS (1988-92) and New G-CPS (1993-1996). Moreover, prior to the introduction of CPS itself, extensive preparatory work had already been undertaken in the preceding years involving the establishment of study groups to examine work factor, Performance Analysis and Control, standard time, productivity improvement, and production technology.

[115] PAC: Performance Analysis and Control, HIT: Canon's version of JIT, QAFC: Quality Assurance Flow Chart, VE: Value Engineering, and PM: Productive Maintenance.

CHAPTER 5. Case Study 2: Bridgestone

History of QC

Bridgestone has a strong quality orientation. The importance attached to quality is expressed in the company motto; "Providing top level quality to society" ("*Saiko no hinshitsu wo shakai ni.*") which has remained unchanged since its inception. It is also reflected in the quality system and in such aspects as the in-house manufacture of a particular component which most companies in the industry source externally and the manufacture of highly specialized, special purpose models which have low profit margins. The former was explained in terms of wanting to have maximum control over the quality of the company's product and the latter as contributing to the technological sophistication and excellence of the company.

As early as 1943, Bridgestone introduced statistical methods of quality control. In 1952, in other words, soon after the establishment of Japan Union of Scientists and engineers (JUSE), the company's employees began participating in QC seminars and in 1957, QC Sections were established at the plant level. In 1964, TQC was introduced under the title of Deming Plan Activities, a plan to pursue comprehensive organizational improvement (*taishitsu kaizen*) of the company and to move the company from "management by the founder to organization-based management" (*sogyosha-gata keiei kara soshiki-gata keiei e*). Four years later, in 1968, Bridgestone was awarded Japan's premier quality prize, the Deming Prize. Significantly, the following year, Bridgestone launched a company-wide IE (Industrial Engineering) programme and Mandel, an American IE expert, was invited to lecture at the company, as were two American QC experts – Juran in 1969 and Deming in 1970. Training courses in IE were also commenced at this time. These courses were expanded in the mid-1970s by adding advanced, specialized courses and further reinforced and expanded as improvement technique courses on a group-wide basis and to affiliated companies during the 1980s.

In 1982, the "Deming Plan Renewal" was launched with a focus on integrating quality control activities as a normal part of routine work. In 1984-85, a campaign to halve inventory was undertaken as the prelude to the introduction of a TPM programme in 1986. In 1988, on the 20th anniversary of the company winning the Deming Prize, a Zero Quality Defects (QZD) programme was introduced. Later again, in 1994, the P150 campaign was launched. This was a company-wide effort to raise productivity by 50% over a three year period but the perceived negative effects of focusing exclusively on productivity led to the subsequent campaign being renamed PQS150. In other words, the pursuit of productivity (P) gains was to be anchored firmly to the maintenance or improvement of quality (Q) and safety (S) standards. The factory gained ISO9002 accreditation in 1994 – the first of the company's Japanese plants to do so. Nevertheless, the plant continued to use the services of a QC/TQC consultant who comes twice a year.[116] It was explained that there was a limit to the ability to maintain a high level of QA/QC activities relying solely on the factory's own resources so the factory enlisted the support and advice of an external consultant. The meetings were attended by managers, foremen (*shunin*), supervisors (*shokucho*) and staff such as engineering staff. It is notable that new programs were added rather than old ones abandoned and replaced. Thus, after the adoption of TQC in 1964, the company introduced IE in 1969 and TPM in 1986 and all these programs continued to operate in parallel and both the new and the old programs together with the associated training programs were expanded and upgraded over time.

During these years, the Hikone Plant was awarded the Director of the Trade and Industry Bureau's Prize, the Director of the Industrial Science and Technology Agency Prize and the Minister's prize for Excellence in Industrial Standardization in 1985, 1988 and 1992 respectively. The factory also won the Japan Plant Maintenance Association Prize in 1990.[117]

In mid-1996, the company issued a "TQM declaration" and moves began to strengthen management to more fully exploit the know-how and technical capability accumulated during the preceding TQC phase. In 1998, declared "the inaugural year of TQM activities", the TQM Promotion Office launched the SZD Renaissance program which was to build on the strengths and redress the weaknesses of the earlier QZD program (1988-92). As part of the new programme, the corporate TQM Promotion Office (*TQM Suishinshitsu*) issued a 54 page "SZD Renaissance Guide". In late 2000, there was apparently another substantial review and up-dating of QA procedures and documentation. This was followed in 2001 by "Action QS21", subtitled "Quality Spiral-up Program", to include everyone from the Technical Centre to the factories. Based on the understanding that 'process improvement' is essential to achieve 'quality improvement', this program was to focus on reforming attitudes, improving work methods and, importantly, putting in place the tools necessary to optimize all aspects of company operations.

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[116] Although the number of consultants has fluctuated (reaching a peak of 18 in 1966-68 and holding steady at 9-10 between 1984-93), the use of external experts (including Asaka and Ishikawa as well as Juran and Mandel (1969) and Deming (1970)) by the company has continued for the past 50 odd years.

[117] Other awards received by the plant include the Minister for Trade and Industry's prize for the best use of electrical energy in 1976 and for outstanding performance in heat control in 1978 (both in the aftermath of the Oil Crisis); the industry record for successive injury and accident free days of operation (5 million hours) in 1984; and the Gold medal from the Japan Greenery Research and Development Centre for the landscaping of an industrial site in 1989.

Organizational Structure of QC/QA

At the corporate level, there is an Executive Vice-president who is responsible for quality assurance and to whom the Quality Assurance Division reports. There is also an Executive Vice-president who is in charge of the production of the main product line and to whom each of the production facilities reports. Within each production facility, there is a Quality Assurance Department. The Quality Assurance Division at the corporate level is divided into three sections; Product QA Department I, Product QA Department II, and Deming Plan Department. The responsibilities of the QA Division are given as the development and implementation of quality policy, improvement of the company-wide quality system, support for quality management and improvement activities, and support for and development of ISO9000 and QS9000 activities. Significantly, the responsibilities of the QA Departments at the plant level (according to this document) are given as 'improvement of **production control systems**' and 'promotion of production (not product) quality improvement activities' (emphasis added) (see "Quality Assurance Related Departments and Basic Functions"[118]).

According to the diagram of the quality documentation system, both quality standards (*hinshitsu kikaku*) (as a subset of product specifications (*seihin kikaku*)) and quality system standards (*hinshitsu shisutemu kikaku*) are determined at the company level (see "*Taiya kankei hinshitsu hyojuntaikeizu*" (Diagram of tyre-related quality standards)). That is, in general, control of the system is exercised by HO. HO sets the parameters, standards and targets – but how any particular factory goes about meeting these requirements is left to the factory. Three aspects of the factory's operations are subject to specific contractual agreements with Head Office; product quality and specifications, the management regime for the initial stage of mass production, and product inspection standards (see "*Hikone Kojo Hinshitsu Hosho Taikei*").

The QA Department at the Hikone Plant is responsible for inspection, monitoring and testing of raw materials, intermediate and final product, promotion and coordination of quality control activities related to ISO9002 and industrial standardization, and has primary responsibility for reviewing the local quality control system. The department is also responsible for education and training in quality control and quality assurance and for the administration of Quality Control Circles. There are approximately 100 employees in the department. The operations of the QA

[118] More details of the quality assurance system at the corporate and factory level are given in "Basic steps and main activities of Bridgestone's QA system" which specifies the responsibilities of distribution and sales companies as well as corporate management, planning and sales, technical centre and plants and "*Hikone kojo hinshitsu hosho taikei*" (Hikone Plant Quality Assurance System) which shows the relationships between the internal production-related departments and the customer, corporate headquarters and sales.

Department are divided among 3 main groups; a staff section, a final inspection section, and the laboratory testing section.[119]

Product Development and the QC Regime

The development of a new model takes about two years from inception to the start of production. The broad specifications for a new model/product for one of the OEM customers are decided about one year before production begins. The final specifications are determined about 6 months prior and at this stage the factory is informed and discussions between the Technical Centre and the factory commence. The Technical Centre determines the product quality standards (*hinshitsu kikaku*) and then it is the responsibility of engineering at the factory to determine the manufacturing conditions (*seizo joken*) and production process necessary to satisfy those standards and comply with the product specifications.

The Master Process (together with the product specifications and drawings) comes to the Technical Services Department at the factory and is converted into the Factory Process, which specifies the actual production process to be used at the factory. Negotiations occur with the Technical Centre about the changes the factory wants to make to adapt the Master so that it is compatible with the local equipment, systems and so on in order to maximize ease of manufacture. Changes may be made to the mid-point (*chushinchi*) and tolerances (*kyoyosa*) as well as more administrative aspects such as numbering system for materials or components. Once an initial Factory Process has been developed, negotiations occur with the factory's Production Department to iron out any problems they identify and a "final" version is produced. Depending on the production area, the relevant part of the Factory Process may be used as is but, in other cases, a simplified form, highlighting the information of particular relevance to operators, is produced.

The QA Department is responsible for drawing up the QC Flow Chart (*QC Koteizu*) which lays down the types and methods of inspection and other methods of control and management. For example, in the case of the assembly process, the operator preparing the materials and components must ensure that he has the right kind and the method for doing so is to read the bar code on each once after each change of product. Or in the case of the operator setting up the machine, he must check that the width of the drum is correct using the bar code card after each change of product. That is, the QC Control Chart (*QC Koteizu*) sets out not only the items which are to be controlled or assured but also the method of control/management and who is to

[119] Details are given in the plant manual, Chapter 3, *Kojo gaiyo* (Outline of Plant in "*Hikone Kojo Hinshitsu Manyuaru*" Hikone Plant Quality Manual).

exercise control (checker, builder, etc.).

Technical Services (TS) is in charge of the Trial Stage where the emphasis is on trialing the production methodology. Tyres produced at this stage are sent to QA for evaluation and the results are sent back to TS. Adjustments/changes are made in accordance with the points that QA indicate for attention and then there is a second trial production stage. The tyres produced are again evaluated by QA and if there are no problems, mass production begins. Once mass production begins QA conducts regular sampling to ensure that the product conforms to specifications.

Normal Operations

The basic production documentation at the factory consists of the Factory Process, the QC Flow Chart (*QC koteizu*) and the Standard Work Procedures (*sagyo hyojun*)(hereafter SWPs). Production draws up the SWPs (Work Procedures (*gyomu tejunsho*) in the case of staff and administrative (indirect) departments) from the Factory Process and the QC Flow Chart. In addition, each production area draws up their own Work Instructions (*sagyo shijihyo*) from the Factory Process, the QC Flow Chart (*QC koteizu*) and the SWPs. The Work Instructions show any points related to quality, safety and so on for special attention by the operator. Production controls how many Work Instructions (*shijihyo*) are issued in relation to a particular SWP. Generally, this documentation is written by the supervisor (*shokucho*) or, in the case of some processes, by the group leader (*kotei rida*) and is finally checked and approved by the manager of production.

For most materials and components, there were a large number of variants so it was not possible for operators to remember or memorize the materials and components to be used and/or the settings for each type. The "local process" (*kobetsu purosesu*) provided the operator with this information. In the past, it was necessary for the operator to refer to the "local process" issued by Technical Services and perform the settings manually. However, at the time of the research, this plant was in the process of introducing a computer system in the production areas. Where the computer system was fully operational, the operator only had to enter the model to be produced and the settings were performed automatically. The operator then referred to the "local process" (*kobetsu purosesu*) to check that what was being produced or used was the correct material or component.

There was inspection of raw materials, intermediate product and final product.[120] All purchased material is subject to receiving inspection. In the factory, material was sampled and tested by the laboratory after the initial processing phase (raw material preparation phase). If the tests showed any irregularity, the lot was withheld and tested again. In the intermediate stages of component production, automatic devices were used to detect and reject defective or non-conforming product. Intermediate product was also sampled for inspection and testing. In the final stages of production where product was handled individually, there was a stronger emphasis on operators notifying any defects or problems as explained later.

There was a final automated 100% check of finished product before packaging. Final product was also sampled and subjected to a range of durability and other tests on- and off-site. The results of testing and inspection were not reported to Technical Services unless there was a problem.

Abnormal Occurrences

As a normal part of process control, abnormalities or defects (*huguai*) that occur are investigated by QA and/or TS. The division of responsibility between QA and TS was explained as follows. Firstly, Technical Services is responsible for setting up the production process and QA is responsible for ensuring that the conditions necessary to implement those instructions as designed exist; that is, that the management and control mechanisms are in place. Secondly, QA is responsible for ensuring that work is performed according to standard methods and procedures, that the resulting product conforms to specifications and that this is sustainable on a continuing basis. Thirdly, QA has the function of detecting defects. If the results of their inspection and testing show a consistent deviant trend, QA conducts an initial analysis.

The resolution of a problem may require corrective action by production or it may require that Technical Services change the production process so that the cause of the problem is eliminated or minimized or it may require the intervention of another department. Where the cause of a problem is clear, it is immediately handed to the appropriate department or section (e.g. a machinery problem is handed to Plant and Equipment Engineering (PEE) (*Setsubi.ka*) or maintenance as appropriate).[121] However, it was pointed out that, frequently, problems are

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[120] The production process can be broadly divided into initial processing of raw materials, production of components (intermediate processing), and assembly and final processing stages – each of which in turn consists of a number of sub-processes.

[121] In company literature, the title "Maintenance Department" is used but the department consists of two parts – a staff section and a line section, the latter being responsible for maintenance. The staff section has a wider brief for design and installation of machinery and equipment, management of measuring

detected on a "phenomenological" basis and the causes are not obvious. In these cases, Technical Services is responsible for investigating the cause. When the cause has been established, it is handed over to the appropriate department or section for action.

In production areas, every month there was a review to check on progress and decide what problems needed to be tackled in the next month. The supervisor in charge of quality[122] <*hinshitsu wo tanto shite iru shokucho*> was the one who produced the analysis for the meeting. Once a problem had been selected and an initial analysis done, it was broken down into its component parts and the foreman (*shunin*) decided how each of the parts could best be handled – by the special Improvement Group (*kaizen-han, nikkin-han*), a quality circle, or through the normal organizational structures (*shokusei*).

The general approach to problem resolution/improvement activities by production was explained using an example from one of the production areas. The area identified and examined the problems which were causing the next process the most trouble. The most common problem was identified by drawing up a Pareto Diagram. In this example, it was a machine-related problem, so each of the machines was investigated to see which ones had the highest occurrence of this defect. Then the operation of these machines was examined to see which particular part of the operation was related to the fault; in other words, each step in the operation (*sagyo*) was examined to see how the defect was being generated.

This particular example was a complex problem which required a number of different improvements to be made so the various parts were assigned to different people or groups – some parts were handled as circle activities, some by the special Improvement Group (*kaizen-han, nikkin-han*) and some through the normal management structures (*shokusei*). In the case of difficult problems, supervisory and management staff normally become involved. In this particular case, there was a subsequent increase again in the occurrence of the defect because there were other latent problems which had not been detected in the initial investigation. These were subsequently corrected and in the space of 3 months the problem decreased to a level at which it was included in the "Other" category.

The production manager explained that one of the reasons why the system didn't seem very

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equipment, energy conservation and ISO-related matters. Also this company translates "*ka*" at the factory level as department (not section) in English.

[122] In each process, there is a supervisor (*shokucho*) in charge of quality. Once a problem has been identified, this supervisor is responsible for organizing the collection of data and making an initial analysis of the problem.

clear was due to the way quality control circle activities were organized for many years after the company won the Deming Prize. Every six months each of the circles was given a problem to deal with and they were supposed to work on it themselves – no-one else was supposed to be involved. (For a detailed discussion of quality circle activities, see below.) But it was pointed out that everything was moving at increasingly high speed so that problems had to be dealt with in as short a time as possible. So it was considered necessary for the formal management structure (*shokusei*) to provide support and back-up.

The "3-Don'ts" System

In production areas, particularly the final production stages, the "3-don'ts" system provided the framework for dealing with faults and abnormal occurrences. The essence of the 3-don'ts system was that the operators particularly at the final processing stages are responsible for inspecting components and materials for any faults before they use or further process them. The "3-don'ts" are: don't use defective material or components (*tsukawanai*); don't make defective components or products (*tsukuranai*); and don't pass on defective components or products to the next process (*nagasanai*).

The detection and handling of problems in the final two stages of production was divided into three distinct scenarios. They were: 1) cases where the operator detects a problem; 2) cases where the next process finds a problem; and 3) cases where final inspection finds a problem (defective/faulty product). In the course of normal work, if the operator detects abnormal or defect materials or components, or decides that his own work is faulty, he fills out a report which specifies the product type/model, machine number, name of component or material, etc. If a problem is detected at the next process, a report is sent back usually together with the faulty component/product. In both these cases (cases 1 and 2), a "Report on Defect or Fault and Application for Local Commendation Award" (*Huguai joho renraku ken chiku hyosho shinseishi*) is generated. If a defective product passes through the final stages of processing and is detected by final inspection (case 3), the QA Inspection group sends a "Request for Issue of 3-don'ts Sheet"（*3-nai shito hakko irai*）to the appropriate process.

The particular fault is traced back to the operator who produced it in order to investigate the circumstances under which the defect was generated. The objective is to assess whether the defect was the result of a problem of the worker's skill which may require additional training, a problem of supervision in that the supervisor had not noticed that there was a problem of, for example, skill or technique, or of larger organizational problems which need to be corrected. A Report and Follow-up on Failure to Observe the 3-don'ts (*3-nai mijunshu hokoku ken foro-appu*) is generated detailing the action to be taken by the operator, the supervisor and any other parties as appropriate and checked by the Foreman (*shunin*) and Manager (*kacho*) to see whether any additional action is required at these levels as well. Finally the report also goes to the manager of QA for comment and to check that the full follow-up process has been carried out. Each incident detected by QA inspection is followed through in this way.

In cases 1 and 2 above, the report to the responsible process may be verbal[123] or may also result in a "Notification of and Request for Action on Defect/Trouble (Red Memo)" (*Huguai jiko no shochi irai ken renrakusho* (*Aka Memo*)) being generated. This is a more generally used form which covers trouble related not only to quality but also productivity, cost, EDP, machinery and equipment, safety or any other trouble.

Self-Reporting (Jiko Shinkoku) System

A system was introduced to encourage workers to report defective product (including intermediate product), particularly ones they produce themselves; in other words, to try to ensure that no defective tyres were passed on to the next process. Records are kept and displayed for each operator showing the defective product reported by the operator himself and the number of defectives generated or passed on by each operator which are detected at subsequent processes or by final inspection. The immediate objective was to encourage reporting so that the latter is less than the former. But there are several secondary objectives.

The records were displayed in the workplace so everyone could see their relative standing at a glance. The hope was that this would encourage a competitive spirit[124] among workers so that those who were performing badly would try harder to achieve a better result ("so as not to be beaten by other workers"); in other words, that it would have the effect of bringing all workers up to the level of the good performers. From the point of the foreman, it meant that he could see which of the shift groups was performing badly and direct his attention to those groups and encourage the supervisor to take more active measures to improve the performance of his group. For his part, the supervisor who was responsible for the training and general skill development of his operators could use it to identify which workers need assistance. In this way, it also acted as a tool for prioritized management (*juten kanri*). In other words, given the supervisor is responsible for the performance and development of a large number of workers, it was a way of ensuring that he didn't waste his time on the good performers but concentrated his efforts on the

[123] Even if a problem is initially reported verbally, it must also be recorded on the form and all other parts of the form completed.
[124] A number of interviewees remarked that one of the aspects of effective plant management is considered to be the encouragement of competition among workers and work groups.

poor performers. The point was to try and achieve the maximum effect on improvement in the overall performance of each group and of the section.

Contract (Keiyaku) System

The contract system was an elaboration or formalization of the general principle of next process as customer (*jikotei ga okyakusama*). There were 27 in place in 1997. A "contract" was actually signed by a process with the next process (customer) to which it supplied product and specified that the former (the supplying process) agreed to decrease the incidence of a certain type of defect (*huryo tokusei*) to a specified level by a specified date.[125] The contract was signed by the responsible foreman (*shunin*). The results were checked on that date and if the contract had been fulfilled, the process received an award and earned points as specified in the original contract. If the contract was not fulfilled, half the specified number of points was subtracted. Competition among processes was encouraged and at the end of 12 months, the process with the highest number of points was given an award and a monetary prize at a ceremony held during the national "Quality Month" in November.

It was further explained that one of the reasons for this prize was to encourage "*nomunication*" (a play on words in Japanese combining the Japanese word for drinking (*nomu*) and the English word, communication). November is just before the end of year/New Year season – a traditional time for parties and drinking in Japan and drinking together is considered to be an important way to improve communication not only among fellow workers but also between workers and their supervisors and managers. In other words, the winning process received a handy sum as a contribution to their end of year/New Year party.

Improvement Activities

As indicated above, resolution of problems was linked to improvement and prioritized management. In terms of eliminating problems, the plant was moving increasingly towards automated and computerized monitoring to avoid or intercept non-conforming product due either to human error or machine error/malfunction. This was expressed in the conversion of the "3-don'ts" to the "3-cannots" system; "cannot use defective material/components, cannot make defective product, cannot pass on defective material/parts". The point was to build controls into machinery and equipment that automatically reject or block defective materials/parts or

[125] One of the production areas had 7 of these contracts, one of which was with the product Inspection group. It was an undertaking to reduce the incidence of a particular type of defect (*huryo tokusei*) from 66 per month to 20 per month. In another production area, the group had come close to the target but then performance had declined again markedly and it was noted that the records had not been kept up to date.

mistaken/incorrect actions.[126] For example, the initial mixing of chemicals was checked by computer and rejected if the mixture did not conform to the programmed details.

In conjunction with computerization, a major advance had been the introduction of bar-coding for component and product identification. In the final stages of production, one of the major problems had been using the wrong material or component for a particular model. In the past, in some processes, a mechanical marking system using a combination of coloured lines had been used for material/ component identification. With the introduction of bar codes, mistakenly using the wrong material or component no longer occurred. The introduction of the bar code system also meant that it was possible to trace back from final product, through each of the intermediate processing stages to the initial raw material inputs.

Improvement Group (kaizen-han, nikkin-han)

One aspect which was given particular prominence was the creation of a special group in the various production areas dedicated to improvement activities. The creation of these groups, it was claimed, was a major strategy to ensure the company's continued growth.

As a matter of policy, one supervisor (*shokucho*) in each of the 7 major production areas had been taken off production duties and assigned to a special group on permanent day shift and given special responsibility to concentrate on improvement activities. In the production area studied, this was a group of three highly experienced and highly skilled workers. The foreman (*shunin*) decided who would be assigned to this group. (It was commented that there were many other operators who were just as highly skilled and capable of doing this work but whose main job remained production work.) One of the reasons given for the establishment of this group was, as mentioned above, the high speed that was now required in response to problems and in finding and implementing improvements meant that it was no longer possible to rely solely on the results of the old, slower system of small group activities. One manager also commented that it was difficult to expect circle members to remain after work and carry out improvements to machinery as these groups did.

The philosophy underlying the creation of the special improvement groups was that, rather than rely on other people, the production department should try and improve the workplace themselves. So, according to the manager, "we stretched ourselves to the limit (*muri wo shite*)

[126] However, it was pointed out that, at least in some cases, the system only works if the standard work procedure was followed and that it was possible to circumvent the computer. One manager commented that the QC/QA system was not designed on the premise that workers would willfully attempt to subvert the system.

and even though we needed those three people, we took them off normal work and set up that special improvement group". For example, in terms of organizational structure, strictly speaking, improvement to machinery is the work of Plant and Equipment Engineering but it was pointed out that PE Engineering with only a small number of staff were responsible for all processes and so small improvements inevitably got a low priority and were put off. According to the manager, this was a case of "when you itch, scratch" (*kayui tokoro ni te ga todoku*) meaning that production needed to deal with small, niggling problems itself. According to the Production Manager, "what is important is how many small improvements can be made. This is what determines whether our productivity goes up or not." In other words, it is the cumulative effect of many small improvements which determines how much the Production Department itself is able to contribute to raising productivity.

The interviewees considered that the idea that production should take care of the production process themselves was a peculiarly Japanese characteristic. One management interviewee did not think it would be possible to have such a group in Australian factories because unions would oppose it on the grounds that it was taking the work of qualified tradesmen.

One expression of this "self-help" approach was the "Parts for Special Attention" (*Kodawari Buhin*) (for convenience, SA Parts) system. Behind this system, was Maintenance's concern about types of breakdown which had proved difficult to decrease. The idea was that just as everyone looks after the condition of their own car, the operator should look after the condition of his machine. So certain parts were selected, for example, the cutter in a machine, and the operator was supposed to monitor the condition of that part and change it when necessary –in this case, when it starts to get blunt for example.

On the basis of discussions between PE Engineering and Production, a decision was made about which parts operators were capable of changing themselves. Operators were then trained by maintenance staff, assessed and formally accredited as competent by the Manager of PE Engineering. In other words, there was a list of authorized parts and operators who were authorized to change those parts. Operators were accredited in relation to individual parts not in general. It was pointed out that if parts were not correctly changed this would cause even bigger problems and more loss of time. The accredited operators change the parts and feedback information to maintenance. There was a designated place for holding the necessary replacement parts in the production area.

The programme had been in place for two years and was in its third stage. (Training for the third stage was still in progress at the time of the research.) At each stage, additional parts were added to the list and additional workers were accredited. It was reported, that, as result of the introduction of the "SA Parts" (*Kodawari Buhin*) system, downtime had decreased because it was no longer necessary to wait for someone to come from maintenance and also that the workload of maintenance had decreased significantly.

Improvement Suggestion (Kaizen Teian) Scheme

Targets were set for the number of suggestions each area was expected to submit. Suggestions could be submitted by individuals, groups, QC Circles, or supervisory and management staff. A budget was allocated for these activities at the beginning of the year, but since such activities are unpredictable, it was also possible to apply for additional funding in the course of the year. Originally, all suggestions were accepted as part of the system but later only those which were actually implemented were accepted. Ideas for improvements were discussed with and approved by one's supervisor/manager, with final approval usually resting at the Section Manager (*Kacho*) level.

Top class suggestions (Levels 1 & 2) were submitted to an assessment committee (*shingikai*) which met once a month if necessary. The committee could make site inspections to see that the improvement was operating effectively or they might decide to downgrade a suggestion to a lower level. All other suggestions were assessed by at least 2 section managers. The number and distribution of suggestions by level is shown below.

1996-97	
Top Level	198
Level 3 and Below	1,552
TOTAL	1,700

An example was given for the Inspection Section. The Inspection Section suggested that a bar code be attached to each product so that they could be sorted automatically. In the past, there had been two workers in each shift group whose job it was to look at each completed product and direct it to the appropriate checking machine. Now the products are allocated automatically by reading the bar code and these 8 workers have been reassigned to other duties.

Comments made by interviewees about this system were similar to those mentioned above; that it was common in Japan ("typically Japanese") for shopfloor workers to make improvements themselves (*jibuntachi no te de*) and that one of the merits of this approach was that it speeded up the implementation of improvements. In addition, it was commented that this scheme also contributes to the skilling ("level-up") of the workforce.

While there was considerable stress on the need for production areas to carry out improvement activities even in areas which are normally considered the responsibility of other departments, there was equally a clear sense of a hierarchy of difficulty with respect to improvement activities and of the sort of improvement activities which lay within the capability of workers in production areas as indicated by such expressions as "when you itch, scratch" or dealing with problems which are "within arm's reach". In addition, it is noticeable that the responsible department exercised considerable supervision or direct control over such activities by production workers as in the example of the "SA Parts" (*Kodawari Buhin*) system.

Engineering departments are clearly recognized as having a responsibility for improvement activities. In the company's documentation, the Technical Services Department is explicitly assigned responsibility for process improvement as well as for handling and resolution of defects and problems. Technical Services is expected to be constantly seeking better ways to make the process operate more smoothly and efficiently and to keep abreast of new production technology. In the case of PE Engineering, at the beginning of the year, there are discussions about process capability and which processes and by how much capability should be raised. The discussions are held together with production and IE (located in the Production Administration Department[127]) but the main responsibility is PE Engineering's. A list of items for improvement is selected and a budget allocated.

One of the biggest concerns of PE Engineering was the slow rate at which improvements were rolled-out (*yoko tenkai*). This was attributed to both limitations of manpower and the demands of production which meant that machines could not be stopped to do the planned up-grading. The example was given of the replacement of magnets with a solid state contact. The magnets were subject to wear (which required them to be replaced roughly once every 12 months) and also to build up of material which caused malfunction. The solid state contact would solve both these problems and result in additional efficiency gains by eliminating the work of replacing the magnets. Despite the fact that work had been in progress for quite some time, replacement work

[127] "Production Administration Department" is given as the translation of *Kojo Kanri-ka* but from the description of the responsibilities of the department, Production Planning Department would probably be more appropriate.

had only been completed on about 60% of machines. (Expense was also mentioned as a factor in this case.)

The recognition of a "hierarchy of difficulty" existed not only within the factory but also between the factory and head office. It was pointed out that it was very unusual for the factory level to be involved in the development of completely new technology, that the design and development of new machinery was done mainly by the Technical Centre in Tokyo. The work of PE Engineering at the factory was concentrated on more practical issues of installing machinery and making sure that it is set up in optimum operating condition, including ease of use by production operators. In that sense, it was explained that it is the Technical Centre that undertakes major improvements and PEE at the factory which undertakes more minor improvements. Relative to production within the factory however, they would be the sort of improvements that are too difficult for production to do themselves – or, in the factory's production manager's words, "they (engineering) perform the large improvements, we perform the small ones".

The drive for improvement also proceeded through the periodic launching of major company-wide campaigns to reinforce and upgrade standards and systems. Many of these campaigns illustrate the interlinkages between quality and other aspects of production operations. The TPM (Total Productive Maintenance) campaign started in 1986 is one example. At the time, analysis indicated that 57% of quality problems were caused by machinery failure. It was concluded that, if machinery and equipment did not operate as intended, it would not be possible to achieve productivity gains in the future. The objective was stated as trying to reduce breakdowns and "short stoppages" (*chokko-tei*) and ensure that machinery and equipment operated as originally intended (*kichinto honrai ugoku yo na katachi ni suru*). The expectation was that ultimately this would have the effect of stabilizing operations (*sagyo wa antei suru*) and thus improving quality and safety. The PQS150 campaign is another example. P150 was introduced in 1994 as a company-wide campaign to raise productivity by 50% in response to the sharp rise in the value of the yen which threatened the viability of manufactured exports. However when it was found that concentrating on only one aspect, productivity, resulted in deterioration in quality and safety, these were incorporated in a new campaign, PQS150, launched in 1997. These were followed by the SZD Renaissance programme in 1998 and the Action QS21 programme in 2001 – programmes which were focused particularly on quality improvement. Importantly, these campaigns and programmes were cumulative – one did not replace the other – and most were accompanied by a range of training programmes.

Documentation

As we have seen, there is extensive documentation of the system itself and formal documents for recording various quality control activities such as handling of defects, maintenance activities and so on. Documents and records are used both for monitoring and evaluating procedures and as the basis for prioritizing and determining future action, targets and policies.

Most individual documents have been mentioned in the context in which they are generated but it is useful to make some general comments here. Most documents specify the route for circulation and who must sign off on the document. This usually includes a number of parties – the person who produced the document and two or more section managers so that managers are aware of what is going on and checking that appropriate action has been taken. Documents generally require detailed records; for example, in the case of problems resolution, details of the analysis, proposed solution and the expected consequences. Particular stress is placed on follow-up and ensuring the problems are followed through to a satisfactory conclusion. The history of the updating of all production, system and procedural documentation is carefully recorded – the generation of new documents, the document which a new one replaces (where appropriate) and the deletion of previous versions.

There is also extensive recording, including historical records, of the QA system, programmes and activities. Much of this is done by the headquarters Quality Division which collates materials from the various operations. This material not only gives an overview of the current state of operations and practices but is also gathered together into a extensive historical record.

Information and Communication

At this factory, information and communication occurred in the form of regular, formal meetings, collection and circulation of reports, workplace displays and in various informal, ad hoc ways. With respect to QA and Technical Services, it was commented that the two sections are located adjacent to each other and that information is exchanged verbally on a daily basis. Similarly, it was pointed out that since the Technical Services Department did not possess much of the information it needed about problems and defects and did not collect data itself, it had to "draw up" (*suiageru*) information from the shop floor. So there was ongoing communication on a daily basis out on the line with production and with QA. This was so much a part of routine operating procedure that the interviewee did not really regard it as a formal meeting.

A number of interviewees stressed that there are not strict divisions between sections and departments but rather that it is typically Japanese to allow work to overlap. That is, there is little concern or even consciousness of 'encroaching on someone else's turf" or conversely refusing to do something because it is outside one's job description. Finally, it was pointed out that decisions are rarely made by one single section but on the basis of discussion and agreement between related or effected sections and departments. However, the work which flows from such decisions becomes the responsibility of the appropriate section or department.

Interviewees remarked that a lot of information is freely available in the workplace. They considered that there is a high level of shared information in contrast to America where the Japanese believed that supervisors and managers tend to keep information in their own personal notebook or diary. This theme of the availability of information was repeated many times. There were a number of examples of the practice of making information widely available and accessible. Maintenance staff mentioned the fact that information on temperature changes in certain equipment was displayed on the side of the machine because if it was kept in a file, only a few people would see the information. Similarly, records of difficult repair jobs were kept in a ready-reference file (Skill-Up Information; *sukiru-appu joho*) for the use of all maintenance staff. Technical Services commented that as far as possible information for the use of production was presented in simple, diagrammatic form. In addition, in each of the major production areas, there were displays which present information on the area's performance with respect to quality, productivity, cost, safety, and group activities. It was noted however, that some of the material displayed was rather old (dating back 12 months) and some incomplete or not kept up-to-date.

The communication and sharing of information occurs most obviously in the form of formal meetings. At Hikone, there are a range of regular meetings, a number of which are specifically related to quality. Each section holds a morning meeting (*Asaichi*). In the case of QA, the Morning Meeting reviews the previous day's problems. Staff from Technical Services also attend – normally, the engineer responsible for the assembly process attends and other engineering staff depending on whether the problems relate to their area of responsibility. The Maintenance Section discusses day-to-day breakdowns at their meeting. The manager (*kacho*), foreman (*shunin*) and both supervisors (*shokucho*; *mae* and *ato kotei*) and the maintenance leaders of the particular processes in question (say assembly) attend. Data about the previous day's breakdowns is presented at the meeting.

There are two weekly "strategy" meetings to discuss ways to reduce defects and which all related processes attend – one to review defective components and the other defective product (*Furyo Buzai, Seihin Furyo Taisaku Kaigi*). Production sections which have a mini-project hold weekly meetings of one and a half hours. Other meetings organized by QA include a monthly

Inspection Meeting (*Kensa Kaigi*), and a monthly QZD Meeting.

The Production Department also holds a monthly Quality Meeting (*Hinshitsu Kaigi*) to review the progress of work on current quality problems and to determine what issues will be taken up in the next month. Sometimes issues are carried over from the current month. As part of this review, each of the supervisors (*shokucho*) responsible for quality is required to provide an analysis of the current situation in his area. There is a monthly General Meeting (*Sogo Kaigi*) – a factory-wide meeting of all employees which, among other things, looks at the results of inspection. At this meeting, the factory manager presents awards to the work groups which have fulfilled their contracts with the next process. A formal factory-wide meeting chaired by Technical Services is held twice a year to plan the product mix for next 6 months. Staff from Head Office and the Technical Centre also attend.

Policy Deployment

Another aspect which is closely related to communication is policy deployment. Effective policy deployment both aids communication and is itself dependent on effective communication. Management-by-policy is identified as one of the key elements – along with the quality assurance system, circle activities and education and training – as one of the key elements of both the Deming Plan approach and later TQM and as essentially the starting point of the quality control system. A number of interviewees referred to the "bottom-up top-down" management approach. Policy objectives and targets are set at the top of the organization and must be reflected in the plans and targets at each lower level.[128] However, the objectives and targets set at the top are based on information passed up from the bottom of the organization. In other words, objectives and targets are selected on the basis that they can realistically be achieved. Therefore, as one interviewee commented, it would be strange if they were not met. This does not mean however that targets are set so low as to be meaningless – but rather that they are realistic targets derived from reliable information about actual operating conditions.

This view was reflected in company documentation which made a clear distinction between management-by-policy and routine or daily management and stressed the need for policy to address all five aspects of the expanded QCD trilogy – QCDSM (quality, cost, delivery, safety and environment, and morale). Interestingly, cost control/management included improvement in productivity, and morale was given as personnel and human resource management.

[128] Unlike the other Japanese company, I was not shown actual plans and targets for local areas.

As noted, major campaigns such as P150 are rolled out across the company. In these cases too, a single uniform increase across all parts of the organization is not demanded or expected rather explicit targets are set for individual sections. In this case, when questioned about the difficulty of meeting such a high target, especially in the case of the subsequent PQS150 campaign, it was admitted that the true target was closer to 30% but that this lacked resonance as a campaign slogan so P150/PQS150 was selected.

Small Group Activities

The first QC circles were formed at the company's plants in 1963[129] and the sub-circle system introduced at one plant in 1966 and later extended throughout the company. The system of "parent circles" and sub-circles (and sub-sub-circles) (referred to in the company literature as "parent", "child" and "grandchild" circles) has continued to be standard practice to this day.

Although companies (including Bridgestone) stress the voluntary nature of QC Circles, circle activities are in fact highly managed and carefully monitored activities in which foremen and supervisors play a key role. At Bridgestone and Hikone, there is a "parent" circle attached to each supervisor who is the leader of the circle. This is then broken down into a number of sub-circles. At the time, there were approximately 180 circles and sub-circles in the factory. Each year each Supervisor (*Shokucho*) (as head of the "parent" circle) is allocated 4 problems by the Foreman (*Shunin*).[130] The problems are selected in line with current company policy. Each is broken down into smaller parts which are assigned to sub-circles. The sub-circles consist of 4-5 people and meet about twice a month to review and process/collate data and discuss problems. The supervisor calls the "parent" circle together about once a month to review progress and discuss quality problems. Each group keeps a record of its activities and the number of problems resolved by each "Parent Circle" is recorded.

Circle activities are classified into a number of broad categories; quality, productivity, safety, TPM, and some other categories such as energy conservation and small ZD were mentioned. Although quality-related activities were continuing, in recent years, a large part of the activities of the groups at this factory were related to TPM (see below, p. 40). Detailed records are kept of QCC activities across the organization and the company produces an annual report. The data

[129] Consistent with the company's history of concern with quality control, it was one of the first to respond to the call for the establishment of QC circles in the journal, *Gemba to QC.*
[130] The standardization of the palette knives used in the assembly process was given as a stereotypical example of quality circle type improvement activities. There were a lot of different shapes and sizes in use so these were gathered up, categorized and tested to see which was the best shape and this was then made the standard.

includes number of circles and sub-circles, number of problems solved (per "parent" circle); number of meetings held; number of factory presentation meetings and participation in external presentation meetings.[131]

In addition to supervision and support by the foreman and supervisor, support structures include regular plant-wide meetings of sub-leaders (sub-group leaders) and of circle leaders (supervisors), and Promotion and Support Committees at the Section level. In addition, there is a plant-wide Promotion and Support Committee to which the leader and sub-leader meetings send representatives. A training programme in quality control techniques and how to make presentations, etc. is provided for Sub-Group leaders.

The factory holds presentations about 10 times a year. It was commented that this factory was exceptional in that it has always held presentation meetings whereas this was less common at other factories. In 1997, there were 5 general QC Circle presentation meetings, 4 safety-related meetings and 1 related to energy conservation at the factory-wide level. A total of 107 presentation meetings were held at the Section or lower levels but this figure includes not only actual QCC presentation meetings but also TPM Workplace Inspections[132] (TPM *no gemba shinsa*). Hikone also participates in external presentation meetings, including the annual National QC Circle Conference. A presentation was made to this Conference by one of the factory's circles in 1997 and the same presentation was also made at the Toyota *Kyohokai*. (These were two of a total of 5 presentations to external meetings in 1997. I was informed that the numbers used to be larger in the past.

One of the interviewees pointed out that changes in the way work is performed have made it increasingly difficult to sustain Quality Control Circle activities. In particular the number of workers assigned to each process is now very small and the work has been increasingly automated. In the past, when each worker only performed a small number of tasks and they were performed manually, there was ample opportunity to observe the quality or variation of the materials with which they were working. There were also a larger number of workers in close proximity doing the same or similar kinds of work and with whom it was therefore possible to discuss ideas and problems. Now a small number of workers are in charge of a large number of machines and tasks and cannot spend time in one place observing what is happening. Moreover, automation also means that the workers are not handling the materials themselves – indeed, the

[131] Data for 2000 show that the factory studied had a total of 212 circles and sub-circles and that for the company's Japanese operations as a whole there were a total of 1938 circles.
[132] The meaning can be lost in translation. The point of the inspections is to make a judgment or assessment of the adequacy of TQM activities.

operation may not even be visible. In these circumstances, it has become very difficult for workers to collect and analyze data themselves which is the basis of quality control circle type improvement activities.

At this factory, the decision to all but cease new recruitment and the resulting aging of the workforce were causing difficulties for the sustainability of circle activities. One manager commented that the plant was facing a problem of "intergenerational transition" in the sense that the occasional recruitment of a small number of young workers meant that the system of older workers passing on their knowledge and experience to young workers was breaking down. Another interviewee expressed similar views saying that it was difficult to retain young workers because they were surrounded by older workers with whom they had little in common. One QA staff member even voiced the opinion that it was difficult to expect older workers (after 20 years or more) to continue to be involved in QC circle or the newer TPM activities – a view which was strongly disputed by another interviewee.

Quality control circle – or TPM group – activities continued but they were coming to rely increasingly on new techniques such as video-taping a particular operation for many hours or installing an automatic recording device to gather data. Moreover, QC circle activities alone were no longer seen as sufficient but as needing to be supplemented by different forms of improvement activities at the shop floor level.

Education and Training

For the purposes of training, the workforce was broadly divided into technical staff, administrative staff and operators. This applied also to the training programmes relating to quality control under the company's Deming Plan. The training used a combination of in-house courses and courses supplied by external organizations. The important point is that different kinds of courses are provided for the different categories of employees, that is:

1. Training courses provided for all categories and levels of employees from operator to top management.
2. A different range of courses provided for each category of employees, with the most specialized being for engineering staff.
3. At the shop floor level, courses are directed primarily towards supervisory staff (foremen and supervisors) and circle leaders. Only fairly simple, basic courses are provided to all operators.[133]

[133] This is an instance where a proper understanding of the different circumstances which apply in Japan

Because of the aging of the workforce and lack of new recruitment, the level of training activity, particularly Off-JT, had declined significantly. This was because most programmes are oriented towards progressive training starting with new recruits or for appointees to supervisory and management positions. At this plant, most employees had already passed through these stages and completed the training. Thus with little new recruitment and limited promotion in management ranks, most of the programmes had become redundant.

The newly-appointed manager of the QA Department considered that the lack of quality-related training in recent years was a problem and had begun instituting some basic, refresher type programmes about QC/QA. Initially, the manager gave some of these courses himself – he said to demonstrate their importance. By 2000, there were six sessions in place ranging from a basic course to uniformity, trouble and human error and a QS9000 seminar. They were only short sessions of one to one and a half hours[134] but, except for two, 400~550 employees had attended the sessions.

One programme which was still occasionally delivered was training for supervisors (*shokucho*). Every employee appointed to a supervisor position goes through a training programme before taking up his position. There are extensive teaching materials covering each aspect of the supervisor's job and supplementary materials about TPM for example. The supervisor was required to have knowledge about a wide range of subjects. The initial programme lasted for 5 days and was very extensive. When it was pointed out that there seemed to be an enormous amount of material to cover in 5 days, it was suggested that this was possible because there was only a small number of trainees. In recent years, there had only been 1 or 2 new appointees each year.

There was also a Process Leader (*Kotei Rida*) (like assistant to the supervisor, mainly in production) training course and a Sub-Leader Training course for leaders of sub-circles. Process Leader was a system introduced in the mid-1980s, apparently to deal with the problem of limited promotion opportunities. Workers were appointed to the position for a period of one year renewable and received a special allowance. In 1997, there were 53 Process Leaders of

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and Australia is imperative. In this case there are two key differences. Firstly, in Japan, historically in the early stages of the introduction of QC circles there was intensive training and support for QC circles. Secondly, in the current situation, the existence of veteran workers with decades of experience with circle activities means that new circle members can learn from their experienced colleagues – a situation which did not apply in Australia.

[134] Again, it should be stressed that these were effectively "refresher" courses for workers who had completed all the scheduled courses years earlier.

whom 31 were newly appointed that year.

On the other hand, there was ongoing training (principally OJT) in production departments. Such training occurred in a number of contexts such as the introduction of new machinery or equipment or when there is a major change in work methods. An individual record is kept for each worker and the worker also signs off to confirm that he has completed the training. In some cases, there is also a period of OffJT held after hours in the Production Office area. The Supervisor is the trainer. There was also a multi-skilling training programme of which fork lift driver was given as an example. However, it was commented that this kind of training was quite costly so that it was not possible to provide training for large numbers at the same time and thus it was a gradual process. Forklift driver is one of a range of publicly recognized qualifications (which also includes, for example, handling of dangerous chemicals) and a large number of employees have obtained such qualifications. However, such qualifications are not explicitly recognized in wage and salary scales; there are more people who hold a given qualification than are required to perform the work by the factory.

Programmes which seemed to be largely inoperative (because need no longer existed) were New Recruit Training and Level-up Training – the latter to further improve the skills of operators who already have some experience. In the case of training of new recruits as operators, I was told that it took about 3-4 months to become fully competent in the assembly area. The programme was described as follows below.

3 days	Desk work only
3-4 weeks	OJT; day shift
<Assigned to work group>	
2 months (minimum)	Supervised
After 2-3 months	Assessment

Job rotation is sometimes regarded as a form of training. However, the scope of rotation in this company suggested that it may be less than is sometimes assumed. While there is rotation of staff among the different factories and the Technical Centre, it is apparently rare for staff to move from one area to another; e.g., from Technical Services to Quality Assurance or Plant and Equipment Engineering. In other words, production engineers will be transferred from one plant to another or to the Technical Centre <u>as</u> production engineers but not reassigned to plant and equipment engineering or quality assurance.

Rotation of staff at the plant level was not pursued on a systematic basis but given that rotation of engineering and other staff occurs on a company-wide basis rather than at the factory level, this was perhaps to be expected. In principle, all Technical Services staff were considered capable of taking charge of any process. However, it was claimed that it takes 2 to 3 years to master one process and since staff assignments were usually only for 5 to 6 years, it was only possible to gain experience on at most two processes at any given site. In the case of PE Engineering, it was claimed that the distinction between the staff and maintenance sections was not based on education and that rotation between the two areas did occur. However, the extent of rotation and the basis on which it occurred remained unclear.

On a company-wide basis, other factories also showed low levels of training activity reflecting the aging of the work-force company-wide. The company has records of the courses attended and the numbers attending for each of the factory operations. The courses attended and the numbers attending differed greatly from factory to factory as did the length of the courses. For example, in the year 2000, one factory did no training at all and another three conducted only one course, two of which were for foremen (2 persons in both cases). As noted, quality-related training at the factory studied consisted of short sessions of only 1.0-1.5 hours duration. However, at other plants, there were courses of long duration such as a 28hr course using a text entitled "Practical Problem Solving No.8", a 16hr externally-delivered FMEA course provided by JUSE, and a 20hr quality assurance training course for supervisor appointees.

At the company level, there was a comprehensive TQM training programme. In terms of target audience, the program distinguished vertically among senior management (directors, divisional general managers and factory managers), middle management, and other employees where the last was further divided into junior, middle and senior. The workforce was also divided horizontally into three categories; production workers and supervisors, engineering staff and administrative staff. There was an introductory course for all new employees based on a booklet produced by the company followed by another common course for all permanent employees. There were two further courses for production workers as they moved up the ranks but, beyond these, training concentrated on circle leaders as mentioned above. For engineering staff, on the other hand, there was a preparatory course followed by the Basic Course (customized by JUSE for the company's needs) and the JSA's Quality Control and Standardization Course. There were also advanced level courses in design of experiments and problem solving methods. For management staff, there were separate training courses designed specifically for middle managers[135], executives and production supervisors and foremen.

[135] It is important to note that, where middle managers had come through the engineering stream, they had already completed the courses listed for engineering staff.

By 2001, the programme had been revised somewhat to reflect the changes in the intervening years. The most obvious changes were the rejigging of courses for engineering staff to BS-SQC[136] basic, intermediate and advanced courses where the last now included reliability engineering, quality engineering and the use of computers for statistical analysis and the inclusion of courses on ISO and internal auditing in the common course category. It is interesting to note that participation in national conferences and presentation meetings was included as part of training for all employees from operators to executive managers. There were also external specialist courses available including introduction to the new 7 tools, FMEA-FTA, design review, quality function deployment, computer-based reliability analysis, physics of breakdown and product life prediction, and ISO9000. These courses were available to middle to upper ranked engineering staff, to production supervisory staff and extended to middle management.

The Social Aspects of QA/QC

At this factory, there was quite a lot of reference to people problems or social issues. As noted earlier, production staff in particular, stressed that, despite increasing automation, the assembly area still depended heavily on the manual skill of the operator. In other words, the biggest issues for the managers and supervisors were said to be, on the one hand, how to up-grade the skills of the operators and, on the other, how to ensure maximum motivation, concentration and reliable performance on the part of operators. Thus, it was claimed that "people are the biggest problem" and so there are "lots of devices and activities to deal with people". At the same time, however, "the general view is that we have to keep on increasing the level of automation and decreasing reliance on the worker".

As explained above, competition among workers was actively encouraged. In the case of the 'self-reporting' system, this involved individual performance being openly displayed for everyone to see. One manager explained the willingness to accept the open display of personal performance in terms of a rather stereotypical version of the relationship between employer and employee in Japan. That is, once a worker joins the company, he has a job until he retires (unless he decides to quit himself) and so the workers' well-being is directly linked to the development of the company – if the company prospers, wages and salaries go up and the worker also prospers.

[136] BS-SQC stands for Bridgestone Standards – Statistical Quality Control.

"Nomunication" and Human Relations

Earlier '*nomunication*' was explained in the context of the contract system. However, *nomunication* was not limited to End-of-Year parties (*bonenkai*). The production manager claimed that he was very busy after 5:30pm. In the two production areas for which he was responsible, there were 300 and 100 workers respectively, each divided into 5 groups. So he joined all ten groups for the purpose of *nomunication*. The foreman (*shunin*), he remarked, only has to take part in 5. ("So my unpaid overtime starts after 5:30. But actually I enjoy it.")

These drinking parties were considered an important opportunity for workers to say what they really think, especially to voice their criticisms. It was explained that Japanese are usually very reserved and don't say what they think, so drinking is a very important opportunity for communication. One manager went even further, saying that, to the average worker, the manager is a very important person ("like someone above the clouds") so they rarely have a chance to speak to him directly.[137] But when they go drinking everyone is on the same level – person-to-person. The operators can get the manager to listen to what they really think and they can find out what sort of a person he is. So, it was claimed, this improved the morale of the whole group.

Indeed, the cultivation of personal relationships went even further. The manager of production produced an invitation to a wedding – he, the foreman and the supervisor had all been invited. And the manager would, as is customary, make a speech. This was regarded as another way to strengthen human relations. So it was explained, especially in the case of the supervisor, even if he's tough at work, if the workers know him personally, the workers will accept what he says and cooperate.

However, the attention given to "people" issues should not be exaggerated. It must be balanced against the attention given to the technical aspects of quality and the production process as one part of a comprehensive approach to quality control. Moreover, the discussions were concentrated on the assembly area where workmanship was still a critical factor – unlike other production areas where most of the work was done by machines not men and therefore, problems were more likely to be of an engineering nature. In other words, such social aspects and activities were likely to have relatively less importance in other areas.

[137] These were interesting comments in view of the fact that it is common practice for managers at the factory level to wear the same work clothing as operators (rather than suit and tie) and of their generally greater presence on the factory floor.

With the introduction of the SZD Renaissance programme, M (morale) was added to the original QCD trilogy. However, it is interesting to look in a little detail at how "morale" was interpreted and how improved morale was to be achieved. In the first place, ensuring motivation to work (*yaruki no kakutoku*) depended on creating a "vigorous organization" (*katsuryoku aru soshiki*). The relationship between these two factors was explained in the form of a 4-part cycle: an organization (or workplace) which enables workers to identify what is an appropriate problem for them to deal with; an organization (or workplace) which enables them to solve such problems quickly; an organization (or workplace) which builds morale through the experience of success; and an organization (or workplace) which generates recognition of new problems. In other words, the building of morale depended on creating organizational structures which allowed workers to identify problems, equipped them to undertake problem solving activities and in particular to do so successfully.

Moreover, morale was only one of three basic objectives; the others being to speed up problem resolution and to raise the level of quality by applying a scientific approach. The basic elements of the new workplace SZD (small zero defects) programme aimed at achieving these objectives were familiar features of existing practices. All workplace problems and issues are to be treated as "parent" (major) issues (*oya te-ma*) then broken down into smaller component parts and assigned as SZD issues (*SZD te-ma no settei*). Engineering and other staff (as opposed to management staff) are identified as playing a key role in relation to all but one of the 9 types of representative problems.[138] A scientific approach must be applied to all problem solving (*kagakuteki mondai kaiketsu apurochi*). The solution or measures put in place must be permanent (*gyakumodori shinai taisaku*) and, where appropriate, must be institutionalized as part of a new control/management regime (*kanri no teichaku*). These activities were to be based on "participation by everyone" (*zenin ga sanka suru*) but the emphasis was on explaining in detail the activities in which they were to participate and the techniques and methods to be used.

The scientific methods to be used include not only a range of QC techniques (Q7, N7 and SQC

[138] The 9 types were occurrence of individual quality defects, work (production, administration) misses; individual difficult to perform work tasks and occurrence of problems (*huguai*) with work; chronic/recurring defects and difficulties (*huguai*) (engineering issue); difficulties during the start-up phase (process-related, delivery, etc); failure to reach planned production volume, delivery (daily basis); problems with the way work is performed (*yarikata*) or organized (*susumekata*); difficulties with systems, structures/mechanisms (*shikumi*), rules (production system, QA system, cost system, etc); difficulties with work standards or work rules (work instructions, specifications/standards (*kikaku*), etc); and problems related to the way work is managed (*shigoto no yarasekata*). The last was the only type for which (engineering) staff did not have a major responsibility. Responsibility was divided among three groups; management staff, engineering and other staff, and shop floor. Management staff were assigned major responsibility for only 5 types (4 together with engineering staff and two shared by all three groups).

– including QFD[139], design of experiments and reliability engineering), but also IE techniques (work sampling, work analysis/work study, flow analysis, ABC analysis (a form of prioritized management (*juten kanri*)), etc), PM (phenomenon-mechanism) techniques, and VA techniques (value analysis, function analysis, etc). Both the range and sophistication of the techniques to be employed is striking.

The key issue was not simply the resolution of problems but the consolidation and institutionalization of a new control/management regime (*kanri no teichaku*). This does not refer simply to the management system but includes the control regime for a particular operation or machine or the way work is performed and so on. There was a clear recognition that the desired level of performance could not be attained by the problem solving capacity of production workers alone. The roles of engineering (and other) staff and production workers are clearly differentiated and the need for staff to be involved stressed – including head office, the technical centre, and all staff departments. Similarly, a distinction is drawn between the roles of the different levels of management and the problem solving activities appropriate to each – ranging from management-by-policy and crossfunctional management at the top through routine management to small group activities at the shop floor level. Finally, it is the effective combination of the activities of these different levels and of the roles of all employees which is seen as creating a "vigorous organization" and improving worker (operator) satisfaction.

Conclusion

While the production of a physical product was clearly the focus of quality control activities, quality improvement activities were not limited to direct production departments. This had two aspects; one was the integral part played by indirect, engineering departments and the other was the recognition of a 'hierarchy of difficulty' in relation to quality improvement. This distinction between small and large problems or improvements applied not only to the relationship between production and engineering within the factory but also to the relationship between the factory and the Technical Centre at company headquarters with each higher level attacking more complex and sophisticated problems and improvement. There was a clear recognition that it is the combination of activities on all these levels which produces the results in terms of quality improvement and performance.

Similarly, it was the combination of mutually reinforcing programmes, a multi-faceted approach to improvement which was seen to produce both outstanding results in quality performance and

[139] Q7: the 7 quality tools; N7: the new 7 quality tools; SQC: statistical quality control; QFD: quality function deployment.

in the combination of quality, cost, productivity and efficiency. This approach was greatly reinforced by the company's decision in the mid-1970s to virtually cease recruitment and vigorously pursue automation. As a result, management of machinery and equipment became a major issue in ensuring high levels of quality performance and an elaborate management and maintenance regime was put in place and a TPM programme introduced at the shop floor level as well as the SA Parts system. Mention has also been made of other programmes such as IE and combined campaigns such as PQS150. It is important to stress that quality control was neither seen in isolation nor as a cure-all.

In some respects, Bridgestone seemed to be somewhat "old-fashioned", harking back to the old methods; "nomunication" and manager attending weddings. On the one hand, there was a tendency particularly on the part of production department staff to stress 'people' management issues and encourage competition among workers and work groups. This was evident in the Self-reporting system and the contract system. On the other, there was recognition – at least in some quarters – that times had changed. This was apparent in reference to the dissatisfaction of young workers with the shift system; the suggestion that it was difficult to continue to expect older workers to remain after work to carry out improvements to machinery and equipment or to continue to take part in small group activities and the creation of the Special Improvement Groups partly in recognition of this fact; and in the explanation of the changes that were undermining the viability of the old pattern of quality control circle activities.

However, this concern about people issues did not in any way mean that such social aspects were considered more important than or a substitute for the technical aspects of quality control. Quite the contrary. The importance attached to the technical aspects of quality control was apparent in the shift from the '3-don'ts' system to the '3-cannots' system; the continuing pursuit of process improvement and machine capability; the continuing push for automation and replacing people with machines; and the emphasis on production technology evident in the company's development of new machinery such as the combined building machines.

CHAPTER 6. The Japanese Quality Control System: An Interpretation

The preceding four chapters have reviewed the history of the postwar introduction of quality control in Japan, the relevant Japanese literature on quality control and the results of the case studies of two plants in Japan, the Canon plant at Ami and the Bridgestone plant at Hikone. In this chapter an interpretation is provided of Japan's mature system of quality control, drawing on these four sources of information.

Table 6.1 lists the key aspects of quality control that have emerged from the historical and literature review and have been found most useful in organizing the case studies. The interpretation provided here is organized in terms of these twelve features.

Table 6.1: Key Features of an Effective Quality Control System

1. Controlling normal operation
2. Procedures for dealing with abnormal operations
3. Procedures for improving product quality and process quality performance
4. Process analysis and control
5. Documentation and recording of data
6. Information and communication
7. Policy deployment and management control
8. Quality (and) cost
9. Internal auditing and diagnosis
10. Quality (QC) circles, SGAs
11. Training
12. The social aspects, three related aspects: • role of engineering staff, particularly production engineering • relations between engineering (particularly production engineering) staff and production workers • role of veteran workers

The quality control system described here is concerned with the internal operations of the factory and its relationships with corporate systems. Thus aspects such as supplier relations and the product design and development process – both aspects which have attracted considerable attention in the discussion of quality management systems (and Japanese management in general) – are treated only in terms of their interrelationship with the internal operations of the factory. This is not to deny the importance of these aspects but attention on these issues has tended to deflect attention from the factory's own internal activities and systems. Ultimately, the quality of a supplier's product (and therefore its impact on the internal operations of the customer) depends on the supplier's own internal quality control system. Thus the concern here is with the company's own internal operations and how the factory must organize and manage its own activities in order to produce a quality product.

Controlling Normal Operations

In the Japanese case, control includes inspection and testing but the emphasis is on in-process controls (building-in quality). This will involve the identification of control points (*kanriten*) which will be incorporated in a document such as a QC Process Chart (*QC koteizu*). Analysis of process and accurate identification of process capability is fundamental to identification of control points and methods and an appropriate inspection regime.

The establishment of the quality control regime[140] for a new product is an important activity that occurs during the product development phase and is usually the work of product and/or production/process engineering. The construction of the QC Process Chart is usually the work of the QC/QA Department with a varying degree of input from production engineering. The regime is determined by a combination of the nature of the product, the capability of the process and the propensity for worker error.[141] An attempt is made to foresee and take into account all possible quality problems or production problems likely to affect quality.

Procedures for Dealing with Abnormal Operations

This includes managing the rework of defective product, but, more importantly, the analysis and correction of the causes of defects and abnormal operations/occurrences. The three essential elements or aspects of an effective approach to the correction of defects or other problems are 'closing-out' (*hadome*), 'prevention of recurrence' (*saihatsu boshi*) and 'dissemination/diffusion of results/solutions' (*yoko tenkai*). There must be procedures in place to ensure that every problem (or activity) is followed through to a satisfactory conclusion (even if that is a clear statement of 'not resolved'). This will include, at the minimum, final signing-off by the QA department and the departmental manager of the area responsible for resolution of the problem.

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[140] Here, 'quality control system' refers to the full range of activities directed towards the control and improvement of quality whereas 'quality control regime' is used to refer to the controls (including inspection) put in place for a particular product or model.

[141] In Japanese, the neutral term "work miss" (*sagyo misu*) is used rather than "worker error"; i.e. intentionally or not, the focus is moved away from the worker to the mistaken operation. Then the reason for the "work miss" is investigated. The reason may be a machine, jig or lay-out problem, a management problem (for example, inadequate training) or worker error.

Prevention of recurrence is dependent not only on finding the 'true cause' but also on effective implementation of the 'solution'/corrective action. Moreover, to maximize the benefits of problem solving activities, an assessment must be made of the extent to which the solution to any particular problem can be generalized: that is, not only whether the solution should be rolled-out to all similar situations but also whether the solution can be used in different applications or situations.

An important point here is the distinction between large and small problems which largely parallels the distinction between large and small improvements discussed in the next section and therefore is not necessary to duplicate here. This issue is also discussed in the context of policy deployment.

Procedures for Improving Product Quality and Quality Performance

The system must incorporate a procedure or set of procedures for pursuing improvement in quality performance and the quality of individual products. Here improvement is used in the strict sense to mean actually increasing process capability; that is, raising the quality level or achieving the same quality level with fewer inputs (where less includes lower cost).

A number of different ways of categorizing 'improvement' were discussed at some length in Chapter 3 but the most fundamental distinction is probably between 'localized' and 'prioritized' or small and large improvements respectively. Small improvements are primarily the concern of operators and quality circle activities while large improvements are the concern of engineering staff (including QC/QA staff). The identification of major improvements is an essential part of "prioritized" management – to ensure that time, effort and money is expended to the greatest effect.

Two important practical aspects related to the implementation of improvement activities are:

a) **Organization for improvement.** The organizational structures by which problem resolution or improvement is handled are not only or primarily quality circles or other small group activities by production operators but rather a range of structures which also involve the various engineering departments including QA/QC. Improvement activities may be broken down into smaller components and the components delegated to a combination of quality circles, teams (cross-functional or in-function) and allocation of tasks through the formal management structure (*shokusei*) as appropriate to the nature and scale of the improvement or problems being pursued.

b) Multi-layered structure and accumulation and dissemination of know-how. The ability to achieve significant or breakthrough improvements is greatly facilitated by the multi-layered structure of large Japanese corporations which typically consists of 3 or 4 levels; i.e., headquarters – division and/or product group – factory. Technical Centres at headquarters or divisional level are likely to include both product and production technology sections as well as a quality control/quality assurance section. This creates a sort of 'division of labour' such that the top level explores and/or develops frontier technologies which may or may not yet be practical, the divisional level works on the application of new technologies, and the product groups work on the refinement and modification or improvement of existing technologies and the introduction of new technologies to production situations. The factory level will be much the same as the last but within the more severe restraints on time and manpower due to the demands of production and the requirement to resolve production problems as they occur.

For engineering staff, rotation among the different levels of the structure (Technical Centre at corporate level, divisional level, factory level) ensures an understanding of actual production problems, on the one hand, and exposure to the latest technology, on the other. For non-engineering staff, interaction with these other levels provides an opportunity for up-grading knowledge and skills.

This multi-level structure also means that where a problem exceeds the capability of the level at which it is being tackled, higher levels can provide the expert back-up necessary to resolve the problem or the problem can be passed on to or 'taken over' by a higher level. In other words, there is a recognized 'hierarchy of difficulty' with respect to problem resolution and improvement and a distinction is drawn between the respective roles of engineering staff and production operators and supervisors.

Liker, Fruin and Adler (1999) present a version of multi-layered structure in their discussion of Japanese management systems (JMSs) and Japanese production systems. Firstly, I disagree with LFA that the 'shop floor production system' represents a system which is separate and distinct from the factory 'production system'. On the contrary, the strength of Japanese TQC lies in the integration of both shop floor and factory systems into the total corporate system. While I agree with LFA about the shop-floor focus this orientation is characteristic of the production management system at the factory level (and arguably even at higher levels) and does not define a separate system. Secondly, there is often another level – a divisional or product-group level – between the factory and the corporate level and one which plays an extremely important role in concentrating on the quality and technical matters related to particular products or product groups (as described here). Another role of corporate and divisional levels is to examine whether techniques and methodologies which have proved successful in a particular factory or other local setting should be generalized and formally adopted on a wider organizational basis.

Process Analysis and Control

The emphasis was on process analysis and control and improving process capability – achieving technical mastery of the production process as the principle means for achieving improved quality performance. This involved – as a first step – eliminating problems and achieving a stable and repeatable process. Ishikawa (1989) regards this as controlling/ managing (*kanri*) the process which he distinguishes from simply 'maintaining the status quo' (*genjo iji*). In other words, actively managing the process includes an element of improvement but only in the sense of realizing the current capability of the process. The important point is that, in the Japanese approach, quality control and process control form closely interlocking and interdependent systems so that improvement in one generally results in improvement in the other. Here, process meant specifically the production process.[142]

The approach to process analysis is comprehensive and detailed. In particular, all components of the production process (the 4Ms) are considered to determine their possible contribution to a particular problem or their potential contribution to improvement in terms of improved process capability.

Process control and process improvement are regarded as inextricably intertwined (one cannot be achieved without the other) and as essential to high levels of quality performance. A distinction is drawn between correcting faults and problems (realizing the current capability of the process) and improvement in the sense of improvement in process capability; that is, achieving more output and/or better quality with the same (or less) inputs (including time, effort, materials and so on). A stable process which is under control is regarded as the essential starting point for effective improvement and improvement is not regarded as complete or effective until it has become part of normal process control. Process analysis is essential both to dealing with

[142] Although claims to the contrary were common in the Japanese literature (Ishikawa himself claims that the application of QC in the service industries can be regarded as a simple extrapolation from the case of manufacturing industry (Ishikawa 1989: 27)), the literature in the 1990s admitted that one of the weaknesses of Japanese QC was that it had concentrated too much on manufacturing and largely ignored the service industries. Indeed, the translation of 'quality' as '*hinshitsu*' in Japanese was blamed for concentrating attention on physical product and manufacturing industry (Kano 2001: 40-1' also see Kogure 1988: 68-9). An interesting demonstration of this fact (failure to develop TQC as a methodology which could be applied in the service industries) was a paper presented at ICQ'05 which was a seminal attempt to construct measures for assessing 'quality' in a service environment (in this case, the work of waitressing in a restaurant).

abnormal operations and to making improvements in process and thus quality performance. The final result of all these activities is the establishment of an effective control regime for normal operations – a regime which however is constantly subject to examination and upgrading.

Data and Documentation

The concern here is not so much with the formal documentation of the QC system in the form of the Quality Manual (especially where this is driven primarily by the need to meet certification requirements), but rather with the documentation used in the actual operation of the QC system and the conduct of QC activities; in other words, the documentation necessary to operate the system effectively.

There must be appropriate and adequate documentation. Documentation serves not only to control and guide implementation of procedures but also acts as a check on correct implementation and provides a standard format for collecting and recording data. In terms of the specification and coordination of the overall quality control system, a document such as a QC Process Chart is essential – a document which indicates where control points are to be located, how control is to be exercised, and by who or what (man or machine). For normal operations, documentation includes the use of check sheets and control charts where appropriate – together with procedures for handling and/or processing of such documents once completed. Identification of control items or control points is an essential prerequisite for the compilation of check sheets and so on. Documents for recording corrective action/problem resolution and improvement activities are of particular importance. Keeping of appropriate records allows past problems and their solutions to be revisited (thus avoiding "reinventing the wheel" each time a problem occurs) and past experience to be used as a learning tool.

Information and Communication

Decisions must be made about the selection and presentation (place, format) of meaningful information appropriate to the various levels and departments/sections of the organization – not only the production floor. The selection of information will depend, in part, on effective policy deployment and the provision of information will depend on the existence of an effective documentation system to record and disseminate information. At the shop floor level, information which is important relates to the progress of the work area against schedules and policy targets, the progress of problem resolution and improvement activities, the performance of the work area relative to the plant as a whole, and the overall performance of the plant and the corporation. In particular, information should be relevant to control of the work environment, be easy to access and easy to 'digest' or comprehend. However, the selection of information to be provided to the shop floor is only part, and arguably the lesser part, of the issue of what information to collect and communicate.

Conversely, effective policy formulation and deployment depends, in part, on the selection of information and the collection of meaningful, objective data; that is, the collection and analysis of data and information for decision-making by senior management at the top of the organization and for prioritizing activities at all levels.[143] Accurate information is considered essential to both effective control of operations and effective problem solving. Accurate information means objective data collected by scientific means such as the various QC or statistical techniques – not opinion or guess work. Japanese refer to "top-down bottom-up" approach; by which they mean that, without relevant bottom-up flows of information, there cannot be effective top-down policy formulation and control. Though much of this information may be collected at shop floor level, it will not necessarily be collected by shop floor operators and analysis may be the responsibility of other sections/ departments such as engineering departments or, for example, purchasing.

Another feature of information and communication in a Japanese organization is the high levels of shared information not only with production operators but again among different levels, sections and departments across the organization. This has two aspects; the dissemination of information to all related parties and ensuring that all parties have the same information and therefore have a common perspective on the issue or problem in hand. The latter is referred to in Japanese as "consolidation of information flows" (*joho no ichigenka*);[144] that is, there should be a single flow of information to all related parties not different information from different sources and held by different people.

Policy Deployment

Effective policy deployment is essential to effective management control[145], to establishing an

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[143] In other words, there is a mutually dependent relationship between selection of information and effective policy formulation; effective policy formulation and deployment determines the information to be collected and collection and analysis of relevant information is essential to effective policy (re)formulation.

[144] The Japanese term is a little stronger; it means that there is a single stream of information which is distributed to all parties.

[145] The term 'management control' is used in contrast to the notion of 'leadership' in the English literature and refers to the institution of an effective control regime and the exercise of management authority over production operations or factory operations generally and responsibility for ensuring that effective procedures are in place, that procedures are followed and satisfactory outcomes obtained. The term 'management control' is not to be confused with 'control/management' which is used as the translation of the Japanese word *'kanri'.*

effective quality control system and to maximizing the benefits of that system. Japanese use the terms "management by policy" (*hoshin kanri*) and "cross-functional management" (*kinobetsu kanri*). As the name implies, cross-functional management is to ensure that all the major cross-functional objectives (often the QCD trilogy) are reflected in the work of all departments. With respect to management-by-policy, there was an insistence that all persons in management and supervisory positions must present meaningful policies. ("Anyone or any position which has the title of 'manager' (a more literal translation is "head") must have policy" ("*Cho to na no tsuku tokoro ni kanarazu hoshin ari*") (Ishikawa 1989). In practical terms, this means that policy is translated into concrete operational targets appropriate to each level and each section of the organization and for each policy objective. Moving down through the levels of the organization, policy and planning become more detailed and concrete and the time span of principal planning responsibility becomes shorter (from 10 to 15 years at the top to 12 months at the first-line supervisor level). Moreover, while managers can and should delegate authority, they remain responsible for the results.

In order for this to happen, there must be effective policy development at the top and this must be much more explicit than a corporate vision or mission statement. Moreover, policy formulation at the top of the organization is based on information passed up from the bottom of the organization; the "top-down bottom-up" principle mentioned above. If the information is an accurate representation of the status of production operations and if it provides the basis to assess where the greatest potential gains are to be made and whether the necessary resources are available, then though they may be (and should be) demanding, the goals and targets set will be meaningful and achievable.

Another important aspect of effective policy deployment is the selection and prioritization of problems for analysis and areas for improvement. In this regard, Japanese draw a distinction between 'prioritized management' (*juten(teki) kanri*) and routine or daily management (*nichijo(teki) kanri*).[146] When problems are solved or improvements made, the results must be incorporated as part of routine management. Overall, the PDCA cycle proved to be a simple but powerful tool for ensuring effective management control as well as problem solving and improvement.

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[146] Translation by author. "*juten kanri*" is translated as "management priority" or "management of priorities" of which the latter is a better translation. The former would correspond more closely to "*kanri no juten*" and does not seem to be quite the same meaning. For "*nichijo kanri"*, the literal translation "daily management" is usually used.

Quality Cost

The most direct way in which quality improvement contributes to reduced cost is through reduction in defect rates, reducing damage and loss of components and materials and reducing the amount of replacement components and materials required, as well as the labour time involved not only in correcting the faults but also in producing the defect in the first place and continuing processing after the defect occurs.

More generally, problem resolution and improvement are assessed in terms of reduction in the cost of production (whether in terms of better quality, higher productivity, increased production or lower cost); that is, whether changes represent savings of time and/or labour (reduction of *kosu*)[147], energy, materials, and other inputs. The cost of implementing the new arrangements should be less than the identifiable/ quantifiable savings flowing from the new arrangements over a specified period of time. In so far as the same (or better) quality level is achieved with less (or the same) inputs, it represents both an increase in quality performance and a decrease in cost of quality.

Internal Auditing and Diagnosis

Virtually until the 1990s, the main external forms of assessment of quality control systems available to Japanese firms were the Deming Prize and the associated Japan Quality Prize. Although the former in particular carried great prestige and played a major role in setting the quality standards for Japanese industry, the assessment of achievements in quality control was largely internally-focused and internally-based. That is, companies set themselves ever higher and more stringent standards – getting more for less. In terms of external assessment, it is also notable that whereas the Deming Prize was a competitive system which only the best could win, the ISO9000[148] series only sets a minimum standard which companies must meet and thus, in contrast to the Deming Prize, does not represent 'best practice'.

As mentioned in conjunction with QC circles in Chapter 3, in Japan, there are various

[147] '*kosu*' is translated simply as 'man hour'; that is, "a measure which expresses the total amount of work, the time necessary for one worker to complete the work". In practical terms, the focus seems to be clearly on canvassing all possible ways to achieve reduction in *kosu* (the time it takes to complete any given portion of the production process). This involves examining everything from worker's experience (*nare*: familiarity with the work) to progress in manufacturing technology, process improvement, design improvement, and improvement in control/management (*kanri*) techniques (*Nihon Keie Kogakukai* 2002: 108-9).

[148] Many countries later established their own national quality awards – many of which were modelled on the Malcolm Baldrige National Quality Award (MBNQA) which was itself closely tied to the ISO9000 standard. As discussed later, the MBNQA in particular has been the subject of considerable criticism.

committee structures which oversee and monitor or assess and suggest improvements to procedures and systems. This includes the quality control system. Usually there will be a committee with a name such as the QC Promotion Committee (*hinshitsu kanri sokushin/ suishin iinkai*) which will fulfill this task. The QA/QC Department will also play a role in overseeing the system, particularly at the divisional and corporate levels where there is less direct responsibility for day-to-day operations.

Another significant aspect of internal assessment is the *shacho shindan* or "presidential review" which is typically conducted on an annual basis. This practice has a number of important effects. It indicates to the whole organization, including management ranks, that quality control and the quality control system has the support or imprimatur of the president/CEO – the very top of the organization. It requires that the president/CEO be sufficiently knowledgeable about the requirements of a QC system to conduct an audit (even with the support of professional staff). And, finally, it means that the president/CEO gets a regular overview of the state of the QC system, whether problems are being addressed effectively and whether policy goals and objectives are appropriate.

QCCs, SGAs and Teams

QC circles are just one of a number of types of small group activities widely practiced in Japan. Others include ZD (zero defects), JK (from the Japanese *jishu kanri*; literally self-managed) and PM/TPM ((total) productive maintenance) groups – each of which was associated with a particular organization or industry segment.[149] Overwhelmingly, QC circle activities are concentrated among shop floor operators, although, in some Japanese companies, indirect staff may also be organized into circles.

QC circles or other small group activities at the shop floor level are an important but only minor part of total quality control activities. Indeed, Ishikawa goes so far as to estimate that such activities constitute only a quarter to a fifth of total QC activities. Moreover, it is important to note that they were not only engaged in problem solving or improvement but fulfilled an important role with respect to training – not only in QC techniques themselves but more generally in the dissemination of standard work procedures and understanding the importance of following such procedures. It has also been noted that most work groups and therefore circles included members (here called veteran workers) who had many years experience of both work

[149] The ZD programme was organized by the JMA; PM/TPM groups by the Japan Institute of Plant Maintenance (JIPM) (*Nihon Puranto Mentenansu Kyokai*); and JK activities or circles developed by the iron and steel industry (Kogure 1988: 30).

tasks and circle activities helped to sustain the circles and increase their effectiveness. Similarly, the existence of extensive support structures inside and outside the firm helped to sustain the circles and enhance their effectiveness.

Training

Training in quality control is provided for all employees as part of extensive, formal company training programmes. Training programmes are differentiated to meet the needs of different groups of employees and in terms of level of difficulty. Though the number of levels may vary from firm to firm, Ishikawa, for example, distinguishes between three main levels of education and training in quality control and statistical techniques; basic, intermediate and advanced. Basic is for all employees from top and middle management to operators and mainly consists of the seven tools of QC. Intermediate courses are directed to general engineering staff and young assistant managers at the operational level and advanced courses to selected specialist engineering staff and QC engineers. Each level assumes a mastery of the content of preceding levels. He points out that these techniques should be widely understood across the organization and applied in a wide range of situations – in market surveys, to the determination of policy and objectives, to the analysis of processes and of quality, to the control/management of processes, of work and of management in general, and to quality assurance and inspection (Ishikawa 1989: 98-100).

Moreover, QC training courses must be viewed in the context of an even more comprehensive programme of training courses in both job skills and management skills. These programmes are conducted overwhelmingly in-house and, in the case of operators have a large OJT component. But the concept of graded and targeted, or purpose-built courses also applies here. There are graded courses in technical skills available to employees at various stages of their careers, some of which are in effect 'compulsory' and others optional. There are also courses in management responsibilities and techniques that all new appointees to each rank in the management hierarchy are required to attend.

The Social Aspects of Quality Control in Japan

Consistent with the emphasis on the technical aspects of quality control and the importance attached to the production process and process analysis and control, it was the relationships between engineering, particularly production engineering, and production rather than between management and labour that were critical to Japanese quality control. It was engineers (not just quality engineers but engineering staff generally) who were the experts in and drivers behind the introduction and development of quality control (both individually and through their organization, JUSE, supported by the other highly technically-oriented organization, JSA).[150] The relationship between engineering and production is encapsulated in the relationship between large and small problems or improvements where it was the smaller problems or improvements which were delegated to production workers, allowing engineering staff to concentrate on the resolution of major problems or on major improvements.[151] In particular, it was the production engineering staff who were responsible for the "dismantling and reconstruction" of the production process which resulted in improved process capability and thus simultaneous and mutually reinforcing improvements in quality and delivery/lead time and reductions in cost – the QCD trilogy.

Importantly, the relationship between engineering and production resulted in cross-fertilization between the parties. On the one hand, it provided engineering staff with an understanding of the problems that occur in actual production situations thus enabling them to design worker-friendly processes – to make it easier (for operators) to do the job well, to improve manufacturability. On the other hand, interaction with engineering staff allowed supervisors and operators to improve their knowledge of the technologies (machinery, materials, methods) with which they worked.

The ability of operators to play a role in supporting the efforts of engineering staff was due to two main factors. One was the extensive in-house training programmes which covered not only quality control but job skills and management skills as well. As noted, these programmes were targeted to the needs of different groups of employees and arranged in progressive levels of difficulty. 'Compulsory' programmes covered all employees in the relevant category. This task was made much simpler by the fact that each cohort of new recruits basically moved through the system together. The second factor was the existence of "veteran workers" – older, highly experienced workers who have worked for the company for at least 10 years but generally many more. These workers have already completed many of the training programmes and are highly knowledgeable about the production systems in which they work. They have also completed many years of training in quality control and have many years of experience of quality control circle activities. The potential for QC circles to undertake problem solving and improvement activities was greatly enhanced by the presence of these veteran workers who were able to pass

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[150] As the discussion of training programmes above demonstrates, managers were not the experts in QC. They were expected to have an understanding of the basic concepts and tools but more particularly why QC was important – in other words, sufficient knowledge to be able to 'manage' the necessary activities. First-line supervisors, on the other hand, were generally expected to be well trained in the techniques of QC and problem solving appropriate to the shop floor level so that they are able not only to effectively lead QC activities in their area but also to train the workers for whom they are responsible.

[151] The development of this "division of labour" has been attributed to necessity – the relative shortage of trained engineering staff in the early postwar years.

on their knowledge to younger workers. Based on their expertise, they were often allocated to work groups to help solve particular problems. This applied both within the company's (or factory's) own operations and to subcontracting companies.

It should be remembered that, historically, supervisors and then operators were the last groups of employees to be incorporated into the QC system in Japan and that serious attempts to do this did not begin until more than a decade after the QC movement began. Even the motivation behind the original proposal for the introduction of QC circles was predominantly technical. QC circles were to provide the venue for the study of quality control using the new journal *"Gemba to QC"* – to learn about quality control and then later to undertake problem solving activities. While it was considered difficult to expect that foremen/supervisors and operators individually would study QC techniques, in a group, workers could encourage and support each other (Udagawa *et al.* 1995: 33; Tsutsui 1998).

There was reference in both the literature and in the case studies to the fact that people and their attitudes may be major obstacles to the successful introduction of quality management. However, there was equally an insistence that what is needed to change those attitudes is not psychological or motivational campaigns but clear evidence that improvement is achievable and this is only possible by the systematic application of scientific and statistical methods to the analysis of the production process. This means that there must be comprehensive training programmes not only in the scientific methods of quality control but also in job and management skills. It is the experience of successful engagement in problem solving activities which will bring about a change in attitudes.

The relationship between the social and technical aspects is considered later after examining the Australian/English literature and the Australian case studies. Suffice it to say that the failure to recognize the dynamic effects of the technical on the social aspects of the quality system meant that the preoccupation with the social in Australia was largely unproductive.

Summary and Conclusion

Japan concentrated on the technical aspects of TQC:

- the production process (production system, physical transformation process) and improving process capability which involved:
    - removing waste in all aspects of the process;
    - in particular, the approach to the analysis of the production process was comprehensive and pursued vigorously in terms of all four Ms – with no bias

towards one particular aspect such as "man";

- additionally, a vitally important proviso was that one of the primary conditions/requirements which governed improvement to the production process was that improvements should "make it easier to do the job well";
  - this task was not left only to shop floor workers themselves, but informed and underlay the activities of all employees, most particularly production engineering staff but also engineering staff generally;
  - the resulting interaction between engineering staff and production workers and supervisors produces cross-fertilization which not only facilitates process improvement of the kind mentioned above but is also ultimately the real source of design for manufacturability; moreover this interaction is not limited to teams or cross-functional teams but occurs in a range of contexts and forums;
  - at the shop floor level, experienced veteran workers played a vital role not only in the development and ongoing viability of QC circles but in the transmission of knowledge about quality control and quality control tasks and practices in general;
  - this was the true meaning of "gembashugi"; that is, that the actual operating production process should be the focus of all employees, particularly engineering staff, not just of direct production sections or departments or the quality department.

In all aspects of the quality system and management in general, the stress was on management control (rather than leadership) and effective policy deployment and coordination across all levels and sections of the organization. Thus the importance of management-by-policy and cross-functional management. There was an insistence that the way in which results were achieved was just as important as the results themselves. Therefore it was important that there were formal procedures and structures and standard work procedures which were appropriate, were understood and were followed.

CHAPTER 7. History: Australia

The Quality Movement in Australia

The socio-economic context of the development of the quality movement in the 1980s was one of economic crisis but one which was not as severe and did not generate the same sense of urgency as that in immediate postwar Japan. Moreover, in Australia, there were two fundamentally different views of the way out of the crisis. One was that the survival and revival of manufacturing industry was essential to Australia's economic prosperity and the other was that Australia lacked comparative advantage in manufacturing industry and should therefore concentrate on the primary and tertiary sectors.

In the 1980s, Australia faced declining commodity prices for its agricultural products and minerals and the rising deficit on trade in goods. At the same time, increasing international pressure for free trade resulted in decisions to wind back tariff protection. This meant that manufacturing industry which had largely served the domestic market would have to become much more internationally competitive in order to survive. Moreover, given the small size of the domestic market, it was necessary to develop export markets in order for businesses to expand and reap the benefits of economies of scale. Improved quality was identified as one of the essential elements of international competitiveness. The opening sentence of the AFR supplement on Total Quality Management in 1989 read:

> It is often said that the Australian economy can no longer afford to ride on the sheep's back, that to reduce a mushrooming overseas debt, Australia's manufacturing sector must become more internationally competitive.

The article continued; "Japan's position as the world's major economic superpower is often related to it embracing total quality control in the 1950s – then a new and radical management practice" (AFR 1989: 1s). These sentiments were echoed in various quarters (Blakemore 1989; AMC 1993; Commonwealth of Australia 1992).

The emergence or re-emergence[152] of the quality movement in Australia in the 1980s must also be seen in the wider context of its re-emergence in America in particular. The interest in Japanese quality control methods emerged in response to the apparently miraculous ability of Japan's manufacturing industry to recover rapidly from the two Oil Crises of 1973 and 1979. The 1970s and 1980s was a period of severe trade friction with the USA which was suffering from de-industrialization. Successive assaults by Japanese exports on steel, shipbuilding,

[152] Established in 1968, the Australian Organization for Quality (AOQ) (formerly the Australian Organization for Quality Control (AOQC)) is the oldest Australian organization dedicated to quality.

televisions, electrical goods, cars resulted in high levels of trade friction and demands for voluntary export constraints, imposition of dumping duties and other measures by the American government and industry organizations to restrain Japanese imports. Japan was accused of exporting unemployment and 'beggar thy neighbour' policies. Japan's continuing large trade surpluses prompted a search for the reasons for Japan's success. The Japanese approach to quality control was identified as one of the reasons for the international competitiveness of Japanese industry. There was a flurry of activity to learn about Japanese quality control methods and production systems in general. What followed was a "boom" in quality control with extravagant claims made for the benefits that could be expected to flow from the adoption of Japanese style quality control systems. The experts who had advised Japanese industry almost 40 years earlier – notably Deming and Juran – achieved the status of "gurus" in their own country. One of the consequences of this boom in America for the Australian quality movement was that the understanding of so-called "Japanese" quality control methods came via America and was filtered through the interpretations of American experts and consultants. As is typical of a "boom", many of the consultants who joined it had only slight acquaintance with the concepts they were professing to sell (Nohria and Berkeley 1994).

Although organizations such as AOQC had existed earlier, it was Enterprise Australia (EA) formed in 1975 that emerged as the driving force behind the development of the quality movement in Australia in the 1980s. While some companies were taking an interest in quality control systems in the late 1970s,[153] the visit of William Conway, President of Nashua Corp. in the USA, in 1981 to talk to management and other groups about his company's experience with TQC provided the catalyst for the development of the movement. As a result of this visit, EA agreed to take the initiative in stimulating interest in TQC.

According to Blakemore (1989), the early moves towards quality in Australia started with the Supplier Assessment Scheme (SAS) in the 1970s. By the late 1980s, the move towards gaining accreditation as approved suppliers of products had gained so much momentum that within a year executives who had previously said that it was irrelevant had changed their minds. However Blakemore claims, on the basis of his personal experience in the late 1970s, that the initial standards (AS 1821, 1822, 1823) were generally inadequate for some high performance applications and consequently, the Canadian standards (CSA Z 299.1-299.4) gained popularity in Australia during this period. In 1987, Australia issued its own series (AS 3900, 3901, 3902, 3903, 3904) based on the ISO9000 series of quality management standards (Blakemore 1989:

[153] For example, Nashua Aust. under then CEO, John Sprouster and Ford Australia under Managing Director, W.L. Dix and Product Quality Assurance Manager, Tom Pettigrew.

43-44).

In Australia, the then Labor government took a positive and proactive stance on the restructuring and revitalizing of manufacturing industry. The government's thinking on these matters was outlined in a report, "Building a Competitive Australia", released in March, 1991.[154] In the early stages, governments (federal and state) had a major effect on the adoption of quality programs by making accreditation initially to AS3900 a condition of tendering for government contracts. The government took a leading role not only in encouraging and supporting the activities of the organizations associated with the quality movement but also in funding and launching a TQM programme through the NIES and establishing the Best Practice Demonstration Programme. In 1990, the government also introduced a Training Guarantee Levy which required companies to spend a certain amount on training programmes. Some companies included training in quality control or quality circle activities and attendance at quality-related seminars and conferences in their training expenditures to meet the conditions of the Act. By the early 1990s, the Commonwealth Government had in place a raft of programmes for industry support and development – 70 programmes listed under 10 areas of perceived industry needs and representing 34 discrete programmes due to multiple listings. Two of these were the NIES TQM programme and the Best Practice Demonstration Programme.[155]

Against the background of active government encouragement and intervention, a 'quality movement' began to emerge in Australia in the 1980s. In 1984, the Prime Minister officially launched the 'Australia for Quality' campaign (organized by EA). The organization had an Advisory Council of 10 members[156] and the sponsors of the campaign were Esso Aust. Ltd., Kodak (Australasia) Pty. Ltd., CIG, Ford, United Permanent Building Society. The AFR Survey reported a surge of activity around 1986 when "representatives of some leading Australian companies, spurred by the economic success of Japan, saw TQM as a new focus for management effort, commitment and training" (AFR 1989: p.1s). In 1987, this saw the establishment of the Total Quality Management Institute (TQMI) of Australia – in which EA

[154] The initiatives announced by the government included continuing reductions in tariffs, labour adjustment programs, rural adjustment package, Australian Made Campaign, upgrade of services available to Australian exporters, breakthroughs in waterfront productivity, Partnerships for Development and offsets programs, workplace reform and the new workplace culture, support for the AQA – all associated with a refocusing of business and trade effort on the Asia-Pacific region.

[155] For a listing of these programmes, see for example Commonwealth of Australia (1991a) "Being the Best."

[156] Unfortunately, the membership of the Board seems to have been determined on largely political criteria rather than the ability of the members of the Board to assemble the expertise necessary to drive the program forward. With only one exception, the members were the Presidents/Chairmen of major business organizations, the peak union body, the main national farmers' organization, and organizations representing business women and the university sector.

was again instrumental. The founding members of the TQMI were 19 leading organizations,[157] all actively involved in total quality management and by 1989, the Institute had 250 members. The mission of TQMI was to be the leader in the development of the principles and practices of TQM and their dissemination and promotion to the Australian community. The First National TQMI Conference was held in 1989, the Second in 1991 and thereafter, the Conference became an annual event. In 1988, the Australian Quality Award which was basically a replica of the Malcolm Baldrige National Quality Award was established. The AQA largely set the limits of the approach to quality control that predominated in Australia. Deming delivered his famous 4-day course in Australia in 1989 and 1990 and Imai was also invited to give a seminar on his world-famous concept of *Kaizen* in 1990. Deming's 14 points and particularly Imai's idea of '*kaizen*', interpreted as 'continuous improvement,' were very prominent in the Australian literature on quality control/management. Indicative of the greatly heightened profile of quality management, Australia's national financial newspaper, the *Australian Financial Review*, ran a 28-page special supplement on 'Total Quality Management' in 1989.

During 1990, the Federal Government Department of Industry, Technology and Commerce, National Industry Extension Service (NIES) Branch released its TQM 'How To' model. It was developed by Australian consultants to provide a basis for the training of quality management practitioners and consultants. Compared to the AQA criteria, the NIES model offered a somewhat more practical approach and importantly also set out an implementation framework. However, the NIES model accepted the TQMI's definition of TQM with all its attendant problems and was consciously "aligned" with the AQA criteria. The Quality Society of Australasia (QSA) was launched in July, 1990, to provide recognition and professional status for quality practitioners. It was supported by Standards Australia, the Australian Organization for Quality, the Institute of Quality Assurance, the TQMI, Enterprise Australia, the National Association of Testing Authorities, and the Federal Government's National Industry Extension Service.

In 1992, the Australian Quality Prize was established "to dramatize the increasingly demanding standards of internationally competitive Quality" (Sohal 1991). Only winners of the Australian Quality Award were eligible to apply for the Prize. It appears that evaluators from the Malcolm Baldrige awards in America were involved in advising on the administration of the prize. The inaugural Award for outstanding achievement in total quality management was awarded to Kodak Australasia Pty. Ltd. The Award was judged on the extent to which the principles and

[157] Among the founding members were BHP, CIG, Ford Motor Co., IBM, Kodak, Tubemakers of Australia, Hewlett-Packard, Girvan Group, Digital Equipment, Nissan, and the James N. Kirby Group.

practices of TQM have been incorporated into the day-to-day operations of the organization. The Award for outstanding product quality was won by W.A. Deutsher Pty Ltd (Metal Products Group); for outstanding service quality by control Data Australia Pty Ltd; and for the outstanding individual quality improvement project by Darling Downs Co-operative Bacon Association (ibid.).

Finally, in 1993, the Australian Quality Council was founded incorporating the Australian Organization for Quality, Enterprise Australia, the Quality Society of Australasia and the Total Quality Management Institute. The AQC was to act as an umbrella organization supporting individual quality organizations so that collectively they could have a greater impact on strategic national issues. The Council was also formally recognized by the federal government as the peak organization for the dissemination of the knowledge and skills of state-of-the-art quality (AQC 1995). The objectives of the AQC were to:

- establish the strategic direction for the quality movement in Australia;
- influence change in target groups to adopt or promote the quality culture;
- act as the principal advisor to the Federal Government on quality matters; and
- coordinate the resources of the quality movement to undertake specific programmes.

As a business improvement strategy rather than a quality control system, TQM in Australia tended to be overtaken by successive waves of new management ideologies and improvement programmes (benchmarking, best practice, reengineering) so that it became only one of many options for organizational change. In fact, it was found that many companies were implementing several change programmes simultaneously. This could result in considerable confusion and uncertainty as indicated by the questions raised at a Quality Management conference held in Melbourne in 1995. What are the relationships? What is the sequence for implementation? Is it better to focus on one programme? (Brown, Miller and Sohal 1995: 89)

At the same time, another series of events was also in train that was ultimately to overwhelm the quality movement in Australia. As mentioned above, the Best Practice (BP) Programme was launched in 1991 by the federal Department of Industrial Relations and the Australian Manufacturing Council (AMC) as a tripartite organization incorporating industry, unions and government. While quality was one of the elements of this programme, the programme had the effect of directing attention even further away from quality as such and towards general business performance. The use of benchmarking and KPIs tended to reinforce this tendency towards performance at a highly aggregate and abstract level – quite unlike the approach to quality performance in Japan. As a result, it became increasingly unclear whether the objective was management of quality or quality of management. The BP programme also further reinforced the "social" bias apparent in quality management programmes by stressing that "Cooperation between management and employees in all aspects of their business is central to the definition"[158] (AMC 1994: 1). Although the first of the 12 principles of best practice highlights the importance of quality ("a comprehensive, integrated and cooperative strategy that results in continuous improvement in cost, quality and timeliness"),[159] the other principles relate to "people" issues or much broader aspects of organizational performance.[160]

1994 was declared the end of the 'First Quality Decade' and in 1995, the AQC announced the formation of the 'Wider Quality Movement', as "a forum of all the key organizations servicing the movement" so that "the various resources each brought to the forum could be used more effectively" (AQC 1995: 7). This 'Movement' included government organizations such as AusIndustry, Australian Association of Certifying Bodies, AOQ, AQC and AMC, as well as private business organizations. Plans were also announced to merge the journals of the AQC (The Quality Magazine) and the AOQ (Quality Australia) (ibid. p.7).

However, in 1998, just 3 years after the launching of the 'Wider Quality Movement', the AQA had been renamed the "Australian Business Excellence Awards", "to better reflect their purpose" (Vogel 2002). Further, just 10 years after the formation of the AQC, the organization went into receivership and its products and services were incorporated into the Professional Services Division of Standards Australia International to create Business Excellence Australia. Thus, with the demise of the major national umbrella organization, an independent presence for the quality movement was greatly diminished and quality and quality management were absorbed as only one part of a broader "business excellence" programme. Thus the hopes expressed by Sprouster in 1984 had lasted barely 15 years.

According to Nettle, there were three strands to the quality movement in Australia. The first, the AOQC (later renamed the AOQ), formed in 1968, was an engineering based organization. It had good relations with other professional organizations of engineers and engineering departments at Melbourne University and RMIT. The AOQC's approach to quality assurance as described by Nettle seems to be quite close to the Japanese conception of TQC; that is, "...all operational functions would be coordinated in relation to quality standards articulated through a

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[158] The origins of the Best Practice program can be traced back to the AMC's publication, "The Global Challenge" (1990).

[159] In fact a restatement of this principle in a study of best manufacturing practices drops all mention of quality and refers instead to best practice as a "comprehensive and integrated approach to continuous improvement <u>in all facets of an organization's operations</u>" (AMC 1994: iv).

[160] For a statement of the 12 principles of best practice, see Australian Best Practice Demonstration Program (1995: 36-37).

process-wide quality assurance (QA) system" (Nettle 1995, 56). The AOQ still offers training courses, publishes a quarterly journal and holds a biennial conference, Qualcon. Interestingly, it is the oldest organization, the AOQ, which is now one of the two remaining organizations dedicated to quality management in Australia.

The second strand was linked to the formation of Enterprise Australia (EA) in 1975. This organization is described as "an anti-union, anti-government organization which promoted private enterprise" and as a major force behind the formation of the Total Quality Management Institute (TQMI) in 1987. The impetus for the TQMI reportedly came from "a network of emerging corporate-level quality managers who were dissatisfied with the lack of management emphasis within the AOQC". Many of the 'leading-edge' companies who were members of the TQMI even abolished 'old quality departments' and replaced them with "new positions ... developed for so-called TQM or continuous improvement facilitators. Many of these new positions were filled by professionals with management training or backgrounds in organizational development, behaviour or psychology." (ibid. 57) Nettle also notes that the TQMI promoted Deming's criticisms of the overemphasis on QA standards and technique-oriented approaches and pushed cultural approaches to change. (ibid.) Nettle considers that the success of this strand of the movement was due to the federal government's promotion of the establishment of an umbrella body, the Australian Quality Council, which the EA/TQMI came to dominate.

The third strand was identified as the Best Practice Programme (BPP) initiated in 1991 by the Department of Industrial Relations and the Australian Manufacturing Council, a tripartite body. The BPP was contrasted with the AQC in that it gave "greater emphasis to a cooperative, negotiated process of change including unions" (ibid.). This presumably was the result of two factors. One was the union representation in the AMC itself and the second was the contemporary government economic and industry reform agenda which included the active intervention of government in the form of a strategy to bargain wages and non-wage benefits against productivity increases.

While Nettle notes that there was less "conscious rivalry" between the AMC/BPP and the AQC and indeed notes several areas of cooperation, these divergent and somewhat competitive trends help to explain the nature of the quality movement in Australia and the difficulties it faced. Firstly and probably most important was the 'defeat' of the AOQ and its ultimate withdrawal from the AQC which seems to have spelled the (almost complete) demise of an effective engineering presence. Secondly and relatedly, the fact that the movement came to be dominated by management specialists helps to explain the particular interpretation of or approach to quality control. This was reflected in the widely-held view, espoused by Deming, that 85% of the causes of variation or problems are 'common causes' which are faults of "the system" and are therefore management's responsibility to correct. This is in sharp contrast to Japan where there were no management schools and little formal management education when the quality control movement was launched. The third was not so much the issue of how to accommodate the unions (which in my view could have been, and indeed in a sense was achieved),[161] but the fact that there were organizations with different approaches to this issue – one (the quality movement itself) which was to keep the unions out (AQC/EA) and the other which was to actively incorporate the unions in the movement (ABPDP/ AMC).

Conclusion

The key events which shaped the quality movement in Australia were:

- the launching of 'Australia for Quality' campaign by PM Hawke in 1984 which greatly raised the profile of quality/quality control for industry and the public in general;
- the inauguration of Australian Quality Award in 1988;
- the release of the NIES TQM 'How To' model in 1990;
- the launching of the BP programme in 1991; and
- the establishment of AQC in 1993.

Of these, it was the Australian Quality Awards, the NIES TQM model and the BP programme which determined the particular interpretation of quality or quality control and the role it played in Australian industry. All of these espoused a view of quality which was heavily "social" in its orientation and all interpreted quality, to a greater or lesser extent, as related more to general organizational performance than to quality of product or performance of the production process. It was the Best Practice programme which most strongly embodied these tendencies and which ultimately prevailed in the conversion of the AQA to the Business Excellence Awards and the incorporation of the AQC into Business Excellence Australia.

In historical terms, one of the most striking differences between the two movements is their duration. Whereas the movement in Japan has continued at a high level of intensity and diffusion for over 60 years since the Second World War, in Australia, the quality movement (as distinct from individual quality organizations) only lasted for about 15 years before it was absorbed into a much broader "business excellence" movement. Moreover, whereas in Japan, it

[161] See Blakemore on ACTU (the peak Australian union body) mission. He commends the union movement for organizing an overseas study tour into "ways of doing things better" but laments the fact that the mission selected Europe instead of Japan. He is also critical of the fact that no such mission had been undertaken by employer organizations (Blakemore 1989: 11-14).

was engineers (their representative organization JUSE) who drove and supported the movement and who were the experts who developed and applied the techniques of quality control, in Australia, the movement was dominated by managers and management organizations. Consequently, it is perhaps not surprising that in Australia, process was interpreted as meaning any business process of the organization or management system but in Japan process referred overwhelmingly to the production process in manufacturing industry. In addition, while in Japan it took about 15 years for the quality movement to turn its attention to supervisors and shop-floor workers/operators (and begin to actively incorporate them into quality programs), in Australia, the movement almost from the outset concentrated on the shop-floor level and the introduction of quality circles or other small group activities as vehicles for involvement and participation.

CHAPTER 8. The Australian Approach to Quality Control

Introduction

Despite the fact that "Japanese quality control" is generally the reference point either explicitly or implicitly (see, for example, Sprouster 1984; AFR Survey 1989; Blakemore, 1989: 6-7(-9)), a major transformation of QC/TQM has occurred in the Australian literature. This transformation is also apparent in the British and American literature, as illustrated in the following points:

- TQM has become a change methodology/technology whose objective is organizational and/or cultural change (see for example, Stace and Dunphy 1994; Harber, Burgess and Barclay 1993; Wilson 1992; Mathews 1994).
- TQM has tended to be overtaken by successive waves of new management ideologies and improvement programmes (benchmarking, best practice, reengineering) so that it has become only one of many options for organizational change. In fact, it has been found that many companies are implementing several change programmes simultaneously. This can result in considerable confusion and uncertainty as indicated by the questions raised at a Quality Management conference held in Melbourne in 1995. What are the interrelationships? What is the sequence for implementation? Is it better to focus on one programme? (Brown, Miller and Sohal 1995: 89).
- TQM is treated as essentially a "people problem" as, for example, in "Total Quality management must be founded first and foremost on solving people problems" (Barnett, 1991: 13) This is an extremely widely held view (see also, for example, Blakemore 1989). More specifically, there is the view that TQM is "one of the most powerful methodologies of workforce involvement" (emphasis added); that is, as a method of bottom-up involvement, devolving accountability to work teams, and encouraging employee commitment to problem solving (Stace and Dunphy 1994). The last is a classic example of the transformation of TQC into a social/human relations strategy which moreover is concentrated on the shopfloor.

Problems of Definition

In the Australian literature (as in the English literature in general), the concept was expanded and, while on the one hand, it became increasingly comprehensive, embracing many aspects of management organization and behaviour, it also became increasingly abstract and ill-defined. Thus the definition of what is meant by quality, quality management system or TQM became very unclear, with many different uses being employed, as the following quotations illustrate:

> ... while there are characteristics of TQM, part of its attractiveness stems from its ambiguity – in meaning different things to different people. (Dawson 1994: 57)

> ... (there is) no universally agreed definition of TQM and ... TQM is still regarded as a somewhat abstract concept. (Mann 1992: 30)

> 'Quality' has been attributed to all kinds of management techniques and initiatives. The appeal of the term is that it can be used to legitimize all sorts of measures and changes in the name of a self-evident good. (Wilkinson and Wilmott 1995: 1)

> Quality is seen by many as an intangible concept. Everyone has a perception of what quality is but there is considerable difficulty in defining those perceptions. The literature abounds with descriptions and definitions of quality. (Eisen and Mulraney 1992: 2)

> Quality was the competitive advantage that most firms rated Number 1. However, our interviews revealed that most firms have different ideas about what they meant by quality. Some firms understand quality to mean providing consistently better products than their competitors, earning a premium in the market. Others see it as no waste manufacturing. (McKinsey and Company and AMC Secretariat 1993: 19)

"Core Concepts", "Critical Factors" or "Critical Success Factors"

One of the consequences of the difficulty of definition – particularly a widely-agreed definition – was that, in the English literature, TQM/quality management came increasingly to be analyzed in terms of a list of "core concepts", "critical factors" or "critical success factors"[162] (see for example, Tumala and Tang 1996; Saraph, Benson and Schroeder 1989; Terziovski, Sohal and Samson 1996; Mann 1992). This approach is typified by the various national quality awards and was consolidated by incorporation in the ISO9000 series.[163] Of course, everyone does not agree on the same set of core concepts.

[162] Concerning the difficulty of reaching a clear definition of quality management or TQM, Kano reports that the working group engaged in the 2000 revision of the ISO9000 series encountered the same problem. In the face of widely differing interpretations of TQM among the members of the group, the struggle to arrive at an agreed definition was abandoned and instead the group worked to reach consensus on the present 8 quality management principles. The 8 principles are: customer-focused organization, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision-making, mutually beneficial supplier relationships (Kano 2001: 25).

[163] The first ISO9000 series was issued in March, 1987 (subsequently revised in 1994 and 2000) and the Malcolm Baldrige National Quality Award (hereafter MBNQA) was established in August of the same year. The European Quality Award (hereafter EQA) was not established until 1992. The EQA includes two items (impact on society and business results and satisfaction) which do not figure strongly in the MBNQA and were absent from the initial ISO9000 series.

It is noticeable that management leadership, people/people participation, partnership/employee relations and relations with customers figure prominently in these lists which may also include strategic quality planning (or quality policy), reference to process and/or improvement or continuous improvement. The list sometimes includes "quality system" which is often treated as a discrete part of a larger TQM 'process' or concept and seems to be equated with the formal structure documented as part of the requirements of, for example, ISO accreditation.[164] Generally, only a brief explanation is given for each of the "concepts" or "factors". Moreover, it is frequently unclear whether the "critical factors" or "critical success factors" are being posed as aspects of the system itself; as conditions or preconditions for the successful implementation of the system; or as collateral benefits or outcomes of the successful implementation of a quality management system.

Emphasis on the Social

Not surprisingly in view of the interpretation of quality programmes as "change methodology/technology" and as fundamentally responding to a "people problem" there are numerous studies which concentrate on the social aspects of quality programmes. These include analyses of:

- total quality management as a cultural intervention; that is, the effect on the organizational culture of a "major organizational change programme" such as TQM (Harber, Burgess and Barclay 1993);
- TQM programmes as a means of "building employee commitment" (Dawson 1994); and
- quality circles as a means for "stimulating behavioural change", specifically as a means for improving worker-management relations (Dunford and McGraw 1988).

This results in the "promise of quality management" being interpreted as "to expand employee autonomy, facilitiate teamwork and and promote participation" (Wilkinson and Wilmott (1996)). At the extreme, TQM is even coopted to the task of reversing gross alientation and restoring responsibility (empowerment) and job satisfaction; that is, of creating a "more equitable, less conflictual, more participative and productive society" (emphasis added; Mathews 1994). The objective of improved quality of products or services is virtually ignored.

[164] For one interpretation of the relationship between a quality system and TQM, see Boyapati (1991). Originally I was mystified by comments like "Howe Leather and other companies … which have adopted TQM through the NIES model, did so without a basic quality system in place." Not surprisingly, Gilbert goes on to say that: "In general this had a restricting effect on the long-term benefits gained from the TQM programmes and their sustainability" (emphasis added: Gilbert 1995: 41). But an interpretation such as that given by Boyapati explains Gilbert's comments.

The particular social aspects which appear to receive the most attention – and to be considered the most important – in the Australian literature are:

- People
- Leadership / role of management
- Labour-management relations
- Participation in management, involvement, commitment
- Shop floor
- Communication
- Organizational culture and organizational / cultural change

Of these, leadership, the role of management, participation and management – labour relations (or a variation thereof such as "partnership" or "employee relations") are included in most listings of core concepts or critical factors and as criteria for national quality awards, including the AQA. Two other factors which tend to be dealt with under the general rubric of "people" issues are quality circles and training which will be dealt with later.

People

As is remarked in a number of contexts throughout this chapter, "people" are regarded as the most important aspect by many writers. Thus we have statements such as "People make quality" (Kanji and Asher 1993c: 74) or "… continuous improvement depends in essence on people-oriented activities" (Boyapati 1991: 67). According to Sprouster, "Western management has generally undervalued the enormous resources it has in its people" (Sprouster 1987: 83). Blakemore places particular emphasis on people who constitute the "apex" of his TQM tetrahedron, because "people are the most important part of any process" and should be viewed as a "valuable investment to be treated with care and consideration and understanding" (Blakemore 1989: 29-30, also 2-3). Similarly, the NIES model places people together with systems and variation as the three "core principles" of TQM (NIES, Quality: The Strategic Advantage). Often, the stress on "people" seems to be intended as an antidote to conventional views of workers as uncooperative and lazy, if not downright obstructionist. Pettigrew of Ford Australia specifically rebuts such views, insisting:

> … more than 99% of all operators, if given the choice, would prefer to do a deliberately good job rather than a deliberately bad one. Very few people enjoy spending eight hours each day producing poor work. (Pettigrew in Sprouster 1987; Blakemore 1989)

In more general terms, the motivation for business is that it "must be stressed that neither efficiency nor profit are achievable without a contented and motivated workforce" (Sprouster 1987: 26).

Shop Floor

One feature of the discussion of "people" issues is that it is concentrated on the "shop floor" – the only other group of employees which is singled out for particular attention is management. One of the common justifications for this bias is Deming's interpretation of "common and special causes" of variation or problems. Although only 15% of the causes are "special causes", the "special causes" must be removed before the more numerous and more serious "common causes" can be addressed. "Special causes" are created by individual things, people or events and are regarded as the responsibility of the shop floor and therefore are best removed by "involving the people doing the job" (Sprouster 1987: 45).

Another reason for the stress on people and people practices was the strength of the conviction that people and particularly people at the shop floor level are the most significant difference between Japan and the West and one of the key reasons for Japan's success. For example, TQM in Japan is said to be "all about motivating employees" (Kanji and Asher 1993: 7) or integrating workers' ideas and skills into the management organization (Abernathy quoted in Kumon 2000: 29). Similarly, Tsutsui, in a detailed and highly enlightening study of scientific management and manufacturing ideology in Japan, concludes that quality control emerged as the "long-awaited innovation which would finally render the 'revised Taylorite' vision into shop-floor reality" and in particular regards quality control circles as the device that enabled "a 'human' approach to labor" to be combined with productive efficiency and technocratic authority[165] (emphasis added; Tsutsui 1998: 191, 235).

Leadership and the Role of Management

Leadership and the role of management are other 'social' aspects which receive a lot of attention in the English quality management literature and are included in most listings of core concepts or critical factors and as a criterion for most national quality awards. The need for management leadership usually involves a particular stress on the role of top management or the CEO. Various writers agree that there are limits to what line management and supervisory staff can do and that senior management[166] must create and maintain the climate to make the new approach

[165] While I agree with Tsutsui's general proposition that there was a much more thoroughgoing implementation of the principles of Taylorism in Japan, I disagree with his detailed arguments and conclusions. Perhaps because, as far as Tsutsui is concerned, the key problem for Scientific Management was "realizing a credible "humane" Taylorite regime on the shop floor" – a problem which he regards as solved by the QC circle concept, he accords quality circles an inordinate importance in Japanese management practices generally and as part of quality management in particular (Tsutsui 1998: 238-9).
[166] Blakemore makes an important qualification but one which is rarely made about the role of management; that is, that management does not need to know the details but must understand the

possible and accept full responsibility for the quality programme otherwise it will fail (Sprouster 1987). As with people, the emphasis on leadership and the role of management is related to Deming's interpretation of "common causes" as "faults of the system" which account for 85% and "can only be reduced or eliminated by the actions of management" (Sprouster 1987: 77; Blakemore 1989).[167]

Two aspects of management leadership which receive particular attention are the need for "constancy of purpose" and breaking down barriers between departments (two of Deming's 14 points[168]). To this end, senior management needs to set a clear mission for the company so that management responsibility and direction can be consistent throughout the organization (Sprouster 1987; Blakemore 1989). "Constancy of purpose" also refers to constancy over time – a stress on long-term instead of short-term goals (Sprouster 1987; Blakemore 1989). The main device by which greater cooperation and coordination among the various departments of the organization can be achieved is cross-functional management[169] which is referred to as "a major organizational tool to realize TQM goals". Examples of cross-functional activities include employee education, customer satisfaction, delivery control, and new product development as well as quality assurance. Sprouster recommends the establishment of Corporate-Management-Directed Quality Circles (CMDQC) to set the "pattern of interdepartmental relationships" for quality circles at lower levels of the organization (Sprouster 1987: 56-8; Blakemore 1989).

The problems of relying so heavily on leadership are summed up by Wilson (1991). Wilson notes that "the extent to which TQM advocates effective leadership as a substitute for organizational structure, hierarchy and control is remarkable", and claims that such faith would

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principles and receive accurate reliable data on which to base decisions (Blakemore 1989: 32).

[167] Blakemore occasionally uses more indirect expressions such as only management has "the <u>authority</u> to eliminate the system problems" or "Management must <u>set up a system</u> to ensure that constant improvement takes place." which at least seem to allow the possibility that problems and their resolution may lie outside the ranks of management but elsewhere declares that production workers cannot solve these problems and only passing reference is made to the possible role of "experts". In this context, Blakemore offers a particularly unhelpful definition of "system" as the "sum of all processes" (Blakemore 1989: 19, 34, 132-3).

[168] Deming's 14 points figured prominently in the Australian literature. The 14 points are: create constancy of purpose, adopt the new philosophy, cease dependence on mass inspection, end the practice of awarding business on the basis of price, constantly and forever improve the system, institute training on the job, institute leadership to help people and machines do better, drive out fear, break down barriers between departments, eliminate slogans and targets, eliminate work standards and management-by-objectives, remove barriers to pride in workmanship, institute a program of education and self-improvement, involve everybody in accomplishing the transformation (see, for example, Blakemore 1989: 33-35).

[169] According to Blakemore, the TQM organization itself "cross links and short circuits the existing hierarchical structure" (1989: 24).

seem to be misplaced given the "paucity of knowledge, the intense level of conceptual disagreement and the apparent gaps in knowledge in the general field of leadership theories. From this perspective, it appears to be a case of blind faith." According to Wilson, "The primary problem … seems to be that no one can agree precisely what is meant by the term 'leadership'." He canvasses a number of options including the view that leadership is a "redundant concept which could be replaced in most organizations by aspects of individuals, the tasks carries out and the organization itself" (Wilson 1991: 96-8). I agree with Wilson that the success of a quality management programme is likely to depend less on leadership than on what I call "management control" which means precisely the establishment of appropriate organizational structures, procedures and effective monitoring.

Labour-management Relations

Related to management leadership and a factor which played a particularly prominent role in the approach to quality management in Australia was labour-management relations, otherwise referred to as "partnership" or employee relations. The stress on the importance of a cooperative relationship between the two parties was almost universal in the Australian literature. The objective of mutual trust and respect between employees and management required that management accept responsibility for all employees and provide them with security of employment (Sprouster 1987; Blakemore 1989). The literature stressed the need to avoid job retrenchments as a result of productivity gains and to "replace fear with trust" (Sprouster 1987: 85; also see Blakemore 1989; Wilson 1991). The economic loss which resulted from workers being afraid to ask questions or report trouble was described as "truly appalling" (Blakemore 1989: 133; Sprouster 1987).

Another recurring theme was the need to foster a sense of common interests – that is, creating an industrial climate in which "the members of the organization can achieve their own goals best by directing their efforts towards the success of the enterprise, hence as the organization succeeds, so do they" (Blakemore 1989: 40) or by creating "an atmosphere in which employees realize that role of management is to improve job security by ensuring viability of company through elimination of wasteful operational systems" (ibid). But Sprouster warned that it might not be so easy to convince the workforce because years of neglect are difficult to correct[170] (Sprouster 1987).

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[170] Because this relationship was so crucial, Sprouster insisted that an IR policy must be established prior to the introduction of TQC. He regarded the essential elements of that policy as effective job training, supervision designed to help staff do a better job, replacement of fear with trust and consensus in decision making by reducing barriers between departments (ibid. 85).

The stress on "people practices" and the importance of cooperative labour-management relations was embodied in and greatly reinforced by advent of the best practice programme[171] and the concept of the "new workplace culture". According to a study of best manufacturing practice by the AMC, "Effective people practices create the cooperation and trust that underpin efforts to improve in all areas" (AMC 1994: v). The report goes on to say that "Cooperation between management and employees in all aspects of their business is central to the definition (of best practice)" (AMC 1994: 1). Other factors served to reinforce this concern. In Australia, there was a view that the human relations issues of TQC had to be addressed "against a background of years of industrial confrontation" (Sprouster 1984: 90) and in some quarters, there seemed to be an underlying agenda that the problems of industrial conflict could be resolved by the introduction of TQC/TQM. As in the case of people and the shop floor, the concern for improved labour-management relations rested in large part on the perception that the success of TQC in Japan owed much to the practice of 'lifetime employment' which engendered a sense of shared interests and cooperative labour-management relations.[172]

Participation in Management (Involvement, Commitment)

Closely related to concerns about labour-management relations was another set of social issues including participation in management, involvement and empowerment of workers. As noted earlier in this chapter, a very strong relationship is widely seen to exist between TQM/TQC and worker commitment, involvement and participation, even to the extent of regarding TQM as "one of the most powerful methodologies of workforce involvement" (Stace and Dunphy 1994). Employee involvement was given as one of the "principles of quality" which can engender "consensus and uniformity of action" and even help to eliminate waste (Blakemore 1989: 22; Sprouster 1987: 84).

Ford Aust. placed particular stress on employee involvement making it the third pillar of its strategy. The view was that "All employees who make a contribution to the achievement of process outcomes should be involved in their improvement". Moreover, there was a recognition

[171] The Best Practice programme was administered by the Australian Manufacturing Council, a tripartite body of trade unions, management and government.

[172] The preoccupation with the importance of cooperative labour-management relations is certainly not limited to the quality management literature. One of the major conclusions of Womack, et al.'s study of lean production is success in achieving high levels of quality and productivity is only possible if there is a "sense of reciprocal obligation, a sense that management actually values skilled workers, will make sacrifices to retain them, and is willing to delegate responsibility to the team" (Womack, et al. 1990: 99; see also 103, 248-9). Similarly, Tsutsui concludes that "the postwar combination of a high-wage productivist system and the innovative QC circle concept was endorsed by managers and workers alike as genuinely participative, empowering, and mutually beneficial" (Tsutsui 1998: 239).

that involvement or participation should be related to the employee's own work and that one of the preconditions for this to happen is that workers have ready access to relevant information about their work. As Pettigrew states:

> Employees will only become involved if they can participate in the decisions about what to do, and for this they need the information on what they are supposed to achieve and why. (Pettigrew in Sprouster 1987: 109)

In fact, however, it was the production operator (and not all employees) who was regarded as of:

> … utmost importance in this involvement, since, by virtue of his role, he has an enormous amount of detailed information about the process – more than anyone else – and, secondly, he and only he can prevent defects. (Pettigrew in Sprouster 1987: 107, 52)

Teams

Much is made of teams in the English literature generally (Wilkinson and Wilmott 1996; Blakemore 1989; Womack, et al. 1990[173]). There is reference to the need for team-building and cross-functional teams to undertake improvement activities. TQM is even defined as "team collaboration plus tools (SQC)". Blakemore declares that "We have so far underestimated the true potential of human resources – particularly the power of a team", that 'Western civilization' has concentrated too much on the individual and neglected the potential of 'organizational team effort'[174] (Blakemore 1989: 41, 133). As a general principle, management is urged to breakdown the distinction between people (in different departments) so that everyone can work as a team.

Quality Circles

Quality circles are generally regarded as quintessentially the vehicle for employee involvement or participation in Japanese quality control. Nevertheless, in contrast to the advocacy of teams and team work, the views about quality circles in the Australian literature are much more disparate. Blakemore (1989), for example, does not mention quality circles at all. Sprouster notes that many unhappy experiences with quality circles were due in part to the misconception among Western observers in the early 1970s that quality circles were the foundation of TQC (Sprouster 1984). In addition, as noted earlier, the motivation for the introduction of quality

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[173] Despite their detailed study of the differences between mass production and lean production and strong advocacy of the superiority of "lean production", Womack, et al. come to the surprising conclusion that "in the end, it is the <u>dynamic work team</u> that emerges as the heart of the lean factory" (emphasis added: Womack 1991: 99).

[174] For more details of Blakemore's views on teams, see p.41; on project teams, see p.25, 104; and on the use of Blakemore's 20 tools in team problem solving, see pp.74-5. On teamwork and the new workplace culture; see Mathews "Catching the Wave" pp.61-2. The new workplace culture is discussed below.

circles varied greatly and often had little to do with improving quality performance (Dunford and McGraw 1988). Although union opposition is often given as a reason for the lack of success with quality circles in Australia, as Sprouster warns, the failure of quality circles probably had much more to do with the fact that the workforce was not sufficiently trained in the principles – or practice – of TQC and that there was insufficient understanding throughout the organization to support these activities.

Communication

An aspect which is closely related to both labour-management relations and involvement and participation is communication. Blakemore lists communication as one of the "people elements" of TQC. In his view, because TQC regards the "next step in the process" as customer, it necessarily places a renewed importance on communication. In this case too, there is a tendency to rely on social or cultural devices or to link communication to social benefits. It is asserted that most of the barriers to communication in an organization can be broken down and communication improved by instilling the understanding that "**we** are the company and **they** are waste, excess and variation". Similarly, open, two-way, non-punitive communication is advocated as a means to reduce fear (Blakemore 1989: 21, 133; Sprouster 1984). One of the major benefits of TQC and of quality circles in particular is seen to be increased communication across the organization since "barriers between departments are broken down and people who normally don't mix work together to solve problems" (Sprouster 1984: 56-8; Blakemore 1989). As the comments about "them-and-us", non-punitive communication and reducing fear indicate, the discussion of communication is also coloured by the view that improved relations between labour and management are essential to the success of TQC/TQM rather than, for example, communicating relevant data about quality performance. One of the consequences of this approach is that a great deal of attention is directed to "how" to communicate, the methods, rather than what to communicate.[175]

In contrast to the above, one case in which the "what" of communication is addressed in a very practical and concrete way is the Ford Australia idea of "process intent". According to Ford, "For employees to talk sensibly and rationally about day to day quality management they have to talk in facts that can be communicated and verified." In this sense, the Process Intent approach provided a "language" of communication. Ford saw this approach as having the added

[175] Woodward in her early work on industrial organization found that information about the conditions of their work and the factors that effected performance of that work was more important to workers than information about the company's investment plans or the "projection of an attractive and benevolent company image"[175] (Woodward 1965: 173-5).

benefit of forcing everyone to focus more on the production operation because "numerical and objective evidence about the adequacy of the product and the process commands more attention than … subjective and narrative type of evidence". The stress on factual and verifiable information related to the work being performed resembles the Japanese insistence on the importance of objective data rather than opinion and guesswork.

Organizational Culture, Organizational / Cultural Change

As we have seen, organizational and cultural change loom large in the English literature on quality management. One of the problems is whether organizational and cultural change is to be regarded as a (pre)condition of a successful quality programme, as a by-product or collateral benefit or indeed, as the "real" intended outcome of a TQM programme rather than quality improvement per se.

Changing attitudes and/or behaviour of different groups within the organization is considered an essential part of organizational / cultural change. According to the NIES model, "Sustained change, especially TQM, is impossible without a real change in the behaviour of all stakeholders in the business. … without an even (more) amazing change in the attitudes of management, workers and unions" (NIES no date: 34). The range and types of organizational or cultural change and changes in attitudes and behaviour called for are extremely diverse. Thus, for example, Blakemore points to the need for Western management which "only looks at the performance or result-oriented criteria" (short-term R criteria) to develop process-oriented criteria (P criteria). He explains: "P criteria call for a long-term outlook, and often require behavioural change" (Blakemore 1989: 115). In the case of the NIES model, we are told that the TQM implementation process should include an explanation of "the change process and likely cultural implications and that the program should be seen as the "first steps in a journey that brings about a culture of continuous improvement" (NIES no date: 10, 19). One of the companies which adopted the NIES model reported that the "NIES …program provided … the opportunity for a 'culture change' that would create unity and a new commercial focus for the company and would have the commitment of all … staff" (ibid. 27). One aspect of organizational culture which receives a lot of attention is the need to change past attitudes which regard all mistakes as "human error" and lay the "blame at the point of the operation". In this respect, the analysis of quality problems or variation in terms of common and special causes is seen as demonstrating that the "employee is the least of our problems" (Sprouster 1984: 45, Blakemore 1989: 9, 32-3).

In Australia, the importance attached to organizational and cultural change was undoubtedly reinforced by the concept of the "new workplace culture" which was a central aspect of the best practice programme.[176] This new workplace culture was described as "fundamentally a **state of mind** that drives constantly for 'best practice'. Its key elements include:

- flatter organizational structures
- continuous improvement approaches to productivity and quality
- more team-based approaches to problem-solving
- more flexible production processes
- increased involvement of suppliers
- human resource policies based on multi-skilling, retraining and a generally more cooperative approach to work." (AMC 1994: viii)

As in the case of leadership, Wilson (1991) makes some fundamental criticisms of TQM as a "programmed approach to organizational change" at the level of the individual organization.[177] He groups the criticisms under eight themes – five of which are of particular interest here.[178] First, TQM was found to be "good at creating plenty of activity" but the amount of organizational change which actually occurs tends to become largely irrelevant and the benefits difficult to measure. Secondly, "TQM can create 'evangelists' among those managers who are (often) its fanatical supporters. This can lead to fragmentation … between those who support the programme and those who view it with less enthusiasm." Third, "Large-scale change programmes like TQM can easily become all-embracing processes into which virtually all organizational problems are put. … so it is judged to have failed despite not being designed to handle everything in the first place." In this connection, I would add that it is frequently not clear even to the majority of participants what the programme is supposed to be "designed to handle". The fourth set of problems relates to the blurring of the distinction between means and ends so that "the progamme itself can easily slip into becoming an end in itself rather than a means to an end".[179] Fifthly and finally, Wilson notes that there is a "general lack of empirical evidence of change programmes deemed to have been successful".[180] Wilson's criticisms

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[176] The central importance of the new workplace culture to the BP program is exemplified by the fact that the BP coordinator or project manager is "usually the human resources manager" (op.cit. 38).

[177] As other types of programmed approaches to organizational change, he examines programmes at the micro level for individual managers (e.g. management training and development packages), the more macro level of strategic cooperation between companies and finally, the economics of deregulation and privatization (ibid: 92).

[178] The criticisms are derived from the analysis of responses of eighty managers drawn from nine organizations to interviews asking how they felt the programme (TQM) had helped or hindered the strategic change efforts which were being made in their organization (Wilson 1991).

[179] Ishikawa (1989) makes a particular point of the need to avoid the problem of 'confusion of means and ends' in relation to both improvement and management in general.

[180] The reasons Wilson gives for the lack of evidence of successful programmes, would seem to be second or third order problems. The fact that programmes were developed in a manufacturing context and

suggest that, to the extent that TQC/TQM has been transformed into a programme of organizational change, it is likely not only to fail to achieve the original aim of improved quality performance but also to fail as a device for organizational change (Wilson 1991: 101-103). As we shall see, one Australian case study (NEC (Aus)) fell victim to most of these problems.

Neglect of the Technical

The converse of the preoccupation with "the social" is the neglect of "the technical" aspects of quality control. There is a tendency to treat such aspects as less important or even as more of a hindrance than a help. For example, the view that TQM programmes have been "unsuccessful because they focused on manufacturing improvements, which can be easily quantified and have neglected employee empowerment" (Radovilsky, et al., 1996: 10). Even where reference is made or seems to be made in a more positive light, there is little or no explanation of the individual 'elements' or what the necessary combination might be. This is all the more surprising in the light of comments such as "the specific practices ... cannot be treated as individual items on a menu of best practices from which firms may pick and choose at will" (Terziovski, Sohal and Samson 1996: 479).

In fact, there is evidence to suggest that the techniques of quality control are poorly understood and that there application is highly problematic. Both Barnett (1991) and Wood and Preece (1992) point to a wide range of problems with the understanding and application of statistical techniques for quality control. Wood and Preece in a study of what they call the "measurement-based approach to quality" (MAQ), found that:

- mistakes were being made in the application even of relatively simple techniques and were not being detected even by software providers;
- certain techniques were unsuitable for the purpose for which they were being used;
- SPC techniques were being used because senior management had taken a decision to do so or to comply with a major customers' requirements. So employees were under pressure to "be seen to be using" a technique even though it was being used incorrectly or being put to little or no practical use;
- particularly in the case of computerized systems, the output and screen displays were often too technical and difficult for the intended users.

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do not easily translate to service organizations is undoubtedly a problem for such companies but does not explain lack of success in manufacturing companies. The concern that programmes do not adapt to differences in international operations or particularly in national cultures is probably at least a third order problem in the sense that most companies fail to develop successful programmes even within their domestic operations.

Although Wood and Preece state that "... the key problems are designing a suitable MAQ, interpreting the results and knowing how to act on them" rather than "the doing of the technique" (ibid.), the above points suggest that 'doing' is also a problem. Indeed, Barnett takes the view that statistical techniques are "in danger of falling into disrepute because of lack of understanding and misapplication" (Barnett 1991: 10-11).

Moreover, Sohal, Ramsay and Samson found that "poor response rates (to questions about quality program evaluation) indicated companies were often less than rigorous in the evaluation of their own quality management programmes and practices". They note that "As more detailed information was requested (about measurement of quality costs), there were progressively fewer responses" (Sohal, Ramsay and Samson 1992: 294, 295). Clearly such responses throw considerable doubt on the adequacy or effectiveness of the quality management systems or practices as technical systems, the ability to evaluate, and therefore presumably to improve such practices. In the light of such findings, questions such as "Has your company introduced SPC?" (yes/no) or, even worse, "Does your company use Taguchi techniques?" (yes/no) become virtually meaningless as indicators or "measures" of the viability or efficacy of quality management systems or practices.

The technical aspects which occur most frequently in the literature are process, variation, continuous improvement and training, and, to a somewhat lesser extent, statistical thinking and methods, and policy and planning. Unfortunately, in some cases such as process and continuous improvement, as in the case of TQM itself, the definition or meaning is broad and sweeping and correspondingly vague. Two other aspects which receive a lot of attention are customer satisfaction and relations with suppliers

Process

Most listings of "critical factors", "core concepts" and national quality awards include reference to process or process management in some form (see Saraph, et al. 1989; Tummala and Tang 1996; Mann 1992). The fact that 'process' was interpreted as 'any business process' meant that quality management was not restricted to the production process but could be applied to any of the activities of a company in any industry. Consequently, process or system[181] is defined very broadly as "a series of actions or tasks done to satisfy a customer's need" (Blakemore 1989: 21,

[181] Sprouster (1984) uses the term "system" rather than process and the NIES model focuses on system and treats process as part of a larger system.

65) or as an "element of the business under consideration" which could be anything from "the entire organization" to "the smallest specification of the smallest raw material" (Sprouster 1984: 43). This approach creates the additional problems of first identifying the process/system and then being able to define it. The aim is then to "understand the capability of the system" and "basic to understanding capability is that all systems have variation" (ibid.).

In contrast to the broad definitions above, Ford Australia defined what they called "process intent" in a very specific way.[182] Process intent describes quality at the operational level (also called Operation Outcome Specification) and is intended to allow the operator to "guide himself predictably "home" to an OK outcome every time" – to enable operators to better understand and control their own work or 'process' (Sprouster 1984: 102-3). The operational definition of process intent includes the following features;

- "a listing of all the outcomes of the operation which matter in terms of objective variables which can be measured practically and with sufficient precision by the operator as he is doing the work
- a value for each which is the OK quality limit
- an explanation of why the outcomes matter."

Clearly, the 'process' in question here is the production process (not any business process) and the emphasis is on the objective measurement of specific physical variables or outcomes – which contrasts with the difficulty of identifying and defining – let alone measuring – the process when interpreted as any business process.

Variation

Variation is treated as one of the central concepts of TQC/TQM by Sprouster (1984), Blakemore (1989) and particularly the NIES model which places (control of) variation as one of its three core principles but variation does not appear in the lists of key concepts or the national quality awards. All three explain variation in essentially the same way. All systems/processes have, or rather are adversely effected by variation. As noted, following Deming, the causes of variation (or problems) are said to fall into two categories – special and common causes of which the latter are faults of the system and can only be reduced or eliminated by the action of management. It is emphasized that the production worker is helpless to reduce any of these causes of trouble. This particular interpretation of variation is one of the reasons for the

[182] The concept of 'process intent' is widely used but often in quite a different sense from the way it is used at Ford Australia. For example, the NIES model refers to "process intents for all key processes" but given that process is not confined to the production process, it would difficult to apply the Ford interpretation. Blakemore also uses the term but in a very general sense quite unlike Ford (see Blakemore 1989: 21). Also see chpt.7: QA through process intent in Mathews (1994).

emphasis on the role of management or the tendency to focus on the "top floor and the shop floor"[183] in the Australian literature and the English literature generally (Sprouster 1984; also Blakemore 1989).

Variation and Waste

Whilst the Japanese literature concentrates on the elimination of waste and the English literature on the reduction of variation, waste and particularly the cost that it imposes on Australian businesses are mentioned by Sprouster and Blakemore. Sprouster insists that the cost of waste "must be reduced if Australia is to compete effectively in international markets and raise the standard of living". Waste and errors are said to account for 30% of cost of Australian goods and services and 15% of all clerical time or 25-40% of costs of manufacturing industry (Sprouster 1984; also Blakemore 1989). The same 85/15 rule is applied to waste so that "most waste and errors are caused by the system and not employees" (Sprouster 1984).

Generally, the relationship between variation and waste is not explained or where it is attempted, the explanation is rather confused. For example, Blakemore attempts to link variation to the Japanese idea of waste expressed by '*muda, mura, muri*'.[184] Thus, "Unevenness means variation. An object of TQM using statistical techniques is to reduce variation" and "Variation in excess can be regarded as waste" (Blakemore 1989: 22). We also find that the elimination of waste is sometimes linked to certain social arrangements in the sense that the "involvement of all employees in the decision making process leads to the consensus and uniformity of action that <u>tends to eliminate waste</u> caused by confusion and antagonism" (emphasis added: Sprouster 1984: 84).

Continuous Improvement

Continuous improvement – sometimes referred to by the Japanese word, *kaizen*[185] – is given particular prominence in the English literature. It occupies the core of the NIES model and the AQC Wheel and, in Blakemore's case, is the factor that extends the sphere of QA "to completely fill the tetrahedron"[186] (Blakemore 1989: 8). Generally, national quality awards do not include

[183] This expression was used by Terziovski, Sohal and Samson (1996).

[184] In fact, the Japanese term for variation is "*baratsuki*" and "*mura*" is a form of waste. For an explanation of *muda, mura, muri*, see Chapter 3. In so far as "variation" is a synonym of "unevenness", it is not an unreasonable translation of "*mura*", nevertheless it is misleading to equate "*mura*", "unevenness", with "variation" in the sense in which it is used in the English literature. This is another illustration of the problems of translation and the potential for misunderstanding.

[185] In fact, "continuous (or continual) improvement" has now been translated back into Japanese as "*keizokuteki kaizen*", not "*kaizen*".

[186] There are exceptions. Sprouster, for example, makes only occasional and oblique reference to

continuous improvement in their lists of major criteria although the AQA refers to 'improving process performance'. As to what it is, how it is to be achieved or implemented and how it relates to the wider quality management system, in most cases, little explanation is offered. The term appears to be regarded as self-explanatory and is one of the aspects which has the aura of a "self-evident good".[187]

Although the most common view (and particularly the view of the critics of TQM[188]) is that continuous improvement is only gradual or small step improvement, there is disagreement about whether it includes large step improvement or even innovation. According to Blakemore, *kaizen* lies between the two Western management activities of maintenance and innovation:

> Innovation is dramatic … KAIZEN, on the other hand, is often undramatic and subtle, and its results are seldom immediately visible. While KAIZEN is a continuous process, innovation is a 'one-shot' phenomenon. (Blakemore 1989: 20, 114-7)

In this case too, ultimately "people" are accorded the critical role. We are told that "A process-oriented manager who takes a genuine concern for KAIZEN … is PEOPLE ORIENTED and directs his activity to teamwork" (ibid. 116) or that the "kaizen concept stresses management's **supportive and stimulative role** of **people's efforts** for improvement of the processes" (emphasis added: ibid. 115). Boyapati (1991) makes an even stronger association. He divides TQM into two dimensions – a core dimension (a formal quality management system) and a peripheral dimension (continuous quality improvement) which is people-oriented and includes employee motivation and involvement, pride in work and a sense of belonging.

Kaizen and Deming Cycle / PDCA

In the Australian literature, the notion of continuous improvement is closely related to the Deming cycle or the PDCA cycle but again there are a number of different interpretations sometimes by the same author. While the wheel is "one of the most crucial elements of TQM and KAIZEN", on the one hand, the results of turning the wheel are explained as "**slow** continuous, rhythmic change **not** sudden step function change" and on the other, the PDCA cycle is associated with step improvement and the SDCA cycle[189] with more gradual improvement (Blakemore 1989: 20, 117). Alternatively, the PDCA cycle is interpreted as bringing "most of the elements of TQC together: independent supplier – maker – seller –

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improvement and rather regards "a predictable degree of uniformity and dependability" as the main element of TQC quality (Sprouster 1984: 27).

[187] This expression was used about "quality" in general by Wilkinson and Wilmott (1995: 1).

[188] The advocates of reengineering make this criticism. For example, see Hammer and Champy (1993).

[189] Blakemore uses two versions of the wheel – PDCA (plan, do, check, act) and SDCA (where the first step is 'standardize') – which he refers to alternatively as the Deming wheel or the Shewhart/Deming wheel (Blakemore 1989: 19-20, 43, 100-1, 119-20, 123).

customer coming together in a drive for market quality and low cost" (Sprouster 1984: 47-8). In other words, attention is focused on the external relations with customers and suppliers rather than internal processes. There is even a version where the Deming Wheel is associated with change and the segments of the wheel are interpreted as recognize the need for change; actually decide to change; make the change; sustain the change (Blakemore 1989: 108, 19).

Statistical Thinking and Methods

In the literature, statistics are generally regarded as the "basic tools needed to introduce TQC and make it work" (Sprouster 1984: 55). Statistics, together with training and process intent, form the base of Blakemore's tetrahedron and are one of the seven "key management imperatives for continuous improvement" in the NIES model. The core concepts approaches refer rather to "fact-based management", "measurement" or "quality data and reporting". Statistical thinking and methods may be used "to manage and reduce variation", to help the organization "make sound decisions based on data and facts" (NIES (Diagnostic Manual) 1990: D1.18) or to "bring product or service under control – at quality suited to the market" (Sprouster 1984: 55). The "7 QC tools" are the "statistical tools" most likely to be mentioned in the English literature generally and are often associated with a version of the problem solving process. Blakemore expands the 7 into his own version of 20 tools[190] and introduces a simple problem solving process which he uses to illustrate the application of the 20 tools to team problem solving (Blakemore 1989: ch.5). Blakemore devotes another chapter to the discussion of sample, probability and prediction, including the application of statistical process control (ibid: ch.4).

Again Ford Australia was the exception – their approach was very specific and very practical. Particular stress was placed on objective measurement in their concept of process intent; "what you can't measure, you can't control". While their objective was more limited – enabling the operator to control his work, their approach was absolutely uncompromising. The measures which are necessary for this purpose must be objective ("if the variable being measured is too subjective, (the result) will depend too much on who measures it"); repeatable ("if different people measure the same thing at different times, in different places, they will get an answer within the same precision limits each time"); sufficiently accurate or precise ("if the variable is objective but the measuring process is too inaccurate, the value depends too much on chance); and practical (that is, it has to be possible for the operator to perform the measurement while he is doing the work). Moreover, Pettigrew insists that:

> … if the production operator (or the machine) can't measure the variables … with sufficient

[190] Blakemore's 20 tools include everything from imagineering, magic lanterns, and memory to data collection, statistics, computers, communication and training.

> accuracy, as he is doing the work, then the product design or the process design, or both, are no good and must be changed.[191]

The practical and concrete approach of Ford was possible not least because the process in question was the production process (the PTP) and not an abstract notion of 'any business process' – to which the principles of objective measurement as stated here cannot always be applied[192] (Sprouster 1984: 102-4, 114-5).

Policy and Planning or the Planning Cycle

Planning is not as prominent in the literature as the other aspects discussed so far although both Sprouster and Blakemore place considerable stress on planning, 'policy and planning' is one of the key elements of the TQM wheel and one of the seven 'management imperatives' in the NIES model. Planning is included in national quality awards but only in some of the core concepts approaches. The most common theme is the need to replace short-term planning and objectives with long-term planning and, in some cases, to introduce a set of manufacturing accounts in addition to the conventional financial accounts. Blakemore criticizes Australian management for too often judging "on the size of the next annual dividend" which is not "as important as continuation of the business in ten years time". Long-term planning is often linked to 'constancy of purpose', the first of Deming's 14 points (Sprouster 1984; Blakemore 1989). Both Blakemore and the NIES model link together long-term planning and continuous improvement and advocate the need to integrate continuous improvement activities and targets with annual plans.[193]

Training

One aspect to which considerable importance is attached but which is sadly lacking in substance is training. Both Sprouster and Blakemore place particular stress on training however it is

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[191] One of the rare references to the role of process (as opposed to product) designers (presumably engineers) but there is no elaboration of the role of engineering staff.

[192] The possible limitations on the application of statistical methods to "any business process" are not discussed in the literature but the actual examples given are usually drawn from manufacturing industry, as in the case of, for example, Sprouster (1984) and Blakemore (1989).

[193] Interestingly, this is an occasion where Blakemore has difficulty agreeing with Deming's 14 points. According to Blakemore, as policy is deployed to lower levels of management, it should be restated in increasingly specific and action-oriented goals, "eventually becoming precise quantitative values" which apparently contradicts Deming's points 10 and 11. Blakemore's final interpretation is that Point 10 means to "eliminate the use of meaningless targets, slogans and exhortations", not to eliminate targets altogether. With respect to Point 11, having first stated that "Standards are necessary as a starting point and as a point of monitoring", later sees the problem as essentially one of eliminating numerical quotas and piecework (Blakemore 1989: 34, 134).

explicitly mentioned in only one of the lists of core concepts and, in many cases, is subsumed under the broader heading of 'human resource development and management' (MBNQA) or under the vague term, 'people' (AQA, NIES model). The NIES model refers to the need for "appropriate training of all people in continuous improvement activities" at a fairly early stage of the implementation of a TQM programme – which begs the question of what constitutes "appropriate" training and whether and how "all people" should be differentiated for the purposes of training.

Despite the fact that training constitutes one point of the base of Blakemore's tetrahedron and is "probably the most important and the most overlooked tool of TQM", he devotes surprisingly little space to explaining training needs instead making sweeping statements that "it doesn't really matter (what it is), if it's needed it should be done" and should "match the needs of the organization" (Blakemore 1989: 100, 26). In general, the discussion of training tends to include training in management and job skills as well as quality-related training as in the case of Sprouster who concentrates on the need to raise the overall skills of the workforce. So reference is made to opportunities for multiskilling, training to widen the experience and ability of future management leaders and sometimes specifically to the need for "statistical training to allow job and task improvements" (Sprouster 1984: 85-86).

As far as quality training is concerned, reference is made to training for management and facilitators but generally training is centred around team activities and implicitly or explicitly tends to concentrate on operators. Depending on views about the composition of teams or project teams, team training will include a cross-section of other groups of employees such as supervisors, managers and specialists. In terms of content, training is often related to some version of a problem solving process and may specifically include the 7 tools or just reference to statistics generally. However, the explanation of the teaching of problem solving may concentrate as much on things such as memory and retrieval, word pictures or communication as on the quality tools and how to use them effectively (Blakemore 1989: 69-73). Training in more advanced skills for engineering or even quality department staff is not mentioned. Overall, a clear focus on the sort of training, the particular quality techniques or skills and the level which is required for different groups of employees is lacking.

There are two other aspects which are given much more prominence than some of the technical aspects mentioned above: that is, customer focus and relations with suppliers. It is probably not an exaggeration to say that the former came to dominate both the Australian and the English literature on TQC/TQM. It is notable that, in a study by Van De Wiele, et al. (1993) of 15 of the "most important factors of TQM", "satisfying external customers" was given the highest mean rank (4.84) by the sample of management surveyed. "Customer satisfaction" or CS became something of a movement in its own right in the 1990s.

Role of Customer and Relations with Suppliers

The customer is posed as the almost absolute arbiter of quality – the company's own definition of the level of quality that is possible or desirable seems to be almost irrelevant. According to the NIES model, "quality is defined in terms of customer perceptions" which are also used "as the basis for continuous improvement planning" (NIES (Diagnostic Manual) 1990: D3.18). "Customer focus" is included in the TQM wheel and the AQA criteria. The definition of "process" itself includes "to satisfy a customer's need" (Blakemore 1989: 21). In Sprouster's case, the customer/consumer dominates his interpretation of the Deming cycle (Sprouster 1984: 27-8, 47). Customers can also be internal. The idea of internal customers or "next process as customer" seems to have acquired much more prominence and significance in the English literature[194] than that of a largely rhetorical device to stress the importance of not passing on defective product to the next process as in the Japanese literature.

Wilson comments about the fact that "the customer comes first and is also the judge". While I think he overstates the point in saying that "ultimately whether of not TQM programmes are judged a success or not lies directly with the customer and is effectively out of the hands of those who seek to control it (i.e. the programme)"[195] (Wilson 1991: 101-2), there would seem to be a number of problems inherent in this approach. It seems inevitable that making the customer the arbiter of quality would have the effect of diminishing the company's sense of responsibility to make its own judgements and efforts to improve quality. It seems unlikely that the customer would have more knowledge about the product than the company which makes it and even less likely that the customer could have better knowledge of the production process than the maker itself. Not only the quality of the product (the outcome) but particularly how the outcome is achieved was a focus of Japanese quality control as a result of which Japanese companies achieved higher quality at lower cost than competitors in many product markets. Nor is it obvious (except in specific circumstances[196]) that the customer is in the best position to interpret its own needs – especially if we accept that the maker has better knowledge of the product and

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[194] See, for example, Blakemore (1989), Boyapati (1991: 67) and Kanji and Asher (1993).

[195] However, this view has become firmly established in the literature and was one of the major points in the 2000 revision of the ISO9000 series. For just such an interpretation of the customer as the ultimate arbiter, see Hill (2001). According to Hill, the role of management is to ensure that customer requirements are determined and met (2001).

[196] The most obvious exception is OEMs which are in effect contracting out part of the production process.

its functional capabilities. Moreover, the ability to find or anticipate better ways to meet a customer's needs would seem to be a competitive advantage over simply waiting to be told what a customer's needs are – quite apart from anticipating future trends in market demand.[197]

The flip side of customer satisfaction and another aspect which looms very large in the both the Australian literature and the English literature generally is relations with suppliers although it is not included in the AQA criteria or the TQM wheel and only appears in one of the lists of core concepts. The general themes are that suppliers should not be selected mainly on price and that a company should develop long-term and cooperative relationships with its suppliers.[198] According to Sprouster, "In a TQC organization, elements of the supply chain are pulled together to "build in Quality" ~ linked together in a chain of support" (designer, purchaser, material and parts suppliers, workers …) (Sprouster 1984: 49, 88-89). Similarly, Blakemore refers to the "TQM process" as "supplier – producer (management / workers / staff, operators) – customer" or as "S – P – C = TEAM" (Blakemore 1989: 29).

One of the main reasons for the prominence given to customer satisfaction seems to be that there is, in fact, an underlying premise that the company is producing for a small number of large corporate customers or OEMs whose satisfaction is critical to its survival[199] and which, as in the case of the automotive industry, have expertise extending over the whole of the supply chain.[200] This was perhaps particularly the case in Australia where many companies are subsidiaries of and/or suppliers to major multinational corporations. Relatedly, it appears that one of the primary motivations behind the development of quality standards was the need for supplier assessment or accreditation schemes – an issue which has, if anything, become more important with the increasing spread of global supply chains (Blakemore 1989: 43-4). This aspect is particularly apparent in the ISO/TS16949 quality standard (and its predecessors) for the automotive industry which was designed precisely as a device to accredit suppliers to the major auto makers. The problem with this focus on customers and suppliers is that much of QC activity and effort becomes externally-oriented – diverted towards the activities of suppliers or towards determining the requirements of customers rather than concentrating on analyzing the

[197] Hamel and Prahalad (1994) make a similar point about the dangers of being "customer-led". In particular, they make the point that the future of a company lies in identifying needs which customers cannot yet articulate rather than simply meeting the articulated needs of existing customers (Hamel and Prahalad 1994: 108-112).

[198] For a discussion of these three aspects of supplier relations in the case of Ford Australia, see Sprouster (1984: 123-127).

[199] For example, the most advanced level on the customer satisfaction criteria of the NIES model is "partnership relations are established with key customers to create a sustainable competitive advantage" (NIES (Diagnostic Manual) 1990: D3.18).

[200] Even so, in Japan, in some cases, suppliers did develop and were recognized as having greater expertise in the components or products they produced than the OEM.

firm's own internal operations. This may become a particular problem if it occurs at an early and immature phase in the development of the company's own quality management system.[201]

Limited Success

In Australia and the West generally, unlike Japan, TQM has always been contentious and contested. This is perhaps partly due to the fact that attempts to adopt TQM have met with limited success. While TQC/TQM was widely hailed both inside and outside Japan as one of the major reasons for Japan's competitive strength and came to be considered essential for international competitiveness in most countries, many non-Japanese companies found difficulties in sustaining programmes over the longer term or in achieving substantial results for their efforts or both. The following quotes are illustrative of these difficulties.

- "Many quality initiatives have failed to achieve the kind of impact we had hoped for in Australia. Very few organizations have been able to effectively integrate and sustain the principles of quality management." (Hames 1991: 15)

- Similarly, about the USA, Radovilsky, et al., report that "TQM programs have produced improvements in quality, productivity and competitiveness in only 20-30% of the companies that have implemented such programs". (Radovilsky, et al. 1996: 10)

- Wiggins (1995) notes that "as many as two out of every three quality management programs in place for more than a couple of years are stalled" (Sharman quoted in Wiggins 1995: 80). She goes on to say: "many businesses may waste millions of dollars a year on quality improvement strategies that don't improve their performance and may even hamper it." (ibid.)

- Basu, referring to TQM, business process reengineering and six sigma, notes that "most attempts by companies to use them have ended in failure". He goes on to say about TQM in particular that: "TQM was the buzzword of the 1980s, but … viewed by many, especially in the United States quality field, as an embarrassing failure – a quality concept that promised more than it could deliver." (Basu 2001: 31, 32)

The main reasons given for the lack of success are typically failures of management or issues of company culture and organizational change; attention is focused on 'people issues' including employee involvement and participation. Given the prominence accorded to the role of

[201] Sprouster does warn that: "Before suppliers and customers can be linked into company's TQC system, there must be internal cooperation and coordination" (Sprouster 1984: 88-9).

management, it is perhaps not surprising that the failure of quality programmes is widely attributed to failures of management in both the Australian and the English literature generally. For example, Terziovski, Sohal and Samson (1996) attribute failure to the fact that senior management was "only paying lip service to implementing TQM without any real commitment to making changes" (Terziovski, Sohal and Samson 1996: 479). Similarly, Longenecker and Scazzero (1993) conclude that management and management culture were the major obstacles; that the company was unsuccessful in developing the management practices necessary to maintain a quality improvement programme in the long term but at the same time find that almost all the failures identified as "critically important, if a quality improvement process is to have a real impact on product quality" relate to the "human side of quality improvement" (Longenecker and Scazzero 1993: 27-28).

As suggested in the previous extract, failures of management are often linked to issues of involvement and participation. However, opinions are sometimes quite ambivalent. While, on the one hand, Terziovski, Sohal and Samson (1996: 477) claim that organizational issues such as employee input, involvement and participation in teams are centrally important to the potential success of any improvement strategy, in another paper, Lu and Sohal (1993) argue that one of the common myths about TQM is "that TQM and employee involvement were one and the same." They remark that managers "elaborated on their orientation towards people, their belief in teamwork and the like" but that other aspects of TQM are seldom discussed" (1993: 253-54). The only examples of other aspects are 'reduction of variability' and 'quality systems' and there is no explanation of these elements. They go on to say that "Organizations which realised the full benefits of TQM did so through the successful integration of several improvement activities, each of which addressed a key element of the TQM philosophy." However what a basic set of 'practices', 'improvement activities' or 'key elements' necessary for successful TQM might be is not explained. In a similar vein, there is the claim that off-the-shelf (quality) packages are "strong on training but weak on facilitating change, i.e., ignoring the cultural and attitudinal issues in the organization" (Terziovski, Sohal and Samson 1996: 477). However, again, there is no explanation of what the authors consider constitutes being 'strong on training', what sort of training is offered and whether it is, in fact, appropriate or adequate.

Similarly, there is a tendency to treat "techniques and processes" (i.e., the technical side of quality control) as less problematic than "cultural and philosophical change" or "behaviours, attitudes and processes" Many studies reach a similar conclusion to Sohal, Ramsay and Samson; "...quality management is as much a matter of cultural and philosophical change within an organization as the introduction of techniques and processes. The desired outcome is a set of behaviours, attitudes and processes ..." (emphasis added; Sohal, Ramsay and Samson (1992:

285). In this case too, according to the authors, the main barriers to 'quality improvement implementation' are middle management resistance, lack of senior management commitment and the need for attitudinal change at all levels. They go on to conclude that much of the successful implementation of quality is a "matter of management style (i.e., an open and participatory management style) and company culture" (ibid.: 290) and make no comment about the formal procedures, documentation and records by which the quality management system is implemented and monitored.

Perhaps the major reason for the inability to arrive at a realistic assessment of quality management systems or programs is the lack of adequate tools to measure or assess success or failure. There is a substantial amount of research that purports to analyze and assess quality management systems or the relationship between quality and say productivity or business performance but, to my knowledge, all suffer from either or both of two problems. The first is the lack of objective measures. Most studies rely on the subjective judgement of managers obtained by questionnaire surveys (Saraph, Benson and Schroeder 1989; Harber, Burgess and Barclay 1993). The second is that attempts to relate quality systems to productivity or business performance generally use end-point measures of the outcome/output of the system and not of the system itself.[202] One of the objectives of this research is to provide a better understanding of the actual operation of quality management systems and practices (what companies actual do not just what they say they do) as the basis for identifying the key features of an effective system and developing an objective instrument for the assessment of quality management programmes.

Other possible measures or proxy measures of quality systems (national quality awards, ISO accreditation, completion of a TQC/TQM program with consultants) also suffer from a variety of problems and have been the subject of considerable criticism. For criticisms of the Malcolm Baldrige National Quality Award (MBNQA) in the USA, see, for example, the debate in the Harvard Business Review (January-February, 1992) and Wiggins (1995). Similarly, for criticisms of the ISO9000 series, see Terziovski, Sohal and Samson (1996) and Juran (1999).[203]

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[202] Unfortunately this situation is not helped by the Japanese literature and research because empirical research is notable by its absence. Da Silva Jonas, Nezu and Ohfuji (2002) raise the issue of the lack of empirical studies in Japan, however this study too resorts to subjective measure – a questionnaire survey of senior managers of quality management departments.

[203] Juran has made some fundamental criticisms of the ISO quality standard. He points out that there is a lack of research to establish whether companies that are certified to the ISO9000 standards actually produce better products (at least two studies had shown no difference); that there is a lack of evidence to show what benefits are being gained from what is a costly certification process; and, finally, that "for companies with good quality systems, the standards often just add costs, delays and burdensome documentation, rather than providing any competitive advantage" (Juran 1999: 30).

Conclusion

As we have seen, the interpretation of quality control or quality management was expanded and transformed into a change methodology/technology whose objective was organizational and/or cultural change, the concept of process was expanded to any business process and a vague concept of continuous improvement incorporated as a central tenet of the system. There was a preoccupation with people issues and the themes were participation, involvement and sometimes empowerment. In fact, the vague term people usually referred to production workers and another of the key concerns was the perceived need to improve labour-management relations which involved replacing fear with trust and changing management attitudes which attributed all problems to workers and the point of operation. The only other group of people who were singled out for attention was management. It was management (from the CEO down) who were supposed to bear the major responsibility for making the system work, in particular for solving the most numerous 'common causes' of variation or problems. Ironically, the failure of quality programmes in Australia and elsewhere have been most widely attributed to lack of management commitment. Conversely, there was a tendency to treat techniques and processes (the technical side of quality control) as less problematic than organizational and cultural change or attitudes and behaviour. Despite warnings that the components of TQM could not be treated as discrete elements from which to pick and choose and urgings for an integrated approach, what a basic set of 'practices', 'improvement activities' or 'key elements' essential for successful TQM might be was not explained. On the one hand, there were vague and sweeping interpretations of 'process' and 'continuous improvement' and on the other, compared to 'people' and 'cultural change', the discussion of statistical methods, policy and planning or even training was limited and lacking in detail.

CHAPTER 9. Case Study 3: Bridgestone Australia

Introduction

The Salisbury plant was constructed in 1965 and commenced manufacturing ply tyres. Uniroyal was a minor shareholder at the time but when it increased its holding to 51% in 1970, the company changed its name to Uniroyal Pty Ltd. The factory began producing textile belted radial tyres in 1972 and, in 1973, was the first plant to produce steel belted passenger radial tyres in Australia. In 1979, the plant began producing truck and bus radial tyres. In 1980, Bridgestone purchased a majority holding in the company and when it acquired over 60% of the stock in 1981, the company's name was changed to reflect the change in ownership (Bridgestone Australia Pty Ltd). The remaining 40% is held by general public shareholders.

The company has three plants in Australia but each produce quite a different product range – the link between them being the use of the same raw material. This and one other plant produce components for the automotive industry but the third produces an unrelated range of consumer products. The Salisbury plant achieved record production and profit in 1995 and held a market share of around 22%. The company sold to the consumer or replacement market, to OEMs (just over 20% of output) and exports (about 8%) to Japan and New Zealand. Of the company's total workforce of 2,200 in Australia, over 800 were employed at this plant. There were a total of 11 Japanese in the company as a whole, all of whom came on about a 3 year "tour of duty".

Like the Hikone Plant in Japan, this plant had achieved increasing output with a declining workforce. Over a period of years output had increased by about 25% even though the number of employees had declined. Some of this had obviously been achieved by automation and investment in new machinery and equipment.[204] However, there were also other important factors mainly related to tighter control of operations.

Details of what happened in the early years after the Japanese company took over were not available but it was generally agreed that the introduction of TQC started almost immediately. According to one of the staff who had been with the company for many years, after B/s took over, they first took a long, hard look at the operation and then insisted that the factory be tidied and cleaned up. Around 1985, the then Technical Services Manager started the pilot stage of a programme to introduce quality circles but this attempt met with limited success. According to

[204] However, it was noticeable that the Japanese management did not appear to be in any hurry to replace the existing machinery with the newer models available from Japan. As noted, local managers were also under pressure to make as much improvement as they could "without spending money".

one interviewee:

> In the beginning, we started from the top down … When we got to the supervisor's level, we exposed people to the concept of TQC without giving enough practical examples of how to use the concept.

In 1991, during the recession, the plant hosted the company's worldwide Deming Plan Presentation Meeting attended by quality circles and teams from the company's plants around the world. In 1992, a grant from the Federal Government's Best Practice "Workplace Reform" programme was used to employ consultants to work on the development of self-managed work teams. But by 1996, only one was still operative although another major attempt to introduce such teams was underway. In 1993 when the plant was only working a 4-day week (although workers were receiving full pay), Friday was used for quality/quality concept training. "We revisited the tools and gave many more practical examples of application. ..... and (people) had time to be involved in quality circle activities." Nevertheless, this proved to be the peak of quality circle activities which declined from a peak of over 20 circles in 1993 to 7 circles by the end of 1995 and only 2 circles by mid-1996.

Despite these difficulties, the plant had an impressive record of successfully pursuing quality accreditation and related activities. In 1989, the company obtained Ford Q101 rating, followed by Ford Q1 rating in 1990. In 1993, the plant was awarded an "A" Rating by the UAAI (United Australian Automotive Industries)[205] and was winner of Toyota's Supplier of the Year award. In 1993, the plant gained AS3901/ISO9001 accreditation – the first of Bridgestone's worldwide operations to do so. In 1994, it won the industry award, FCAI[206] Supplier of the Year, after receiving the Certificate of Merit in 1993.

In 1996, the plant was engaged in a major upgrading of its quality system to meet the criteria for QS9000 accreditation (the quality standard for the automotive industry required by the three major US car makers[207]) and at the same time pursuing the P150 programme which was a world-wide programme undertaken by the parent company to increase productivity at every facility by 50% over a three year period (1995-97). QS9000 accreditation was achieved in 1997 – making this the first plant in its industry in Australia and, as in the case of ISO9001, the first

[205] UAAI was a joint venture between the part of the Australian operations of GMH and Toyota Australia – established in 1989 and dissolved in 1996.
[206] FCAI: Federal Chamber of Automotive Industries.
[207] In Australia, QS9000 was also endorsed by other major car manufacturers such as Toyota and Mitsubishi. At the time, QS9000 was one of several national quality standards for the automotive industry. After a transition period, QS9000 was finally abolished in December, 2006 and replaced by the international standard ISO/TS16949 first established in 1999.

of the company's worldwide operations to do so. Among the Australian case studies, this was the company which seemed to be most advanced in terms of a practical, operating quality system.

Organization of QA

In terms of organizational structure, the Quality Assurance Department appears to have full and independent control of quality matters. The main formal link with the Technical Centre in Bridgestone Japan is through the Brand Qualification Standards and Specifications and through the 5 Japanese technical staff (referred to as Development Managers) posted to the plant. In reality, however, in addition to the key role of the Japanese technical staff (who were generally referred to as advisors and did not seem to be in the direct line of command), there are multitudinous links in many forms between this plant and the company's operations in Japan and to some extent worldwide.[208] Numerous employees from management to shopfloor had been sent to Japan and, on at least one occasion, on a study tour to the company's plants in America. There has been quite extensive use of external consultants for various aspects of the development of the quality management system and at the time of the study, they still employed one consultant who was a former employee of the company.

Organizationally, the QA Department consists of 4 groups and a total of 25 staff. One group is responsible for product auditing (monitoring) and release testing. This group includes the 5 quality auditors and the Laboratory which has 2 Technical Officers and 9 Technicians. This group reports to the QA Engineer who is in charge of operational quality matters. The second group of only 2 staff (the Quality Systems Engineer and a technician) is responsible for the development, maintenance and revision of the quality control system, internal systems auditing and matters relating to accreditation. There is also a test room with 2 Technicians working under a Supervisor and a single Technical Officer responsible for a particular form of product analysis.

The main functions of the QA Department were explained as:

- tracking product properties of both components and finished product
- handling the QA auditors, the laboratory and QA's monitoring functions
- handling procedural items, general factory-wide procedures and protocols, and working towards accreditation at various quality standards
- supervizing the test room and its functions in a production supervisory type capacity

[208] For example, the performance of plants is compared on a worldwide basis. In terms of costs, the Australian plant was the worst performer of all the company's plants worldwide.

Normal Operations

The company had developed clear and simple control procedures for production workers; the Process Operating Card (POC), the Easy Read Specification, and the 2C card and other check sheets. These documents were automatically generated by computer for each product specification developed by Technical Services (TS). The need for each individual to check the work passed on to them ("it's like everybody is checking everybody else") was stressed as was the need for Leading Hands (LHs) to make regular checks to see that "everything is alright". But according to the LH, "They'll (the operators) will tell you anyway because the people are trained too". There was also a warning light (*andon*) system in place but how extensively it was used was not clear.

The company had taken half of the Technical Services (TS) Department and allocated them to new positions called Production Technical, which reported directly to production Area Managers. The intention was to provide production more rapid access to technical expertise. The main task of production technical was reported to be "just basic control" – making sure that the correct specifications and production documents were in place and available to line workers as required. In the final processing area, Trades Assistants had been introduced to expedite the changing of moulds which was a frequent and crucial part of operations in this area. The trades assistants also did greasing and other general labouring work to assist the tradesmen. In addition, the company had moved from 100% inspection of all batches of materials and components to an audit basis and reduced the number of QA Auditors from 15 to 6. The QA Auditors reportedly also did "a lot of leg work for QA and TS" – in particular, gathering data on various aspects of production as required by TS or QA.

Abnormal Occurrences

One of the major foci of quality control activities seemed to be the reduction of rework/repair and scrap and at the time of the research there was a concentrated effort to reduce machine downtime. In the main assembly area[209] which was the core of the production process, operators were required to make an assessment of materials and components and those considered unsatisfactory were thrown in the rework bins. Two LHs were responsible for sorting through rejected product to determine whether it could be used or repaired or must be scrapped. In the case of night shift, faulty materials were tagged and left on manager's desk with a request

[209] This was not the final assembly process in the conventional sense and was not the terminology used by the company or the industry. However, since the activity closely resembled assembly, I have chosen to use this term.

for follow-up. However, it seemed that the resolution of problems was far from speedy. One supervisor/manager reported his operators as complaining, "What are we doing? When are they going to fix these things up? It's been the same for years. What's going to be done about it?"

The final processing stage recorded all product which needed to be repaired or was thrown out as scrap and the faults and defects were identified by product model and by the location at which they were generated. This information was then available on-line to the Supervisors and LHs in the respective areas so they could identify whether certain kinds of faults were recurring over the preceding 24 hours and take action before it became a major problem.

If there was a problem with a batch of material or components, the LH or supervisor could reject it – sometimes in consultation with the supervisor from the area that had produced it. If a batch was rejected, a red label was placed on it and the supervisor/LH reported to Scheduling where a record was kept of who discovered it, the time, what was wrong with it and where it was being held. Ultimately, TS was responsible for deciding whether the rejected material could be used or whether it was scrap.

Defective materials and product were recorded in the Daily Performance Report. The report listed the main types of defects and figures were recorded for each shift. Total for the day and percent of production for the day were shown. There was space to list the product variant or type and some additional details about the type of defect were also given. Total figures for scrap and repair for the main product groups were also shown in absolute figures and as a percentage.

The quality manual did lay down guidelines for corrective and preventive action and there was a table (in the company's Standards and Specifications Manual) setting out the major kinds of quality troubles and responsibility for review. There was a form for recording the handling of quality problems (Quality Trouble Analysis Sheet) which included a section for follow-up to be completed by the QA department. This form also required quality problems to be graded into 4 ranks – each associated with a different level of prevention measures. So-called 'serious quality trouble' was tracked separately from the 'other quality trouble'. The form required a statement of problem detection and problem occurrence in terms of 5W1H[210] and an estimation of cost in terms of materials/components, labour and machine time as well as analysis of true cause (both direct and indirect), countermeasures and an implementation plan. There were 11 categories for classifying types of faults including no existing standard, standard not followed/ never followed/

[210] 5W1H: the method of using the six questions (What? Why? Where? When? Who? How?) to analyze the problem.

misunderstood, 4M change, training or clerical. However, it was not clear how widely the form was used or by whom, or the extent to which follow-up occurred in practice. Certainly, there was no mention of follow-up procedures in the interviews – nor indeed any comment about the use of this form by anyone.

Data and Documentation

A lot of work had been done on documenting the quality system for the purposes of ISO9000 and although, according to one manager, "We probably went overboard", further documentation of the system was again a major part of the activities undertaken in preparation for QS9000 accreditation. For the purposes of QS9000 accreditation, the Quality Manual had increased in size from 20 to 36 pages.

As noted, basic documentation for production workers was in place and interviewees commented that it had been improved over the years. The main sources of quality-related data were the Daily Performance Report and the Monthly Quality Assurance Report but both the collection of data and the distribution of these reports seem to have been largely limited to management ranks. Except for some particular cases, reporting below the supervisor level seems to have been almost entirely verbal. The exceptions were those with special duties such as the QA auditors, Production Technical and LHs responsible for sorting scrap.

The Daily Performance Report was a single sheet in which the data was entered by hand. In addition to the information about defects outlined above, the report also included the number of product releases for the two main product groups and output against schedule shown as a percentage. The 'Monthly Quality Assurance Report' contained 5 items; serious and other quality trouble, claims, inspection, results of a particular form of product analysis, and internal system audits. This Report was also a simple, one page numerical report (covering all 5 items) with only minimal space for comment for some of the items. The report gave a target for most items and showed the figures for the current month and the year-to-date. The report was distributed to all departmental managers and to all of the Japanese development managers.

At the time of the research, in the maintenance area, downtime was the "big issue" which was receiving attention all the way up to the Japanese Managing Director. There had been "quite a step change" in the importance given to finding ways to reduce downtime during the preceding year. Major changes had been made in the maintenance area with the introduction of the Maintenance Information Problem Analysis Sheet and the tightening up of reporting procedures and the keeping and distribution of records. In the past, there had been "no record keeping as such and very little interchange of information". Now when there was a breakdown longer than a certain amount of time, tradesmen were required to investigate the cause and submit a Problem Analysis Sheet. The reports were made available to all of the supervisors so that they were aware of the kind of problems occurring elsewhere and how they had been resolved and so that they could learn from each other's experience. There was also a weekly meeting where the report sheets were handed to the Japanese development manager. As one interviewee commented, "There have been attempts to do it in the past but no one was held accountable for it so it just wasn't done. But now we have a meeting every week … and because you've got to hand them in every week, you're held accountable for doing it and so it's happening." In addition, Australian maintenance staff were being shown overheads of the way particular problems had been overcome in Japan. In this case too, although one interviewee claimed that some of the problems have been overcome in a similar way in Australia, he added that "The difference is that over the years the Japanese have documented it all, whereas we've just done it and it hasn't been documented." Finally, there was another attempt to tighten up reporting procedures by comparing the records held by maintenance and production. Maintenance workers recorded the jobs they did and how long each took. Production also recorded machine breakdown (basically to account for lost production) but, in the past, this information had not been available to maintenance and there had been no crosschecking of records. The information was now input into the computer system and was available to maintenance supervisors who could then compare the two records. This system too had only been put in place a few months prior to the research.

Improvement Activities

In general, Bridgestone (Aus) had been tightening up operations and installing control procedures and systems. This was evident in everything from tighter control of the labour supply in both production and maintenance areas, changes to recruiting practices, creation of Production Technical and Trades Assistants, improvements to production check sheets, the changes to maintenance work mentioned above and measures to increase productivity. At the time of the research, there were a number of major improvement drives underway. Two of these, P150[211] and the systematic application of IE, did not address quality issues directly, but could be expected, particularly in the latter case, to have a major impact on quality performance.

P150, started in 1995, was a 3 year programme to improve productivity by 50% by the end of 1997. The factory was told that their costs were too high and that they had to become world

[211] Also see Chapter 5 concerning the P150 programme in the Japanese parent company.

competitive. Two main areas of activity were identified; machine productivity and "man" productivity. The key aspect of the former was the reduction of non-operating time by 50% and of the latter, multi-skilling of workers. Multi-skilling was reflected in the job ranking system so that being able to perform more than one job gave operators a higher rank.[212] Machine productivity was to be increased by reducing non-operating time by 50%, increasing machine speed, and introducing low-cost "semi-automation" devices. In order to reduce non-operating time, the issues to be addressed were reduction in set-up and shut-down time, reducing the number of product variations (which impacted set-up time), and introduction of Total Productive Manintenance (TPM). In practical terms, however, the emphasis in the FMS (Flexible Manufacturing System) Room was on achieving less scrap generation, less downtime and less absenteeism – for each of which targets had been set for each of the main production areas.

The P150 programme had been introduced in Japan a few years earlier. Groups of employees were sent to Japan to learn about P150. The first group included the Manufacturing Manager and the Executive Director, followed by the area managers to look at P150 activities in their own areas and later groups including Supervisors and tradesmen. As one manager commented, "So it's not just managers who go to Japan on business trips." As he explained:

> We try to get everybody because the success of P150 is not me being sold on it, it's the people who actually have to do it. At 2:00 in the morning, I'm not here.

In production areas, the main thrust of the P150 programme was apparently to try and keep scrap down to a minimum.[213] In particular, the emphasis was on repairing and recovering defective product. Asked whether there were targets for specific kinds of scrap or defects, one Leading Hand replied, "… we've just got to try and keep the (product). Repair them wherever possible". Another part of P150 was the reexamination of tolerances to see what productivity gains could be made by introducing less severe tolerances and having common tolerances for a range of components and dimensions to reduce the number of times that change over and set up were required. This was the work of Technical Services.

As to perceptions of the relationship between P150 and quality, some saw P150 and quality systems improvement as separate issues with the target of achieving QS9000 accreditation by December, 1996, running parallel with P150, while others saw the two as related.[214] According

[212] One interviewee commented on the fact that in the past operators in the assembly area had concentrated exclusively on one type of job and that there had been little interaction between workers doing the two different kinds of jobs.
[213] Scrap apparently did not show a consistent trend – "... some months it's up and some months it's down."
[214] As noted in Chapter 5, in Japan, a second programme called PQS150 had been introduced because it

to one interviewee:

> If quality wasn't part of P150, we'd be seeing more problems, but all the indices show the opposite – claim rate and warranty continues to decline, scrap costs continue to decline, etc.

Related to the P150 programme, there had also been a major push to apply IE methods and the Assistant Manufacturing Manager had been put in charge of the IE Section. IE techniques were to be used to analyze work methods and to set or revise standards for existing machinery. This involved IE staff making a video of the work being performed and then drawing up a man-machine chart. Then the IE staff worked with the area manager to find points where a few decimal minutes[215] could be saved. The main objective was to lower production costs. Technical Services staff were not involved unless a product was to be manufactured on new machinery and equipment and then the IE section would work with TS to determine the standard time.

Another major area of improvement activity was the upgrading of the quality assurance system and procedures to meet the requirements of QS9000 accreditation. Three aspects were mentioned as receiving particular attention; documentation, reviewing process controls and formalizing process control plans, and documenting the change over process. Documentation and process controls are discussed elsewhere but in the case of change over, I was told that it wasn't simply a matter of documenting the process but of making "that document a living document" and ensuring that, if there were any slight method changes or tolerance changes, "everything is done correctly". The Japanese Executive Director commented that operators in particular did not have a good understanding of the importance of change control or of the need to consider all four major inputs – materials, machines, man, methods (4Ms) – to the production process.

Mention has already been made of the introduction of Production Technical and Trades Assistants in production areas. Another change in the production area was the introduction of a display board in the final inspection area. The display board had been put together by a group of shop floor people as part of their small group activities. Perhaps related to the drive for reduced scrap under the P150 programme, this display board was to assist final inspection in deciding whether defective product was repairable or not. All existing specifications had been reviewed and written in "plain simple terms". The group was supposed to have used a version of the 5W1H technique to identify and explain possible defects, including where they might occur on

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was considered that the drive for productivity improvement had had a detrimental effect on quality.

[215] The importance of finding these small savings had apparently been impressed on the area manager during a visit to Japan.

the product and indications of dimensions of the defects. The board consisted of a written chart on one side and actual examples of the defects on the other.

In contrast, a major project (Management Information System project) was underway to introduce a new computer system to the factory. This was a large scale, multi-faceted project which had been undertaken as part of the P150 programme and involved about 30 people. It had been broken down into almost 100 parts with detailed scheduling for its introduction to the various areas of the factory. The scheduling and progress of this project were displayed in the FMS Room.

The changes being made in the maintenance area to reduce downtime were mentioned earlier. Some aspects of these activities could also be regarded as improvement activities; the steps taken to improve the ability of maintenance workers to deal with breakdowns effectively and the system to compare the breakdown records of maintenance and production. The intention of the latter, in particular, was to ensure better coordination between production and maintenance and more timely action on machine breakdown.

In general, however, the approach to improvement seemed to be quite ad hoc. There was little indication of analysis or prioritization. One of the production managers commented that employees sent to Japan to study P150 "come back with a whole heap of ideas and then we start putting them in".[216] Similarly, when asked why a particular type of equipment had been chosen as the next team project, the vague reply was that it was one of the newer pieces of equipment but that there was no real reason why that was chosen. Indeed, there was very little detail in the course of the interviews about how improvement activities – as opposed to dealing with scrap and defects – were handled.

Two other important aspects related to improvement activities were the role of the on-site Japanese engineering staff and relations with the Japanese parent company. The pressure from Japanese headquarters to improve operational performance was mentioned by a number of interviewees. This included the requirement for brand qualification, ongoing pressure to reduce costs, restrictions on the use of labour (mentioned elsewhere) and the tightening up of recruiting procedures. As a result of the last, more than one interview reported that there had been significant improvement in the quality of the workforce. At the same time, however, every effort was made to allow Australian employees to learn from Japanese experience. One of the striking

[216] The P150 projects monitored in the FMS Room and the changes made to maintenance work would be exceptions as opposed to the "ideas" referred to here.

features of the Salisbury plant was that groups were frequently sent to Japan to observe and learn about programs being run in Japan and about practices in general. Company policy seemed to be to give as wide a range of employees as possible the opportunity to go to Japan as noted earlier. Moreover, the company seemed to make a point of giving Australian managers and employees when they returned every opportunity to make changes and implement what they had observed.

In addition, it appears that Australian staff, particularly engineering staff, had open access to all the technical information relating to both product and process design and actively made use of the information. This included information available not only from Japanese plants but also from many of the company's worldwide plants as well as the Technical Centre in Tokyo. One engineer commented that he didn't believe in "reinventing the wheel". Instead, as he put it, "We try to use whatever information can be gained from other people's experience rather than having to learn ourselves from scratch."

As mentioned, there were five Japanese Development Managers – each with responsibility for one or more of the key production areas and product development. The Japanese development managers were generally regarded as highly knowledgeable in their respective fields and as a valuable source of expertise on which local staff could draw. As one interviewee remarked, "In all of the areas, we're fortunate to have a Japanese advisor who usually has many years experience and certainly more than any of our engineers." It was apparent that the Japanese Development Managers monitored operations in their respective areas closely and reviewed and analyzed available data. So while Australian staff were given every opportunity to implement what they had learnt, if they failed to do so or if their efforts were considered ineffective, the Japanese Development Managers stepped in, made the necessary changes and ensured that they were adhered to. The case of maintenance is a good example.

Process Analysis and Control

Process analysis and control did not seem to have been a prominent part of quality control/ quality assurance activities at least prior to the drive for QS9000 accreditation. For the purposes of QS9000 accreditation, the plant had set up a system to review process controls and formalize process control plans (PCPs) which were developed by cross-functional teams for each segment of the production process. All plans had been completed and were in use in 1997. Interestingly, none of the interviewees in production areas mentioned the PCPs. However, this may have been because the documentation used by production operators was already in place and was not effected by the development of these new plans.

As far as Technical Services was concerned, the development of PCPs required the use of techniques such as D (Design) FMEA and P (Process) FMEA.[217] In the interviews, FMEA was referred to by one engineer as a proactive quality method but prior to the drive for QS9000, TS staff did not seem to be familiar with the technique although I was told that most TS staff had done courses "at some time" on FMEA. At the time, activity was also being undertaken by Technical Services on process potential studies, the objective of which was to ensure that components were produced to the right dimensions from the commencement of production. Process potential studies could be initiated by Production Technical as well as Technical Services. The procedure was laid down in the company manual which explained how to conduct the study showing the steps in flow chart form, how to record it and how to move from process potential to process capability which was explained as being able to sustain process performance on an ongoing basis.

Information and Communication

Many interviewees expressed clear preference for informal verbal communication over formal, written reporting procedures. Although it seems clear that the Japanese management staff considered it necessary to improve recording and reporting procedures and ensure that more information was available and that it was more widely circulated, there continued to be resistance in some quarters to formalizing and documenting procedures and keeping records. As one interviewee commented, "So everybody is keeping records. It sort of seems a bit silly ... to that extent I don't really bother so much about it ... if someone's keeping records, I don't have to." The aversion to formal procedures and record keeping was by no means limited to maintenance. An interviewee from production commented that it was "not something we're really good at. … When we require help we just ask for it."[218] On the other hand, some interviewees seemed to realize the benefits of written communication and formal meetings as evidenced by the reaction to the changes made in the maintenance area and the comments about improved understanding among departments as a result of the joint morning meetings.

Meetings

Meetings are an important venue for communication and the sharing of information. There was a series of daily meetings (Morning Production Meeting, Morning Management Meeting and

[217] FMEA: failure mode and effect analysis.

[218] In view of this resistance to formal written communication, it is interesting to note that the basic booklet about TQC distributed in Australia placed considerable stress on the importance of communication. In contrast, communication is not even mentioned in the Japanese version of this booklet.

Scrap Meeting) and a longer list of monthly meetings and one or two meetings held on a weekly or fortnightly basis. A monthly schedule was issued showing the time and place of all meetings as well as a list of attendees. Meetings were generally confined to management and staff ranks but some also included supervisors and Production Technical staff. Generally, Leading Hands did not attend and there was certainly no suggestion that operators did – although there were a small number of individuals who participated in cross-functional and some other teams. According to one Leading Hand, there were no regular meetings at his level. Communication between supervisors and LHs was almost entirely verbal. The supervisor would report back from the morning meeting about any matters relevant to his area. Occasionally, the manager would call the workers together to "have a chat" and inform them "what's happening, how the company has gone or the way they want to go". Despite the manager's comments about involvement and ownership and the insistence that operators had "heaps of knowledge and experience", in the view of the Japanese Executive Director the sharing of information with the operator level was very weak.

There was a factory-wide, monthly QA meeting. The Monthly Quality Assurance Report was prepared for this meeting. The meeting covered the full range of issues from claims for faulty product after it left the factory, serious and other quality trouble, results of audits of materials and components and testing of final product conducted by QA staff, and the implementation and results of internal audits. There was also a monthly Management Group meeting attended by all area managers and all department managers. This meeting looked at broader issues of planning rather than day-to-day issues. Once every quarter, the meeting also looked at the data on factory costs and benchmarking against the key performance indicators (KPIs) displayed in the FMS Room.

At the time of the research, as part of the major P150 improvement drive, there were two additional series of meetings. There was a Weekly Meeting in each of the production areas to discuss their P150 plans. Technical Services attended "for their own edification" and to provide whatever help they could. There was also a monthly, presentation-style meeting where each of the areas, including for example Technical Services, made a presentation on the progress of their plan for the year.

Interviewees commented that there were now more meetings where staff from different departments and sections were exchanging information; for example, the morning meeting attended by production, maintenance and Technical Services. As a result, a maintenance supervisor reported that relationships were "more dynamic and interactive".

> There's a lot more interaction between the maintenance and production and the Technical which

> didn't used (sic) to happen. Because of that, at the meetings, everybody has a better understanding of what is going on and because of that, I think … we're more aware of what problems quality causes production. And because of that, we're better able to react to those problems.

He contrasted this to the situation 4 or 5 years earlier when "They used to have meetings but the people who attended the meetings were very limited." In the past:

> … the maintenance supervisor used to go and talk to the superintendent … and the superintendent would give him a list and that would be it. ... There was no discussion entered into. It was 'Here's your list of work – go and do it.'

The tendency towards more consultative, two-way communication rather than one-way directions from above was also mentioned in relation to the hand-over of machinery from Projects Engineering to Production. According to one interviewee, "once upon a time, the (projects) group would come out and say, there it is, use it and then wonder why people got their backs up." Instead, it had become the practice for "the engineers (to) come to me and say we believe this new piece of equipment is ready for you". Then there would be a process of safety assessment by the safety rep and the supervisor to make sure that it was in a safe condition for production trials during which they would identify items of concern that they believed needed to be fixed before it became a regular production machine.

The company newsletter was another source of information. Interestingly, it contained items about practical, work-related matters such as reports on significant changes to procedures, work methods and so on including, for example, the introduction of process control plans, the results of a periodic ISO9000 reassessment and the establishment of task forces which had achieved a dramatic decrease in time lost to injury in one production area.

Policy and Policy Deployment

The formulation and deployment of policy did not figure prominently in the interviews. Although a new policy for business plan deployment had been introduced in 1997 and the Division manual contained a diagrammatic representation of policy deployment down to the department/area level, this was not clearly in evidence and I was not shown any such policies or operating targets by individual managers.

The place where targets were displayed and most obviously monitored was the FMS (Flexible Manufacturing System) Room. This room had been set up about three years earlier. Here monthly factory performance against seven KPIs was displayed on one side of the room and the activities and progress of the each of the P150 teams on the other. The seven KPIs – volume, scrap and repair, productivity, machine breakdown, safety, energy consumption and absenteeism – were tracked separately for each of the two main product groups and for the initial stage of processing which feeds into both. The seven KPIs were quite aggregate level indicators, however some individual measures such as occurrence of trouble or machine breakdown were tracked by individual machines and others such as repairs/ rework were broken down by type or, in the case of costs, broken down by item.

There were seven P150 teams with a total of 54 members. Essentially, there was one team for each of the main production areas, one dedicated to a particular product group and another in charge of developing and installing the new computer-based management information system (MIS) mentioned earlier. In general, the activities of the teams were concentrated on achieving less scrap generation, less downtime and less absenteeism in their own area. Targets were set for each of the individual items and graphs showed actual performance against the targets. Details of individual improvement activities (KAIZEN), the people responsible and progress were also displayed.

However, the relationship between the targets and information displayed in this room and the process of policy deployment was far from clear, as was the relationship between the information displayed and the nature of activities by which the outcomes were being achieved. Nevertheless, consistent with the comments of a number of interviewees, the figures in the FMS room showed a significant improvement in overall performance – e.g. a 30% to 50% increase in average daily output over the preceding 4 years. But for some indicators such as scrap and machine breakdown, progress had been quite slow and erratic.

The use of this room seemed to be confined largely to management ranks. The person in charge of SGA activities had some difficulty explaining what was displayed in this room because he hadn't "had much to do with it". One LH commented that "anybody who wishes or has the time" could attend meetings but it seemed that few if any did. Even the weekly P150 meetings in each area were mainly attended by the people nominated as responsible for P150 activities – generally supervisors and Production Technical people.

Quality and Cost

Reduction of costs was a major and long-standing issue. A number of interviewees mentioned the pressure from the Japanese management and the parent company to reduce costs in various aspects of the factory's operations. The focus was on production costs rather than quality costs in particular. There was no mention that the company tried to calculate quality costs as such.

The drive to reduce costs was evident in much tighter control of the labour force in both production and maintenance areas. The past practice of increasing the workforce when there was an increase in production was no longer allowed. Similarly, whereas in the past maintenance had brought in up to 8 contractors to assist with weekend work, this too was no longer allowed. As noted, the factory was achieving substantially higher output with a smaller workforce.

Another aspect of cost control was making sure that costs were allocated to the correct source – "to find out exactly where all the money is being spent". As mentioned before the main reason for the using IE techniques to revisit and examine the old machines was to reduce the time it takes to produce the product and achieve the cost reductions necessary for the plant to become world competitive. One production manager commented that in the drive to reduce costs they were expected to do what they could "without spending any money". The Japanese management seemed to be in no hurry to replace all of the old machinery with the new combined assembly machines. As noted earlier, at lower levels of the organization, the drive against costs was received as a general ultimatum; "we just have to … repair the product wherever possible".

Small Group Activities and Teams

Over the years, different types of groups and teams have been tried, none of which seemed to have been particularly successful. Quality circles were first introduced in 1985 when 5 pilot circles were set up. Consultants were engaged to train a coordinator (the present coordinator was the third incumbent of the position) and to provide training for circle leaders. In 1991, the local operation hosted the company's world wide quality circle presentation meeting. There was a surge in circle activity in 1991-93 reaching a peak of 21 circles in 1993 when the plant was only working a 4-day week and every Friday was devoted to quality training. However, by late 1995, the number had declined to 7 and by mid 1996, only 2 circles remained – although altogether there was a total of 33 groups or teams of some kind operating in1996.

The difficulty in establishing and maintaining quality circles was attributed firstly to union opposition. Two of the three unions were strongly opposed to quality circles mainly on the grounds that they were a manipulative device of management that offered workers little real control. However, the policy of the main shopfloor union was to accept them as long as they were voluntary. However, other and probably more important reasons were given, including tardiness in implementing improvement proposals; inconsistent support from management (initial encouragement followed by withdrawal of support or just general lack of interest); an emphasis on winning presentations, particularly national presentations that resulted in loss of interest if groups were unsuccessful; and the fact that only two members of a circle could go to Japan to make a presentation tended to be a divisive issue for team members. Interestingly none of the interviewees suggested that insufficient training or knowledge might be reasons for the failure of quality circle activities.

In the early 1990s, Employee Involvement Groups (EIGs) and Kaizen Groups or Teams were introduced. EIGs were regarded as another way of getting people who did not like the idea of quality circles involved. The coordinator regarded the EIGs as having essentially taken over from quality circles. But the final demise of the circles was attributed to the anticipated introduction of SMWTs – which in some quarters were referred to as the "Rolls Royce version" of small group activities and which saw more operators drop out of circle activities. Consequently, by 1996, there was only a "trickle of quality-related training being conducted". However, this was expected to be revived with the advent of the new work teams.

Types of Group/Team Activities at Bridgestone (Aus), 1996

Quality circles	2
Improvement teams	2
Kaizen Teams	9
P150 teams	7
Employee involvement groups (EIG)	9
Self-managed work teams (SMWT)	1
Other	3
TOTAL:	33 groups, 176 members

Apart from the P150 teams,[219] the activities of the groups were described as related to downtime, training, scrap reduction, small improvement projects, reject analysis, productivity improvement, and daily process problems. The number of members ranged from as high as 13 or 14 to only 2. In 1996, the number of suggestions submitted by all groups and teams was 131 of which 31 had been implemented and 45 rejected – 55 were still pending. Despite the difficulties, some of the results achieved by quality circles and other groups included reduction in various kinds of scrap (in two cases, resulting in cost savings of $35,000 and $37,000), improvements to checking systems, and revised training and inspection procedures. Nevertheless, clearly the number of groups and their achievements, especially at the workplace

[219] The P150 teams were fundamentally different from quality circles, EIGs or the proposed SMWTs in that they were not a form of small group activities for operators so it was misleading to list them together. If the seven P150 teams and 54 members are excluded that leaves a total of 26 groups with 122 members.

level were extremely limited.

There was an "Improvement Teams Monthly Report"[220] which was basically a record of the number and membership of teams and attendance at meetings. It did not include any information about what the teams planned to do or had actually done. There was also a Work Team Steering Committee (sometimes referred to as the Quality Circle Steering Committee) which consisted of all the area and staff department managers and met once a month to review the activities of the various groups and teams.

In 1996, a second major attempt[221] to introduce self-managed work teams (SMWTs) was underway. As in the past, the sticking point was reportedly that the unions were insisting on pay increases for taking on the extra responsibilities of SMWTs while management was refusing arguing that the extra responsibilities were offset by the fact that workers would have more say and more job satisfaction. Moreover, it seems that there was also a basic difference of opinion between Japanese and the Australian management staff. The Japanese staff believed that quality circles were preferable and were skeptical about the likely benefits of SMWTs while the Australian managers were prepared to accept the introduction of SMWTs, especially given that the unions favoured SMWTs over quality circles. One interviewee remarked that whereas, in the case of quality circles, support had been unequivocal (as he put it, it was virtually like a directive), the attitude to SMWTs was that they were worth investigating but there had been no clear statement of support from head office. The strong support for quality circles had nevertheless not been sufficient to ensure their success.

In the materials prepared to put the case for the introduction of the teams, the concern was overwhelmingly for what were referred to as the "soft skills".[222] There was a long list of 21 items which covered everything from communication, managing change and handling conflict to group dynamics, effective team meetings, team leadership and adult learning. The only skills which related to what the teams would actually do were expressed in very general terms such as continuous improvement, customer service and problem solving or as data collection and analysis, cause investigation, measuring and monitoring performance. "Advanced improvement tools" appeared in one list but there were no details of which specific tools or techniques would

[220] "Improvement team" was used in two ways: one, to refer to all types of small group activities and, two, to refer to a particular type of SGAs.
[221] The first attempt to introduce SMWTs in 1992 with the help of consultants ended in failure.
[222] This material also provided a review of quality circle activities but again it was the soft skills which were emphasized. This included leadership, communication, consensus decision making and team analysis as well as presentation skills and public speaking. Interestingly, even problem solving was listed as one of the "soft skills".

be required or how and by whom they would be used.

As to what the SMWTs might do, quality improvement and problem solving were just two items in a list of nine which covered everything from inventory control and scheduling, equipment maintenance and safety to labour allocation, leave arrangements and discipline and even customer interface. Clearly, these teams were a far cry from the Japanese conception of quality circles. The focus was not on solving quality or production problems more broadly. Rather they were intended to take over many of the functions of management – as indeed the name implies. There seemed to be no reason to believe that this ambitious new plan would be any more successful than earlier attempts. In the very least, the time and resources which would need to be committed to training would have to greatly exceed earlier attempts.

A lot of time and effort had been and was continuing to be spent on trying to develop small group and team activities. However, the evidence suggested that these efforts had met with little success. The figures for all groups and teams and the number of participants were small and had decreased over time. The majority of teams (such as P150 and Kaizen teams) operated at supervisory and management level and only a small number of operators participated. Activities at the operator level were particularly weak. For example, there was one Leading Hands whose two attempts to become involved in quality circles had both ended in failure and in one case in the collapse of the circle altogether. The interviewee could not remember receiving the TQC booklet or using it for circle activities. Indeed, it was claimed that some participants had not received any training and that they relied on someone (presumably referring to the coordinator) to tell them what to do when they took part in circle activities.

Training

Considerable attention appeared to have been given to training at Bridgestone (Aus) – to the extent that Competency-Based Training and multi-skilling were mentioned as key aspects of human resources management in the Annual Report. At this plant, there were separate career paths and associated training programs for shopfloor employees, tradespeople and management staff.

The career structure for shopfloor employees consisted of 5 Levels or Groups. The top level, Group 5 meant that the individual was multi-skilled, i.e., able to perform at least two Group 4 jobs. The OffJT component was part of the National Broad Based modules in the metal trades and therefore could be counted towards other higher qualifications, such as a full trade qualification. The training was delivered on site and consisted of 4 main subject areas, one of which was 'Quality Concepts' which accounted for a combined total of 16 hours (of an overall total of 79 hours) across all 5 levels. The OJT component was based on the competency statement[223] for each job. OJT was delivered by three specialist Training Leading Hands – all of whom had more than 25 years experience. There was also a full-time 2-day induction program for all new employees before they were released to their own work area. Training records for each individual employee showed completion of the OffJT modules and also tracked the worker's progress in OJT against an average worker (in terms of units assembled per hour of machine operating time). A similar career structure also existed for tradespeople. This provided five levels beyond the initial qualification as a tradesman on completion of apprenticeship training.

The company had also made major changes to its recruiting procedures about 5 years earlier. This involved a written test of basic literacy and numeracy, a medical examination and an interview. Prior to this assessment, Personnel organized a group of 25 potential applicants who were taken on a tour of the plant during which they were given an explanation of the nature of the work, working conditions and the company's expectations of its employees. Those who were interested were invited to come back the next day for the formal recruiting procedures. Generally about 18 or 19 would come back the next day but ultimately only 1 or 2 out of the group of 25 would be successful. As a result of this system, turnover had dropped dramatically – from as high as 20 a month about 10 years earlier to as low as 2 a month at the time of the research.[224] In addition, as a result of the medical examination which checked particularly for back injuries, worker's compensation costs had also dropped dramatically. According to one of the Leading Hands, there was a "better type of people coming through" who seemed to have "a bit more up top" as he put it. He also thought that the workers seemed more confident – a fact which he attributed to what he thought was now a very good training system.

There was also a range of management training programmes. Training for Leading Hands and Supervisors was provided under a TAFE-based system – the National Generic Management Skills Project. The company had stipulated three of the available 18 modules as required training for LHs – managing effective working relationships, managing information, and managing and organizing work for goal achievement. There were also special courses such as Assessor Training and Train the Trainer courses (nationally recognized and provided by TAFE) for particular categories of employees such as training LHs.

[223] The competence statements were clear detailed descriptions of the tasks that a worker was required to be able to perform in each job and were written as a document to be used for assessment.
[224] One interviewee pointed out that the labour market was rather tight at the time so undoubtedly this was another factor contributing to lower turnover rates.

The company also had a Supervisory Development Program which all appointees to supervisory positions were required to attend. The existing course consisted of 7 modules, including managing people, time management, selecting and interviewing, counselling and disciplining, presentation and communications skills but was about to be replaced by training under the National Generic Management Skills Project because employees preferred to have nationally recognized training. A number of supervisors had already continued beyond the Certificate of First-Line Management and were studying towards the Advanced Certificate in Management and the Associate Diploma.

The company had abolished its Management Development course for senior managers[225] and changed to a system of personal development through individual appraisal conducted by the employee's manager. Training needs were determined on the basis of discussion between the individual and his/her manager.

There was also a Studies Assistance Scheme to undertake studies which were not part of the training directly required for career progression. Employees were required to pay for courses themselves and were reimbursed on successful completion. A Committee consisting of the person's area manager or their immediate manager, the General Affairs manager and also the Manufacturing Manager for more senior level courses was convened to consider applications for assistance. The courses available included Certificate, Advanced Certificate, Associate Diploma, Diploma, and Degree courses but post-graduate study, including MBAs, was no longer available.

There was a Training and Accreditation Committee consisting of the General Affairs Manager, Employee Relations Manager, Training Coordinator, union representatives (usually 2) for the relevant production union and the State Secretary for that union. Meetings were convened once a month to look at up-grading jobs, multi-skilling opportunities or adding functions, and developing career paths as well as developing or revising training programs.

As noted, several years earlier, one day per week had been devoted to quality training and a small booklet entitled "Total Quality Control: The Guide" (referred to as the "yellow booklet")

[225] Apparently the system was changed when a change of government led to the abolition of the Training Levy. The Training Guarantee Levy was introduced by the federal Labor Government in 1990. The main purpose of the Levy was to require industry to make a larger contribution to post-school training and to revamp the award system to reduce the number of classifications but at the same time provide a hierarchy of skills for all categories of workers so that higher levels of training and experience were linked to higher levels of pay. (For an overview of the training levy and award restructuring, see Jennings (1992).

had been distributed to all employees. However, this provided only the most basic introduction to the seven tools and what were called the "six passwords to TQC" which included a brief explanation of PDCA, the 5W1H method, and the importance of standardization and accurate data. This Guide was really only an "awareness level" booklet and would not have been sufficient to allow workers to apply these techniques. Moreover, I was informed that many of these booklets had been found in the rubbish bins. Quality training was included in both the OffJT and OJT components of job training, but it appeared that content of the OffJT component was very basic. The simple yellow booklet was not introduced until the final Group 5 level.

In the case of engineering staff, quality-related training seemed to be rather haphazard. I was told that quality-related staff "might do a course in quality engineering or be sent to consultants to do an introductory course in QS9000, … or that sort of thing". It seemed that Technical Services staff were even less likely to do courses in quality control. According to one interviewee, TS staff "rely on our quality assurance people to be fully trained and that they are offering us sound, valid advice". The same interviewee thought that "because TS work closely with QA, TS staff tend to pick up at least the basics of quality theory" so that they generally "understood the principles." Reference was made to the period some years earlier "when quality was heavily promoted – at that time, everybody did some courses". Nevertheless, this was apparently not sufficient to give TS staff more than the "basics" they were able to pick up while working with QA staff. As with engineering staff, it was not clear whether any systematic training had been provided for management staff since the initial burst several years ago. It seemed that quality-related training basically meant quality circle training and that training for other groups of employees was just some sort of adjunct to circle training. Moreover, there was apparently no systematic plan to provide additional training for those who had received the initial training back in 1993 or to provide quality or quality circle training for new employees.

Although a final decision about the introduction of SMWTs had not been made, elaborate plans had been drawn up for a 4-phase team development process and a training programme of 200 hours. Part of the training programme was to be Covey Leadership training – based on Covey's "7 Habits of Highly Effective People".[226] The training was to be delivered by a TAFE[227] college and the first of the 3-day seminars had already been held in late 1996 and another announced for 1997. This course stressed leadership and "people skills" and covered the principles underlying personal and interpersonal effectiveness, the habits of people who consistently achieve their desired results, and self-development. Workers were also to be given

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[226] Covey, Stephen R. (1989) The 7 Habits of Highly Effective People, Simon and Schuster.
[227] TAFE: Technical And Further Education – colleges which provide higher secondary and post-secondary education with an emphasis on job skills, including apprenticeship training.

training in the 7 tools and problem solving again, however, Covey Leadership training was the only part of the program which had commenced. In fact, this was the second programme of leadership training – many employees[228] had already received training in 4-quadrant leadership some years earlier.

The Social

There did not appear to be a strong emphasis on social aspects at Bridgestone (Aus) but some of the themes in the Australian literature emerged in the interviews; ideas like ownership and involvement, the value of teams, and reference to culture and the need for cultural change.

In reference to ownership and involvement, as one production manager put it, if people are involved in activities from an early stage so they see them progressing, then there's ownership. "That's what we're trying to develop in this area." He went on to explain:

> I like to involve people in what's happening because if they're not involved they don't own it. If they don't own it, they're not interested – it's my project. Whereas if people are involved in what they're doing, they've got a lot to share. You've got guys out there with years and years of experience. ……the people to involve are the people who use the equipment.

Conversely, if people[229] weren't involved and didn't have a sense of ownership, there would be problems. As he explained, referring to the P150 programme:

> At 2:00 in the morning, I'm not here. Then once again, it's, 'What's this P150 they're trying to push. We don't want to have anything to do with it. It's not ours.'

In one of the few references to the need for cultural change, one manager commented, "We're in a culture change process." As he explained, "Some people still say, 'That's not my job' and we've got others who say, 'This is the job that's got to be done'. The next task is to have it so that all people say, 'This is the job. How can I contribute?'"

There was one reference to "people skills" by a senior TS engineer. According to this engineer:

> TS find themselves in the middle, trying to balance the needs of quality, production. We do a lot of problem solving, but we don't have a lot of direct authority over people. We have to motivate other

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[228] One interviewee claimed that everyone had done this course but it was not clear whether everyone meant all employees or only all staff (professional and management level employees).

[229] Here I use the word "people" because this was the word used by interviewees. In this case, it seems fairly clear from the context that "people" actually meant operators and probably also Leading Hands, but the widespread use of the word "people" was highly problematic. It was frequently unclear which particular employees were included in the word people and this in turn had the effect of obscuring the role of different groups of employees in relation to quality management.

people to do the job for us in most cases.

Consequently, in his view, the department needed to look for people "with the right approach to problem solving and with good interpersonal skills". This remark implied that issues of coordination between TS and production were to be solved by having staff with "people skills" rather than, for example, formal procedures for the exchange of information or delegation of problem solving among different departments.

Reference to the value of teams was more widespread, particularly in production areas. Indeed, teams had something of the aura of a "self-evident good" – to use Wilkinson and Wilmot's (1995) phrase. As noted, it was considered important to involve the people who were doing the work in teams such as the Risk Assessment Teams or ad hoc teams. Although the term cross-functional team[230] was rarely used, there were references to involving employees from other areas in team activities. According to one production manager, there was "not a lot of requirement for Technical Services" but he went on to say that production did try to involve them as much as possible so that there was a whole team effort in the approach to problem solving and improvement**.** In other words, it seemed that the "team effort" was valuable for its own sake and not because Technical Services staff were expected to make a substantial contribution to the outcome. There were also attempts to involve maintenance workers in the Risk Assessment Teams which operated in production areas although, in this case, they were seen as making a practical contribution both in coming up with ideas and in doing the work to actually fix the problems. The manager also added that he liked to chair the meetings in order to establish a "good record of working together".

The area in which the emphasis on the social or "people" aspects of QC was most apparent was the plan to introduce SMWTs and the associated training programmes. As discussed earlier, attention was directed primarily to the social aspects of group activities or what were referred to as the "soft skills" and to "the how" of group processes – how to form groups, how to run groups, how to run meetings, how to manage interpersonal relations[231]. The long list of soft skills far outnumbered the "hard skills" which were only specified in the most general terms as problem solving, continuous improvement, measuring and monitoring performance and advanced improvement tools. Similarly, the only part of the training programme which had commenced was Covey Leadership training and this too concentrated on personal and interpersonal effectiveness and self-development.

[230] One area in which cross- functional teams were mentioned was in the development of the Process Control Plans (PCPs) required for QS9000.

[231] Gilbert noted that often in Australia, groups received little direction but lots of facilitation in group dynamics and behaviour (Gilbert 1995: 39).

Conclusion

At Bridgestone (Aus), the focus of quality management and indeed management in general was clearly on the production process. There were five Japanese development managers – each responsible for one of the major segments of the production process and for product development. The main thrust of improvements was concentrated on improving actual manufacturing operations. Initiatives included:

- bringing Technical Services and QA under a single manager;
- setting up Production Technical and introducing Trades Assistants;
- introduction of simple check sheets for production workers;
- improving the training system, drawing up competency statements and establishing career paths and multi-skilling for the shop floor workforce;
- requiring recording of maintenance and repair work and making the records available to all tradesmen so that they could learn from each other's experience;
- P150 programme and pressure for cost and productivity gains; and
- comprehensive review of process controls as part of the drawing up of process control plans for QS9000.

The company had gradually but inexorably been extending and tightening management control over all aspects of the operation but particularly over the manufacturing operations themselves. Reportedly, one of the first things the Japanese company did when it took over was insist that the factory floor be tidied and cleaned up. As noted, they exercised much stricter control over the size of the workforce particularly in production and maintenance areas and increasing production volume was no longer accepted as a reason for increasing the workforce. The company had also changed recruiting procedures substantially, as a result of which turnover and workers compensation costs had dropped dramatically. From the start, there was also pressure to bring costs down and this was ongoing. In particular, the company was insisting that the source of all costs be clearly identified.

Procedures were becoming more formalized and more fully documented but, while some interviewees recognized the importance of having formal procedures and keeping records, this was an area in which there was still some resistance. Some interviewees considered the keeping of records an unnecessary waste of time and thought that if help was needed, it was better to just ask for it. One interviewee commented that attempts to require record keeping in the past had been unsuccessful because there had been no follow-up, but this time the Japanese development manager required the reports to be submitted at a weekly meeting so maintenance staff were now complying. This was another instance in which management control was now being exercised – albeit by the Japanese development manager.

Various comments indicated that there had also been considerable improvement in communication among the different parts of the organization. This was the result not only of more formal record keeping and making the records more widely available but also of meetings attended by different departments and sections. The latter, in particular, was seen as having resulted in greater sharing of information and better understanding of the needs of other departments and of production in particular.

Perhaps the most striking feature of this case study was the role of the Japanese development managers, the local senior Japanese management and the Japanese parent company. The Japanese head office obviously set standards and applied pressure to conform – transmitted through the on-site senior Japanese managers. Generally, procedures were imported from Japan and documents were translations of those used in the Japanese operations – sometimes via the company's American operations. Head office also gathered and monitored data on the performance of the local operation and data about the relative standing of the company's worldwide plants was available to plant management. While pressure was applied, the company gave a wide range of employees the opportunity to go to Japan and study the practices or special programmes of its Japanese operations. In addition, the parent company apparently made technical information about products and processes not only of its Japanese plants and Technical Centre but also of many of its overseas operations freely available at least to engineering staff. As we have seen, some engineering staff made active use of this information.

In terms of converting this knowledge and experience into practice, the local Japanese development managers played a vital role. The Japanese managers were recognized as highly knowledgeable particularly by engineering staff but also by employees more widely. They clearly took a very active role in monitoring and analyzing data about actual operations and it seemed apparent that, when they considered it necessary, they stepped in and installed formal procedures and directly monitored the implementation of those procedures. The fact that there was no indication of resentment from the Australian staff might be attributed to the acknowledgement of their expertise.

In contrast, there were relatively few references to social aspects or people issues. Rather, Japanese management had concentrated on improving selection processes and job skills training which reportedly had had a positive effect on the quality of the workforce. On the other hand, as in the other Australian case studies, attempts to introduce quality circles had not been successful despite repeated attempts and a concentrated effort on training. The main concern about people issues or the "soft skills" (as they were referred to in this company) was in the proposal put forward by Australian staff for SMWTs and the associated training programmes but this was an issue about which there appeared to disagreement between the Australian and the Japanese managers. The Japanese managers were apparently not convinced of the merits or benefits of SMWTs.

The quality system seemed to work reasonably well, simple but effective work and operational procedures had gradually been put in place and, in many cases, seemed to have become accepted practice. However, the achievements of this plant should not be exaggerated. The system was far more basic than that observed in the Japanese case studies. There were fewer documents and records in routine use and less information which was also less widely available. Interviewees were not able to offer the detailed explanation of the system and their own activities which interviewees in Japan were able to provide. Moreover, there were linger doubts about whether the system would be self-sustaining if and when Japanese support and back-up (in particular, the hands-on Development Managers) were withdrawn or indeed whether practices would ever have been developed to their current state if Australian staff had been left purely to their own devices.

CHAPTER 10. Case Study 4: NEC Australia

Introduction

This company was part of NEC's worldwide operations with over 100 affiliates and subsidiaries worldwide and a work-force approaching 200,000. NEC's association with quality control has a long history going back to technical agreements with major American corporations in the prewar period. In the immediate postwar period, it was one of the five major telecommunications and electrical equipment makers which received extensive advice and guidance on management methods and systems and particularly on quality control from the engineering staff of the CCS (Civil Communications Service) of the Occupation Forces GHQ (see Chapter 2).

The Melbourne operation was only part of a larger NEC group in Australia with complex operations which had, moreover, undergone a series of major changes over a period of years prior to the research. The Melbourne subsidiary consisted of a corporate headquarters and a manufacturing site which commenced operations in 1971. Activities on the Mulgrave site were divided into six operating divisions which were serviced by the two production facilities or manufacturing areas. The main production area could produce product for the second smaller area when demand exceeded the latter's capacity. The main manufacturing area was divided into two areas – a highly automated and computerized plant producing PCBs which were the main building blocks of all the plant's other products and a second assembly and test area which incorporated the output from the former into a wide range of different products. The highly automated surface mount technology (SMT) centre was organizationally under the direct control of Production Engineering because of its critical importance.

Development of the Quality Control System[232]

In the late 1980s, the Melbourne operation faced the threat of closure and many employees were retrenched. At the time, according to the interviewees, the initiative for doing something about quality improvement came from the middle of the organization. At that time, I was told, the company didn't have formal systems in many areas and "were making it up as they went along". The primary concern was to get daily control of operations and one of the first steps was to put a formal quality system in place.

[232] Because of the nature of the approach to quality management at this company, the headings in this chapter differ significantly form those used in other chapters. It was considered that trying to mould the information around these headings would be too artificial and would not give a true representation of quality management in this plant.

Conceptually, the quality control system was regarded as consisting of three main components – quality control, quality assurance and quality improvement or business process improvement. Quality control was regarded as the responsibility of the operating divisions and quality assurance and support as the responsibility of the QA department. Although the operating divisions were responsible for drawing up their own documentation, the QA department provided support to help the divisions formalize their quality systems and ensure that their documentation and procedures conformed to the requirements of ISO9001. The QA department conducted regular audits to ensure that systems and procedures were actually being implemented and coordinated the audits of external certification bodies. The department included a group of quality engineers who, apart from conducting internal audits and auditing projects, also provided expertise in quality control and analysis techniques for the operating divisions either by undertaking the tests and analysis themselves or by advising engineers in the operating divisions on how to use the techniques.

For the purposes of quality management, products were divided into three types – standard products, custom built products and total system products. The first were "mass produced" products manufactured by the production department. In the case of standard products, it was the role of the quality control coordinator to identify characteristics for which the inspectors/operators should inspect the product. Custom built products were managed as projects and therefore a product quality plan was required. In the case of total systems, a detailed project plan and a quality plan were prepared. The quality plan was described as a document that tied in all the department procedures that were relevant for that project. Information was not duplicated, rather the quality plan was explained as being like a map showing where to find the relevant information. Since each project could not justify putting on a person to look after quality assurance and quality control issues, the QA department provided that service. QA department staff played an active role in both drawing up project documentation, ensuring that all quality issues were covered and auditing the progress of projects against this documentation.

The quality management programme as described by Quality Department staff seemed to be very practical. Interviewees claimed that the company had taken up TQM for "hard-nosed business reasons" (customers, costs, revenues) and that activities were directed towards obtaining "tangible specific improvements" in QCD. The activities of improvement teams were supposed to be related to the department manager's objectives and company policy. To ensure that this happened, each proposal had to be submitted to and approved by the divisional or corporate TQM committee. They also stressed the need to check whether in terms of procedures, what was supposed to be happening was actually happening and, for this purpose, implementation audits were conducted. There seemed to be a clear appreciation of the importance of actual production operations and of quality management at this level. In the view of one interviewee, the two were inseparable – "operating is quality". The operating divisions were important because that's "where money comes from". Indeed, it was commented that "if they're not working properly, the rest is a waste of time". However, the gap between the intentions of QA staff and the reality was considerable.

Key Concerns at NEC (Australia)

Management

In their attempt to develop a TQM programme, this company concentrated heavily on management and "people". Very early in the programme, QA staff discovered what they considered to be deficiencies in management – in response to which they undertook an "intensive wave of management training". Interviewees explained that they were very concerned to try and improve management because "if management, professionals and planners haven't got it right, the process worker on the floor hasn't got a hope". Interviewees considered that this training was one of the major factors which contributed to their success in gaining ISO9001 accreditation.

They also stressed the importance of introducing a process to make management accountable. This was to be achieved by two main mechanisms; a Joint Monthly Progress Review and annual MD audits. The Monthly Review was linked to the process of setting policies and targets. The company received a medium range plan from the parent company in Japan and this was then reviewed by the Managing Director in the light of local conditions and initial company level policies and targets set. These were then discussed interactively with operational management and a final Mid-Range Plan agreed. The policies and targets were then cascaded down through the organization with the divisions developing action plans to implement improvements and achieve targets. The Monthly Review examined progress against those plans. The results of this review were also supposed to be fed back into what was called a formal improvement cycle. There was also a formal annual Managing Director's Audit which was modeled on the Presidential Audit in Japanese companies. However, this aspect was not "universally welcomed at divisional management level" and though still in existence, was reportedly not as strong as it had been some years earlier.

The interviewees were extremely critical of senior management – claiming that, in the end, "they did not learn". Most of the key players attributed the failures of the TQM programme to lack of divisional and senior management support. This included everything from the failure of quality circles to the decline in MD Audits to the difficulty of having the new measures of performance devised as part of the strategic management approach accepted. There were also comments about the inconsistency of management and the consequent cynicism of the workforce – the necessity to convince the workforce that TQM was not just another management fad that would disappear in a few months. Interviewees referred to the fact that 97% of senior executives say that quality management is important to the success of the business but only 30% of them will provide it with the resources.

A number of reasons were offered for the lack of management support. The use of jargon associated with TQM was seen as a problem. There were "one or two significant players" who were resistant to the jargon and as a result, "once you get them turned off, it's very hard to get them turned on again". Similarly the use of jargon was seen as giving certain people at the managerial level the excuse to think there were two sorts of jobs – running the business and "this quality stuff" – with the implication that the latter was not considered important to running the business. The fact that divisional management tended to be hard-nosed and concentrate on day-to-day activities and did not see things such as quality teams as important was given as another reason for their lack of support. Lack of support from senior management was also attributed to the fact that the system had been set up so that they were "kept far enough away" from the actual activities. More recently, the QM&D manager claimed that he was struggling against a "very powerful lobby group" in the organization who wanted to wipe out training and save the money and reduce the reliability and quality assurance department by 50%.

In contrast to the other Japanese subsidiary, Bridgestone (Aus), there were quite negative views about the role of Japanese management staff in this company. Interviewees commented that there were "some vetoers" among the Japanese staff and that leading Japanese were "quite happy to sell, sell, sell". I was told very forcefully that it was a myth to say that Japanese managers were going to lead quality in areas like quality circles and so on – rather they were seen as often the biggest obstacle.[233] On the other hand, I was also told that there had been a flow of senior Japanese who had a commitment and who had provided the resources (money, time and manpower) for quality management. Furthermore, one manager commented that he could not "praise enough" the planning process of Japanese management in the sense that they do not stifle your thinking and that the position description was not important because they are not trying to put people in boxes. As a consequence, in his view, they allowed creativity and

[233] One of the reasons offered by an interviewee was that the first thing Japanese managers forgot when they came to Australia was that in Japan they were in a quality environment – i.e. by implication, they failed to understand that the same quality environment did not exist in Australia.

innovation to happen by not hassling people. But generally there seemed to be a strong consensus among all of the key players that it was a misconception to believe that one could rely on the support of Japanese managers.

Part of the explanation for these apparently contradictory views was that there had been a significant change at the very senior level as a result of the amalgamation of several of the company's Australian operations shortly before the research. As a result, "the father of our quality journey who really made it happen and who brought the general managers into line" was replaced by senior managers who were not interested or did not understand and whose catch cry was to save costs and sell more. They made no mention of on-time delivery or customer satisfaction. But there were probably at least two other factors. Japanese staff[234] were all in middle to senior management positions. Unlike the other Japanese subsidiary, there were none directly involved in or responsible for actual operations in an engineering capacity with the exception of one area. Moreover, there was some resentment expressed by Australian staff about the fact that relatively young Japanese were placed in management positions for which they were considered too inexperienced. Various other comments did suggest that there was a practice of sending relatively junior Japanese employees to the Australian operation to gain some experience.

People

The second major focus at NEC (Aus) was on "people". There was a widely held conviction that there was a "strong interrelationship between quality and people practices and the work climate" to the extent that it would not be possible to achieve "good quality unless you've got that right". Or to put it another way, improvements in quality performance were not going to be achieved "unless the people … were reasonably happy". So the QA Department was organizationally linked to human resources to form the Quality Management and Development (QM&D) Subdivision – a part of the Corporate Services Division. The subdivision was responsible for both quality management and training – including the whole range of training needs not only quality-related training. The company pursued various types of "people studies" and Human Resource improvements, as a result of which the company won a state government Human Resources Award in 1996. Consistent with the prescriptions of the NIES model, the QA Department also conducted Employee Perception Surveys which were one of the inputs to the improvement cycle.

Another aspect of people practices was a concern for labour-management relations. There was

[234] The number of Japanese staff (36) was considerably larger than Bridgestone (Aus).

perceived to be a need to overcome the cynicism of the workforce – which largely seemed to be regarded as justified because of poor management practices in the past, particularly lack of consistency on the part of management. As one commented:

> We had to try and sell it to a cynical work force that this was not just another management fad. We weren't just going to do this for a couple of months and it was going to disappear,

which was felt to be typical of Australian industry. In addition, interviewees felt there was a need to counteract what were regarded as long-standing attitudes that the workers (operators) were to blame for all quality (and many other) problems.

There were also attempts to make operators more receptive and sympathetic to the management message. This included training in communication skills which involved workers selecting their own representatives (excluding union representatives) who were then paired up with equal numbers of management staff and put through team training together. One interviewee attributed the fact that the company had not experienced a strike on the shop floor for 7 or 8 years to the fact that employees had been given the skills enabling them "to identify what's right and wrong about where they work". The manager of QM&D had also taken another initiative. He had called together the union representatives in one area of the plant to be briefed by senior management about the economic circumstances of the company. At subsequent meetings, he invited them to bring along a friend to share the load and lighten the task until operators outnumbered the union representatives by three to one. The manager had succeeded both in diminishing the influence of the union and having operators take management's message back to their colleagues. He believed that he had thus succeeded in engendering a commitment to the company.

Improvement Activities

Another key focus of the quality management programme was improvement or continuous improvement. ISO was criticized because it did not attach sufficient importance to improvement but interviewees stressed that the company was "very concerned" about improvement. Quality improvement meant business process improvement which was to be pursued in relation to all of the organization's systems and practices. According to the interviewees, the operating divisions were responsible for improvement and the role of the quality department was to "support and facilitate process improvement" at the divisional level as well as being directly responsible for improvement to the quality system and other corporate level activities. The company had what was called a "formal improvement cycle"[235] at the organizational level. A "formal quality

[235] Though labeled PDCA, this cycle did not conform to the steps of the PDCA cycle.

system" such as ISO9000 was regarded as a prerequisite of this cycle. Divisional policies and plans were subjected to implementation audits and these together with quality system audits were fed into the improvement strategy. World's best practice audits and benchmarking were used to identify business improvement needs which were then fed into the MD's annual improvement plan. This improvement policy or plan was issued separately from the mid-range plan. However, it was unclear whether this was a continuing practice or whether it had only been a short term measure adopted when the company was considering applying for the Australian Quality Prize.

Improvement Teams

An organizational structure had been created to carry out improvement. This consisted of a Customer Satisfaction and Quality Committee at the executive management level and Divisional TQM Committees which oversaw the activities of improvement teams. There were two types of improvement teams; project teams which operated at management and professional levels and were mainly cross-functional and quality teams which was the company's name for quality circles and which were based on natural work groups. Quality teams were only to work on problems in their own work area and problems that could be solved. In the case of quality teams, the team leaders and advisors formed a Block Committee. This committee had a block leader and a block advisor and the block advisor sat on the divisional committee. The problems or projects on which the quality teams worked had to be approved by their respective divisional TQM committee and were supposed to be related to departmental goals so that the activities would have the support (commitment) of the manager. The examples given were how to save electricity in the warehouse area and a very broad topic of how to save time in the manufacture and assembly of a particular product. Presentation meetings where morning tea was provided and the groups presented their results to general managers and department managers were considered important in giving recognition to the groups.

Project teams were cross-functional and operated at management and professional levels. The members were nominated so that the most appropriate people were assembled to deal with a particular issue. The teams were temporary and dissolved when the particular task was complete. The drive for ISO accreditation had reportedly been managed by a cross-functional project team. Other examples of project team activities were a team which had been put together to deal with the issues associated with a major new project; another which was looking at ways to improve the company's various, previously separate field service operations and standardize procedures and a major project which addressed the very high level of outstanding accounts receivable and was able to substantially reduce the level.[236] Project teams were considered more appropriate in a situation where the company was faced with a complex technological environment which was changing rapidly and which therefore required large step function improvements.

Training

The importance attached to training was in large part a reflection of the focus on "people practices". The overarching objective of the introduction of TQM was said to be the achievement of world class performance so that the company would remain internationally competitive and the principal means by which this was to be achieved was by educating and training the employees to bring them up to a world class standard of performance. Training included job skills and management skills as well as quality training. The job skill training programmes ranged from the Certificate of Basic Electronics course to computer training and English language courses. There were management training courses for supervisory, middle management and executive management levels.[237] The programmes seemed to have been well planned, targets were set[238], resources allocated and large numbers of employees put through the relevant programmes. Considerable time and effort had been expended on ensuring that the content of training programmes was relevant to the work being performed and on devising ways to make them as accessible as possible to the workforce. The Certificate of Basic Electronics course was designed so that it could be delivered on line and the factory premises were opened 24 hours a day 7 days a week so that operators could work in their own time and at their own pace. Operators were allowed 2 hours of company time per week to spend on the course, a member of the training staff was available to answer questions and a mentoring system had been established. Shop floor workers in particular seemed to have been eager to take advantage of the various courses offered.

While training in job skills and management skills seemed to have been quite successful, the content and the success of quality training programmes were less clear. In devising the quality

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[236] Other examples mentioned included project teams dealing with accounts payable, stock minimization, introduction of MRP2, rework costs, reduction in design costs, and enterprise bargaining. The examples did not show a clear focus on quality improvement as such but rather covered a wide range of the "business systems" of the organization.

[237] 80 employees were put through the supervisor leadership course (20 per year over the preceding 4 years); 120 through the middle management course; and 20 through one of the advanced middle management courses. The middle management course consisted of 9 days (in blocks of 3 days full-time at university) over 4 months where people worked on assignments back in their workplaces between sessions. The executive management development programmes were one to two day courses dealing with strategic issues related to marketing, cost cutting and so on.

[238] Company policy was that, at any one time, 4% – in other words 40 employees in a workforce of around 1000 – could be undertaking education at a tertiary institute and a further 4% at certificate level.

training programme, it was considered important to focus on management and professionals in the first year and general employees from the second year so that managers would know what they were talking about before other employees were involved. "The managers had to be seen to be walking quality, talking quality and have a commitment to it." Interviewees considered that starting with quality circles and the shop floor level gave management "a chance to cop out" and would perpetuate the mentality that "all the quality problems, everything that goes wrong in the organization" happens "down there" at the workplace level.

Employees received training in problem solving using the QC storyboard which was also used as the format for reporting quality team activities. The training covered the logical and analytical processes of problem solving, the 7 QC tools, what a process is and why it is important and so on. The family budget was used as the example during training on the grounds that this would be familiar to all employees. The training consisted of 20 hours over 3 months, followed by a further 9 months back at the workplace but with continuing support from QA or training staff. Thereafter, the teams were to work independently with only their team leader and a team advisor. It was considered important to have line managers and supervisors deliver the training wherever possible and, in order for this to happen, QM&D staff provided "train the trainer" programmes for managers and supervisors. The intention was that this would demonstrate to employees the importance that their own manager attached to quality training and circle activities.

With respect to quality training, I was informed that "Our people out there on the factory floor loved it. It had been a promise that was made and for once management had gone ahead and delivered." In the view of one interviewee, it "helped to improve morale". However, another interviewee commented that workers were "getting a bit of the Hawthorne effect.[239] They were feeling really important because they were getting this training." In other words, the manager was aware that the substance of the training may have been less important than the fact that management was taking an interest in the workers/operators.

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[239] The Hawthorne experiments were a series of experiments conducted at the Hawthorne Plant of Western Electric in the late 1920s and 1930s. The experiments started out by trying to test Taylor's theories of the effect of physical conditions and pay systems on productivity but ended up examining social relations in the workplace, the formation of work groups and so on. These experiments became the basis of what was known as the Human Relations school. The "Hawthorne effect" refers to the fact that, when workers are invited to take part in experiments, they feel that they are being taken seriously, that they have an important role to play and therefore they "do their best" to cooperate with the researchers. The effect, in the case of the Hawthorne experiments, was that irrespective of whether physical working conditions were made better or worse, production increased or at least remained at a high level.

Teams and Training

Interviewees reported that initially improvement teams were very successful and the company achieved 7 million dollars cost and productivity improvements in the first year even while the training was being carried out. However, apparently the good results did not continue for very long in the case of quality teams. The number of quality teams reached a peak of about 60 and then decreased considerably. Interviewees commented that improvement is "easier when you start" because there are "more grosser (sic) things that you have to fix" so "anywhere you turn, you can improve". One of several reasons given for the decline of quality team activities was the assertion that processes had been stabilized so there wasn't much for the teams to do. However, comments by various interviewees indicated that there were still plenty of problems occurring in production areas. Project teams, on the other hand, were reportedly continuing "with great vigour" and were considered to be viable in the long term.

There was also a discrepancy between the explanation of QM&D staff and practice in operational areas in the case of quality training and quality team activities. According to one production manager, although a lot of training in TQC had been delivered several years earlier, it had been "fairly marginal in its success". He also pointed out that the delivery of the training and quality team activities had been very uneven across the organization – receiving strong support in some areas and being virtually ignored in others. In general, he attributed this failure to the fact that training or QC generally had not received sufficient support from many senior managers because, as he saw it, "It was set up with enough structures and layers so that they were kept successfully far enough away from it." In one particular area, he considered the fact that the area had held very lucrative long-term contracts with a large profit margin had also contributed to the lack of interest. According to this interviewee, even in one area where there had been quite a lot of training, there wasn't much training delivered in the production area because many of the workers couldn't speak English.[240] The view that quality teams had met with limited success was also supported by a LH who remarked that although she had received quality training, she had never had an opportunity to participate in quality team activities.

QA staff themselves had become disillusioned with quality circles or quality teams as they were called. The fact that quality teams only operated at "lower echelons" of the organization and only worked on small, incremental improvements came to be seen as problems. In addition, the lack of support by divisional management was seen as a major problem. QA staff mentioned

[240] Although one member of QA staff estimated that about 60% had received quality-related training, according to the production manager, the figure for operators in the new combined production area was more like about 40%.

brick-walling and problems with leadership – that managers did not provide the encouragement or environment which allowed sustainable conditions of improvement brought about by quality circle activity. QA staff had taken considerable trouble to set up support structures but apparently they had been inadequate and had failed to overcome the disinterest or resistance of divisional management. However, interviewees were inclined to see the lack of divisional management support as a general principle that applied throughout Australia. They pointed out that there were very few Australian organizations which had a long-term history of successfully operating quality circles. Finally, QA staff came to the conclusion that quality teams/ quality circles were "gimmicky", that they were no longer suited to the company and its business. The fact that they were not sustainable in the long-term was ultimately put down to a cultural difference between Australia and Japan – not as something that might be explained by, for example, inadequate training or inappropriate or ineffective support structures.

Despite the failure of quality teams, there was a strong conviction that teamwork was one of the keys to success. It was claimed that the principles were still relevant and, in particularly, that "the process of teamwork itself" was "the main thing". In the future, the emphasis was to be on cross-functional "self-sustained teams" and project teams which were considered to be more effective. I was told that the company also attempted to have cross-functional team-based committee structures operating at executive management level in the case of planning and major contract committees. The Suggestion Scheme had been abolished "because we were talking about team effort". The principle of teamwork was seen as all-pervasive. I was told that if everybody "works together as a team", crisis could be averted and the company would survive. In other words, despite statements to the contrary, there was always an underlying tendency to fall back on people and teamwork rather than effective, operating procedures as the means to ensure better quality and performance generally.

Data, Documentation and Communication

It seemed that, in other respects too, the good intentions and systematic approach of the QA staff had not been converted into practice – particularly at the operational level. Despite the importance that the QA Department attached to putting formal systems in place and making the processes of the organization more "effective and sensible", there was an aversion to formal procedures and written records in operational areas. The only two formal documents which were routinely used in the cell production area[241] were the Fault Tag and the Faulty Material Report

[241] There were two manufacturing areas – a smaller one attached to a particular product division and the main production area which was an amalgamation of several previously separate areas and which now manufactured product for all of the product divisions. The main production area was itself divided into

(FMR). Part of the fault tag was completed by the operator who discovered the fault and sent to the Quality Coordinator and then the work was sent to a technician for repair. The technician completed the other part of the tag showing what repair work had been done and sent the tag to the Quality Coordinator. The Quality Coordinator was the one who recorded, analyzed and reported the data. There was also a Corrective and Preventive Action Request but this was not mentioned by any of the interviewees in production. The FMR had to be submitted to Planning in order to raise a new production order to replace lost production. The Coordinator was also responsible for coordinating the faulty material review process when there was found to be a problem with a batch of material. This involved coordinating the investigation and the corrective action to be taken.

Testing was a major part of the work in this area but testing was computerized and the results recorded automatically. The Test Engineer was responsible for reviewing these records. The supervisor reported that testing was one of his major sources of feedback but in this case reporting was verbal. If testing was detecting that a particular type of fault was recurring, it would be reported verbally by the Leading Hand. If the fault could not be corrected internally, it would be reported (again verbally) to the Quality Coordinators or to the responsible person in Production Engineering (PE).

For problems which were not covered by the Fault Tag or the FMR, the preference was also for direct verbal reporting and action. Thus, for problems which originated earlier in the process, the Leading Hand went and spoke directly with the person concerned. Similarly, if a tool or piece of equipment failed, the LH dealt directly with the workshop. If a problem could not be resolved within the production area, the supervisor would go directly to either the Quality Coordinators or PE for assistance. In all these cases, no formal reporting was required. In the case of PE, there was a PE Services Request but this was considered the "long way to do it". As far as the supervisor was concerned, it was much easier to go to the person concerned and "get action straight away".

Even where a problem stopped production, there was still no formal reporting requirement. The example was given of a problem with a metal casing which was reported to inward goods inspection and then to the Quality Coordinator so that he was "aware of what was going on". Such incidents were apparently reported at the weekly Production Meeting but the supervisor did not "write memos or reports about occurrences like that". It was regarded as sufficient to

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two parts – a high-tech, highly computerized SMT (surface mount technology) area and a cell production area engaged in assembly and testing.

inform "people" that production had stopped and why. Although "getting action straight away" seems admirable, this meant that there were no records of the extent of disruptions or delays to production or of their causes (other than records of defective or reworked product) and thus no way to analyze the causes of problems or delays and prioritize the more serious problems for attention.

In terms of actual work instructions, there seemed to be a similar gap between the explanation of QM&D staff and the views of operational management. According to QA staff, work instructions such as an assembly diagram or a test procedure were kept as simple as possible – they were pictorial and graphic and used as few words as possible especially since there were so many different nationalities in the workforce and the level of English comprehension varied considerably. According to the manager of the newly amalgamated production area, however, the work instructions available in the area were the complete detailed instructions prepared by Production Engineering covering the whole of the production process. The manager insisted that he was "not a fan of detailed work instructions" (claiming that this was another battle he still had to fight) but there was no mention that the simple, pictorial work instructions described by QA staff existed or had ever existed.

In terms of information and communication, various devices were only just being introduced in the main cell production area.[242] This included a flip chart which had been trialed and was about to be extended to other areas and the introduction of a status card which was not in place at the time. The status card was to indicate whether production was on schedule, late or stopped and was explained as an attempt to get more visibility of the state of operations. The flip charts were to be used to monitor first pass yield, failures or retests that passed and the backlog of faulty product. In the past, there had been data collection charts which operators were supposed to fill in on a daily basis but apparently they were not very successful and had been abandoned. The flip charts were a variation on a suggestion from Japan – as indeed had been the data collection charts.

Meetings

Meetings are an important forum for communication and exchange of information. But, at this factory, the meetings were few and far between and participation rather limited. There was a morning meeting in the SMT area convened by Production Engineering which had control of this area. This was considered important because it was the start of all other processes so any

[242] In the computerized SMT area, the only formal report which did in fact play a central role in the control of the SMT line was the Inspection Report prepared by the line inspectors.

problems in this area potentially had effects all down the line. This meeting looked at product quality as reported by the line inspectors and was described as "fairly informal". A report was presented to the meeting by the Quality Coordinator. However, this data was then recorded and became part of a formal process to check whether the same defects were occurring in subsequent runs of the same product.

There was also a weekly Production Meeting attended by the divisional manager, the scheduler, planning and representatives of internal customers if necessary. Representatives of internal customers, divisions for which the production area was manufacturing product, were asked to attend at a certain time during the meeting to discuss the product/s which were being manufactured for them. This might be to seek help from divisional staff to deal with manufacturing problems or, interestingly, to identify problems that the division was causing for production. It was explained that these were matters which needed to be discussed out in the open.

There was also a monthly Management Meeting and a monthly Quality Meeting – both of which were attended by divisional managers but not by supervisors. Quality-related data was centralized in the hands of the Quality Coordinator who was responsible for analyzing the data and reporting the results to the monthly meeting. The coordinator provided information on the yield trend, the type of defects detected and performance for the production line and each product line. In other words, apart from the SMT area, the only regular involvement of quality staff and the only regular review of quality issues were at the monthly meeting.

Auditing

The company had put a great deal of effort into auditing activities. As well as regular system audits to ensure continued compliance to ISO9001, implementation audits were also conducted. The purpose of the implementation audits was to ensure that what was supposed to be happening was actually happening. As one interviewee commented, "There's no point having a procedure documented if you are not following it." As noted, the results of these and other audits were to be fed into the improvement cycle. Another major area of auditing activity related to projects. In the case of projects, QA staff conducted audits to check that appropriate contract, project plan and quality plan documents were in place and to monitor progress according to these plans. Most auditing activity seemed to be carried out by QA department staff, particularly the Quality Engineers who were responsible for conducting audits of projects and other auditing activities in engineering areas. The QA department was also responsible for coordinating external, third party audits.

Engineering and the Role of the Quality Engineers

Another issue was the relationship between the QA department and Production Engineering. One interviewee expressed the view that production engineering was critical in the sense that the efficiency of production was determined by how production processes were designed. In this view, production operations themselves were relegated to a largely unproblematic role of marshalling the necessary workforce and materials to implement the process as designed. However, this was the exception. In general, the "professionals" were simply lumped together with management and planners and there was no indication that they were seen as having a distinctive role or distinctive needs (especially training needs) in relation to quality that was different from management. Indeed, most "operating engineers" were not expected to know how to use quality control techniques since they did not learn them at university and normally did not have to deal with them. So, if a requirement came up in a contract[243] for a particular quality methodology, it was the quality department which provided the expertise about how to use such "esoteric" techniques. In addition, QA department staff saw their role as being to interact with "external quality people" (the quality representatives of customers or certifying authorities) on behalf of the operating divisions – as standing between the operating divisions and "the weird and wonderful quality types". The QA department then translated customer requirements and certification authorities jargon into terms that people in the operating divisions could understand.

Many of the roles or functions which might have been undertaken by engineering staff were performed by the Quality Engineers – or at least depended on the support of the QEs.[244] It was the Quality Engineers (QEs) in particular who had expertise in the "esoteric" quality control techniques and methodologies. The QEs also performed some other key roles. They assisted the divisions to draw up Project Plans and Quality Plans and audited the progress of projects against these plans – ensuring that the necessary project documentation was generated, that the work was carried out in accordance with plans and that problems did not go undetected. They also provided support for projects by undertaking the evaluation of suppliers and contractors.

Other Key Concerns at NEC (Aus)

There were several other aspects to which QA staff attached great importance and which deserve brief mention here. This included the idea of "ownership", issues of culture and cultural

[243] There was little indication of active planning or application of QC techniques to improve production operations, rather action was taken to comply with the requirements of customers.
[244] There were three Quality Engineers in the QA department and a fourth in one of the operating divisions concerned with design and development and where there was no manufacturing.

change, and the importance of the customer and customer satisfaction. Great importance was attached to the idea of "ownership". The fact that operators could become involved in improvement committees and quality teams, come up with solutions and see the results of these activities implemented was thought to give operators a sense of ownership of the problems and the solutions. Reward and recognition for group activities were also seen as reinforcing the sense of ownership. Overall, staff of the quality department were concerned that quality management would not be seen as "centrally owned". As the interviewees explained, they tried to take the authority and responsibility as far away from themselves as possible so that there would be "local ownership and local responsibility by the local managers". However, the pursuit of local ownership and local responsibility may have been self-defeating, since in practice it seems to have allowed the skeptics to expend as little time and effort as they saw fit on quality management.

Another aspect which received considerable attention was the importance of culture and the need for cultural change. It was remarked that during the early period of training, QA staff were changing the culture of the organization. There were comments which related the success or failure of certain aspects of the quality management system to culture and/or cultural change. In fact, however, culture was treated in two quite different ways. On the one hand, QA and other staff saw it as necessary to change the culture of the organization and saw themselves as actually doing so as an essential part of the implementation of TQM. On the other hand, cultural differences between Australia and Japan were given as reasons for the failure of certain aspects of TQM and essentially treated as insurmountable obstacles. The latter applied to the failure of quality circles or quality teams[245], the lack of acceptance of MD Audits and even to the "hard-nosed" attitudes and therefore lack of support from divisional management.

One other aspect which was accorded particular importance in the quality management system was the role of the customer and customer satisfaction. It was stated that the purpose of the company was to satisfy customers ("whatever you produce you have to satisfy the customer's requirements"). This it was claimed by one interviewee is "the definition of quality itself". It was the customer which should define its own needs in relation to QCD as clearly as possible – though it was recognized that in the case of consumer products, the company had to define customer needs itself. The role of sales and marketing was to transmit customer needs and product information back and forth and the Managing Director and executive management were responsible for monitoring customer needs and wants. Customer perceptions of the company's

[245] In the case of quality circles, it is interesting to contrast the cultural explanation given here with the view of one of the leading Japanese experts, Ishikawa, that quality circles would fail if an effective operating quality system were not developed within three years.

products were regarded as a strategic measure and surveys of customer perceptions conducted. In the mid-1990s when the company won a state Customer Service Award, it was commented that the Japanese Managing Director had stressed the importance of customer satisfaction but the QM&D manager complained that although local senior management claimed to believe in customer satisfaction, they weren't prepared to do anything about it. Nevertheless, by the time of the second visit, the Quality Department had been reorganized and a new position of manager of customer satisfaction established and a customer satisfaction policy drawn up. Conversely, the business process improvement section had disappeared.

Difficulties and Disillusionment with TQM

Some of the key players were critical and questioning in their approach and were aware of the weaknesses and pitfalls of the Australian prescription for TQM and of the ISO series. Interviewees commented that compliance to ISO alone did not provide an adequate quality management system especially for organizing and operating projects. As mentioned, they criticized ISO for not attaching sufficient importance to improvement. Interviewees reported that they had experienced difficulty in developing internal measurements and strategic measurements of the organization – in addition to the conventional financial measurements. Internal measurements included such things as process yield, inventory levels, lead times and on-time delivery. One interviewee claimed that, according to Australian Quality Award staff, this was the area in which Australian companies were weakest.

QA staff were also struggling to develop meaningful benchmarking as opposed to what they saw as "fairly shallow, gimmicky" or "flavour of the month" type approaches. One interviewee commented that they had been unable to find any external organization which was doing effective benchmarking and complained about high-priced consultants who had little of substance to offer. The development and trialing of benchmarking and best practice audits was still an ongoing exercise. The quality department had also experienced difficulty in trying to measure quality cost. Although they found it easier to do in conventional manufacturing areas, they were having difficulty finding an effective way to calculate quality cost in research and development areas.

This was a thoughtful, critical and careful attempt to implement what was essentially the Australian model of TQM. However, despite their best efforts the key players failed in the areas of major concern. A lot of effort had been put into trying to ensure that processes were more "effective and sensible" and to make management accountable but, in the end, lack of support from divisional and senior management was given as one of the main reasons for the failure of various aspects of the quality management programme. Similarly, in so far as people meant operators, after a brief initial surge of activity, quality teams began to decline and ultimately came to be seen as gimmicky and not suited to the company's business. While training in general was an aspect about which QA staff were rightly pleased, quality training encountered various problems. Training had not been disseminated throughout the organization and this too, together with the failure of quality circles, was put down to lack of management support. Overall, the view of the QM&D manager was that "whilst we put all that TQM in place, … I worry if we took procedural control of the business and without taking procedural control, it is not sustainable." So at the time he was devising ways to measure performance[246] so that he would know "whether what we set about doing initially for (the company) is sustainable – not just going to be working in pockets".

Beyond TQM

In effect, the manager of the QM&D subdivision had all but declared the TQM project dead. He reported that they were struggling with the philosophy of TQM and reassessing. In his view, quality circles belonged to the awareness phase, the immature phase and the company had now made the transition to the mature phase. The next step – the mature phase was strategic management. It was not TQM – indeed no names were to be used – apparently a reference to the belief that the TQM project had been blighted by the use of term TQM itself and associated jargon. The manager declared that he did not want people "talking about Pareto charts or control charts or things like that" but about accounts, sales and marketing and engineering – "things that are applicable to the business". He went on to say that the company no longer talked about total quality management but about customer satisfaction management. TQM was referred to as "purely an education process" and "the gospel according to Deming and Juran" was interpreted as having provided "magnificent tools to get people working together". But it was claimed that attention needed to be refocused and people had to get back to thinking about the bottom line, mission, profits and growth.

There was a sweeping vision of the new phase, the "big leap forward" which was strategic management. Strategic management was described as looking at:

> … why the enterprise exists, what are its core competencies, do we have the process where there will be continuous improvement at all times in those core competencies to keep us internationally competitive, do we know what the standard is for that part of the business.

Best Practice audits (with which as mentioned QA staff were still struggling) were to be a key

[246] These were the measures that were being devised for the best practice audits mentioned below.

part of this new phase. The objective was to be to define best practice for functions such as leadership, customer satisfaction, management of technology, productivity and so on. However, these so-called functions were even more abstract and remote from actual operations than the earlier attempts at measurement and indeed than the perception of TQM itself had been.

The word 'quality' was still scattered through the description of this new phase but it had become all but meaningless – as Wilkinson and Wilmott (1995) put it, 'quality' was now "being attributed to all kinds of management techniques and initiatives". In the course of the explanation, quality or TQM was variously interpreted as:

- sustainable continuous improvement in all business processes;
- a combination of ISO9001, the Big Q (explained as the company's creative quality environment) and the new strategic management;
- customer satisfaction;
- "purely an education process";
- "magnificent tools to get people working together";
- intellectual property, brand name (which was seen as particularly related to quality) and cash flow (to finance growth) which were referred to as the "new way we have to look at quality"; and
- market alignment (which had to be quality market alignment), product differentiation and on-time delivery (also both referred to as quality).

But, as with TQM, the acceptance of this project was by no means clear. The manager had devised seven measures; 4 strategic and 3 financial (including 2 for the total health of the business) – measures that he claimed were accepted as suitable by other major Australian companies. But they had not been accepted by senior management of this company. Among the reasons which the QA manager offered for their unwillingness to do so were that senior management did not like to be measured themselves (although they are quite happy to measure the workforce) and that they were "not mature enough to be accountable for their actions". Management accountability was an issue that had been raised in the early stages of the introduction of TQM but apparently still remained unresolved.

Conclusion

It is difficult to fault the careful, critical and methodical way in which the key players went about trying to establish what they understood to be TQM in this company. Their difficulties and ultimate failure perhaps say more than either of the other Australian case studies about the weaknesses of the conception and practice of quality management in Australia. Put simply, one could say that this company had fallen victim to the fact that, as Basu (2001: 32) commented, "the pendulum swung too far toward the concept of quality equating to goodness and employee culture".

Culture and cultural change were prominent aspects of the approach to TQM in this company. As we have seen, the failures of the TQM programme, such as quality circles, were put down to a combination of a lack of management support and cultural differences between Australia and Japan. Lack of management support was itself attributed in part to cultural differences. Another reason given for the lack of management support was the use of quality-related jargon and the term TQM itself. The problem with cultural explanations (or attributing failure to the use of jargon) was that they obviated the necessity to look other, more substantial reasons for the lack of success – reasons such as the conception or understanding of TQM or quality management, the suitability and adequacy of the systems and mechanisms put in place, the adequacy of training, and so on.

It is likely that the failure to convince management was a symptom rather than a cause of the difficulties encountered in trying to establish TQM. The real reason was probably neither jargon nor cultural differences between Australia and Japan but the inability to demonstrate that TQM could deliver substantial benefits, particularly over the longer term.

With respect to management support, it was noted that interviewees strongly denied that Japanese staff were more likely than Australian[247] managers to support TQM or particular aspects of the system. On the contrary, it was claimed that they were sometimes the "biggest hurdle". In practical terms, it was noted that although there were a larger number of Japanese management staff in this company than in the other Japanese subsidiary, almost all were in more senior management positions and had little contact with the operational level.

The key players also failed to achieve one of their own key principles – i.e. to take the actual implementation of quality management as far away from themselves as possible so that there was what they called local ownership and local responsibility. In fact, the QA department remained the repository of most knowledge about TQM. Engineering staff depended on QA staff to provide this expertise when the need arose. Moreover, QA staff reported that they stood between operational management and the "weird and wonderful quality types" from customers and accreditation organizations and translated their requirements into terms that operational

[247] In fact, irrespective of whether they held Australian citizenship or not, there were many different nationalities among management staff at all levels.

management could understand. There seemed to be no clear perception of a distinctive role for engineering staff and departments.

Overall, it is interesting to compare this company with the other Japanese subsidiary. One of the striking differences between these two Japanese subsidiaries was the position of the quality department within the organization. In this company, the Quality Department had been linked to the human resources function while at Bridgestone (Aus), the Department had been linked to Technical Services (the main engineering department). In both cases, the combined departments had been brought under the control of a single manager but whereas at NEC (Aus), the professional background of the manager was in human resource management, at Bridgestone (Aus), the manager was an engineer by profession and was actively involved in product development. It is difficult not to see this organizational arrangement as having had a major effect on the way quality management evolved in the two companies.

Certainly the QA staff in this company were confronted with a number of complications. These were complex and diverse operations which, in Japan, would probably not have been part of a single operation. In other words, unlike the other Japanese subsidiary where operations were a virtual replica of the parent organization's factories in Japan, it was more difficult to simply "copy" operational quality practices from Japan. In addition, there had been a decline in "traditional" production operations and a shift towards highly computerized and automated operations, on the one hand, and towards a greatly increased proportion of project work as opposed to conventional manufacturing operations, on the other. This change meant that the role of engineering had become relatively (if not absolutely) more important. If there had been a more balanced view of the roles of production and engineering, this shift away from conventional manufacturing operations might not have been seen to mean that quality management was of decreasing relevance to the company's operations.

In summary, the key players in this company were preoccupied with the people issues. They were concerned with changing the attitudes and behaviour of people and many problems were posed in terms of what they saw as the problematic relations between management and workers. In part as a consequence of this preoccupation, they failed to drive home the implementation of quality management at the operational level. The problems of implementation at the operational level were also related to failure to disseminated knowledge about quality management more widely through the organization and to the inadequacy of training programmes in terms of both content and coverage. These problems applied not only to quality circle training but also to training for managers and especially engineering staff. Ultimately, there were too few people with too little knowledge.

CHAPTER 11. Case Study 5: GMH

Introduction

This site、Holden Engine Operations (HEO), was one part of the Australian operations of the US giant, General Motors. HEO was one of two manufacturing sites in Australia and part of the site was occupied by another company (GMHAL: General Motors Holden Australia Limited) which incorporated design and development and the national head-office. HEO produced a range of engines and components for passenger vehicles – 4, 6 and 8-cyclinder, for both the domestic market and for export. The company had a high degree of both vertical and horizontal integration – covering the whole process from casting to final assembly and producing a wide range of components in-house.

The company had undergone numerous reorganizations and more were planned. This included both minor and major organizational changes and changes to product lines. In 1986, when GM-Holden's was reorganized into two separate companies, Holden's Engine and Components Company and GM-Holden's Motor Co., the engine operations were required to find and expand export markets and deal with overseas customers. This was apparently a rather confronting and cathartic experience for the organization and its customary practices as well as many of the staff. Subsequently, the engine company was again reintegrated with the car assembly operations. The reintegration was still in progress at the time of the research.[248]

Figures for the 6 years prior to the research showed that production for each of the main product lines had peaked in the years 1994-96 and then declined substantially. At the end of the decade, there was a planned major expansion in production volume to meet a new order from an Asian customer and the company put on an additional 350 odd workers but, when the customer was severely hit by the Asian financial crisis, production was suddenly reduced to half the planned level and some areas of the plant reduced to a 4-day week.

The site itself was also a complex one consisting of nine plants of which the four smaller ones housed the foundry operations. The layout was a combination of product, process and some special areas such as a components manufacturing area and an agile manufacturing area. The operations could be broadly divided into three more or less distinct parts – which actually represented major divisions of the production process; foundry, fabrication and assembly.

[248] The assembly operation, GM-Holden's Motor Co., became part of a joint venture with Toyota in Australia, called United Australian Automotive Industries (UAAI). When the joint venture was dissolved in 1996, the two operations were again reintegrated into one company.

Despite the fact that the operation had held and been re-accredited to ISO9001, a new attempt began just prior to the research to try and install an effective operating quality management system. Of the three Australian case studies, this company had the least developed practices. As the newly-appointed QA manager put it, the quality management system only existed in a set of binders and the different areas "were operating to whatever system they had evolved". The operation had made quite a number of past attempts to install a quality system – dating back to at least 1980, the remnants of which were still scattered around the factory. There seemed to be an extreme lack of coordination and consistency across the organization – an issue which continued to exist during the new attempt though it wasn't necessarily seen as an issue by all participants. This really was a case of "only working in patches" – and even then generally at a very primitive level. While at the time of the first visit, the approach seemed to be an uncompromising "out with the old and in with the new", by the second visit, there seemed to be a deliberate attempt to place those who were thought to have knowledge and experience of quality management in charge of production areas which were experiencing particular difficulties.

The outstanding feature of this company was that the attempt to install a quality system was very much a "one man band". This was the view of the QA manager himself but was also shared by some other interviewees. In the words of the QA manager, he had to keep the pressure on his own QA staff because although they were better than the rest of the organization, "they were not a lot better". Another interviewee expressed the view that when the QA manager "backed-off", progress slowed down and "things stopped happening". The QA manager also commented that the initial drive to put some basic quality management practices in place had been a shock to the organization from which it had still not recovered. So although he had to keep "turning up the heat", he was also conscious of need to proceed with some caution.

There was a great deal of variation among different parts of the organization in whether practices and procedures were implemented or not, in the way in which they were implemented and in the degree of success or effectiveness with which they were implemented. Overall, the level of knowledge seemed to be very low and the knowledge of different members of the organization including (or even particularly) managers varied greatly.[249] As did it would seem opinions about whether the system was necessary or likely to bring about significant improvement in performance. The lack of consistency in practices across the organization seemed to be partly the result of an apparent reluctance to standardize practices and to enforce

[249] There were only two or three managers to whom other interviewees referred me as being knowledgeable about quality management when they weren't sure about the details of how things worked.

them. This was evidenced by comments such as, "they've (area managers) done it differently in different areas and that's fine as long as they get results. I don't want to squash their entrepreneurial flare".

In this respect, the drive for QS9000 accreditation represented a major change in direction. It was acknowledged that QS9000 was being used to force quality management practices into place and to standardize them across the organization. Although assessment was imminent, it was impossible to say how successful these changes would prove to be. The single fact that there was a race against time to get even some of the most basic requirements in place did not seem to augur well. As with the earlier ISO accreditation, there seemed to be a real danger that the effort would simply end with the reproduction of a formula which was poorly understood and to which few had any real commitment – in other words, simply end in a case of form without content.[250]

At the time of the research, there were at least two approaches that seemed to be running in parallel. One was the approach of the newly appointed manager of QA and the other was called Quality Network Synchronous (QNS) which had apparently been brought to the operation some years earlier by the then newly-arrived American Executive-in-Charge, Operations.[251] The new QA manager claimed to know nothing about the QNS group, what it did, or how and when it had been formed. Indeed, according to the QA manager, QNS was not about quality but about "getting rid of non-value-added activities. … It is really about cost reduction." However, this view was not shared by other interviewees who clearly regarded QNS as a quality system – or at least as quality-related activities and as actually being in operation at the time. And indeed some existing quality system documents carried a QNS logo.

Normal Operations

In this company, there seemed to be few (if any) standard routine practices in place. The newly-appointed QA manager was particularly damning in his assessment of the state of quality management when he took up his position. According to the manager;

- the plant received "sporadic feedback from customers all around the world" which was often out of date;

[250] Indeed, one manager replied that if I read the QS9000 manual, I would find the answer to my questions.
[251] This manager (posted from the US parent company) left before the second visit and was replaced by an Australian veteran of the company who seemed to have thrown his weight behind the former approach although a QNS group continued to exist in the new ME Department which was an amalgamation of former Manufacturing Engineering and Central Services Departments.

- there was no effective process to track and monitor corrective action or to communicate the information to the employees generally;
- "the ISO system was in a set of binders and the areas were operating to whatever system they had evolved";
- there were virtually no internal quality performance metrics;
- of the few exceptions, the integrity of the first-time quality measures available on two assembly lines was highly questionable and again the information was "years out of date";
- if some problem did occur, there was no system in place to flag it and contain it within a discrete batch of product to be checked more thoroughly;
- the real cause of problems was that there were no systems in place to check or to validate that what should be done was being done; and
- what was referred to as a "Weekly Quality Report" in one production area was "probably a scrap summary" which was fed into the plant's MRPII system controlled by the Materials Management Department to add extra units to the next run to replace scrap.

It was claimed that even in areas where a procedure did exist, it was not being followed. More generally, the QA manager commented that there was a culture that "the quality of the product and the whole quality control system was owned by the QA Department and quality or the quality system had nothing to do with most people". He also commented that the organization was volume driven and this too was seen as a matter of culture. More than six months after his appointment, the QA manager felt that he was still "battling with lack of understanding from the management structure down." A staff member with almost 30 years experience largely agreed with this assessment. According to this interviewee:

> I've seen a lot of systems but I've got to say that the true total quality management system as such which you would get out of a textbook was never really given much credence in our operations. We've tended to do it our way and do it in an old-fashioned way.

At the time of the research, in the fabrication and assembly areas, the routing (the complete details of the production process) was still handed directly to production without any modification. A number of production interviewees commented that this document was not very "user friendly", that it was "written by ME (Mechanical Engineering Department), really for ME"; that "We're struggling with that one. …it is a very complex set of information".[252]

[252] The fact that it was computer-based but that the operators on the shop floor did not have access to computers was also mentioned.

In the foundry, however, a combination of Production Routing Sheets and Process Intent (PI) Sheets seemed to have been in use for some years whereas I was not shown Process Intent documents in any of the fabrication or assembly areas. An early copy of the foundry PI sheet was dated 1990 and others had been updated in 1995. Apparently, the PIs were produced by Production Engineering and were signed off by both PE and Production.

By the time of the second visit, work had begun on converting the routings to Process Control Plans – which would be displayed at the operation. Production Engineering was responsible for preparing the PCPs but the master copy was to placed on the job and when a change was made, this was to be the first copy to be amended. It was explained that the purpose of the PCP is to guarantee that the part is OK by specifying what is supposed to be done and how it is supposed to be done, by whom and at what frequency action is to be taken.[253]

A Standard Operating Sheet (SOS) was then to be developed by Production from the PCP and to include other information not in the PCP such as how to store materials or components – whatever additional information production considered necessary. Whereas in the foundry, it appeared that the SOSs were also being produced by PE and that there was discussion and collaboration between PE and Production, the manager of PE in the fabrication and assembly areas declared that "It's (SOS) got nothing to do with us. We have in the past been involved in these things ..." In at least one production area, SOS sheets had been prepared even though the PCPs were not yet available. This had apparently become necessary in order to meet the deadlines for forthcoming QS9000 accreditation.

According to Production, the importance of the SOS was to standardize – to tell the operator the way to do the job and to do it that way every time. Now the standard operation was seen as a way of maintaining quality. As one interviewee explained, "I believe if you don't do things the same way every time, then there's a good chance that you're going to get variation and then you get variation in quality as well." The idea of non-value added activities – which had also been mentioned in other Australian companies – was raised in the context of the SOS. The sheets were to have a column showing the "value-added number", the purpose of which was apparently to highlight non-value added activities which are "something you really want to get rid of. The customer doesn't see any value in that – he doesn't get anything for it and it costs us money".

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[253] According to Hishinuma (2004), the PCP could be regarded as the equivalent of the QC Flow Chart which was widely used in Japan.

In at least one production area, the manager was also trying to introduce quality check sheets. This was an area in which a large number of gauges were used to check the product. One was to show where each gauge was used and the other sheet would show the frequency with which each gauge was used and when the last check was performed. It was stressed that this should be "visually apparent" so that the manager could walk past and see it.

Abnormal Occurences

QA activities at HEO were overwhelmingly concentrated on dealing with customer complaints and correcting abnormal occurrences – scrap and defects. As the QA manager mentioned, "we shouldn't be, but at the moment we're using the (external) customer as the arbiter of our quality". Quality gates were the major device used for managing scrap and defects and addressing major quality problems. Overall, one senior production manager summed up the situation at the time as follows: the basic tasks were not being performed and basic maintenance not being done resulting in large amounts of scrap. A 44% reduction in scrap was achieved in one area in one month by "just … concentrating back on some of the basics".

According to the QA manager, the first thing he had to do was stop "the rubbish we were making going out the door". For this purpose, he introduced what he called quality gates at the end of the production line in the foundry and in the assembly area – both of which were under the control of QA and at which product was inspected for faults before it was released. Initially, the manager decided to use the introduction of a new product line because, he explained, this allowed him to stop production without "killing the organization". In addition, the QA manager involved the operators and had them submit in writing any problem they were having with the pilot run. The pilot run was not allowed to continue until a certain number of these problems (that were considered major problems) were fixed. In this way, a lot of improvement was driven through very quickly. However, the manager pointed out that "no one really understood the process of getting out there and helping operators" so, although some gains were made, the systems and culture of the organization were not changed.

The main function of the quality gates was to review feedback from external customers – either final product assembly plants (mainly overseas) or, in the case of the foundry, both external customers (to whom the area supplied castings directly) and the fabrication area within the plant. In principle, only the top five problems went on the quality board. When a problem was resolved, it was erased and replaced by another. The quality engineers (QEs) were responsible for selecting the items which went on these boards but generally did so in consultation with the managers in the areas for which they were responsible. A person from the area which was the source of the problem was nominated as responsible for resolution of each of the items. The main quality boards were particularly for discussion by the senior management group but were also attended by the responsible QEs. Daily reviews of the boards were held at 8:15 in the fabrication/assembly area and at 9:00 in the foundry but the production areas were rostered on different days so each area manager only attended a meeting once a week. A "beach-ball" chart[254] was used to track progress in resolving each of the problems.

External customers reported problems directly to the QA manager but a copy was also sent automatically to the responsible QE. So, according to one QE, he would probably be looking at ways to address the problem even before the manager saw the report. All complaints were logged on a data base and a formal written response to the customer (the Defective Product Corrective Action Advice (DPCA)) was required. When the QE had sufficient information to identify the problem, the probable cause and the corrective action that was going to be implemented, the form was faxed to the customer. The DPCA also required the signature of the responsible Area Manager.

In the case of internal customer problems and internal supplier corrective actions, there was no formal written documentation. Problems went on the quality board in the area experiencing the problem to make the area responsible for the problem accountable for positive corrective action by reviewing the board periodically. The name of the person responsible for addressing the problem at the "supplier" end was recorded on the board and a commitment given to particular action and time frame. The person from the responsible area was required to attend the meeting. In the past, an attempt had been made to initiate a system of issuing "internal" DPCAs but this had met with considerable resistance and had been abandoned.[255]

Apart from recording problems and reviewing action via the board system, there was also direct action taken to deal with problems. If an Area Manager on the assembly line had a problem, he would ring an area manager in fabrication and then the manager and the group leader[256] (and probably also the responsible quality engineer) would go to the assembly line and investigate the problem. In general, there were no set procedures and no documentation required. Basically,

[254] The beach-ball chart was divided into quadrants representing improvement item identified, action plan defined with response and completion date, action plan implemented, and customer satisfied. As each stage was completed, the respective quadrant was blacked out.

[255] As explained later , as part of the comprehensive review of quality documentation, a similar system was about to be introduced in the form of a Quality Problem Report.

[256] Group Leader was the new title for what used to be called supervisor/ foreman and all three titles were used in the course of the interviews. There was also a position of Senior Group Leader.

the manager "would take whatever actions he deemed necessary". Where it was not possible to find a quick solution, the fabrication area might take some containment action such as checking all parts to ensure that only good ones went through to the assembly area to "move the pain" from assembly to their own area.

By the second visit, each of the area managers also had their own quality gates or quality boards and in this case, there seemed to be considerable variety. As noted earlier, one of the Production Managers commented that he didn't want to squash their entrepreneurial talent. In one area, for example, there were 10 lines and each had one or two quality gates. The boards were reviewed each day by a small team consisting of the quality engineer and "probably" the group leader, team leader, a couple of operators and a tradesperson from maintenance. The process engineer only attended occasionally. In another area, the one with the worst record in terms of defects within the fabrication area, seven scrap boards (an alternative term for quality gate) had been set up – one for each of what they regarded as their major product groups but here the boards were reportedly only reviewed weekly.

Another major area of concern was machine downtime which was particularly acute in some key production areas. There was a recognition that in most cases ("probably 80% of the time") machine breakdown effected quality. There was a computer system on which downtime information was recorded and which also managed regular and preventive maintenance work. Jobs were notified automatically and the system also reported on preventive maintenance compliance.[257] The system allowed the Production Manager to track downtime by line, by individual machine and right down to which operation of a particular machine was causing the most problems. However, there were differing views about who controlled or had "ownership" of this system with production managers saying it was controlled by maintenance and maintenance managers saying it was controlled by production.

In terms of problem resolution, the most widely mentioned technique was the 5-WHYs[258] – although this largely seemed to be for the use of managers and staff. More than one manager expressed the view that everyone should be using the 5WHYs approach "for any problem they encounter". It was explained that the objective of the 5WHYs system was "to establish the root

[257] Although some areas worked 24 hours a day 6 days a week, the seventh day was generally reserved for preventive maintenance and other major or special maintenance work. However, various comments suggested that, despite these systems, maintenance work was not being carried out to schedule.

[258] The 5-WHYs is a simple method of asking the question why five times (as a rule-of-thumb) to explore the cause and effect relationships and determine the root cause of a defect or problem. The 5-WHY approach was first used by Toyota but was later taken up by the advocates of lean production and six sigma in the USA.

cause ... So we can stop it. So we can irreversibly fix it." However, one manager commented that this approach was "a little bit difficult for us (because) people tend to … have a root cause fixed in their mind and when you use the 5WHYs you could find it's something different." This was regarded as a matter of culture. As he put it, "that's the culture we're trying to install" but as with other issues of cultural change, this too was "a little bit difficult".

The problems associated with the lack of a widely accepted formal problem solving procedure were graphically illustrated by the example of how a particular problem in the fabrication area had been handled. The manager at the time gave directions about how to deal with the problem. However, his successor disagreed and issued new instructions. This too proved unsuccessful so IE were called in. IE put measures in place to deal with the problem but afternoon shift workers didn't agree and made their own changes. Next ME were called in but at this point some people finally decided that a more systematic approach was needed. So the Continuous Improvement/ QNS group became involved and offered their services to the supervisor saying that they would provide advice but that the supervisor was to be the owner of the problem resolution exercise. When the supervisor said that he and his top four operators would examine the problem and make notes, the QNS group advised against this and instead provided the standard QNS forms and charts covering workplace organization, 5S, waste, flow, pull systems and so on so that everybody would have a common reference point and framework for examining the problem. As a result, the work group came up with what were referred to as 46 "good solid" improvement items. The other interesting comment about this case was that there was a former QNS facilitator in the area. The reasons given for his failure to apply the principles in the first place were that unless the principles were being applied on a regular basis, they tended to be overlooked and to be overwhelmed by pressures to meet production schedules.

In many situations, there was a tendency to stress that production in general (including production operators) could and did handle most problems themselves – a tendency which was apparent in the other Australian case studies as well. For example, one manager commented that production used the "quality people" to identify problems but then immediately went on to claim that the guys (meaning the production operators) also identified problems "because, in most of the cases, they know better than the quality guys where the problems are occurring".[259] This tendency could also be seen as part of a broader stance of non-interference by other groups

[259] What was missing here was a distinction between large and small problems – which was clearly made in the Japanese case. In other words, operators may well know more about small local problems than QA or engineering staff but are unlikely to know more about large fundamental problems of process design or operation.

in production operations.[260] Thus the QA manager commented that even though production managers agreed that certain action was a good idea, QA had been unable to convince them to actually take action.

Improvement Activities

In this company there was no clear distinction between correcting problems and making improvements. Improvement activities, generally referred to as continuous improvement, were, at best, an extension of activities to deal with scrap and defects. Variation Reduction Teams and the Continuous Improvement Progress Chart (CIPC) were the key mechanisms for pursuing "improvement" as it was interpreted at HEO.

Variation Reduction Teams (or Problem Solving Groups) existed in both fabrication and assembly areas[261] and met to review the problems on the quality boards. In the foundry, focus groups were effectively the same thing. According to one interviewee, 'Variation Reduction Team' (VRT) was the corporate name for when people gathered around the quality boards for half an hour once a week and reviewed the problems. The VRT meetings were run by the responsible QE which meant that a QE might attend three meetings a week – one for each of three assembly lines, for example. In general, VRTs were regarded as being engaged in continuous improvement because, as one manager put it, "if you reduce variation, you're going to improve". One QE admitted that it could be difficult to get results – everybody was always too busy and the problems got pushed to the bottom of their list. Variation reduction teams operated at staff level, not at the wages level. In other words, they were not a form of quality circle meeting. As the description indicates, these were also basically informal activities with very little formal documentation.

At least in the fabrication area which contributed about half of the scrap generated by the operations as a whole, the most commonly used document was reported to be the Continuous Improvement Progress Chart (CIPC).[262] According to the Production Manager who had put a

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[260] Similarly, an engineer at Bridgestone (Aus) remarked that production engineering did a lot of the problem solving but didn't have any authority and so had to persuade production staff to take the required action. One interviewee at HEO provided an interesting historical perspective on this issue. He commented that some years ago, manufacturing were the "top people". Marketing and sales would send an order to production but production would decide to produce and deliver less than the requested order. The attitude was that each area should attend to its own business and marketing and sales should not tell production what to do.

[261] In fact one of the production managers did not know this. However, one possible explanation of his apparent ignorance was simply that he had not heard the term 'VRT' – one effect of each area "doing its own thing". There were meetings in his area that seemed to be fulfilling the same role as the VRTs.

[262] In another area, however, the forms were only just about to be introduced and monitoring was only to

lot of effort into using Pareto charts to identify the main contributors to scrap, this activity led directly into the continuous improvement areas using the CIPC. However, the CIPC was really a device for monitoring corrective action or problem resolution activities – or as another interviewee referred to it, an action plan. The principle was the same as that used on the quality boards in that generally only the top five problems in any particular area were listed on the CIPC together with the action to be taken, the person responsible, date containment action was taken, breakpoint dates for the external supplier and for the company's own operations, the date when action was verified and used the beach ball chart to track progress.[263] The action to be taken was only specified in general terms – the space provided allowed for less than 30 words and although more space could be taken, this was rarely the case.

In one area, the production manager reported that a continuous improvement plan had been drawn up for a key sub-process which was one of the slower producers and one of the major bottlenecks in the plant. This plan had been put together in conjunction with IE and was an attempt to identify what needed to be done in order to increase output to the required level. A meeting was being convened by the Area Manager[264] and was attended by IE and some other support departments such as ME which were involved in making the changes which might be to increase the cycle time[265] of a machine, buy a second machine or introduce quick tool changes. The focus of these activities appeared to be, as the quality manager had claimed, very much on volume. There was no clear or explicit acknowledgement that quality performance might be a major factor affecting the ability to meet volume targets. However, it is interesting that someone who had been in a senior management position in the quality department and responsible for dealing directly with external customers had been assigned to this production area. This certainly suggested the intention to bring both a quality perspective and more quality knowledge into the production area.

The company also had a suggestion scheme. It wasn't clear how long the Suggestion scheme had been in place but it had been revamped 3 or 4 years earlier – supposedly to focus on problems which were small and easy to handle so that they could be implemented quickly.[266]

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occur at a monthly quality meeting – also newly convened.

[263] I was shown three different versions of this form. Although one had perhaps been simplified for internal departmental use, another simply had three check date columns which had not been filled in.

[264] This manager was newly appointed to the position and had formerly been the manager in charge of Customer Liaison for the fabrication and assembly areas in the QA department.

[265] Interestingly, in reference to cycle time, the manager commented that "It's no good concentrating on improving the cycle time of the fastest machine in the line which is what we would have done many years ago."

[266] Apparently, this view was put when another part of the Australian company was engaged in a joint venture with a Japanese company.

However, the manager[267] claimed that all suggestions were accepted – not just simple ones. It seems that this system was also quite slack. The manager reported that he was working on an implementation process because suggestions were being accepted and the company was paying out considerable amounts of money but the suggestions were not being implemented.

Overall, there didn't seem to be a consistent view among managers about what the major problems and priorities should be. On the one hand, one manager commented that "The assembly line is red-hot. If you're stopping the assembly line, you're losing a lot of money. It's like (thousands of dollars) every 30 seconds." However, another manager regarded external customer complaints as the "biggest issue". As he explained, "we're losing credibility with the customer and we're giving him hassles". In contrast, he expressed the view that in the case of on-line problems, "we may not go all out to contain it because we know the problem's been there and we're the people that suffer" although he did add that "certainly we've got to fix it because it's costing us money. It's waste."

This lack of consistency with regard to which were the major problems and priorities was no doubt related to the fact that policy formulation and deployment was an area which was particularly weak in this company. The weakness of this area was, in turn, related to the freedom accorded managers to organize their own areas ("run their own business") as they saw fit. As mentioned, targets and time frames were not generally accepted and targets were often set by Executive-in-Charge, Operations for individual managers in areas with particularly serious problems – on what seemed to be an essentially ad hoc basis. A business plan had only been produced for the first time shortly before the second visit.

Process Analysis and Control

Another key problem area had been the conduct of statistical process control and process capability studies. Reports on SPC/ process capability did exist but, as in other cases, these were reportedly "weeks out-of-date" ("the engines were already on boats") and the calculations were "essentially meaningless". This was also seen as a cultural problem in that the group responsible was "quite happy to keep doing it and publishing it and having people ignore it" and did not see this "as being a problem". As to the basis on which the decision to conduct a process capability study was based, I was informed that originally studies were to be conducted on all processes "but then it got too hard … and they stopped the hard ones".

[267] This was the manager of continuous improvement who reported to the manager of the new Mechanical Engineering Department and to whom a QNS coordinator and 2 suggestion coordinators reported as well as 3 facilitators who conducted the QNS training.

By the time of the second visit, I was informed that the profile of SPC was about to be raised and that there would be a heavy emphasis on it in the coming couple of years. The computer software had been upgraded and the staff of the statistical analysis (SA) group were being retrained to "perform capability studies and perform SPC in line with current practice and in line with QS9000". The training was being conducted by the provider of the software package. The training sessions also included a range of other employees such as QEs, supervisors, shop floor inspectors and checking centre tradespeople. In addition, where capability studies showed a process not to be capable, it was now to be recorded on a section allocated on the quality gate boards and then as part of the review process, "the person who's responsible for making it capable has … to explain to the group once a week what they're doing to make it capable."[268] Plans for the next stage were to try and "get SPC out of that group (the SA group in the QA department) and back where it should be which is … at the very shop floor operator level". So the SA group would perform the capability study and generate the control chart which would then be located on the line and filled in by the operators or by automatic equipment which existed on some lines but which was then underutilized. The QA manager believed that it would only take 5-6 months to put such a system in place.

By the time of the second visit, Mechanical Engineering had also begun performing Process FMEA (PFMEA)[269] on all new product as a requirement of QS9000. However, PFMEA was only to be undertaken retrospectively if there were special reasons to do so; such as a major customer complaint or a process which was experiencing a particularly complex set of problems. PE[270] had the prime responsibility for PFMEA but it was carried out by a cross-functional group which included production, maintenance, quality control, product engineering if necessary and metallurgy (in the foundry). The information would then be used by QA to set up the necessary quality controls such as what to sample and how often.

Data, Documentation and Communication

With regard to data and documentation, a complete about-face occurred between the first and second visits. At the time of the first visit, many interviewees expressed the view that written

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[268] Though it was not explicitly stated, presumably this meant an engineer from PE – the first real indication that engineering staff were to be more actively involved in the quality system. Nevertheless, it appeared that engineering staff were to be called on to rectify problems identified by others rather than taking a proactive role in looking for ways to improve process capability themselves.
[269] FMEA: Failure Mode and Effect Analysis.
[270] The person assigned from the foundry was a relatively junior member of staff but still took charge of most of the PFMEA meetings irrespective of the component under consideration – the reason given was that he was the person most familiar with the requirements of PFMEA.

records were unnecessary and even undesirable. Even the quality manager remarked that "we're not about having a bureaucracy". As he explained, if a defect was found, it should be counted and recorded on the board together with the right-first-time number "and that's it". Once it was dealt with, "Rub it off. Never see it again." Another manager (who previously worked as a superintendent in the quality control department) agreed:

> I don't really want to see it (the problem) recorded somewhere else. ... I mean if it's on there (the quality board) and it's fixed and it's not recurring – and it shouldn't get taken off there until it's properly solved, it's an irreversible fix – then why would you want to keep a record of it.

The problem was that there was no way of knowing whether the action taken was indeed an irreversible or permanent fix.[271] When questioned, the manager agreed that if the same problem was to recur six or twelve months later, probably no one would know.

Similarly, concerning the 5-WHYs approach to problem solving, the same manager commented:

> You've probably gathered that I'm not really crazy on having sheets of paper either. **I don't think you really need a sheet of paper** … If you get a group of people from different disciplines around the place, sit down together and say let's go through the 5Ys, I think you'll find the root cause 99.9% of the time. (emphasis added)[272]

The Area Manager's explanation of why written records were unnecessary or undesirable related to past practices. In the past, there had been "reams and reams of reports, documents, papers, graphs, charts" but they were all "fairly meaningless". The inspectors checked the product and recorded any problems but the "trouble with the sheet of paper was that nobody saw it – or it was hard to see". The inspectors' records went back to the QC department which then produced a monthly report but, as he commented, "That's history – it's too late." In other words, this was a case of "throwing the baby out with the bath water". The fact that record keeping in the past had been inappropriate and/or poorly organized was not seen as a reason to reorganize and improve record keeping but as a reason for not keeping records at all.

Another manager had quite a different explanation for the fact that written records were not kept

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[271] This very problem emerged in an interview with one of the QEs. One of his patrol auditors reported a problem to him which had occurred before. On the previous occasion, he had followed it up and been advised that action had been taken. When contacted the Area Manager replied that he too thought the problem had been fixed. Clearly whatever action had been taken – presumably as an irreversible fix (and accepted by both the Area Manager and the QE at the time) had not solved the problem.

[272] While it is true that Ohno (1978) refers to the 5WHY approach as the basis of Toyota's scientific approach, the approach described here is the antithesis of that advocated by Japanese experts such as Ishikawa. According to Ishikawa, the resolution of problems should be based on factual data obtained by objective, scientific methods – precisely because individual opinions – apart from the fact that they may not be correct, do not have persuasive force (see Ohno 1978, Ishikawa 1989).

even for the five major problems. As he put it:

> The honest truth is I don't think we're that good yet. I think we've got so many big issues, all we would do is create a paper warfare where no one could ever get through them. So what we've got to do is we've got to tackle the top 5 and keep working our way down through those top 5.

He contrasted this approach to the situation in the company where he had previously worked and where the system required that whenever there was any reject, a non-conformance report of some type would be raised and had to be closed off.

One of the recurring themes was that information should be "visually apparent". From the outset, the QA manager stressed the importance of visibility – particularly the visibility of the problem resolution process. By this he meant the displaying of the top five problems on the quality gate boards and the tracking of progress using the beach ball charts. Although some interviewees referred to the desirability of information being accessible to operators, in fact the visibility of information seemed to be as much for the benefit of managers as for operators; in other words, so that the managers could walk around and see the state of operations.

As noted, at the time of the first visit, the only two documents which were mentioned were the DPCA and the CIPC. While a DPCA was generated for every external customer complaint, it was not clear how widely the Continuous Improvement Progress Chart (CIPC) was used. Most interviewees claimed that no written records were kept of the items on the quality boards.[273] By the second visit, however, various formal procedures and record keeping requirements had been or were about to be put in place to comply with the requirements of QS9000 accreditation. According to the QA manager, the revision of electronic document control systems was effectively being used "to revise every piece of documentation in the place". As part of this review, documentation (document formats) used at the company's final assembly plant was being imported and adapted where necessary. Moreover, contrary to the comments at the first visit about 'entrepreneurial talent' and each manager doing it his own way, one of the key issues was now to try and get "some level of commonality" of documents used across the organization instead of having "10 versions of the same document" or a "personalized fabrication document that has the same purpose as a personalized assembly document".

In terms of documenting actual operations or activities related to quality, at least two new formal, written reporting requirements had been prepared to comply with the requirements of QS9000 but not yet introduced. These were the Quality Problem Report (QPR) for internal customers and the Problem Resolution Work Sheet (PRWS) – for resolution of critical problems

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[273] For details of the CIPC, see pp. 230-231 above.

and were specified in the Work Instructions for Defective Product Advice Resolution in the revised Quality Manual which provided a detailed explanation of the action required at each step and the documents to be used. The PRWS was structured in terms of 4W1H[274] (which had not been mentioned in any of the interviews). Problem solving was to use the "appropriate tools" – fishbone diagrams, Pareto charts and 5-Why's; of which the latter two had been widely referred to in the interviews. The Work Instructions required that solutions be documented as an action plan on a CIPC form with nominated responsibilities and timing. The Quality Problem Report (QPR) was to be sent to the relevant production Supervisor who was responsible for investigating the problem, determining the route cause and organizing resources to implement the action plan. All QPRs were required to be registered by the area Product Quality Assurance Group and returned to the group leader and the "customer" when corrective action had been determined. The Area Manager was also required to review QPRs each week and sign off when a satisfactory resolution had been reached. Follow-up checks and audits were now to be required and when effectiveness of the action taken had been established, there was to further signing-off and up-dating of the register.

The thrust of the changes being made for QS9000 accreditation seemed to mean that the view that records need not be kept except on the quality boards or that problem solving could or should be "done in the head" would no longer be acceptable. One interviewee commented that QS9000 was being used as the "tool" to say:

> Look, here in QS9000 it says that you as the manufacturing manager need to do this, … and show us and prove that you are in fact doing it. So now you have no alternative but to do it." (emphasis added)

He contrasted this to the situation in the past where a manager would say:

> Oh, yes that's OK. Yes I'll do it – and do nothing. However, the new documents were not yet in circulation so it remained to be seen how widely or effectively they would actually be used or whether the level of compliance would be higher than it had apparently been in the case of ISO9001 accreditation.

Although documentation was very limited, there was, nevertheless, a range of data available on a regular basis to the Production and Area Managers to assist them in planning their activities.[275] Firstly, records of scrap classified by type of defect were available for all production areas; how many for the day, the week and the year-to-date – and in some cases at least, how many for the

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[274] 4W1H: what, when, where, why and how.

[275] One production manager pointed out that each of the Area Managers had administrative staff who could help them to pull together any information they considered necessary "to run their business" – the emphasis again being on the Area Manager's autonomy.

hour. This was the basis on which the five main causes of scrap ("our biggest headaches") were identified. As mentioned previously, the source of scrap could be identified by line, machine and even the particular operation of a machine.

The other data which Production Managers received on a regular basis included performance against schedule (reported as net good parts); safety (daily reports on incidents as well as work-days-lost cases reported separately); weekly feedback on right-first-time data (for each of the production group); machine downtime, and cost. This data was then combined with the monthly data on cost versus budget from the Finance department and in conjunction with the person from Finance responsible for the particular production area, was used to identify the main causes of the cost overruns on which effort needed to be focused.

As indicated above, cost was a major focus of attention. Cost overruns seemed to be an unexceptional occurrence. The areas which showed up in the monthly budget as having the highest cost overruns were the ones targeted for attention. Cost was the basis on which the five problems to go on the quality/ scrap boards were identified. It is probably fair to say that most corrective action was driven by cost – whether cost of scrap or of downtime. After the new Executive-in-Charge took over, there was a renewed emphasis on cost reduction and a weekly meeting had been introduced to review progress on a list of cost reduction items. A specific person was nominated as responsible for each item. Each of the areas drew up a list and prioritized the items for attention at the meeting. In some cases, factors other than cost (such as health and safety) determined the priority of an item but there was no specific reference to the relationship between quality and cost.

Returning to the issue of information and communication, a number of fundamental issues were highlighted by the QA and other managers. For example;

- the integrity and reliability of data were regarded as a major issue by the QA manager and were mentioned by some other interviewees
- there were many comments about the fact that information was often out-of-date or not available when needed and not in a suitable format for the user
- the need to make information more widely available, including to operators, was mentioned – but still had not progressed very far

Meetings

Meetings were an important vehicle of communication in this company. Since much information was only kept on the quality gate boards, review processes inevitably involved meetings. Nevertheless one interviewee grumbled about what he considered an excessive number of meetings even though meetings were actually relatively few in number and generally very brief. The key quality-related meetings were the morning meetings held at the two main quality gates at 8:15 in the fabrication/ assembly area and 9:00 in the foundry. The other regular meetings directly related to quality were the VRT meetings mentioned above .

By the second visit, meetings were also being held in local areas – the Production Managers with their Area Managers and the Area Managers within their own areas. Quality boards/ scrap boards had also been established in the local areas. Meetings were held at these boards – this meant there were a total of 25-30 small meetings of about 20 minutes duration. These meetings were run by the responsible QE. Attendance at the meetings varied somewhat from area to area.[276] Although some interviewees claimed that some operators took part in these meetings, this seemed to be the exception rather than the rule. (Participation by operators is discussed in more detail below.) In the foundry, two area managers had recently introduced group meetings with some of their operators to discuss quality problems, productivity and so on. One interviewee explained that these were an attempt to try and get some worker input again but not to revive Waste Busters groups as such. There were also many ad hoc meetings held by the parties assigned responsibility for dealing with the problems listed on the various quality boards. These groups dissolved when the problem was resolved.

Internally to the QA Department, there was a weekly meeting between the QA manager and the quality engineers. This meeting reviewed the status of external customer complaints, the progress and outcomes of the VRT meetings and "any other problems worth sharing with others". No files were prepared for or written records (including minutes) kept of this meeting. As one QE commented, "If I had to do that, I'd do nothing else. I'd be forever at my desk writing reports."

About 3 or 4 months before the second visit, a series of meetings had been put in place to oversee the introduction of QS9000 and prepare for accreditation. There was a top-level management meeting held weekly between the Executive-in-Charge of operations and the

[276] In one production area, they were attended by supervisors, Leading Hands and perhaps the responsible production engineer. According to one production manager, the production engineers did not generally attend but efforts were being made to make this a more regular occurrence. In one of the maintenance areas, the meetings reportedly had a broad representation including trades group leaders, all the production group leaders, process engineers, the industrial engineer and a representative from SQA (the Source Quality Assurance group) as well as the Production Manager for the area. The SQA was included because many of the major problems occurring in this area related to castings, some of which came from external suppliers.

senior managers – sometimes referred to as the Steering Committee meeting. According to the QA manager, this meeting looked at problems in more detail and could be more rigorous in its assessment of quality management activities because "you're not going to have someone feeling that there being hung out to dry in public" – referring presumably to the Area Managers. There was also a Coordinating Committee of middle-level managers to review progress towards QS9000 and a weekly QS9000 Working Group Meeting within each of the functional areas such as QA, ME (machine shop & foundry), production (machine shop & foundry), maintenance, personnel, shipping and receiving, and so on – also referred to as area or functional committees. These meetings were responsible for developing the procedures particular to their own areas. These procedures were then fed up to Coordinating Committee and finally up to Steering Committee for approval. The intention was that at least the top-level meeting would continue after accreditation and become a "maintenance of QS9000" meeting reviewing internal audits and conducting a more vigorous review of problem status for more complex issues.

Auditing

I was informed that prior to the present attempt to introduce an operating quality control system, there had been no effective internal or external audit processes. When audits were conducted, they did not find as much as could or should be found and there was no process to ensure that corrective action was taken in a timely fashion based on the findings. When audits did pick up significant problems, they were apparently corrected on a piecemeal, ad hoc basis and there was no system to check whether similar problems were occurring in different areas and treat them on an organization-wide basis. Nevertheless, there had been a high level of system or procedural audits conducted in accordance with the then company procedures. All were under the control of the QA group and the records were kept by the QA department. At the time of the first visit, most of the information obtained from checks by QA inspectors or auditors was reportedly ignored anyway, so the QA manager was not attaching much importance to the work of patrol inspectors or auditors. Rather he was stressing that those who ran the process should be responsible for the process and for checking it.

Between the first and second visits, two groups of about 25 patrol auditors were set up, each of which reported to one of the QEs. The patrol auditors conducted both product and process audits. The results of every audit were documented and, on the reverse side of the audit sheet, there was provision to record the action taken to correct any problem identified. The audit sheets were processed by the test and audit group within the QA department and this group distributed a report itemizing the problems highlighted by product audit for a particular day. Copies of the report were given to the responsible groups and then tracked until feedback was received as to what corrective action the group would take and whether it had been implemented. The auditor reports were reviewed on a daily basis and any major discrepancies reported. Copies of the reports also went to the area managers and were widely distributed at the management level but it was up the individual area manager to decide whether to distribute the report to supervisors. The reports also went to the quality engineers.

At the time of the second visit, company procedures were being re-written in line with those of the company's other operation, according to which each area would be responsible for auditing its own procedures. Auditing activities had been suspended (for about the preceding 2 months) while the new procedures were put in place and to allow time for training which was still in progress at the time of the interviews. Auditor training was a 3~4 day programme to train auditors in each of the main production areas so that they could undertake internal auditing.

Role of Quality Engineers

It was clear that the Quality Engineers played a key role in implementing procedures, ensuring that they were followed and in recording or monitoring data on quality performance. According to one of the quality engineers, the prime function of the quality engineers was to satisfy the customer – the external customer. When a customer (including internal customers) advized a problem, it was up to the responsible QE to determine the most likely source of the problem and therefore who should be responsible for corrective action and implementation, coordinate the corrective action and satisfy the customer (particularly the external customer) that the problem wouldn't occur again. It was explained that all aspects of QE's job were related to the production line but where they needed go to address what happened on the line, could be anywhere – product engineering, process engineering, materials QA – depending on what the problem was and what needed to be done to address it. I was told that, in any one day, contact with the area managers and line supervision would account for about 40-50% of a QE's time – the rest would be with other support groups such as engineering. As has been noted, the quality engineers were also responsible for collating and distributing various quality-related data, for calculating data such as the RFT rate, for selecting problems to go on the various boards and conducting quality meetings at the boards.

While the QA manager admitted that the QEs played a key role in terms of keeping the quality management system rolling along, he nevertheless expressed serious reservations. He commented that it was still necessary for him to play "a very key role in keeping the heat on them because they don't all understand it either". As he explained, "Some understand, some want to use Attilla the Hun methods, some don't see it as a problem and just want to retreat back to their little office area." In his view, "The QA department is probably slightly more turned on –

but not … a lot more – than the rest of the organization." This was part of what he saw as "the all pervading culture that we're trying to change". On the other hand, he admitted that the quality engineers were somewhat embattled and in need of peer group support and was planning to introduce some team development activities as explained later.

Small Group Activities

Generally, there was agreement that there were no quality circles and no other small group activities at the wages level. One manager objected saying that some workers had become involved and that his production department was "trying to do more … to get those people involved". But these efforts were largely limited to what were regarded as "key players" or "influential players" from the floor. Others agreed that getting operators involved was still at a "very early stage". Some saw this as an "historic thing" in the sense that "we probably haven't been very good at that (getting operators involved) in the past" and because a large number of employees had worked for the company for many years:

> … they feel a little bit uncomfortable about why all of a sudden you actually want to get them involved when you haven't really wanted to do that in past. ... They always think there's some sort of ulterior motive involved.

As a consequence, some interviewees considered that it would take considerable time and effort to convince the workers to become involved.

As in the other Australian case studies, various difficulties were encountered in trying to maintain group activities – including considerable difficulty in getting the foremen to release workers for their meetings. According to a manager in the foundry, one of the problems with "all these training and involvement programmes is people forget that things have got to be implemented" and that the resources to implement the ideas have to be available. He agreed that it was not possible to identify any measurable benefits[277] that had flowed from the work of the groups but that "in some ways, we had a group of more satisfied people" and at the same time, "a group of more dissatisfied people … because some of the problems that they'd brought up hadn't been fixed". As he pointed out, this was "another good way of turning people off."

There was also another broader and more fundamental problem. In effect, the Waste Busters, which had previously existed in the foundry, had been "destroyed" by the advent of the QNS program instead of trying to consolidate and build on the existing groups – a consequence of the "out with the old and in with the new" approach mentioned before. When the new program was

[277] The manager in charge of QNS agreed that there were problems in measuring both the effectiveness of the training and of the activities of the groups themselves.

introduced, Waste Busters was abandoned and large numbers of workers were sent to QNS training. But in fact no provision had been made for workers to use the training when they returned to the workplace. In addition, the facilitator had been moved from the foundry to become a QNS trainer. So the result was that "we … trained all these people and didn't use them" whereas the Waste Buster groups had been an operating system and had reportedly been gathering some momentum and starting to work on more substantial problems. The interviewee considered this symptomatic of the "old HEO way of how many heads can we get trained, not how do we use those heads once we've trained them". He stressed the point, saying:

> I guess I've been here 35 years and we've been through at least a dozen of those where you get a consultant in and you train hundreds of people and then never use them.

By the second visit, the QA manager reported that some attempts were being made to include Team Leaders[278] in the Weekly Review Meetings in the various production areas, particularly looking at the corrective action section of the quality gate boards. But he was still very cautious, saying that there would be little benefit or, worse, that there was a risk of creating "mass confusion if we try and draw in more people" before the Area Managers and supervisors understood and believed in the quality management system.

There were some references to the value of teams and teamwork but these issues did not have as high a profile as they did at NEC (Aus) for example. The QA manager was planning to organize team building activity in his own department[279] – mainly to provide peer support for the quality engineers who were dispersed around the plant and worked in isolation in what was if not quite hostile, certainly not a supportive environment. Crossfunctional teams were not mentioned in the interviews but were actually operating in some areas. As noted, both variation reduction teams (or focus groups) and core teams[280] were structured as crossfunctional teams as was Process FMEA, led by production engineering. Task forces set up in at least two areas to deal with a complex set of problems also included participants from different departments and sections of the plant.

Training

This was probably the company in which training had the lowest profile and where the approach

[278] In this case, Team Leader was the title for what used to be called Leading Hands, usually the first-line supervisory level in Australia.
[279] The plans had been put on hold because the manager in charge of the QEs had been moved to a new position and his old position was still vacant.
[280] The core teams were based in the engineering departments and were responsible for managing the introduction of new product.

was most ad hoc. Perhaps the only exception was the recently introduced "high potentials" programme. There had been some earlier quality training programmes but they seem to have been very basic indeed. In 1980, a short programme – of about three hours duration – was provided for shop floor employees and was generally described as an "awareness" type programme. There was also a programme provided by an external consultant that led to the creation of the Waste Buster groups and then the most recent QNS programme – although the QA manager did not regard the QNS programme as primarily concerned with quality.

For the purposes of QNS training, employees were formed into teams which represented a cross-section of the organization from production operators to management and even finance staff. This meant that everybody, irrespective of their position, received exactly the same training. However, QNS training had only reached about 41% of the workforce although there was a concerted effort to increase the coverage of the programme over a 3 month period – mainly to enable operators who had not yet done so to complete their training for the industry training certificate. Previously, there had not been any problem solving component in the QNS training programme but one had been added about 3 or 4 months prior to the second visit. (Presumably this was one of the reasons why staff in the area responsible for QNS training had been sent to problem solving courses in recent months.) But when parts of the factory were reduced to only a 4-day working week, the training programme was also reduced to 4 days[281] and the problem solving component dropped again. The intention was to reintroduce it when workers went back to a 5-day week.

Despite the reservations of the QA manager, plans were underway by the Continuous Improvement manager[282] to broaden the QNS training and add more modules to the current seven.[283] The new modules were to cover running meetings, negotiation processes, health and safety, relations between union and company, and various aspects of team activities such as the roles and responsibilities of teams and team leaders and empowerment; in other words, the

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[281] It is interesting to compare this company with Bridgestone (Aus). Here the fact that parts of the operation were only working a 4-day week was regarded as an obstacle to reaching the target of 50% coverage by the end of the year. At Bridgestone, on the other hand, the fact that the factory was only working a 4-day week was taken as an opportunity to use the 5th day for training. It has to be said, however, that at the time, Bridgestone had access to the Training Guarantee Fund, a scheme which no longer existed.

[282] Previously, this manager had been assigned to a components area when there had been an attempt to set it up as what seems to have been essentially a Strategic Business Unit and where he was in charge of sales and marketing. This unit had been "out on its own" and so relationships had become very close-knit. The manager regarded this as the "first semblance of any sort of team activity" in the company.

[283] A working group of 12 people (6 management and 6 union) had been put together to work on setting up team activity and was examining 12-14 additional modules to decide which ones would be most appropriate.

social rather than the technical aspects of group activities. There was no mention of additional training in quality control or statistical techniques or problem solving methods.

As far as quality-related training was concerned, the only other programmes were the specific-purpose courses mentioned earlier; auditor training and the statistical process control (SPC) courses which were necessary to ensure that selected staff had the skills to perform the tasks required by QS9000 – although a range of other employees including managerial and supervisory staff, the QEs, some shop floor inspectors and checking centre tradespeople also attended the courses. Apart from these specific courses, the "training" provided in preparation for QS9000 was minimal. There had been an initial session of 4 hours for every manager and staff member to highlight the lack of systems in the organization. Just before the second visit, a 1 hour refresher briefing session had been held for all managers and staff. It was then the responsibility of managers and staff to brief the employees for whom they were responsible. For example, two of the QEs were responsible for briefing the patrol auditors who reported to them.

With regard to job skills and management skills, the training offered by this company was similarly limited. Apart from the industry training certificate, most training was delivered on a departmental level or an individual basis. About every 3 months, the training section published a list of the training courses available. It was then up to each manager to determine what training the department or individual members of the department needed.[284] Asked about the training that had been undertaken in their departments in the preceding 12 months, most managers mentioned computer courses of one kind or another. In the Continuous Improvement area, staff had taken courses in problem analysis, problem solving and decision making analysis – presumably because of the introduction of a problem solving component to the QNS programme.[285] Generally, all of the courses offered were short courses of only a few days duration.

In the course of the interviews, it was mentioned that no formal training was provided for those appointed to supervisory or management positions.[286] In part to remedy this situation, 'High Potentials' programme was introduced. A battery of tests was used to identify individuals,

[284] One manager commented that he did not know of any quality-related courses offered by the training section but as noted elsewhere there was a plan for the training section to deliver the additional people-related QNS modules which were under consideration.
[285] In one of the engineering departments where there had been relatively little training during the preceding year, the manager explained that most of his staff have been there longer than he and had already done "all the courses imaginable".
[286] One manager commented that, in the past, employees had been "whisked off the shop floor", placed in supervisory or management positions and been expected to perform without any preparation or training.

including shop floor workers, who were thought to have high potential to take on supervisory and management roles in the future. These individuals were then to be provided with specialized training courses – one part of which (a live-in programme at a training facility outside Melbourne) took place during the research and was accompanied by a good deal of fanfare. Virtually the whole senior management team departed to attend a luncheon on the opening day.

The Social

People

In this company there were two "schools of thought" about people issues. The QA manager and his department were fully occupied with trying to put an operating quality system in place while others, centred around the QNS group, the former Central Services department and the new amalgamated Mechanical Engineering department, stressed and advocated the importance of "people" and "people issues". In general, many references to people lamented the "bad old days" and the consequences of the bad management practices of the past. According to one manager, the culture of the organization especially in regard to people and relationships was still back in the 1940s and 1950s. He referred to it as the "old traditional manufacturing type ways" – the essence of which was an attitude to workers/ operators which said 'when you come into work leave your brain at the door and we'll tell you what to do'. He saw his task as being to develop team activities so that the organization would be more people-oriented and there would be closer cooperation and more sharing of information.

The manager in charge of continuous improvement and QNS[287] had also spent some time trying to convince the area managers that they were mistaken in thinking that they were responsible for "getting things out the door" rather than being responsible for the people who did get things out the door. He told them that if they simply gave orders, they would be met with resistance and resentment but if they allowed the workers to make their own decisions or at least kept them informed at all times, they would cooperate and enjoy coming to work.

Culture and Cultural Change

While there were different attitudes about people and people issues, this was the company in which there were probably the most frequent references to culture and the need for cultural change. As we have seen, many issues were interpreted as cultural issues, including the

[287] About a year prior to taking up this position, he had taken a course on employee involvement and changing culture. He believed that both the former Executive of operations and one of the current top executives were strongly supportive of such ideas.

following:

- The culture of the organization was said to be volume driven.
- There was a culture that the quality of the product and the quality control system was owned by the QA department.
- Lack of understanding of quality management, even among the quality engineers, was regarded by the QA manager as part of "the all pervading culture that we're trying to change".
- The difficulty in setting targets for quality performance was put down to the fact that the organization did not have a culture "that accepts that setting a target is a good thing and setting a time frame to achieve it is a good thing."
- There was reference to the attempt to install a culture of using the 5WHYs to address any problem but this had met with difficulty because people tend to have a root cause fixed in their mind – another cultural problem to be overcome.
- The fact that the reports on statistical process control and process capability studies were essentially meaningless but that the group responsible was quite happy to keep on doing them and have people ignore them was seen as a cultural problem.

One interviewee remarked that there was a very awkward situation where there were different cultures and different thinking in the organization. Some people were totally focused on production and, in the past, others had been totally focused on quality but they were not "serving a real good purpose". Instead, the goal was to change the culture so that the "hands-on people" were focused on quality and although he thought the situation had improved significantly, he agreed that this view was still not fully accepted throughout the organization. The fact that the quality management system was still a high maintenance system which depended on the QA manager continuing to apply pressure was attributed to the failure of those driving the introduction of quality management to change the culture of the business to see the quality system as being "really value added and as a tool to go forward".

According to one interviewee, culture had been identified as a central issue for the restructured ME department. The department had held a meeting and determined that its mission was to serve the production operations. Accordingly, they were planning to introduce training in service culture – delivered by an external organization because the company's training centre was not considered to have the capability to do so. As part of this service culture, there were also plans to conduct surveys of their internal customers within the plant. There was, however, no explanation of how this would improve interaction between engineering staff and production areas – an issue which remained unresolved. Moreover, while changing the culture of the department was considered an issue, there was no mention of the need for or plans to provide training for engineering staff in quality control techniques.

There seemed to be a degree of incongruity between the apparent recognition of the importance of establishing appropriate systems and ensuring that they worked effectively on the one hand and the conviction that cultural change was of fundamental importance on the other. The QA manager in particular commented on the absence of effective processes or systems in many aspects of the quality management system and yet in summing up the progress that had been made so far, he declared that ultimately it was a matter of how much cultural changed had been achieved.

As at NEC (Aus), another theme which ran through the interviews and to which considerable importance was attached was "ownership". In the case of the problem in the fabrication area described earlier, it was considered important that the production section take ownership of the problem resolution process while QNS staff act only in an advisory role. In the view of one interviewee who thought there had been a major change in the approach to quality management, the first step was to get people to take ownership of quality as opposed to the situation in the past where production was responsible for producing the numbers and the quality system was seen as owned by the QA department. The new approach was that "if you're going to make the part, you take ownership of the quality outcome of that part." He saw this as part of the slow and difficult process of changing the culture of the organization. QS9000 was said to be helping QA in its endeavour to have the organization take ownership of quality but in this case, "ownership" seemed to be little more than a euphemism for enforcement in the sense that QS9000 required proof that action had been taken. In other words, it would no longer possible as had been the case in the past to agree to take action and then do nothing.

Conclusion

In the end, despite past attempts and despite receiving ISO reaccreditation, this company was only just "getting started" in terms of installing an effective, operating quality management system. There had been some progress but it was still fairly minor. Quality boards had been established in local areas and regular meetings were being held to review the boards. All boards were supposed to show a right-first-time rate but there were still doubts about the integrity of this data. QS9000 accreditation was being used to drive major change in quality management practices but it remained to be seen whether this attempt would be any more successful than past attempts had been. The fact that there was a race against time to get some of the basic requirements in place in time for QS9000 assessment did not seem to augur well.

With respect to virtually every aspect of the quality management system, procedures and practices had only just been or were about to be put in place. This applied to the auditing system, statistical process control and new documents and formal reporting requirements for problem resolution activities. Only a few weeks earlier a business plan had finally been drawn up but as yet there seemed to be no formal policy deployment system. Some attempts had been made to include some operators in meetings but there were still no quality circle or other small group activities and any such moves were still considered highly risky at least by the QA manager. There was what seemed to be a last minute attempt to increase the coverage of the existing QNS training programme. At the time of the second visit, lack of consistency in practices across the organization was still a major issue. In this case too, it remained to be seen whether the changes made to bring practices into line with the requirements of QS9000 would solve this problem and prove sustainable in the longer term.

To use the quality manager's own words, "Is it (the quality management system) self-sustaining? No." The weekly review meetings at the quality gate boards were still being run by the quality engineers. As mentioned, the QEs also played a key role in deciding which problems went on the quality gate boards and were responsible for recording much (though not all) of the data on the boards. About every other day, the quality manager himself went round to one of the quality boards on a random basis to see whether the boards were being kept up-to-date although the fact that the management group had also begun checking the boards in one area each day could be seen as a sign of progress.[288]

This was an even more extreme case of too few people with too little knowledge than was NEC (Aus). Responsibility for installing an operating quality management system was essentially in the hands of a "one-man-band" – the QA manager. The manager himself felt that he was "battling with lack of understanding from the management structure down" and that even the QA staff were not sufficiently committed and knowledgeable about the requirements of an effective quality system. Knowledge which had been acquired in what seemed to be an entirely haphazard way was scattered thinly through the plant and there seemed to have been no systematic effort to pull this knowledge together and build on it – at least until the most recent reorganization prior to the second visit. At this stage, a number of knowledgeable individuals had been placed in charge of areas of the plant which suffered from particular quality and performance problems generally. There still remained two centres of power, the QA department and the Continuous Improvement/QNS group in the ME department – with no obvious

[288] On the other hand, the cynical view might be that this was a last ditch attempt to try and ensure that the organization would be sufficiently prepared to pass the imminent assessment for QS9000 accreditation.

connection, let alone coordination between them.

In this company, there seemed to be an extreme lack of what I call management control. The QA manager commented that he was unable to persuade managers to adopt certain practices even when they agreed that they were necessary. He also commented that managers didn't accept the setting of targets or a time frame to achieve them. There were a number of references to the failure to perform gauge checks (which were a critical part of many operations). One interviewee commented that at some point workers had stopped doing gauge checks but since no one ever asked about the checks, the workers continued not doing them. In one area, the fact that quality management practices varied from one area manager to another was interpreted in a positive light as demonstrating their "entrepreneurial talent". However, another manager declared that everybody from the production managers down was "doing their own thing", that each manager had his own ideas about what to implement and how and that there were no common reference points or resource base. Reference was also made to practices in the past when managers said that they would take action but did nothing though it was considered that this would no longer be possible because QS9000 required that managers demonstrate what action they had taken.

In this company where reference to people issues had consisted largely of criticisms of the poor practices of the past and continuing neglect and where training had also been relatively neglected, it seemed that "people issues" were to be given a higher profile if the new plans for QNS went ahead. The new plans to expand quality training were to focus on "people practices". A working group was looking at a selection of new modules which were to cover things such as running meetings, negotiation processes, the roles and responsibilities of teams and team leaders, empowerment as well as health and safety and relations between union and management. In a similar vein, the new Mechanical Engineering department, having determined that its mission was to provide a service to production areas, was planning to introduce training in service culture for its staff. There seemed to be no consideration given to whether there was a need to expand and upgrade training in the use of quality control and problem solving techniques – in other words, in the technical aspect of quality control.

CHAPTER 12: Concluding Comments

The central conclusions of this thesis have been summarized in Chapter 1 above. This final chapter simply highlights three major themes emerging from the research.

Japan: Emphasis on the Technical

In Japan, attention was concentrated on the technical aspects of the system which centred on process analysis and control and improving process capability and where process meant specifically the production process. Achieving technical mastery of the production process was the principle means for achieving improved quality performance:

- This involved – as a first step – eliminating problems and achieving a stable and repeatable process as the basis for improving process capability. Ishikawa (1989) regards this as managing (*kanri*) the process which he distinguishes from simply 'maintaining the status quo' (*genjo iji*). In other words, actively managing the process includes an element of improvement but only in the sense of realizing the current capability of the process.
- The important point is that, in the Japanese approach, quality control and process control form closely interlocking and interdependent systems so that improvement in one generally results in improvement in the other.
- In both Japanese case studies, the focus was clearly on the production process, all activities reported and data and documents sighted related to the production process.

Secondly, improving the process involved redesigning the process (removing waste) to achieve higher levels of quality, cost and productivity performance.

- Importantly, waste must be understood in all three forms (*muda, mura, muri*) and pursued with equal vigor in relation to each of the major components (the 4Ms) of the production process. Seishi (1999) referred to this activity as the complete dismantling and reconstruction of the production process.
- In many cases, this pursuit of waste resulted in product makers having a very detailed knowledge of their production processes and being able to design their own machinery and equipment (Ono & Negoro 1990; Seishi 1999). Both of the Japanese companies in this study had developed their own production machinery.

Thirdly, stress was on management control (rather than leadership) and effective policy deployment and coordination across all levels and sections of the organization

- Management control was exercised through formal, documented procedures which serve not only to monitor execution of activities but also to record results which are then analyzed and fed into the policy making process.

- In both Japanese companies, I was shown extensive documentation, records and data relating to quality management activities. At Canon, plans showing specific targets for activities related to QCD and other items were available at the department and section level clearly linked to corporate level policies and targets and reviewed regularly.
- All interviewees were able to give detailed explanations of the activities for which they were responsible and the significance of those activities.
- At both companies, the ongoing records had been compiled into an historical record of the development of the quality system over a period of decades. This was usually the work of the corporate level quality department.

Fourthly, engineering staff have been overlooked by outsider observers but actually they were the experts who played the driving role behind the system (both individually and through their organization, JUSE, supported by the other highly technically-oriented organization, JSA). In both Japanese companies, staff of engineering and maintenance depts. were well versed in and played an active part in the operation of the quality management system.

Fifthly, the shop floor was an important but still minor part of the total QC system and it was the simpler problems and tasks which could be delegated to the shop floor operators.

- In fact, the motivation behind the original proposal for the introduction of QC circles was predominantly technical. QC circles were to be the venue for the study of QC (using the new journal "Gemba to QC") and where workers could encourage and support each other (Udagawa et al. 1995).
- It is important to reiterate that, historically, supervisors and then operators were the last groups to be incorporated into the QC system in Japan and this attempt did not begin until more than a decade after the QC movement began.
- Both Japanese firms had a history of vigorous circle or group activities. There were workplace displays detailing the activities of the groups and classified under major areas of concern such as productivity, quality, safety and TPM and the SA Parts system (Bridgestone). Detailed records of the activities of the groups and their achievements were also complied into an annual record of activities for the whole corporation.
- In both cases, there was a clear recognition of the relative roles of the shop floor, engineering at the factory and divisional levels, and engineering and QA departments at the corporate level. A clear distinction was drawn between large and small (prioritized and localized) problems where the latter were the province of the shop floor and the former required the attention of engineering (and on occasion, management) staff.

There were several other outstanding features of the Japanese case studies. As noted, there was an extensive range of detailed information available on all aspects of the quality management system. This information was widely circulated and considerable trouble was taken to ensure that all relevant information was distributed to all related parties – interviewees commented on the high levels of shared information. This was achieved in part by formal meetings which all related parties attended.

In both these companies, there were extensive training programmes offering a wide range of courses (including quality training courses) targeted to the needs of different categories of employees and with progressive levels of difficulty. This was in sharp contrast to the "one size fits all" approach in Australian companies. The content of courses was focused on the technical aspects of QC – mastery of QC techniques and problem solving methods – the most advanced courses being for engineering staff. Delivery was carefully planned and executed with high levels of coverage – again in terms of content as well as coverage in contrast to the Australian companies.

Perhaps one of the most striking features of Japanese quality management programmes was the careful preparation and planning which preceded implementation of the programmes and the time span which was allowed for implementation. Implementation was often preceded by a year or more of research and study. Typically the time span allowed to implement the programmes was three years and there were successive programmes to build on and develop the quality system to a higher level of sophistication. This was particularly striking in the development of Canon production system centred around the QCD trilogy but was also evident in the various programmes implemented at Bridgestone. This was in sharp contrast to the experience of GMH where there was a race against time to get the basic requirements in place to meet an accreditation assessment and where there was little or no prior preparation or planning. At Bridgestone Australia there seemed to be a slower and more methodical but persistent approach to gradually upgrading the system. This may have been another reason why Bridgestone was more successful than the other cases. In contrast, an interviewee at a company which was not part of this research boasted that it had only taken three months to put the quality system in place.

The time factor is also important in another respect; that is, when Australian companies and companies in the West generally set out to follow the Japanese example, they were looking at a mature system which had been developed over a period of decades. Looking at the mature systems operating in Japanese companies – without understanding the slow process of development and evolution – does not offer many clues about what the most successful strategy might be for a company which is "starting from scratch" or just what is a realistic time span for implementation.

Consistent with the technical aspects of quality management outlined above and in contrast to the aspects which are usually highlighted in the English literature (such as security of employment or cooperative labour-management relations), I consider the important social aspects of quality management in Japan to be the role of engineers, the relationship between engineering and production, and the role of veteran workers.

- In Japan, it was engineers (not managers) who were the driving force behind the quality system. They were the ones who had the expertise to make the system work.
- The crucial relationship was the relationship between engineering (particularly production engineering) and production – not management and workers. The resulting cross-fertilization between engineering and production was a learning experience for both parties. Such interaction provides engineers with an understanding of real life production problems which then informs their approach to the solution of engineering problems and process design. For operators, it provides exposure to engineering knowledge and expertise which enables them to upgrade their understanding and skills.
- Finally, veteran workers at shop floor level – workers who have 10, 20 and more years experience not only of the production system but also of circle and problem solving activities provide a base of knowledge and experience. In my view, these highly skilled and knowledgeable workers were essential to the success of QC circle activities and the dissemination of knowledge about QC at the shop floor level in general. In the Australian context, these operators are roughly equivalent to tradesmen. For QC in Australia, this raises the issue of how to integrate tradespeople fully into the QC system so that they can play the key role that "veteran workers" do in Japan.

Australia: Emphasis on the Social

In Australia and the West generally attention was directed to the social aspects of quality control. The literature focused on the top floor (management) and the shop floor (production operators) but both the literature and the interviewees indicate that the programmes failed at both these levels. Managers were accorded a major role and the stress was on management leadership. This was in accordance with Deming's interpretation of common and special causes of problems or variation, according to which 85% of problems are attributable to common causes (that is, they are system problems) and their rectification is the responsibility of management. However, in both the literature and in the case studies, failure to convince management was given as a, if not the major, reason for the failure of quality management programmes. As we saw, at NEC, the leaders of the quality programme declared that "management did not learn" and at GMH, the quality manager was still struggling against lack of understanding from the management structure down. With regard to operators, this meant delegating as many tasks as possible to the shop floor and also that problem solving activity was supposed to be concentrated at the shop floor level, or at least in production departments (Sprouster 1984; Blakemore 1989; Stace and Dunphy 1994; Wilkinson and Wilmott 1996). But here too there was a large gap between theory and reality. In practice, attempts to introduce QC circles or other SGAs were unsuccessful as were attempts to involve operators in QC activities generally. This was true of two of the Australian case studies. In the third, Bridgestone, although there had been some success in having basic quality control tasks performed by operators, quality circles had been a failure.

Related to the focus on the shop floor was the concern to improve relations between management and workers. The establishment of a cooperative relationship was seen to depend on establishing a long-term relationship or, more particularly, "reciprocal obligation" (Womack et al. 1990) between management and workers and involved removing the fear of job loss. The effect of views that Japanese labour management practices (particularly lifetime employment) had contributed to successful QC is apparent here. In practice, the main device which was used to address this problem was team training, where the teams included representatives from different levels of the hierarchy (NEC, GMH), but there was little evidence that this had produced any substantive change in relations between management and labour.

In both the English literature and the Australian case studies, engineering staff are conspicuous by their absence. Interviewees in production areas, at GMH in particular, remarked that they were still trying to get engineering staff more involved in quality-related meetings and activities but at the same time declared that they didn't really need the help of engineering (or even in some cases, QA staff), claiming that their own workers knew more about the problems and that they could resolve problems themselves. For their part, engineering staff (production engineering at Bridgestone; QA staff at GMH) reported that they had difficulty convincing production managers to take action on quality matters. Overall, there was little sign of active cooperation and coordination between engineering and production which is a key feature of Japanese quality control.

In contrast to the importance attached to the social aspects of quality management, the technical aspects were relatively neglected. Of the aspects which were given prominence, process and continuous improvement, like TQM itself, were vague, ill-defined and all embracing concepts. Process was interpreted as any business process. At NEC, interviewees stressed that they interpreted quality very broadly and were trying to achieve improvement in all their business processes. The effect, however, was to divert attention away from the production process to dealing with, for example, issues of a large backlog of outstanding accounts receivable. While the latter may improve the "bottom-line", it has no effect on the efficiency (quality, cost or productivity) of production. As noted, continuous improvement/ kaizen was given a particularly high profile in the literature and was frequently mentioned in the interviews at both NEC and GMH but interestingly not at Bridgestone (Aus) – the company which had made the most progress in improving operational performance. In the other two, there was no clear distinction between correcting faults and making improvements and GMH in particular was still struggling to get on top of the former. In the literature, attention was focused on variation rather than waste but in the case studies, GMH was the only company where variation figured prominently in the interviews. Reducing variation was seen as a way to reduce defects and the company had established Variation Reduction Teams. In effect, this limited the focus to reducing variation in the current process rather than major reorganization of the production process.

Several other observations and issues which emerged from the Australian case studies deserve mention here. There was widespread resistance if not aversion to formal procedures and written records which was part of a larger and more serious problem of lack of management control. There seemed to be a lack of organizational structures or authority which required managers to comply with the requirements of the quality management programme. At GMH, this was related to views about entrepreneurial talent and the independence of individual managers to make their own decisions and "run their business as they saw fit". Even at Bridgestone, where there seemed to be general acceptance of and compliance with the programme, the view was expressed that engineering staff needed to have people skills so that they could persuade managers to take action on specific issues.

Rather than lack of compliance being addressed as an issue of organizational structure with clear procedures and responsibilities, there was talk about abstract notions of "ownership". At NEC, the issue of management control was obscured by views that there should be local "ownership" for implementation of the quality programme. Unfortunately, this seemed to have been counterproductive in that it allowed local managers to take as little or as much action as they saw fit in the implementation of quality management. The result, at NEC and particularly GMH, was a lack of consistency across the organization in whether quality management practices were adopted and how they were implemented. The exception was Bridgestone where there was little reference to people, culture or ownership. It is difficult to escape the conclusion that the difference in orientation between Bridgestone and NEC was reinforced by the fact that the QA dept was combined with the human relations department at NEC and with the technical services department at Bridgestone.

Quality training was inadequate in terms of content, delivery and coverage. The approach to training was "one size fits all" and was centred around the development of circles or teams at the shop floor level. Both NEC and Bridgestone had had considerable success with job training programmes. Delivery was better planned and coverage somewhat better although at NEC, the profile of training seemed to have declined. But overall, including circle training at Bridgestone, the programmes were too short and the content barely more than awareness level with only a brief introduction to the seven tools and maybe a version of the problem solving method such as the QC storyboard. Systematic quality training specifically for managers and particularly engineering staff was virtually non-existent. The result was that only a few simple statistical techniques such as Pareto charts or the 5WHY method were mentioned and there was little evidence that any of the other 7QC tools were widely used. NEC was the only company where more sophisticated QC techniques were mentioned but their use was limited to the three or four quality engineers in the QA department.

Underlying all of these problems was the fact that there were too few people with too little knowledge. The most extreme case was GMH where the attempt to install an operating quality system (as opposed to an ISO accredited system which only existed in the binders) was very much a one-man band. Otherwise knowledge was scattered thinly through the plant with little attempt until the final drive for QS9000 accreditation to consolidate or build on this knowledge. At NEC, the staff of the QA department provided a larger knowledge base but it was largely confined to the department which provided the expertise in 'esoteric' quality techniques for engineering depts. Even at Bridgestone, formal knowledge about quality control was not widespread. Engineering staff remarked that they relied on the QA staff to be the experts in quality control. The difference in this case was that relatively large numbers of employees had the opportunity to gain knowledge by visiting the company's Japanese operations, that the parent company made engineering and production information freely available, and that the Japanese development managers provided an in-house source of knowledge.

The "Reverse Effect"

If both organizations and quality systems are regarded as socio-technical systems, the contrast between failure of Australian firms to achieve substantial results from the introduction of quality management programmes and the success achieved by Japanese companies suggests that there may be what I call a "reverse effect". In the English literature and in the interviews in Australian companies, dealing with people issues and issues of cultural change was widely regarded as essential to the successful implementation of a quality management programme. Here, it is suggested that the effect operates in the opposite direction – the reverse effect. In other words, greater job satisfaction, motivation, and involvement/ participation (the social aspects) are more likely to be a consequence and not a precondition of the installation of effective quality management practices in terms of the technical aspects and demonstrated improvement in quality performance.

In the social science literature, there has been an emphasis on the social aspects of organization as the means for ameliorating or removing the negative consequences (such as deskilling and alienation) which are regarded as inherent particularly, but not exclusively, in the mass production assembly line system (e.g. starting with the early work of Trist and Bamford or Rice (Lansbury and Gilmour 1977)). The focus has been overwhelmingly on ameliorating the effects of technology by manipulating the organization of work or the social organization. However, there are a number of studies of quality programmes which indicate the limitations of such an approach in terms of the achievement of quality objectives and suggest that much more attention needs to be paid to the dynamic effects of technology or the technical aspects of organization, or the quality control system, on "the social". Unfortunately, the implications of these studies have not been taken up.

First, Dunford and McGraw (1988) in a study of an Australian manufacturing company, report that management's primary objective in introducing quality circles was as a "convenient catalyst" for behavioural change and not to improve product quality. However, a subsequent major strike indicated that management's attempt to use quality circles for such "social engineering" purposes had been a failure. In a study by Dawson (1994) of the introduction of TQM on the shopfloor, a number of interviewees commented that machinery and equipment was unreliable, in poor condition, or not operating – or capable of operating – at the required standard and that training was inadequate. One interviewee added that setting up TQM teams did not provide a solution to these problems. Dawson makes no reference to these comments and instead concludes that there was a need to "revise and continually develop methods for attaining and maintaining employee involvement" (ibid. 60). Rather, it seems to me that these comments clearly suggest that reliability of machinery and equipment may be an important factor effecting employee responses and commitment. In a study of NEC Malaysia, Ozawa (1988) found that the result of successive education programmes (or psychological campaigns) was always the same – about three months after the programme, the fraction defective returned to the level prior to the training. However, when improvements were made to machinery, the fraction defective not only decreased but was maintained at the new lower level. He concluded that the effects of morale management can be maintained for only a few months at a time.

In my view, the answer lies in an observation that Woodward made in her study of industrial organization as long ago as the 1960s. She noted that, contrary to conventional wisdom, there was "almost complete lack of resistance to change" and that even industrial workers "appeared to take pride in the fact that their firms were technically up to date". In particular, she noted that where new machines and old machines[289] were being operated side-by-side, "It was obvious to all concerned that the new way was the better and easier way". (Woodward 1965: 48, 49) In Japan, process improvement or improvement in process capability is pursued in such a way as to remove sources (actual and potential) of human error and make it "easier to do the job well" – to make the production process "worker-friendly". In other words, all those problems beyond the workers' control – the problems that cause frustration and discouragement – are taken care of in such a way that "it is obvious to all that the new way is a better and easier way". (Indeed, one manager in this study reported his workers as complaining, "When these problems going to be fixed? It's been like this for years.")

Importantly, this is also the counterargument to those who claim that the Japanese system merely represents an "intensification of labour" (Dohse et al. 1985). Process improvement, in this sense, doesn't simply mean speeding up the process and requiring operators to work faster or harder. On the contrary, workers are able to produce more because the inordinate effort and unnecessary repetition (*muri, muda*) of trying to deal with faulty machines, parts and materials, poor work station layout and so on are systematically removed.

In other words, it is not necessary to try and replicate or simulate Japanese labour management practices, to offer security of employment or a sense of reciprocal obligation between management and workers. Nor is it likely that concentrating on changing the "social" aspects of organization or cultural change as such will facilitate, to any significant degree, improvements in quality performance or operational performance generally. On the contrary, the evidence would suggest that the social changes themselves are likely to be short-lived. Conversely, if the process changes (large improvements) made by engineering staff consistently and demonstrably make it easier to do the job well and if their expertise is available to support QC activities and

[289] Woodward only mentions machines but it is important to stress, that the "technical" also includes the other components of the production process, materials, methods – and even man in terms of, for example, appropriate training. As has been noted in both the literature review and the case studies, Japanese firms concentrated on process improvement – modifying machines, adding jigs and tools, changing the work process – to make it easier to do the job well. At Bridgestone Australia (in contrast to say South Pacific Tyre) there was no rush to replace old machines with new but a consistent push to eliminate problems and improve operating rates.

provide back-up to the shop floor, it is more likely that operators will be encouraged to participate in QC activities (to deal with the small, local problems) and that they will be successful – setting in motion a "virtuous circle" of more success encourages more participation which produces more success.

The results of the case studies seem to support this hypothesis. As we have seen, there was a pronounced difference in the success achieved by quality management systems in the Japanese companies and the Australian companies and, to a lesser extent, among the Australian companies. Moreover, this difference in success was associated with a difference in approach to quality management. In the Japanese companies, the emphasis was clearly on implementing formal, documented procedures to manage and improve the quality performance of the production process (the technical aspects) – and this was basically the approach followed by Bridgestone Australia. At Bridgestone (Japan), some interviewees talked about the importance of managing people in relation to both work life and private life but this was in no way considered a substitute for the careful implementation of the technical aspects of the quality system. On the contrary, this company had made a conscious decision to vigorously pursue automation and the plant had a comprehensive TPM programme to ensure that machinery and equipment were able to deliver the required quality performance. Canon had a corporate-level Production Technology Centre and had undertaken a major review of available production technologies. In neither case was there any indication of problems with the motivation of the workforce. Of the two Australian companies where the focus was on people or culture (the social aspects), neither had managed to achieve any significant success in terms of quality performance. At NEC Australia, a great deal of time and effort had been expended on the "people" issues and although the key players considered that they had been relatively successful in this regard, overall the drive to install a quality management system was judged a failure. At GMH where achieving cultural change was seen as a major issue, past attempts had yielded little result and it was still impossible to say whether the latest attempt to install an effective quality management system would be more successful.

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APPENDIX: The companies

The Japanese Case Studies

A-1 Case Study 1: Canon Ami Plant

The Ami plant was one of the production facilities of Canon, Inc., a large national and international corporation with a total workforce worldwide of 75,000 of whom approximately half were located outside Japan in 1996. At the time, Canon had manufacturing operations in 12 countries including 5 operations in the USA and 4 in Europe. The domestic market accounted for just under one third of the company's worldwide sales. At the time, the company's traditional main product line (cameras)[290] accounted for substantially less than 10% of total sales, optical devices for an even smaller proportion and office equipment for the rest. In recent years, Canon had placed great stress on obtaining patent rights to new technology as a key part of its competitive strategy. In the period 1991-97, it was ranked fifth, first, third, and, from 1994, second respectively among major corporations registering patents in the USA.

A system of independent product divisions was adopted in 1978 so that the divisions formed the vertical axis and development, production and sales/marketing activities formed the horizontal axis of a matrix structure. Organizationally, Canon Inc. consisted of six major "support" divisions (information and communications systems, quality, intellectual property and legal affairs, production, research and development, and product development or commercialization) and six major product-based operating divisions, all of which had one or more manufacturing operations. The Quality Management Headquarters was divided into three main areas; Quality Planning Centre, Quality Technology Centre and Software Quality Assurance Centre. The Production Headquarters included a Production Technology Research Institute, Production Design Technology Centre and a Production Technology Centre (the last of which was located at the Ami site). In addition, there were seven largely administrative divisions such as finance, personnel and so on – of which the CE (cost engineering) Division had staff posted to the factory studied. Finally, a division had been established in 1990 to promote the development of new ecology-related business (E-Business Promotion Division).

The Ami Plant commenced operations in 1981 to manufacture electronic business machines,

[290] Even though cameras had declined to only a minor part of the company's output, I was told that there was no intention of abandoning production because of their importance to the company's corporate image. Cameras embodied two – and with the advent of the digital camera – all three of the company's core technologies (i.e. lenses (optics), imaging technology and electronics).

particularly facsimiles and also high precision metal moulds used in the manufacture of components. The Plant later evolved into three separate operations. The main plant (Ami Plant) was purely an assembly operation – except for one special case, no major components were manufactured at the plant. The one exception was the electronic boards/PCBs (*denso kiban*) produced by the Plant and Equipment Engineering Department. In 1983, the manufacture of production equipment was set up as a separate operation, Ami Precision Equipment Plant (*Ami Seiki Kojo*). In 1994, the Manufacturing Technology Centre (*Seisan Gijutsu Senta*) took over the design and development of machinery and equipment, including machinery for manufacturing high precision metal moulds used for making intricate plastic componentry. In 1996, the third installation on the site, Ami Koki (Optical Equipment) Plant was established as a separate operation to manufacture semi-conductors, LCDs and printed boards (PCBs). The Ami Plant was one of 10 domestic manufacturing operations located on six different sites. (This was in addition to 13 affiliated manufacturing companies in Japan.) In 1997, the plant's five main product lines were two types of facsimiles, two types of printers, and copying machines – for each of which numerous variations were produced. Most products were for commercial or office use but some products such as printers and facsimiles also included smaller models for personal or home use. The subject of this research was the main manufacturing operation, Ami Plant, which is also referred to simply as "the factory" or "Ami".

Since the plant was essentially an assembly operation, supply chain management was an important function for which there was a separate "Promotion of Supply Chain Management Department". There was also an "Overseas Components Department" and a "Materials and Components Engineering Department". In relation to the plants internal operations, in addition to three production departments, each dealing with a different line of products, there was a Production Planning Department and a Production Engineering Department. The latter included two production engineering sections, a packaging engineering section (an important issue for products like these to ensure that there is no damage during transport and handling), a PCB engineering section and a section actually manufacturing PCBs. There were also three engineering sections in one production department and one in another. There was a QA section in two of the production departments and in the Materials and Components Engineering Department as well as a separate QA Office located immediately below the factory manager.

The factory studied had a workforce of approximately 1400 (male; 740: female 660 (figures approx)) and used substantial amounts of contract labour supplied by a labour dispatch firm and adjustable on a monthly basis. The approximately 700 contract workers employed at the plant was the highest number for any of Canon Inc.'s factories and one of the highest proportions (relative to the regular workforce). It represented roughly one quarter of the total contract labour employed at all Canon Inc. plants.

Quality Control at Canon

Although a system of sampling inspection and inspection standards was introduced as early as 1953, Canon appears to have had a slow and somewhat shaky start to its involvement in quality control. In 1957, a study group on statistical quality control was set up under the guidance of one of the key figures in the quality control movement in Japan, Ishikawa Kaoru of JUSE. Despite considerable investment, Canon's attempt to enter the audio-visual field with two new products introduced in 1959-60 proved to be a failure. In 1961, quality control was introduced on a company-wide basis. Apparently, the company tried for the prestigious Deming Prize but was unsuccessful. The reasons given were that the company was in too much of a hurry and did not allow enough time for preparation. As a result, a decision was made to put aside the pursuit of prizes as such and to work on consolidating the system as a total system. No detailed information was available about the company's quality control activities during the 1960s and early 1970s. The next clear reference to quality control or quality assurance was not until the mid-1970s although by this time, the company's products certainly had a worldwide reputation for high quality and at relatively low cost – compared to, for example, its German rivals which had long held a reputation for top quality.

Beginning in 1970 and continuing throughout the decade, there was a proliferation of programmes and activities and associated training courses aimed at improving operations and raising efficiency. In 1970, a Work Factor (WF) Study Group was set up to oversee the introduction of WF as part of a major drive to develop a system to manage productivity improvement (*seisansei kanri shisutemu*)[291] and, starting in 1977, was used to develop commonality of standards (referred to as Canon Standards (CS)) across all of the company's operations. In 1971, the first version of Performance Analysis and Control (PAC)[292] was introduced. In 1973 and 1974 respectively, a Standard Time (ST) Study Group and a Productivity Improvement Study Group were set up. In 1974 (following a reevaluation of C-PAC in 1973), the decision was made to abandon the existing version of PAC and develop a new on

[291] The development of this system took place over a period of no less than 12 years (1970-81). The period was divided into two broad phases of 6 years: the first being to use WF to set standards times and establish a system to measure productivity and the second to establish the work place structures (*gemba no taishitsuzukuri*) to enable ongoing improvement in productivity. These two were further divided into 3 year phases; an exploratory phase to disseminate WF methods, a preparatory phase to establish a system for measuring productivity, a dissemination phase to implement the productivity management system and a development phase to consolidate the system.

[292] For an explanation of PAC in English, see Kadota, Takeji (1968) "PAC – Performance Analysis and Control." The Journal of Industrial Engineering, vol.XIX, no.8.

In the first half of 1975, in the aftermath of the "Dollar Shock" of 1971 and the Oil Crisis of 1973 and a quality problem which occurred with one of the company's product lines, Canon was forced to suspend dividend payments – a set-back which added impetus to the process then underway to develop its own Canon Production System. Consequently, in 1976, building on the programmes introduced in the preceding years, the company launched 3 new programmes: the Premier Company Plan (*Yuryo Kigyo Koso*), the Canon Production System (CPS) and N-PAC (the new version of PAC). In 1977, a Production Technology Study Group and a 5-year Basic IE Plan were launched involving the company-wide diffusion of Work Factor and Canon Standards (CS). Some years earlier, in 1972-73, three of Canon's four manufacturing operations had introduced small group activities for which the model chosen was the JMA's ZD (Zero Defect) groups, not JUSE's quality control circles. Although new plants were established in 1976 and 1981, small group activities were only gradually introduced to these plants between 1979 and 1984. Significantly, it was not till 1979, three years after the launch of CPS that the widespread diffusion of SGAs throughout the company's operations began.

Quality and the CPS (Canon Production System)

The Canon Production System, introduced in 1976, consisted of three components; the Canon Development System (CDS), the Canon Production System (also abbreviated as CPS), and the Canon Marketing System (CMS). The development phases and associated activities for each of these components were planned separately to suit the particular needs of each component. The total Canon Production System evolved over the years through a series of 3 year programmes. Then, in 1988, the company launched G-CPS, Global CPS, reflecting the increasing internationalization of the company and the need to coordinate and optimize its operations world-wide. The goals of the total CPS were stated as "to strive for the best quality, lowest cost and fastest delivery anywhere" (JMA 1987: 8), the classic QCD trilogy. The fact that this is a comprehensive system not limited to the "shop floor" or the work of production operators in the narrow sense is evident from the three "pillars" of the system: the basic production system (line-centred); a staff-centred support system supporting the line effort with both production technology and management techniques; and workplace vitalization activities. (ibid. 31)

The "basic production system" component in turn consisted of "three arms" – again the QCD trilogy;

- production assurance (PA); achieved through the HIT just-in-time delivery system;
- quality assurance (QA); emphasizing standardization and increased process capability;
- cost assurance (CA); using value engineering (VE) techniques to promote cost control and cost reduction. (ibid. 15)

Training and human resource development are also considered important aspects.

The key to the system was elimination of waste and was to be pursued in relation to all 5Ms (Canon included measurement as the fifth M). Canon identifies nine types of waste[293] (ibid. 17-8), classified according to the sources or aspects of the system where waste may be generated. The fact that the pursuit of quality requires a comprehensive approach is apparent from the description of defects as “a form of waste that can result from inadequate machine maintenance, improper equipment operation, lack of reliable standards or lack of adherence to standards, damage due to excessive handling or inappropriate containers, etc.” (ibid. 11) Basically manufacturing operations are divided into three aspects (products, methods and systems, and resources) and the ways in which the different types of waste in any of these aspects could impact quality, cost and delivery were to be identified and dealt with.

There was also strong emphasis on the impact of production technology and process capability on quality. As noted, there was a Production Headquarters at the corporate level and a divisional Production Technology Centre located at the factory site. The development of production technology standards was to “prevent defects and ensure reliability of manufacturing conditions”. (ibid. 178) The effect of improvement in process capability, particularly in upstream processing of parts, is that “defects decrease in assembly, adjustment operations are reduced and work can be simplified. Since simpler work will also result in fewer mistakes ..., defects are reduced even more.” (ibid. 183) Increased process capability was also seen as contributing to reduction in start-up time for new products.

This comprehensive and integrated approach was duplicated at the shop floor level in the concept of workplace organization, called the Premier Work Center or “Premier Workplace” (*Yuryo Shokuba*). The main components of the Premier Work Center are the basic structure, the departmental and section managers’ policies, the specialist committees, the foreman’s G-CPS plans together with the workplace environment and at the centre, improved efficiency and quality, on-time delivery (basically the QCD trilogy), 5S and human resource development. The factory manager’s policies are supported by follow-up bodies at the factory, departmental and section level. The basic structure underlying the Premier Work Center as described by the production section at Ami consisted of the five E.Q.C.D.S. assurance systems and the G-CPS Plans for each work area set targets for each of EQCDS. Workplace environment was only one component of the “Premier Workplace” which both influenced and was influenced by the

[293] The nine wastes are work-in-progress, defects, equipment, expenses, indirect labour, planning, human resources, operations, and start-up.

supervisor's G-CPS plans. Moreover, workplace environment was seen as resting on specific activities such as education and training, 5S activities, small group activities and the suggestion scheme as well as the HELPA system of social activities.

It is important to note the extent of the support structures which had been put in place at both the corporate and factory level. At the corporate level, this included;

- at the highest level, corporate committees for each of G-CPS, G-CDS and G-CMS
- the Quality Division (Hinshitsu Honbu) and the Production Division (Seisan Honbu) which in turn included the QA Promotion Centre (Hinshitsu Suishin Senta) and the Production Management Administration Centre (PMAC) (Seisan Kikaku Senta) respectively. The PMAC included the G-CPS Planning and Promotion Department/Division.
- in the case of quality, there were also separate QA Centres for five of the six product-based operating divisions. (e.g. BJ QA Centre; BJ Hinshitsu Hosho Senta)

At the factory level, this included;

- the QA Office which was located directly below the Factory Manager and had a coordinating and supporting role and the IE Promotion Department
- committees at the section, department and factory level, many of which were parallel structures, concerned with quality and CPS. At the departmental level, for example, there was a CPS Committee with representatives from engineering, QA and production/assembly sections. (See Chapter. 4, pp.76-77 and 45-48.)

These structures can be seen as constituting a multi-tiered structure which plays a vital role in achieving and maintaining high levels of quality performance and the sophistication and coherence of the quality control system. In this context, the factory is the lowest level – the application level of this structure. Looking only at the factory level may give an exaggerated perception of the weight of direct production activities or of problem solving and corrective actions as opposed to major improvements. The existence of this multi-tiered structure demonstrates that both within the factory and particularly beyond, quality control does not depend only (or even mainly) on direct production activities, much less on the "shop floor". Rather, the contribution of indirect staff departments/sections (particularly engineering departments) both at the factory level and at higher divisional and corporate levels is essential to achieving the required levels of performance, including quality performance. Indeed, it is not difficult to see that given the demands of production, it would be impossible to develop and maintain systems of the level of sophistication apparent at Canon relying only on the activities of the shop floor.

A-2 Case Study 2: Bridgestone Hikone Plant

Background: The Company and its Operations

Bridgestone is a major international maker of automotive and other special use tyres. At the time of the research, the company had a total of 82 plants in 18 countries in addition to 14 plants in Japan of which 37 and 9 respectively produced its traditional main product line. The company also manufactured a range of other related products in addition to its main line including sporting goods (especially golf) and marine products. The company was established in 1931.

At the company's inception, the founder, foreseeing that the future of the company would lie in exports, decided to select an English name for the company. Moreover, the importance attached to quality is expressed in the company motto; "Providing top level quality to society" ("*Saiko no hinshitsu wo shakai ni.*") which has remained unchanged since its inception. As a manufacturing company, it was exceptionally profitable with a (profit to sales ratio- *uriagedaka no keijo rieki*) in excess of 10% compared to the usual 4-5%. The company had a workforce worldwide of 92,000.[294] It was the third largest domestic maker of automotive tyres with a workforce of approx 13,500. Only about 40% of the company's output of tyres was produced domestically, of which 50% was exported, 20% went to local OEMs and 30% to the local consumer market. While the company, like all of its competitors, had diversified, the main product line still accounted for a larger proportion of its total output. Its share of the world market was approximately 20% (the highest in the world though by only a very small margin and depending on the exchange rate) and in regard to certain specialized types of tyres was as high as 60%.

The company Technical Centre (R&D) had three principal divisions; product design, quality assurance, and manufacturing technology. Bridgestone was one of the Japanese companies which had embarked on the development of its own machinery and equipment. The company's Japanese plants had a significantly higher level of automation than its overseas operations. This was explained in terms of the relatively high labour costs in Japan which it was claimed account for a large proportion of production cost and was regarded as a major issue given that Japan, and this particular company's business, depended on exports and therefore had to be internationally competitive.

The Hikone Plant commenced operations in March, 1968, the year Bridgestone won the Deming

[294] While the company had progressively expanded its operations mainly in Asia up until the 1970s, in the 1990s, it took over a major international competitor (with world wide operations) which more than doubled the company's production capacity.

Prize (Japan's premier quality award). In 1968, the plant received authorization to use the JIS (Japan Industrial Standards) mark. Hikone manufactured a range of passenger steel radial tyres. The plant was an integrated manufacturer handling the whole process from raw material to finished product. The plant produced about 22% of the company's output in terms of units but only about 12% in terms of weight since it did not produce any of the large size models. About 20% of the plant's output was exported, about 45% went to OEMs and 35% direct to the consumer market.

Employment at the plant peaked in the mid-1970s and by the late 1990s had decreased by more than 25% to about 1100, of whom 940 were production-related (710 direct; 230 indirect). Production however roughly doubled over the same period. Aging of the workforce was a problem with the average age at 43 years. Quite exceptionally for a Japanese company, Bridgestone ceased annual recruitment of new school leavers for the shopfloor workforce in 1976, although there was an intake in 1978-80 and again in the early 1990s. Recruitment of young workers was a problem because the work was at least uncomfortably close to what is referred to in Japan as the three Ks (one or more of difficult (*kitsui*), dirty(*kitanai*), dangerous(*kiken*) – the three Ds in English).

Attempts to recruit both new school graduates and "mid-career job-seekers" (*chuto saiyo*) in 1992-94 had met with limited success in terms of retention rates. The factory recruited 86, 50 and 25 workers in 1992, 1993 and 1994 respectively, of whom 21 in 1993 and 25 in 1994 were new school/university graduates and the rest "mid-career job-seekers" but all of whom were under the age of 35. By 1997, only 31, 25, 15 respectively of these recruits were still with the company. In other words, less than half had been retained. About one third of the new school leavers and over half of the mid-career recruits had left. (In the Personnel manager's view, it seemed that mid-career recruits had developed the habit of quitting a job soon after they started). New school leavers complained about night shift and not being able to meet with their friends on the weekend because of the shift system. In addition, the manager explained, because their numbers were dispersed among the four shift groups, the new young recruits found that they had little in common with their co-workers, most of whom were 40 years of age or older. The present personnel manager was transferred to the factory in 1994 and, in 1994-95, many of these new recruits left but by the following year most seemed to have settled in and there were almost no 20 and 30 year olds who quit.

The factory worked a 7-day week operation on a 4-3 shift system. The workforce was divided into 4 groups (*han*) which rotated through a 3 x 8 hour shift system on a five days on, two days off pattern. It was stressed that job assignments were not rigid. So if someone was absent and a substitute could not be found in the form of overtime from the previous shift or an early start by the following shift, then work assignments were reorganized within the shift to cover the gap. Indirect staff did not work on weekends but were rostered onto an on-call list. There was a specified procedure for calling out indirect staff and contact details were available. The supervisor played an absolutely key and crucial role and was responsible for overall management of operations and supervision of his subordinates. If a problem occurred at the weekend, this was the person who was responsible for deciding whether a staff member needed to be called out. Manufacturing operations were closed down for a total of 18 days a year during which time major maintenance and improvements were carried out on machinery and equipment.

In general, automation and computerization had been vigorously pursued and it was commented that the plant was considered a highly automated operation by industry standards. The old technology required 2 machines operated by at least 3 workers (in total) and transport of partly processed product on trolley racks from stage 1 to stage 2 machines. The company developed a system to link the two machines together thus eliminating the transport of product between processes and reducing the required number of operators to one. Various other features such as the automatic feeding and centering of materials and automatic cutting to length had also been added. Despite these greatly increased levels of automation, it was pointed out that the key process (building) still depended heavily on the manual skills of the operator.

The Australian Case Studies

A-3 Case Study 3: Bridgestone Australia

The Salisbury plant was established in 1965 and taken over by a major US-based multinational in 1970. In 1980, Bridgestone Japan purchased a majority holding in the company and when it acquired over 60% of the stock in 1981, the company's name was changed to Bridgestone Australia Pty. Ltd. Since this was not a fully-owned subsidiary, the company actually manufactured product under license from the Japanese parent company and was required to obtain and maintain brand qualification. However, to all intents and purposes, the company appears to have operated as a subsidiary of the Japanese parent with close technical links. The Managing Director and three of the four Executive Directors were Japanese but other senior managers were Australian. The company's head quarters and corporate office in Australia were located at a different site, adjacent to one of its other plants.

The company had three plants in Australia as well as 6 product reconditioning plants, 5 warehouse and distribution centres and 2 sales companies related to its core business as well as a chain of retail outlets. Types of product/models which were not manufactured in Australia were imported from the parent company and sold through its retail outlets.

The product consisted of about 8 to 10 major components all of which were manufactured in-house as part of an integrated manufacturing process from raw material to finished product. The production process could be broadly divided into four stages; raw material preparation and processing, component production, assembly, and final processing and finishing - each of which represented a separate production department with an area manager. There was a fifth production department looking after all stages of the process for a particular range of product. In addition, there was a Maintenance Engineering department, and the main production-related staff departments were Technical Services, Quality Assurance, and Projects Engineering.

The plant achieved record production and profit in 1995; annual production of over 2.2 mil units of the main product range (of a total domestic market of about 10 mil) - in other words, a market share of around 22% - and over 97,000 of the other two major product ranges as well as 51,000 units of refurbished product. The company sold to the consumer or replacement market and to OEMs (just over 20% of output) and exported about 8% of production to Japan and small numbers to NZ. The company had only one major domestic competitor but several other major overseas competitors which serviced the market through imports. Of the company's total workforce of 2,200, over 800 were employed at this plant. There were a total of 11 Japanese in the company as a whole, including the Executive Director of this manufacturing division and 5 technical staff at the plant, all of whom come on about a 3 year “tour of duty”. The factory worked a 5-day week 24 hour operation using three shifts which rotated on a weekly basis. Weekends and overtime were used for maintenance, as was the major shutdown at the Christmas/New Year period.

As with its parent company, the plant had substantially increased output while, at the same time, decreasing the workforce. Some years earlier, the plant was producing 8,000 units/day with more people (and reportedly thought they were doing well), but, at the time of the research, had increased production to over 10,000 units with less people and was aiming to further increase production to 11,500 units. Some of the reduction in labour requirements was the result of automation. For example, when the Japanese company took over the plant, assembly was basically a three stage process requiring 1 operator for each stage but with the introduction of a combined assembly machine developed by the company itself, only 1 operator was required for the whole assembly process. The old machines were gradually being replaced by the new but there were still several different types in use at the time. However, as discussed in Chapter 9, automation was by no means the main factor which explained the greater efficiency. There were also other important factors mainly related to tighter control of operations.

A-4 Case Study 4: NEC Australia

The Japanese parent company, NEC, had worldwide operations with over 100 affiliates and subsidiaries worldwide and a work-force approaching 200,000. In the mid-1990s, the company reportedly ranked, in the world, no.5 in telecommunications, no.6 in computers and no.2 in semi-conductors and electronic components.

NEC Japan's association with quality control had a long history going back to technical agreements with major American corporations in the prewar period. In the immediate postwar period, it was one of the five major telecommunications and electrical equipment makers which received extensive advice and guidance on management methods and systems and particularly on quality control from the engineering staff of the CCS (Civil Communications Section) of the Occupation Forces GHQ (see Chapter 2). The Japanese parent was one of the first winners of the Deming Prize and received the inaugural Japan Quality Award in 1997. In the early 1990s, the company released a major publication on quality control systems for software development and continued to maintain its position at the forefront of the quality movement in Japan.

The Melbourne operation was part of the larger NEC group in Australia and consisted of a corporate headquarters and a manufacturing site. Initially it appears manufacturing operations consisted largely of assembling product imported from Japan. By the time of the research, the manufacturing operation was engaged in a diverse and complex range of activities which included designing, building and installing large to very large scale telecommunications equipment and providing service contracts for installed systems.

The Australian company experienced a major crisis in the late 1980s when it was faced with the threat of closure. As a result, the Australian operations underwent a major restructuring which continued through to about 1994 and culminated in winning the Australian Quality Award in that year. During this time, the Melbourne operation also obtained ISO accreditation in 1992. "By 1994," one interviewee remarked, "we thought that all our problems were in the past" since the company had apparently achieved a massive turnaround - from a debt of $75 mil to the parent company to a local surplus/profit of $40 mil.[295]

In the two years prior to the research, there had been an amalgamation of two other formerly separate subsidiary companies in Australia with the Melbourne operation. As a result of the

[295] This seems to have been an internal accounting device used by the parent company to ensure that its overseas subsidiaries maintained profitable operations.

amalgamation, employment, which had been reduced from 1500 to 900 during the restructuring, increased again to 1200 and if the extensive use of contractors (approx. 400) is included, the actual figure was about 1600. At the same time, there had been a consolidation of the manufacturing function from four to two facilities and the breaking up of some divisions into separate functional areas. It appears that one of the objectives was to clearly identify the cost structure of the organization. In 1996-97, the Australian operation contributed only 1% of the organization's total worldwide sales but 3.5% of its world-wide profit.

There had been a fundamental change in the nature of the company's business from mass production for long-term contracts with large customers (mostly public corporations and government departments) to an emphasis on intellectual property and R-&-D with a major increase in software and hardware engineering activities. This shift was also associated with an increase in project-based work providing complex systems sometimes in conjunction with major overseas companies.[296] As a result of these changes, there had also been a fundamental change in the composition of the workforce – a decrease in the proportion of production operators and a substantial increase in engineering and design and development staff. Despite the shift in the company's operations towards R-&-D and projects, the view was that manufacturing would continue to exist because the two were complementary. One interviewee claimed that "if we're going to remain an active R-&-D organization which is Japan's plan for us, we need to maintain a stable manufacturing base in the country where the R-&-D is taking place".

The Mulgrave Plant had two manufacturing areas, of which the larger was divided into two areas - a highly automated and computerized plant producing PCBs and an assembly and test area. The assembly and test area had recently been converted to a cell manufacturing system of six cells partly product and partly function based. This had reportedly been attempted once before but had not been successful. Organizationally, the manual assembly and test area had a production supervisor to whom five Leading Hands reported – four general and one technical. The workforce of 55 in the production area was divided into two groups - operators involved in assembly and inspection and technicians responsible for testing, repair and trouble shooting. The Production Engineering Department was divided into two product groups, each with a line manager (meaning product line manager), and a support group. Within each product group, there were basically product engineers and test engineers and each engineer was assigned responsibility for a number of products which they typically saw through from start-up to cessation of production. Their responsibilities included process design for assembly and testing,

[296] For example, just prior to the research, NEC (Aust.) had joined a joint venture with an overseas partner which had won a major Australian government contract in the multi-media area and manufacturing of product for this project was occurring at this site.

preparation of manufacturing documentation, setting of standard times, process improvement and general production support activities.

A-5 Case Study 5: General Motors-Holden's (GMH)

This site was one part of the Australian operations of the worldwide operations of the US car maker General Motors (GM). The engine operations (alternatively referred to as HEO or HEC)[297] produced a range of engines and components for passenger vehicles – 4, 6 and 8-cyclinder, of which the 4-cylinder engines accounted for by far the largest proportion. For 4-cylinder engines alone, the company was (at one time) producing approximately 90 variations based on a combination of different engine sizes, manual/automatic transmission, rear/front wheel drive, emission levels and levels of trim. This was not without its problems. As one manager commented; "... customers were given an opportunity to say, well, what type do you want - we've got a deck of cards here, just pick one the one you want. ... and knocking it down the line out there is just absolutely horrendous. But we did it and we got into trouble a few times. We had to air freight and it cost us money. … but a while ago we were making a fair amount of dollars."

The operation had a high degree of vertical integration – covering the whole process from casting to final assembly. And, for a major car manufacturer, an unusual high level of horizontal diversification in that it produced a wide range of parts/components in-house instead of sourcing from suppliers: this included 4, 8, and 15 components for each of its main product lines and another 5 by a separate/ dedicated components production area. (Some components were common to more than one product line and/or the components area.) Depending on the component, some were either cast or machined and some both. Moreover, as well as production of engines for both the domestic and overseas markets, the company also manufactured engines and components for export to different parts of the parent company's worldwide operations and provided contract engineering services for domestic and overseas customers (again generally part of the company's own worldwide operations). Production peaked in the years 1994-96 and then declined substantially. The exception was an expected new high level of production for 4-cylinder engines – plans that were thrown into confusion when the major Asian customer was severely hit by the Asian financial crisis in 1997.

Holden's originated as a saddlery business in Adelaide in 1856, moving on to repairing and then building horse-drawn carriages and coaches in the latter part of the 1880s and to car upholstery, hoods and side curtains in the early 1900s. In 1914, the company (then Holden and Frost) produced its first complete car body using traditional carriage building techniques. The

[297] When the operation was set up as a separate company, it was called Holden Engine and Components Company (HEC). As part of the reintegrated Australian operations, it was called Holden Engine Operations (HEO).

company commenced large scale production of car bodies for imported chasses during World War One and by 1919, had evolved into Holden's Motor Body Builders Ltd. The company took a leading role in the industry introducing the latest technology and expanded rapidly. In 1924, GM Export Company (Aust.) (the GM subsidiary in Australia) was so impressed by the company's newly-opened facility at Woodville, S.A., that it abandoned its own plans and contracted HMBB to be its sole body builder in Australia. In 1926, the company produced over 36,000 car bodies. Unfortunately, the company had just completed another major expansion in 1930 when the Great Depression hit and the company was closed for much of the following year. As a result, it was taken over by General Motors in 1931 and became known as General Motors-Holden's Ltd and cars continued to be marketed under the local Holden brand name. By 1935, the company was profitable again and continued to play a leading role producing its first all-steel body that year (a year earlier than GM in the USA) and installing the first 1000 ton press in Australia in 1938.

In 1936, GMH bought the 20 hectare site at Fisherman's Bend in Melbourne – the site on which it currently operates – and provision was made for a foundry and engine shop. Discussions about the manufacture of a complete car in Australia began but were put on hold with the outbreak of the war in Europe. Instead GMH factories began working for the war effort producing aeroplane frames, bomb cases, anti-tank and machine guns, armoured cars, semi-trailers, troop carriers, boats, pontoons and other military hardware. During the War, GMH became the first Australian company to mass-produce internal combustion engines. At the end of the War, GMH had a full-scale foundry and the ability to make engine blocks and other mechanical components. When GMH produced the first all Australian passenger car in 1948, it was a great success. Ultimately, over 120,000 were sold. Exports to New Zealand commenced in 1954. A new plant was opened at Dandenong in 1956 and Holden's production capacity reached 100,000 a year. A new engine plant and foundry were opened at the Fisherman's Bend site in 1963.

By 1963, exports had reached almost 11,000 cars to 55 overseas markets and GMH continued to expand its operations. In 1967, the company produced its first small car and opened a new assembly plant followed by another new engine plant to manufacture 8-cylinder engines. Production and exports continued to increase with the 1,000,000th vehicle produced in 1962, the 2,000,000th in 1969 and the 5 millionth in 1990 and exports of cars reached 20,000 in 1965. A plant to manufacture 4-cylinder engines was established in 1981 and exports of 4-cylinder engines commenced. Engine exports reached a cumulative total of 250,000 at the end of 1983, 1,000,000 in 1988 and 1.5 million in 1991.

In the wake of the Oil Crisis, GMH produced a local version of GM's first world car in 1975. By 1980, GMH badged cars were being manufactured by Isuzu in Japan in which GM had a substantial shareholding by 1985. During the 1980s, Holden also set up local joint ventures with Nissan and then Toyota in Australia. By the 1990s, some GMH badged models were combinations of designs, engines, bodies and components sourced from and built in different parts of GM's worldwide operations (including Germany, the UK and Spain) to which the Australian operations were also contributing engines and components.

The engine plant and its relations with other parts of the Australian operations seemed to be in an almost constant state of flux[298] – at least in recent years. The company had undergone numerous reorganizations and more were planned. This included both minor and major organizational changes and changes to product lines. It seems that the beginning of turbulent times for the engine operations dated from the renewed emphasis on exports in the 1980s under the then Labor Government's plans for rationalization of the car industry and the expansion of manufactured exports generally. GM-Holden's was reorganized into two separate companies, Holden's Engine and Components Company (HEC) and GM-Holden's Motor Co., its assembly operations, in 1986 and in the following year, plans were announced for a GMH-Toyota joint venture in Australia (United Australian Automotive Industries).[299] The joint venture was established in 1988 and dissolved in 1996. Furthermore, in the midst of all these changes, HEC was also required to find and expand export markets and deal with overseas customers. This was apparently a rather confronting and cathartic experience for the organization and its customary practices as well as many of the staff. During the phase of its independent operations, there was also an attempt to set up component manufacture as a separate, self-contained business unit within engine operations and raise manufacture and sales of components to external customers to 25% of the company's business. The attempt was not successful and was eventually abandoned.

Subsequently, with the wind up of the joint venture, the engine company was again being reintegrated with the car assembly operations. The reintegration had been in progress for about 18 months in late 1998. The reintegration of the businesses raised some major issues which were only just coming onto the agenda; in particularly, the reintegration of training systems and what to do with the QNS program (which had only operated at the engine operations) and the

[298] A brief scan of the history of the parent company also indicates that there had been frequent reorganizations of its worldwide operations, including the forming, restructuring and withdrawal from joint ventures and the restructuring of its corporate headquarters which controlled the worldwide operations.

[299] At this time, GM and Toyota also had a joint venture in the USA (New United Motor Manufacturing, Inc.; NUMMI) established in 1983.

Holden Production System (which had been developed at the assembly operations).

Mention has already been made of the fluctuation in production volumes during the 1990s, partly as the result of problems experienced with a major new Asian customer. The 350 workers recruited to meet this new order were retained and eventually the customer did recover and was able to reinstate the order. However, this incident prompted the company to diversify its customer base to guard against a recurrence. Other changes about to occur at the time of the research were the phasing out of one major product line and the commencement of supply of 4-cylinder engines (which had previously been for export only) to the domestic car assembly operation.

Finally, just as the research began, the company was in the midst of a major disruption to production caused by a large explosion in the state’s privatized gas supply system as a result of which restoration of supply was uncertain but expected to be a protracted process. Since the operations’ energy supply was heavily dependent on gas, staff were scrambling to secure and install alternative supplies of energy in order to restart production.

The Engine Operations

The engine plant was a highly complex operation which produced for different parts of the parent company organization and for both domestic and overseas customers. There were four major product types or groups (4-cylinder, V6, V8 engines), including a component manufacturing group. The site itself was also a complex one consisting of nine plants. The operations could be broadly divided in to three more or less distinct parts –foundry, fabrication and assembly. Whereas assembly was common to all product lines, the number of components cast and/or machined in-house varied from product to product. At the time of the research the engine operations employed about 2,500 people of whom over 500 worked in the foundry.

One part, the foundry, seemed to be almost a world of its own and indeed combined its own production, engineering and maintenance functions. Even the quality assurance staff gave the impression of being at least as strongly attached to the foundry as to the separate QA department. One got the impression that the employees from management down saw themselves as different and were inclined to rather jealously guard “their territory”.

Of the other two areas, fabrication had four area managers apparently divided by a combination of groups of components and types of manufacturing systems and a fifth area manager in charge of afternoon shift. In the assembly area, there were three area managers – one in charge of afternoon shift and responsible for all product lines and the responsibilities of the other two divided by product line. The fabrication and assembly areas were serviced by a single Manufacturing Engineering Department which reported to the same Plant Manager. However, maintenance[300] and quality assurance were provided by departments at the next higher level of the organization. Within the fabrication area, three group leaders were identified as being in charge of maintenance – one on afternoon shift and two reporting to one of the area managers. There were no group leaders in the assembly area who were identified as responsible for maintenance.

After the reorganization and the abolition of the position of Plant Manager, Engines, the managers of Fabrication and Assembly reported directly to Executive-in-Charge, Operations. This seemed to represent an elevation of their status to the same level as the manager of the foundry, finance, materials management, employee relations, quality assurance, and the new Manufacturing Engineering. The last was created by combining most of the former Central Services and Manufacturing Engineering into a single department. The maintenance section of the former Central Services had been dispersed to form separate maintenance sections with their own managers under each of the production managers for fabrication and assembly (which made the pattern more consistent with the foundry). In general, this appeared to be a much more rational organization of functions which had formerly been split between Central Services (reporting to the Executive-in-Charge, Operations) and Manufacturing Engineering (reporting to the former Plant Manager, Engines).

Partly because of the fluctuations in volume mentioned above and partly because of the differences in the range of components produced in-house for different product lines, working hours and working patterns varied considerably across the plant. For example, in the fabrication area, there was a combination of both 8 hour and 12 hour shifts. There were three 12 hour shift groups working a 6-day week with one rostered off while the other two rotated.[301] Moreover, whereas some areas were working "all day, every day", others had been cut back from three to two 8-hour shifts and still others had been cut back to one shift and then, for a period of months, to 4 days a week. It was interesting to note that these cutbacks had highlighted the pressures for higher performance. The cut back to one shift had been caused by a reduction in volume to

[300] The maintenance section was located within the Central Services Department which was subsequently amalgamated with Manufacturing Engineering to form the new Manufacturing Engineering Department.
[301] There were plans to abolish 12 hour shifts because the company was finding difficulty getting the quality and continuity that was considered necessary. I was told that it was "very difficult to get continuity and get people to take ownership of the job they're doing. They're thinking about their game of golf tomorrow or what they'll do on the weekend". However, it was unclear when this was likely to happen since the company had just completed an enterprise bargaining agreement for next 3 years but the issue had not been raised because the company did not want to "upset the apple cart during negotiations".

almost half. But as one interviewee reported, “we could knock out [that number in] a day, no problem in three shifts. But … we’re trying to do [that number of] engines a day in one shift. Never, ever done that before. And that’s very, very difficult.”

History of QC at GMH

It proved difficult to obtain information about developments prior to the time of the research. The newly appointed QA Manager disclaimed almost all knowledge of what had happened before he arrived. With respect to activities leading up to initial ISO9000 accreditation, he remarked, “1993 was a long time ago and I wasn’t here.” Similarly in relation to QNS and the QNS group, he declared, “I don’t know how it evolved and how it evolved into the group that it is now.” and as to what activities had been undertaken prior to 1993, his only comment was, “I wouldn’t have a clue.”

Another staff member with almost 30 years experience with the company was able to throw some light on past activities. In the course of his experience with the company, he commented that “I’ve seen a lot of systems but I’ve got to say that the **true total quality management system as such which you would get out of a textbook was never really given much credence in our operations**. We’ve tended to do it our way and do it in an **old-fashioned way**.” (emphasis added) In 1980, this employee had been asked to give a quality awareness programme to all employees at the company’s assembly plant. Later in the same year, his boss was appointed Executive Director of engine operations. The plant was just beginning a new programme to build 4-cylinder engines and the interviewee was asked to come to the plant and deliver the same quality awareness programme as part of the preparation for the manufacturing programme. As production workers were employed, they were put through the programme. The programme was “just an introduction to quality” and lasted for about 4 hours. The programme itself was put together by the interviewee based on his own knowledge and experience – not taken “out of a textbook”. In 1985, the interviewee held the position of Senior Quality Analyst whose duties were to format QC operating methods & procedures. At this time, there was also a training course in Total Quality Control in place at the plant. In 1993, the plant gained ISO9000 accreditation. I was told that preparation for ISO9000 accreditation was largely the responsibility of the Departmental Managers at the time – with input from a few other individuals.

Around this time, a new Executive-in Charge, Operations was appointed from America and introduced the QNS programme which had been developed in the company’s US operations. The interviewee mentioned above undertook a Quality Network Synchronous (QNS) training programme in 1994 and in January, 1995, was sent to North America to look at the QNS type activities at 6 of GM’s facilities. On his return, he was immediately assigned to the QNS group and delivered a training programme focusing on IE and employee involvement in designing work practices. Early in the following year, however, he was transferred back to the QA department to provide “quality support to manufacturing groups”.

The plant successfully obtained ISO re-accreditation in 1996 – much to the annoyance of the new QA manager. The QA manager had been transferred from one of the company’s other plants to fix what was considered to be a barely functioning quality management system. He was incensed to find that a matter of months before he arrived the engine operations had received reaccreditation to ISO 9000 and planned to meet with the accreditation agency to make a complaint.