PDCA TULTA® METHODOLOGY: An Innovative Problem-Solving to Enhance Quality Activities in Manufacturing

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Finally, this dissertation is dedicated to my beloved Grandson "KAIZEN" as well as his dad and mom - Dimas and Hani; since his blessed name was imbedded in the thesis which is meaning "Continues Improvement".

SPECIAL DEDICATION

I dedicate this thesis to my lovely wife Mrs. Rini Wiyanti., Master of Management, who never had stop supporting me, both during my severe pain strokes and up to now when this study written. At my age of seventy-one, she is my source of inspiration, wisdom, knowledge and understanding, where she has been the source of my strength throughout this program and beyond. I am also very grateful, for all her encouragement, especially for formatting and editing this study work, which I gratefully acknowledged.

DECLARATION

The dissertation titled "PDCA TULTA® METHODOLOGY". An Innovative Problem-Solving to Enhance Quality Activities in Manufacturing, submitted to Selinus University of Sciences and Literature, Faculty of Engineering & Technology, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy (PhD) in Industrial Engineering.

The study is my original work, and the dissertation has not formed the basis for the award of any other degree, or any other associateship or fellowship. The thesis beefed up by hands-on experience and years of exposure to "Total Quality of Management" activities, initiatives and programs as the Fundamental Concepts of Quality Management, such as Continuous Improvement, Customer Focus and the Value of Every Member of the Organization. Reference materials cited from other sources incorporated in the dissertation have been duly acknowledged. "I do hereby attest that I am the sole author of this thesis and that its contents are only the result of the readings and research I have done".

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ABSTRACT

In this study, researcher would like to show the deep research finding about the complexity of manufacturing procedures in Indonesian companies; that had been implemented for a very long time. The negative consequences on workers were the difficulty of improving quality, as same as productivity. What's the main reasons? Based on long experience, the fact shows that for more than three decades, much has changed in the world, in United States; Europe; Asia especially in Indonesia as well. The consequences force continuing evolution of business and business improvement methods. The Why and the How of Total Quality Management (TQM)by then had developed over 40 years, first in the USA then in Japan and in Indonesia. Historically TQM was focused on improving the quality of products and services and doing so with maximum efficiency. (Researcher called it as Total Quality--TQ). By the time the concepts known as TQM that moved from the management of quality to the quality management, dealing with the ongoing improvement of the way an organization is managed in the rapidly changing world. But in fact, based on deep experience, researchers realized that finally the focus not limited to product or service quality, but in this study began stated and written about Total Quality of Management (TQ of M).

Due to non-standard production methods applied by most companies, coupled with its absence of proper quality assessment system, the quality improvement performance was difficult to be measured. The researchers who conducted study for two years had invented the steps by step of problem-solving which will be useful for speeding quality improvement up which adds value to the company's quality performance. The research title is "PDCA TULTA® METHODOLOGY", an Innovative Problem-Solving to Enhance Quality Activities in Manufacturing, consisting of Seven (7) Steps, as explanation of Plan-Do-Check-Action (PDCA) functions. This methodology was initially developed for Indonesian workforce's Problem-solving Standard Guidelines.

The PDCA TULTA® METHODOLOGY" (henceforth written as "TULTA") can be implemented by QC Circles after attending intensive the continuous-training, provided by IQMA (Indonesia Quality Management Association) regularly. But in practice, I found a non-inconsistency between 'TULTA" implementation vs. "QC Circle overall performance results, due to the absence of quality evaluation standard procedures.

That is the main reason why researcher conducted further studies to develop "Evaluation System for QCC-TULTA Practitioners", that translated from Bahasa as *"Sistem Penilaian PDCA-TULTA"*, originally. After the 2nd methodology used to evaluate the overall performance of QCC-TULTA, which was carried out in a Quality Conventions (both at National and international level), researcher stated that: By *using "Sistem Penilaian PDCA-TULTA"* as reliable assessment methods, QCC "TULTA" implementation also increases significantly. (Case Studt; Indofood Noodle Divisions Manufactures Assessment Results in ICQCC'22, organized by IQMA (Indonesia Quality Management Association) in Jakarta-Indonesia, and ICQCC'23, organized by CAQ (China Association for Quality) in Beijing-China *(see Case study in page 72 to 94).* **As lesson learned, this study emphasizes the need of company must integrate management technology into its strategic objectives and will be taking the proactive stance in introducing and promoting new methodology developed with a greater emphasis on cycle time. Besides, the management should be understanding how vital the interdisciplinary needs in implementation of the "PDCA-TULTA Methodology" combined with the "QCC-TULTA Assessment" System.**

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INTRODUCTION AND AIMS OF STUDY

INTRODUCTION

The title of the study is **"PDCA TULTA® METHODOLOGY", An Innovative Problem-Solving to Enhance Quality Activities in Manufacturing.** The reason is; after applied many kinds of productions procedures where all those methods brought by the technology owner into the country, such USA, Germany, Holland, Japan, China etc. as shown in **Figure.1**. It took so long time after Indonesia independence (from 1945 to 1995), finally by invented this new problem-solving, the company having the production technical step by step standard; namely "PDCA- TULTA methodology". The origin name of the methodology created in **Bahasa** as "**TULTA**"; the combined words of **TU**L and **TA**; the short of "***TUL*** as TUJUH LANGKAH" means "Seven Steps" (meant the 7 Steps of Plan-Do-Check-Action cycle) and "***TA***; TUJUH ALAT" means "Seven Tools" (meant 7 QC Tools). So, the meaning of TULTA translated as "Seven Steps & Seven Tools". After three decades, based on the number of convention participants, the PDCA TULTA practitioners have reached thousands of companies in the country and researchers hope that through this dissertation writing, more and more company could bel use it, correctly and effectively.

1.1 Research Aims.

In this thesis, researcher explore the intricate relationship between "QC Circles - TULTA" practitioners and "Its Evaluation Results" that carried out by Quality Evaluator. (carried out by Certified QCC Judges) through competition programs. The final assessment results will able trace the complementary of each other intermutually and by applying the methodologies, the QC Circles overall performance will be significantly increases.

The main reason why this quality problem-solving methods was developed based on Indonesian workforces behaviors, because of all production processes they practices were imported by manufacturing owners, so by developing this Indonesian "production's behavior", researcher hope that it will be motivate the workforce solving all their own quality problems in the workstation; regardless in production lines or services manufacturing. As Senior TQM (Total Quality of Management) Consultants, researcher have been fascinated by the profound influence of these twokinds of inventions, that complement and support each other, in TQM.

1.2 Study Methods.

This study employed a sequential mixed methods research design, which combines both quantitative and qualitative methods. Combining quantitative and qualitative methods provides broader perspectives and better understanding of research problems than either approach alone (Creswell, 2014; Johnson & Onwuegbuzie, 2004; Johnson, Onwuegbuzie, & Turner, 2007).

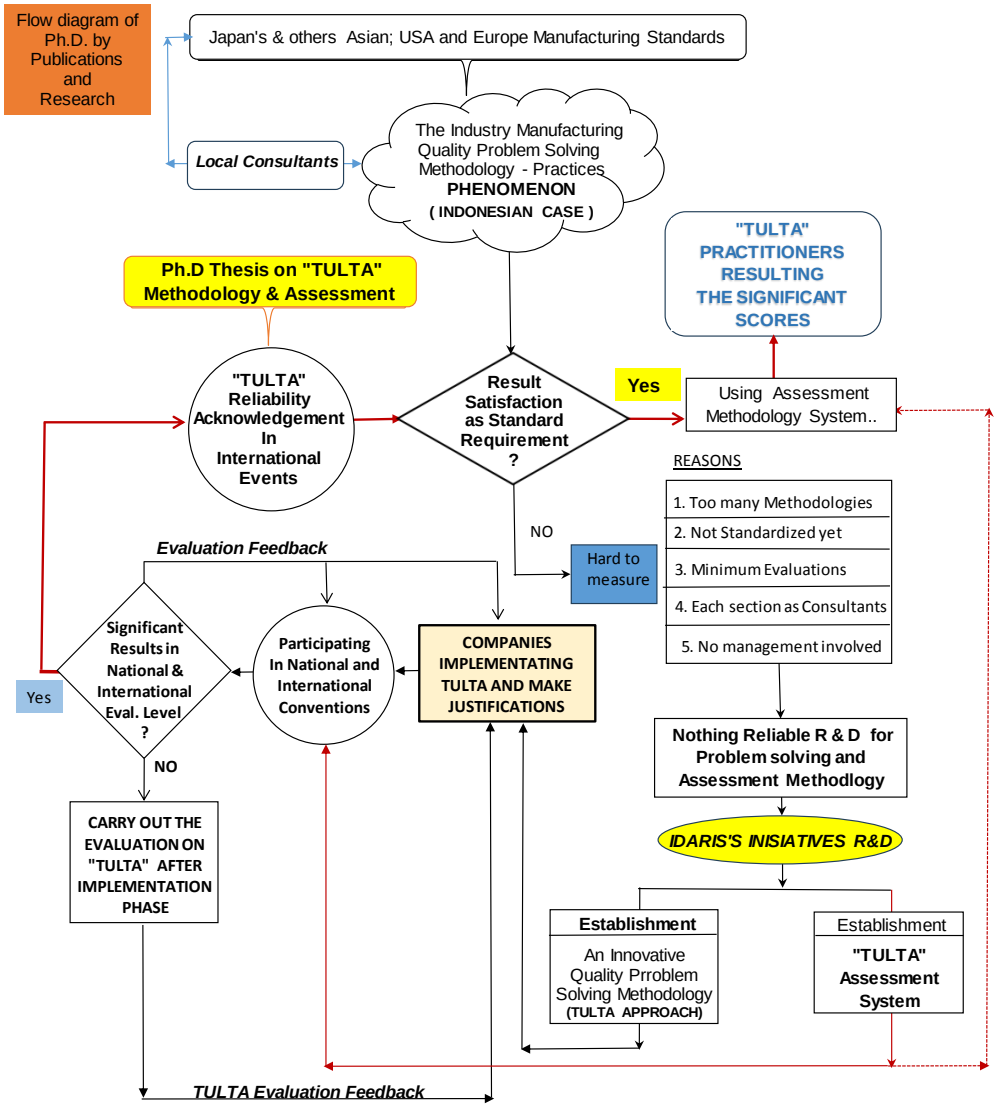


Figure.1. The Complexity of the productions processes in manufacturing. (Indonesia Case)

The study began with a thorough review of the existing implementation of TQM (TotalQuality of Management or TQM) in the field of PDCA cycle (Plan-Do-Check-Action) and quality issues problem prevention, especially concerning approaches related to Quality Improvement (QI) and SOP (Standard Operating Procedures) in daily management, using SDCA cycle (Standard-Do-Check-Action). This research results were obtained from qualitative study methods. Following, this phase study was focused on the evaluation of overall performance of QCC, the implementor of PDCA- TULTA Approach. As fairness and objectiveness, the evaluation was carried out by Certified QCC Judges or Auditors in the Quality Conventions.

The results of QCC- TULTA Evaluation system, categorized as quantitative methods; because the evaluation results will be calculated quantitatively which is finally arranged in The QCC Scoring sheets. (*Score = Weigh x Marks*)

1.1 Plan for Work

In this study, researcher will explore the role of PDCA-TULTA METHODOLOGY as aneffective *Problem-Solving Tools* and at the other hand, the development of TULTA Assessment System, that will be becoming the *Overall Performances Measurement Tools*. In practicing these two methodologies, the researchers hopes that the results will be complement each other to improve total quality performance, ultimately.

1.2 Delimitations of the Study

This intentioned problem-solving methodology (PDCA-TULTA Approach) and the TULTA-Evaluation System (QCC-TULTA Evaluation Guidelines) were developed through deep studied and reviewed on the existing of non-standardized production techniques & procedures, practiced for so long-long time by any kinds of companies, long before Indonesia became independent. As shown in the Fig 1. above, due to very complexity of the productions technical processes in producing goods or services, the choice of research this method aims to provide an *objective method applicable* rather than narrative view to minimize bias.

1.3 Assumptions

In established this innovative methodology, the following assumption were made: 1. The independent as well as dependent variables are respectively defined in the studies, as “Problem Solving PDCA “TULTA Approach” and “QCC-TULTA Evaluation System”. 2. Research consulted in this study defines independent variables in terms of all QCC TULTA Practitioners which are joining the Convention, has the capacity to be evaluated, while dependent variables are defined by “Scores” sheets (Score = weigh x marks), which obtained by each QCC, conducted by Certified Quality Auditors Judges in the same Convention. In this study, for reliability and validity; the companies as the evaluation object (such as, size and type) are clearly denied in terms of the effect that they will produce equal measurement results.

1.4 Organization of the Thesis

This systematic review study has four parts as follow:

1. The Old-8 and 12 Steps of Production processes.

2. The PDCA- TULTA Methodology as an intervention.

3. QCC Convention, organized by Company and by IQMA (Indonesia Quality Management Association) at the national level.

4. ICQCC 2022 Jakarta and ICQCC 2023 Beijing as **International Quality Competitions**

Parts #.3 & 4 should be assumed as **Specific Outcome Implementation** of PDCA "TULTA" Methodology, due-to the standard requirements of Quality Competitions, has to be evaluated by IC**QCC Certified Judges** as **the Proven of the Comprehensive Practices** of "PDCA TULTA® METHODOLOGY" to managing for Quality Improvement in **Total Quality Management (TQM)** of the company.

CHAPTER. 2

LITERATURE REVIEW

TOTAL QUALITY MANAGEMENT (TQM)

GENERAL INTRODUCTION

In the past 20 or 30 years a few companies have radically transformed their businessperformance. Many of the concepts and methods they have used are now collectivelycalled “total quality” or “total quality management”. Many other terms have also been used. These include “business transformation, performance excellence, business excellence, and six sigma”. The successes of these companies have dramatically changed how they and others see both quality and business management today,they are rethinking how they organized, how they manage themselves, and evenwhat businesses they should be in.

2.1. Introduction to Total Quality Management

In the past two decades many organizations throughout the world have been under tremendous pressure. Some have been battered by international competition, others by new entrepreneurial companies that redefined businesses, and yet others were seriously challenged by new technologies which created formidable alternatives to their products and services. Some leading companies have changed rapidly. While some of the new companies have now become major players, other companies are still engaged in daily battles for survival, and many other companies have disappeared.

Many companies have found that all of their radical restructuring, reengineering, downsizing, and numerous quality programs may have helped them survive, but they still do not have a distinctive quality advantage. Their future will be determined by three key areas: alignment, linkage, and replication. Combined with the fundamental concepts of quality management continuous improvement, customer focus, and the value of every member of the organization), their work in these three key areas is transforming the way they are managing the entire organization.

During these years there has been an increasing global emphasis on quality management. In global competitive markets*, quality* has become the most important single factor for success. Quality management has become the competitive issue for many organizations. Juran has gone so far as to state that, “Just as the twentieth century was the century of productivity, the twenty-first century will be the quality century”.

Reimann (1992a), then Director for Quality Programs, National Institute of Standards and Technology, U.S. Department of Commerce, in testimony to the U.S. Congress, stated this clearly,” there is now far clearer perception that quality is central to the company and to national competitiveness.”

In the United States, the President and the Secretary of commerce have given their personal support and attention to quality, thus; elevating quality on the national agenda. Their efforts have helped the American public understand that quality is a main component in national competitiveness. In other countries, such as Argentina, Brazil, France, Greece, Indonesia, Malaysia, and Singapore.

From where leadership from the top levels of government and business has also been creating national programs of awareness, training, and awards**.**

In October 1991 a leading international business magazine, *Business Week,* published a bonus issue devoted entirely to the subject of quality. The editor-in-chief, Stephen Shepard, called is bonus issue "the most ambitious single project" in Business Week's 62-year history. Shepard further commented that quality "may be the biggest competitive issue of the late twentieth and early beginning of third millennium centuries."

This Issue was sold out in a matter of days. The demand was so high in the United States and throughout the world that *Business Week* had to make two additional printings of tens of thousands of magazines. At the end of the year, the magazine's editors of the United States named this issue the" Magazine of the Year." The top honor for magazines in the United States.

During 1991, the U.S. General Accounting Office (GAO) completed a study of Malcolm Baldrige National Quality Award winners and site-visited companies. The GAO carefully studied the relationship between quality management activity and success and profitability. This report, GAO report 91-190, become GAO's all-time best-selling report. In early 1995 the National Institute of Standards and Technology of the U.S. Department of commerce issued a new report contrasting the stockmarket success of the Malcolm Baldrige National Quality Award-winning companies (companies with divisional winners and site-visited companies) with average companies. The results were convincing. The National Quality Award Program in the United States does not maintain information on an individual organization's financial results, but for the fourth year in a row a special stock comparison study has shown significant differences (Port 1998). The Malcolm Baldrige National Quality Award recipients as a group have outperformed the Standards & Poor 500 by nearly a.2.5 to1 margin. The recipients achieved a 362-percent rate of growth versus a 148-percent rate of growth for average companies (Port 1998, p.113).

In Europe, the creation of the European Foundation for Quality Management in 1988 has already had a significant impact on the understanding of quality management as a leadership issue and as a competitive tool. The introduction in 1992 of the European Quality Award has had a major impact in raising senior executive awareness and understanding of quality management concepts and methods. The oldest award is, of course, the Deming Application Prize, which was started in 1951 by the Union of Japanese Scientists and Engineers (JUSE). This prize stimulated the adoption of quality control in virtually every sector of Japanese industry. Over time the prize criteria evolved into the concept of company-wide quality control (CWQC) and total quality control (TQC) (Kondo, Kume, and Shimizu 1995, p.4).

We should mention here that will use the generic term "total quality management" to mean the vast collection of philosophies, concepts, methods, and tools now being used throughout the word to manage quality. Other terms are frequently used. Total quality management (TQM) is probably the most frequently used term in the United States, while total quality control (TQC) was until recently most often used in Japan, although this may be changing." The term TQC (total quality control) has begun to be replaced in Japan by the term TQM (total quality management)" (Kondo 1995, p,vi). Kondo himself uses equivalent term"

Companywide Quality Management" in hisrecent book (Kondo 1995). Another term sometimes encountered is "continuousquality improvement" (CQI). In 1997, JUSE announced a formal change from theterm TQC (total quality control) to TQM (total quality Management) (The TQM Committee 1997a,p.1).

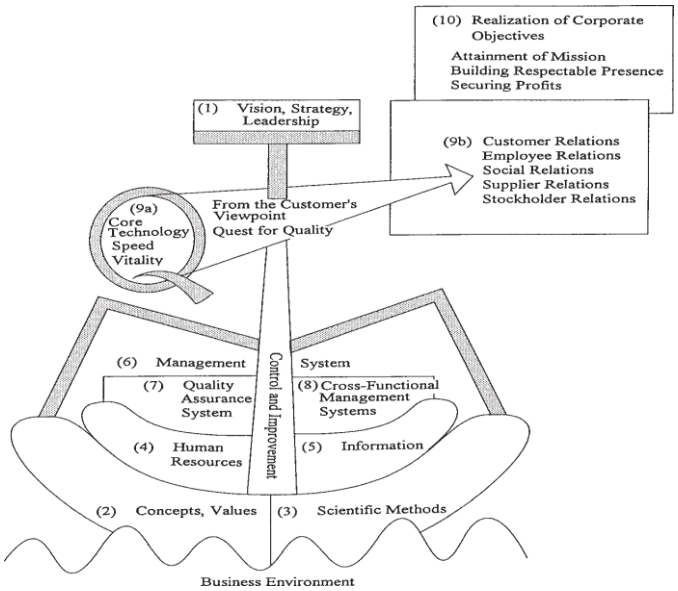
This name change was made both to adopt a more internationally accepted term and to provide an opportunity to revisit the origin of quality control and rebuild the concept to meet new environmental challenges in business management. The TQM Committee of JUSE explained this change in four publications (The TQM Committee 1997a, 1997b, 1997c, and 1997d). A summary of their thinking is provided by the diagram in Figure 1.

In JUSE's view TQM is a management approach that strives for the following in any business environment:

In JUSE's view TQM is a management approach that strives for the following in any business environment:

- Under strong top-management leadership, establish clear mid-and long-termvision and strategies.
- Properly utilize the concepts, values, and scientific methods of TQM.
- Regard human resources and information as vital organizational infrastructures.
- Under an appropriate management system, effectively operate a quality assurance system and other cross-functional management systems such as cost, delivery, environment, and safety.
- Supported by fundamental organizational powers, such as core technology, speed, and vitality, ensure sound relationships with customers, employees, society, suppliers, and stockholders.
- Continuously realize corporate objectives in the form of achieving an organization's mission, building an organization with a respectable presence, and continuously securing profits.

In any discussion of total quality, it is useful to start with the basics: the results we expect, the three fundamental concepts, the three strong forces, the three critical processes, and the key elements of the total quality infrastructure.



. Figure 2-1. The Overall picture of TQM. The TQM Committee 1997

2.1.1 The Results of Total Quality.

The almost universally accepted goals of total quality are lower costs, higher revenues, delighted customers, and empowered employees. These goals need little explanation. Figure 2. from Juran Institute's *Leadership for the Quality Century* workshop graphically illustrates this.

In the past few years, we have moved quickly from believing that managing quality just means conformance to specifications and requirements. Quality also means meeting and even exceeding the needs and expectations of customers. Quality includes having the right features, correct documentation, and error-free invoices. It also includes the proper functioning of critical business processes on-time delivery, friendly and accurate technical support, and no failures. Quality involves reducing all the costs of poor quality**.**

2.1.1.1 Lower Costs*.* Higher quality can mean lowering costs by reducing errors, reducing rework, and reducing non-value-added work. In the past 15-or-20 years companies around the world have repeatedly demonstrated that higher quality frequently means lower costs. The costs associated with pre- venting errors during design is often far less than correcting the errors during production, the costs of preventing errors during production are far less than correcting the errors after final inspection, and the costs of finding and correcting errors during final inspection are far less than fixing the errors after the customer has received the goods or services. Our understanding of these costs has grown rapidly in the past decade (Godfrey 1998, p. 18). Sörqvist (1998, pp. 36–39) defines these costs in five basic categories: traditional poor-quality costs, hidden poor-quality costs, lost income, customers' costs, and socioeconomic costs. See Section 8 for a more detailed discussion of quality and costs. See Section 7 for a discussion of quality and income.

2.1.1.2 Higher Revenues. Higher quality can mean better satisfied customers, increased market share, improved customer retention, more loyal customers, and even premium prices. Customers are increasingly beginning to expect and demand high-quality goods and services. By exceeding the levels of quality offered bycompetitors in the marketplace, organizations can add new customers, retain old customers, and move into new markets. Often, informed customers are willing topay a price premium for higher levels of quality that provide new and useful features or that reduce total life-cycle costs.

2.1.1.3 Delighted Customers. "Delighted" customers are customers who buy over and over again, customers who advertise your goods and services for you, customerswho check you first when they are going to buy anything else to see if you also offer those goods or services. Loyal customers will frequently increase their purchases to the point of selecting sole suppliers for certain goods and services (Reichheld 1996). Market studies have recently shown the dramatic impact of such delighted customers. In one study, customers giving satisfaction ratings of 5 (on a 1 to 5 scale)were 4 times less likely to leave during the next 12 months and 5 times as likely to purchase additional services than those giving satisfaction ratings of 4. In fact, those giving ratings of 2, 3, and 4 were remarkably similar, basically neutral.

2.1.1.4 Empowered Employees. For many years organizations viewed empoweredemployees as a means for achieving lower costs, higher revenues, and delighted customers. Now most leading organizations realize that creating

such employees is also a major goal of total quality management. These organizations not only aim to solve the- -problems of today, but they also want to create an organization that can solve, or even avoid, the problems of tomorrow.
The concept of empowered employees embraces many new ideas. Empowered employees are in self-control. They have the means to measure the quality of their own work processes, to interpret the measurements, and compare these measurements to goals and
Take action when the process is not on target.

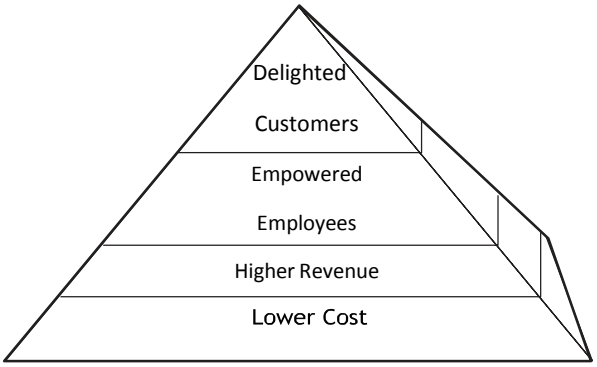


Figure 2-2. Results of Total Quality Management.
(Leadership for the Quality Century, 1997.Juran Institute, Inc., Wilton, CI

But the concept of empowered employees goes far beyond self-control. Employees also know how to change the process and to improve performance, improving both the effectiveness and the efficiency of the process.

They also understand how to plan for quality. They understand who their customers are; what the customers need, want, and expect; how to design new goods and services to meet these needs; how to develop the necessary work processes; how to develop and use the necessary quality measurements; and how to continuously improve these processes.

2.2. The Three Fundamental Concepts.

In the past few years many leading companies throughout the world have begun to revisit the fundamental concepts of quality management: customer focus, continuous improvement, and the value of every individual.

2.2.1. Customer Focus. That customer focus is a fundamental concept of quality management perhaps seems obvious. After all, organizations only exist to provide goods and services to customers. Aren't all organizations customer focused?

For most organizations the answer to this question is a resounding no. During the evolutionary progress of almost every industry, the first phase is a focus on quality of the new product in the most basic terms. The goal is to make the product work. The early automobiles, airplanes, and telephones are dramatic examples. There are no customers in the beginning, only wild-eyed inventors trying to make something noone has ever seen before. Later in this section we trace the basic evolution of quality in typical organizations and industries.

The customers provide little input at this stage. Most are not even sure they want these goods or services. They have little understanding of what they are, why they should buy them, or what they do, much less ideas on how to make them better.

Unfortunately, many organizations do not progress far beyond this stage. The technology-driven companies and organizations providing health care are two highly visible examples.

One of the hottest trends in business today is the creation of custom products for mass markets. Bicycles, jeans, shoes, carpets, and numerous other items are being customized to individual taste. Financial services, hotel services, meals, and even health care are being designed and delivered to meet individual customer needs (Peppers and Rogers 1993).

The biggest challenge facing companies today is linking measurement of how well they meet customer needs to the actual behavior of the customers. Knowing that you have a 4.3 customer satisfaction rating means nothing. What truly matters is whether a 4.3 satisfaction rating is creating business or losing business.

More and more companies are finding that keeping customers (reducing the churn) isfar more profitable than acquiring new ones. A Xerox study found that sales to current customers were over 20 percent more profitable than sales to new customers. The other critical factor is what percent of the customer's business you have. Becoming the dominant supplier can have stunning business results.

Reichheld (1996) documents many of the examples of how companies have gone beyond customer satisfaction and customer retention to customer loyalty. Building customer loyalty is becoming a bedrock of corporate strategic planning and process management.

2.2.2. Continuous Improvement. Juran (1964) documented the structured approach that many companies use to achieve breakthrough improvements. In recent years rapid change has become a way of life. Many companies now employ this and similarapproaches to create improvements by the hundreds and even thousands.

But this was not always the case. For thousands of years societies and governments have been organized to prevent change. In some societies doing something in a different way was punishable by death. In his novel, The Egyptian, Waltari (1949) describes how a physician in ancient Egypt was trained to perform 128 different procedures. Only these could be performed, and there was only one way to perform each. Even artists were trained carefully in the only way to draw a bird, a crocodile,or a person.

In medieval Europe the various trade guilds established rigid guidelines for the making of each object. Daring to experiment in the ways things were made or the materials used was grounds for expulsion from the guild. In the Byzantine language the word for change was the same as the word for danger. Change in societies, in production practices, in armies, in governments came slowly. Many societies endured half-witted rulers rather than risk changing the form of government.

Organizations and companies mirrored society. Companies were governed by thick policy manuals and corporate executive instructions in multivolume sets. Promotions were given to those "not rocking the boat." Strong hierarchies were created to control all operations and individual work. Scientific management, the so-called Taylor System was used to carefully define each step in the work process and each person's role. Job description defined clearly what one did and didn't do.

Things began to change rapidly in the years following World War II. The Japanese were so far behind in many areas of commercial production that they had to improve rapidly to survive. The continuous improvement methods they perfected worked well. Faced with severe competition, many U.S firms started copying these ideas, some with great success.

The literature now abounds with examples of astonishing improvements. These improvements are being made in manufacturing companies, hospitals, telecommunications companies, government agencies at every level, all types of service companies, and in schools. The names of the means used to achieve these results have become quite familiar to all of us: cross-functional teams, quality control circles, re-engineering, quality action teams, creative idea suggestion systems, process improvement teams, quality in daily work, and many others.

2.2.3. Value of Every Associate. The value of each associate in an organization is another idea that sounds simple on the surface. For years companies have published clear statements about the strength of their organizations being the people who work for them. But most of these are just hollow statements. The companies are still blindly following the Taylor system. A few planners, man- agers, or engineers are planning all the steps of every process, defining carefully worded job descriptions,and enforcing the unthinking following of instructions.

Even the most cursory review of history illuminates how radical an idea it is to have each person thinking, creating ideas, challenging authority, and making changes to the system. Entire armies marched side by side with spears pointed forward at exactly the same angle. Archers fired precisely when told. Musketeers marched in ranks, fired precisely timed volleys, reloaded, and fired again. But only on the orders of the commander.

Individuals were trained in long apprentice programs by demanding masters. Rows ofclerks transcribed exactly what was written. The early factories contained rows and rows of workers each doing each task exactly the same way.

The average number of implemented ideas per employee per year in the United States still only 0.16. That is one idea implemented for every six employees per year.In organizations truly valuing the ideas and personal contributions of each employee the number is dramatically higher. Already in the United States, Toyota is achieving eight implemented ideas per employee at its Georgetown manufacturing facilities. Overall, Toyota receives 4,000,000 ideas from its 80,000 employees. Since over 95 percent are implemented, this is over 46 implemented ideas per employee per year (Yasuda 1991).

Some companies in the United States have achieved similar results. Globe Metallurgical and Milliken have averaged over one implemented idea per employee per week. Milliken is now one of the country's leaders at 68 ideas implemented per associate per year. One employee in a Marriott hotel contributed 63 improvement suggestions in one month (Fromm and Schlesinger 1993, p.8).

But ideas contributed are just one measure of individual contributions. Other contributions may be even more important. These include participation on quality improvement and quality planning teams, membership on business process re-engineering teams, work on statistical quality control and self-control of their own work processes and working as members of high-performance or self-directing work teams.

Eastman Chemical was already 6 years into its quality journey in 1985 when they began to recognize the strong connection between culture, values, and quality excellence. Their objective was to identify, understand, and emphasize the people elements of their quality policy. They now use their internally developed quality management process as a vehicle to bring all employees into the improvement efforts. They use interlocking teams of employees at every level to define how each work process links together with the next and with the customers' needs and expectations.

Eastman Chemical has also formally defined "empowerment" as the creation of a culture "where people have the knowledge, skills, authority, and desire to decide, act,and take responsibility for the results of their actions and for the contribution to the success of the company." They implement this clear, working definition of empowerment by providing just-in-time training where employees come to class with improvement projects already selected. Quality coaches (facilitators) provide direct support back on the job.

2.3, The Three Strong Forces.

There are three primary drivers of performance excellence: alignment, linkage, and replication. To achieve breakthrough results the organization must focus its efforts onthe most important issues it must have its strategy correct and the organization's goals, resources, and activities aligned with the strategy. The organization must also understand the cross- functional nature of work, the linkages across the organization. Sometimes called "systems thinking" or "process thinking," this understanding of the way work is done is crucial. Associates in the organization must also be able to replicate successes quickly. A simple improvement may be worth only a few thousand dollars. But replicated 100 times it may become a major contribution to the organization's success.

2.3.1. Alignment. A recent study by the Association of Management Consulting Firmsin the United States found that executives, consultants, and business school professors all agree that business strategy is now the single most important management issue and will remain so for at least the next 5 years (Byrne 1996, p. 46). In the past few years, there has been a new understanding of the importance of strategy. This strategy must include:

1. A clear vision of where the company is going-this must be clearly stated and communicated to every member of the organization in language he or she understands.
2. Clear definitions of the small number of key objectives that must be achievedif the company is to realize its vision.
3. Translation of these key objectives throughout the entire organization so that each person knows how performing his or her job helps the company achieve the objectives. This alignment of all associates with the top priorities of the company is absolutely critical (Sugiura 1992).

One of the biggest changes in the strategic planning process has been the inclusion of many layers of the workforce, customers, suppliers, and even competitors in the planning process. These changes are creating a whole new set of buzzwords: co-evolution, business ecosystems, strategic intent, business-

designs, corecompetencies, game theory, and white-space opportunities. The key differencesinclude the creation of networks of new relationships with customers, suppliers, and rivals to gain new competitive advantages, new markets, and new opportunities.

The second big change has been the inclusion of numbers of employees of all ages, levels, and job functions in the planning process. Some years ago, Electronic Data Systems Corporation (EDS) launched a major strategy initiative involving 2500 of its 55,000 employees. A core group of 150 worked full time for a year coordinating the input from the larger group. Finland's Nokia Group recently involved 250 employees in a strategic review. Nokia's head of strategy development, Chris Jackson, reports that the involvement of more people not only makes their ability to implement the strategy more viable, but they also win a high degree of commitment by the process.

To be effective, strategic quality planning must be used as a tool a means to an end and not as the goal itself. It must be an endeavor that involves people throughout the organization. It must capture existing activities, not just add more activities to already overflowing plates. Finally, it must help senior managers face difficult decisions, set priorities, and eliminate many current activities, not just start new ones.

The third change has been the extreme focus, perhaps even obsession, on customers. The new strategic planning starts with customers. Hewlett-Packard bringsboth customers and suppliers together with general managers from many different business units to work on strategies. For example, they brought together managers from divisions making service-bay diagnostic systems for Ford with those making workstations for auto plants and those developing electronic components for cars. Many of the ideas for new opportunities came directly from the customers.

Far too many companies have stopped with creating the strategic plan. Their plans are beautifully developed and packaged but come to nothing. Somehow these companies assume that packaging and distributing the plans to a select number of managers is actually going to make things happen. Nothing could be further from the truth. To really get results these plans must be carefully deployed throughout the entire organization. Every associate must be clearly aligned with the key objectives ofthe company, every associate must understand the strategic goals and how he or she contributes.

Every strategic goal must be broken into subgoals, and these must be subdivided into annual goals. The organization must then clearly define thespecific work projects which support the annual goals. They must assign clear priorities, establish specific measurements, and provide the resources to achieve the desired results for each project.

2.3.2 Linkage (Process Management or Systems Thinking). In the past few year companies through- out the world have embraced the concept of re-engineering with a fervor that defies description. Pioneered in the early 1980s by companies such as IBM, Ford, AT&T, and NCR, and popularized in Michael Hammer's best-selling book, Reengineering the Corporation, re-engineering has become a common tool for corporations throughout the world (Hammer and Champy 1993). The definition of re-engineering by Hammer as "the radical redesign of business processes for dramatic improvement" captured and excited

the imagination of managers around the world. More recently, Hammer has stated that “the key word in the definition of reengineering is ‘process’: a complete end-to-end set of activities that together createvalue for a customer” (Hammer 1996, p.xii).

As companies have rediscovered the importance of linking their activities across all functions and departments in the company, they have also rediscovered how criticalit is to think of how many activities are actually in series. Unless we link our efforts across all parts of the company, we fail to achieve the results we so desperately need.

With this critical emphasis on linkage (or process management) the worlds of total quality management and re-engineering converge. A fundamental tenet of quality management since Shewhart in the 1920s (if not before) has been the importance of controlling the process. Deming later further developed Shewhart’s ideas of statisticalprocess control with the now famous PDCA cycle (Plan, Do, Check, Act), and Juran pioneered the concepts of process improvement with his text Managerial Breakthrough (Juran 1964). As leading companies moved into rapid improvement activities in the 1980s, the need for process management became clear. In the manufacturing plants the series nature of work was obvious. If any part of an assembly line failed or created a bottleneck, the whole line suffered. What wasn’t so obvious was how many administrative processes were also series systems. With a mistake in the order entry step, there may be no way to complete the delivery of the product or service on time and correctly.

The steps to managing the critical linkages and making dramatic and continuous improvements to the key processes are now well defined. The first step is identifying the organization’s key processes. There are numerous methods for doing this, butthe essence of them all is narrowing down the list to the most important few and making sure everyone knows them. The next step is creating the necessary measurements. Many companies have long lists of measurements for almost every task in the organization. Most of these measurements are focused on departmental activities and many are related to the budget. But these same companies have few measurements on the critical processes that drive the success of the company.

They cannot tell you how long it takes from the receipt of an order from a customer to the time the customer receives the goods or services, much less the time until they receive payment. They do not know the real cost of processing the order, delivering the product, or providing follow-up service.

The final step in managing the critical linkages is to actually get serious about managing these linkages. Without major changes in the structure of the organization, without assigned process owners, without realignment of authorities, responsibilities, and accountabilities, nothing much happens. Although quality management has for many years been about process control, improvement, and planning, we have still not developed all of the needed understanding, tools, and measurements to manage in this critical new way. This is major challenge for the future.

The single most important word in the definition of process is “customer.” As many of us have discovered in the past decade, a company is a collection of processes, and the customer only sees the company in terms of the output of those processes.

The customer does not care how the company is organized, who reports to whom, what the various titles are, or even where the different departments are located. The customer does not even care what parts of the goods or services are produced by the company, the company's suppliers, or the company's competitors. The customersrequest products, want them delivered exactly when promised, want the required service to be available when needed, and want the bills to be exactly as agreedupon. If a process is not providing value to the customer, the process is producing waste. There are many subprocesses in a company that exist primarily as enablers for the company to produce value to the customer. Most key processes touch the customer directly, and these processes must add value for the customer.

The second key to managing processes is to determine exactly what value is added by each step in the process. When we see a purchase order for a $30 book with six signatures that has taken 6 weeks to process, we know there is a better way. What value has this process added? Organizations throughout the world have been stunned to learn how many steps they have in key processes, how many useless handoffs, and how much wasted time and effort.

Just focusing on cycle-time reductions can illuminate how unmanaged many of our key processes are. The Royal Leicester Infirmary in the U.K. reduced a neurological testing procedure from 40 days to 1 day and removed 40 percent of the administrative costs by redesigning the process in which 14 departments worked together. Motorola reduced from 6 weeks to under 100 minutes the process time required to take a pager order, produce the pager, and ship it.

The third critical area of managing the critical linkages is the realization that almostall key processes cut across many different areas of the company. To manage these processes success- fully requires a team-based approach involving employees with new skills, new understanding of the company's strategy, goals, and competitors,and new tools for doing their rapidly expanding jobs.

The challenge for the future is to continue to identify these skills, tools, and understandings, and to know which are part of the essential core knowledge of the company (which must be taught to all employees) and which are the needed new skills and tools. Companies that a few years ago thought they could rush through a "quality training program" and be through with it are now finding that training has become a full-time activity.

Many of the ideas of process management, teamwork, and problem-solving skills are now finding their way into business and engineering schools, but companies need to quickly introduce all employees to the key processes, the measurements used, and the way the company continuously challenges and changes process performance.

2.3.3. Replication. Probably the most powerful and the least understood way to dramatically accelerate the results of quality and productivity improvement efforts is the third strong force, replication. An example from a leading international service company makes this clear. The CEO was justifiably proud of some of their accomplishments. In one location a true chronic problem had been solved the savings were over $350,000/year. In another location, a different chronic problem had been reduced by 75 percent. The increased revenues were also in the hundreds of thou- sands of dollars.

It was not hard for the CEO to do the math. If each of the more than 250 locations could duplicate these results, the company would exceed its aggressive financial goals for the next year. But he knew how hard it would be to get each of the locationsto understand what had been done in these two locations, to modify the approach to fit their situations, and to apply a similar problem-solving methodology and achieve similar results.

When we address replication, we are learning firsthand about resistance to change, the dreaded not-invented-here syndrome, the entrenched beliefs that every locationis different, and even the reluctance of many corporations to "stifle innovation and creativity" by directing business units and branches to act. Problems remain unsolved, new solutions are invented and tried, opportunities are missed, and companies muddle along with slow rates of change and dis-appointments in results.

The successful companies take action; they make things happen. They use passive means to encourage replication, they use active means to force replication, and they make replication an obligation not an option.

Passive systems include sharing, reward and recognition, newspaper articles, and team presentations. The results of quality improvement projects are made known widely throughout the organization. In these systems we assume that those with similar problems or opportunities will hear about the project, obtain the information they need, and act.

Active sharing systems force the issue. At Honda's annual facilitator network meetings (attended by over 3000 people worldwide), participants are expected to share one completed and well-documented project and to study thoroughly four others that could be used in their location. Upon returning to their location, they are expected to implement these four projects. The support structure is in place to assist them, and results are expected.

2.4 The Three Critical Processes for Quality Management.

These three management processes are not new. They are the same management processes we have used for years to manage finance. This commonality is helpful to managers. Their long experience in managing for finance becomes useful to them when they enter the world of managing for quality. These three processes are closelyinterconnected.

***2.4.1. Quality Planning*.** The logical place to start is quality planning. Quality planningconsists of a universal sequence of events a quality planning roadmap. We first identify the customers and their needs. We then design products (goods and services) which respond to those needs. We also design process- es which can produce these goods and services. Finally, we turn the plan over to the operating forces. They then have the responsibility of conducting operations. They run the process, produce the goods and services, and satisfy the customers.

The quality planning process is summarized in **Figure 2.3.**

In later sections we provide some in-depth coverage of some of the more technical tools used in quality planning (or as some call it, quality by design). These tools include experimental design and reliability prediction and reliability estimation.

But no matter how well we apply our methods and tools of quality planning, most processes are not perfect. They have associated with them some chronic waste: timedelays, errors, rework, non- value-added work, scrap. (The Juran Trilogy. Figure 2.4.)

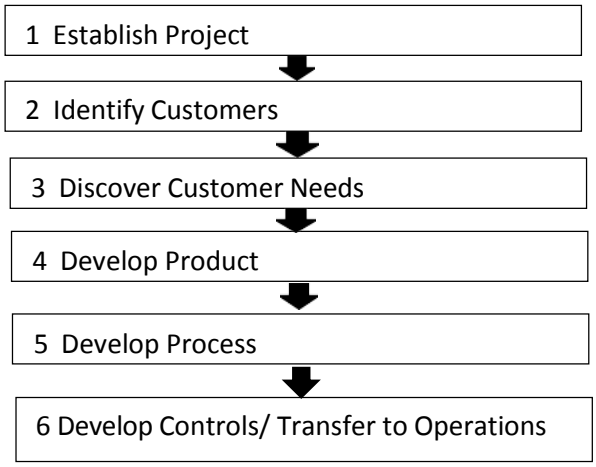


Figure 2-3. The quality planning process.

(Leadership for the Quality Century, 1997) Juran Institute, Inc., Wilton, CT.)

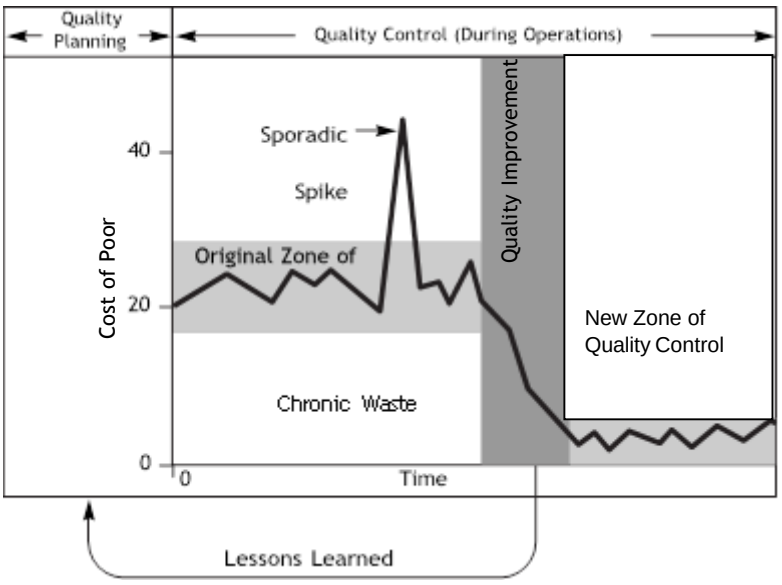


Figure 2-4. The Juran trilogy. (Juran Institute, Inc., Wilton, CT)

In this figure we have plotted the cost of poor quality on the vertical scale, so what goes up is bad. These are the costs associated with imperfection. Despite our best efforts at planning, the costs in this example are about 20 percent. These costs could be from defects, or they could be even harder to see. Examples of hard-to-defect costs are work-in-process inventory, non-value-added work, underutilized capacity, and unnecessary delays and handoffs.

Our first job is to build the quality control system to ensure that our quality performance is at least as good as planned. On the diagram in Figure 2.4 (above), we see a sporadic spike, a major deviation from our planned level of performance.
In this example, the quality control system seems to be workingwell. Since this point is a spike, it indicates that the problem was detected quickly, thecause of the problem found quickly, and the cause was removed quickly. Little time elapsed before the quality performance was back at the planned levels. In many real-life cases our quality control systems do not function this well. Several days or even weeks may go by before we realize we have a problem. Then we may spend more days or weeks investigating the possible causes of the problem and more days or weeks developing remedies. The new level of costs of poor quality persists during this time, causing much damage to the organization.

2.4.2 Quality Control. What the operating forces can do is minimize this waste. They dothis through quality control. Quality control relies on five basics: a clear definition of quality; a target, a clear goal; a sensor, a way to measure actual performance; a way to interpret the measurement and com- pare with the target; and a way to action, to adjust the process if necessary.

2.4.3 Quality Improvement. But all this activity only keeps quality at the planned level. We must take deliberate, specific actions if we wish to change this level.

As Deming pointed out some time ago, “Putting out the fires in a hotel doesn’t make the hotel any better.” As he states in Out of the Crisis (Deming 1982, p. 51), “Putting out fires is not improvement of the process.

Neither is discovery and removal of a special causes detected by a point out of control” (our sporadic spike in Figure 2-4. above).

“This only puts the process back to where it should have been in the first place (an insight of Dr. Joseph M. Juran, years ago).” Juran (1964) describes the quality improvement process used by individuals and organizations to make “breakthrough” changes in levels of performance.

The quality improvement process is directed at long-standing performance levels. The quality improvement process questions whether this is the best that can be attained.

2.5. The Total Quality Management Infrastructure.

Figure 2.5 below, shows the main elements of the total quality infrastructure. These elements include the quality system, customer-supplier partnerships, total organization involvement, measurement and information, and education and training.

2.5.1 The Quality System. The Total Quality infrastructure consists of several key pieces. The first, and one of the most important, is the quality system. Best defined by ISO Standard 9004-1, the quality system is a critical building block for total quality management. A good quality system also contains customer supplier partnerships. Again, the ISO 9000 series of standards provides a good starting point for contractual relationships by adding a solid quality management structure. But many companies are going far beyond contractual relationships. Many customer- supplier relationships in the leading U.S. companies are evolving quickly to resemble those pioneered by Toyota and other leading Japanese automotive companies.

To achieve quality improvement at a revolutionary pace, we must also have total organization involvement. In the words of an interdisciplinary study group convened at Columbia University in 1988 to study global competitiveness (Starr 1988) we have collected some basic principles of what makes a firm competitive, the first of which is quality.

The successful business no longer sees employees as a cost of production but asa resource for production. Although job uncertainty will never be eliminated, it must be recognized that long-term commitment of and to workers is at least as important as machinery or technology. Employee involvement in efforts to improveproductivity and quality is vital, and they must also be able to share in the gains.

A key element of the infrastructure is measurement and information. Donald Peterson, former chairman of the Ford Motor Company, stresses how important having the right information is. When Ford benchmarked Mazda, they were quite impressed with how well Mazda manage this part of the business Peterson-1992.

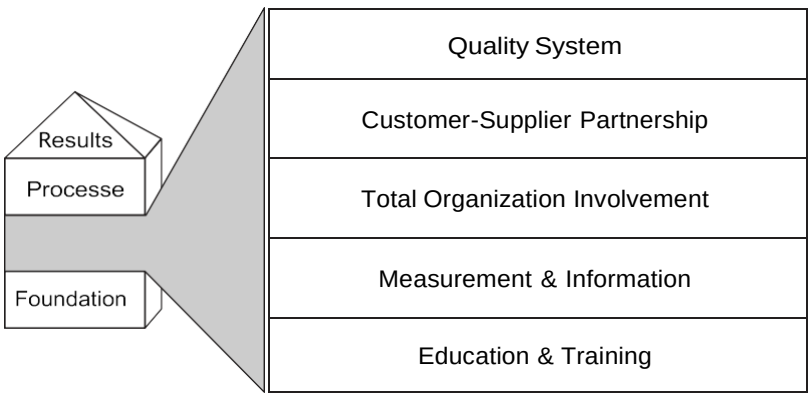
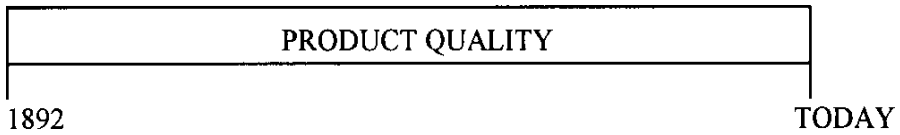


Figure 2-5. The Total Quality Infrastructure.
(Leadership for the Century,1997,Juran Institute, Inc., Wilton, CT.)

Perhaps, most important, Mazda had been able to identify the types of information and records that were truly useful. It didn't bother with any other data. (At Ford) we were burdened with mountains of use- less data and stifled by far too many levels of control over them. The last, and perhaps most important, part of the infrastructure is education and training. Organizations must train the teams in how to work as teams and in how to diagnose problems and provide remedies. This type of training should be directed---at changing behavior. The training should be just in time. The best learning comes by doing. Training in how to improve quality should be done during actual improvement projects. The training should be designed to help the teams complete these projects quickly and successfully.

2.6 The Evolution of TOTAL QUALITY

In many countries, industries, and companies TQM has appeared to evolve through several distinct steps or phases. These phases include a focus on product quality, on product process quality, service quality, service process quality, business planning, strategic quality planning, and integrated strategic quality planning.

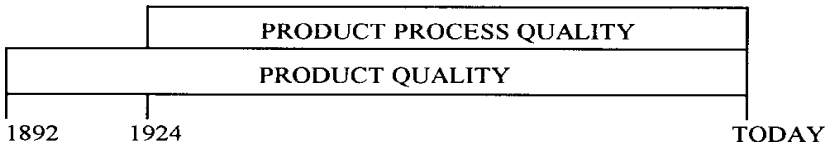


2.6.1. Product Quality. All organizations began their quality management efforts with a focus on product quality. At the first introduction of a product, this is necessarily a definition of product quality from the producer's point of view. Since theproduct is unknown to the customers, the customers have little input as to the definition of quality. They may be surveyed for needs and wants, but in the case of atruly new product their inputs are ambiguous and somewhat vague.
In a recent study of the evolution of quality in telecommunications, this was clearly the case (Endres and Godfrey 1994). The telephone was truly a new product. Potential customers were amazed it worked at all and had absolutely no idea how it worked. The driving forces for defining quality were the engineers trying to make it work well enough to be a salable product.
As early as 1892, the Bell System was developing inspection procedures to ensure that the specifications and requirements, developed by the engineers (the company's definitions of quality) were being met by the production personnel.

This was also the case in other industries such as health care. For many years in modern medicine the definitions of quality focused on outcomes. These were defined by the medical specialists, the doctors. Elaborate quality assurance procedures, usually based on inspection, were developed to review the outcomes, and assign responsibility for less-than-perfect outcomes.
For other industries (service or manufacturing), this also appears to be the case. Theearly airlines concentrated their entire efforts on product quality providing quick transportation from point A to point B. This basic definition of product quality safe, fast, reasonably on-time air travel occupied all their efforts for years.

We should also note that this focus on product quality has continued up to the present. Telecommunications companies extended their efforts beyond initial

qualityto reliability in the field, then to availability, usability, maintainability, and other definitions of product quality. Some of the methods used to manage these broadened definitions of product quality have become quite sophisticated. In health care, much recent work on clinical outcomes would fall in this category. Researchers have extended the traditional definitions of outcome to include patient performance, lack of pain, and ability to work. This carries the traditional definition of outcome quality far beyond the walls of the hospital (Godfrey 1997).



2.6.2 Product Process Quality. The next phase of the evolution for telecommunications quality began in 1924 with the creation of the control chart. For some time, it had been becoming evident that controlling product quality by final inspection was quite expensive. In the installation forces of the rapidly growing American Telephone & Telegraph company, the rallying cry had become, "Do it rightthe first time."

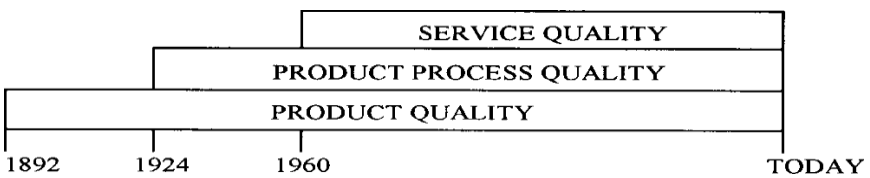
Finding the wiring errors in complex switching machines after the machine had been assembled was a time-consuming, costly process. It was far more economical to ensure functioning parts and carefully control assembly than to go back and try to find the problems.

Earlier examples abound. During World War I, there is evidence that the British developed rather sophisticated control procedures for ensuring proper tensioning of the wires between the wings of the biplane fighters.

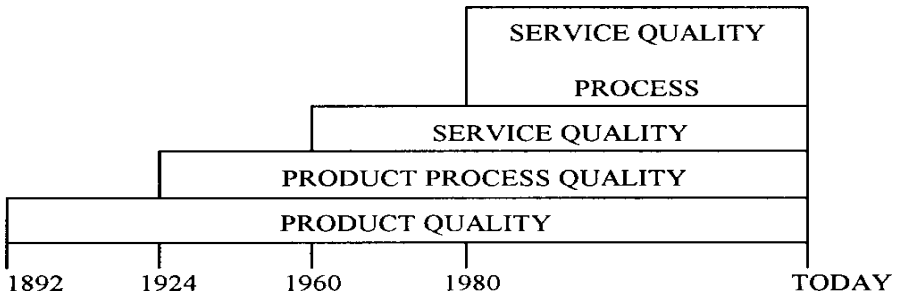
But it was the creation of the control chart that made it clear how easily process control could be transferred to the operating forces. This would reduce the reliance on final inspection and free up numerous people for productive work. In this way product quality could be improved and costs driven down at the same time.

This stage of product process quality focus on the processes producing the products, has also continued to the present. Many sophisticated methods have been added to the arsenal: engineering process control, experimental design, evolutionary operations, robust design, and more recently process simplification andreengineering.

In health care there are numerous examples: patient-focused care, care maps, clinical guidelines, protocols. Any methods that try to improve the outcomes of our work through improving the process- es by which we create those outcomes are in the product process phase. For the most part, in other industries, these havefocused on the cost side of producing the product.



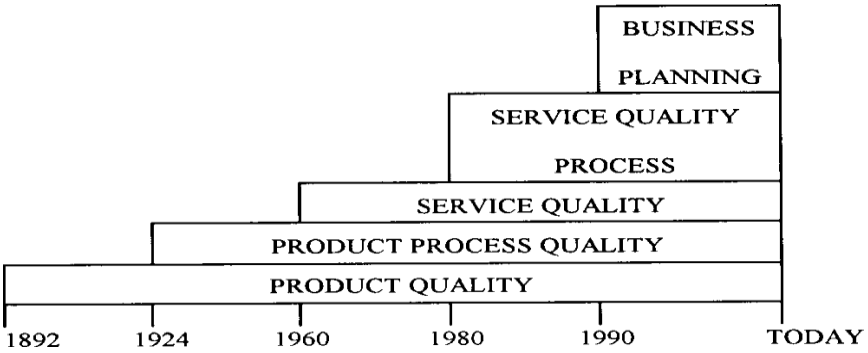
2.6.3 Service Quality. The next phase for some industries began in the early 1960s. We suspect of other industries it had begun much earlier, for others not until the 1980s or even 1990s. This was the expansion of the traditional definition of product quality to include the services surrounding the product. For telecommunications this expansion includes repair and maintenance services, order entry, billing, and modular phones that the customer could easily self-install and maintain. In health care many new ideas emerged. These included patient-focused care and many other means of pro- viding services beyond basic clinical ones. Many new ideas emerged concerning admissions, waiting times, bedside manner, housekeeping, laundry, room layouts and decor, phones, TVs, food (beyond basic nutrition), parking, and other services surrounding the basic product of the correct out- come. These are sometimes called the features, or the salability part of quality. For many manufacturing companies the 1960s and 1970s were the wake-up calls for this aspect of quality. The customer was no longer just interested in the quality of the car. Service provided by the dealers, availability of parts, roadside assistance, the sales experience, financing, leasing, and many others aspects of the supplier/customer relationship became part of the competitive quality battleground. In the late 1980s we saw this accelerated with the introduction of the Japanese luxury cars (Acura, Infiniti, and Lexus) with their special dealership, new service relationships, and new levels of support. General Motors has applied these concepts to the basic car in its Saturn Division.



2.6.4 Service Quality Process. In the 1980s a new focus on quality occurred. Pioneered by IBM, companies started focusing on the costs of providing the quality ofthese services or business process quality management or improvement. Many of the same techniques (for the most part rather standard industrial engineering tools) used in product process quality were applied for the first time to the horizontal processes that cut across organizations and had been, for the most part, totally unmanaged.

Some new ideas also emerged. The concept of a process owner and a process team expanded the power of a quality council by continuously examining and identifying opportunities for team interventions in critical business processes. In many ways these process teams acted as focused councils, deploying improvement, control, and planning teams to the macro process or to micro processes within the macro process.

Again, the focus was primarily on costs. These re-engineering or business process quality efforts were directed at reducing cycle times, reducing numbers of steps or handoffs, and improving efficiency overall. Many of these business process interventions also improved the quality of the output.



We began to see a cycle emerging. The evolutionary process of total quality management seems to alternate between a focus on quality and a focus on the costs to attain that quality

2.6.5 Business Planning. In the past few years, we have observed many companies starting to integrate quality management into their business planning cycles. This integration of the quality goals with the financial goals has been a majorthrust of the leading companies. Recently this integration was listed as the major effort currently underway by the respondents to the Business Roundtable survey on TQM.
The setting of quality goals; the subdividing of goals into subgoals, annual goals, and projects; and the deployment throughout the organization (hoshin kanji, hoshin planning, policy deployment, or strategic quality planning) has become one of the major breakthroughs in total quality management for many companies. Some are going beyond the annual business planning cycle to incorporate these methods in their 5-year or even longer-term plans.

This naturally leads to the question: What are the next steps in the evolution of total quality? The immediate next step to the pyramid is obvious strategic quality planning. Some companies are beginning to go even further: they have implemented integratedstrategic planning where they are involving customers and suppliers in joint strategic planning.

2.7 Re-Engineering, Six Sigma and Other Extension of Total Quality Management.

In the past few years there have been many redefinitions of total quality management. TQM has become an umbrella term for many different collections of concepts, methods, and tools. As new concepts are created, they are often added asextensions to the basic collection.
Sometimes the creators of these ideas and tools attempt to differentiate their ideas from TQM and energetically stake a separate place for their efforts. But most of the leading companies continuously integrate the new methods with the older successful methods and discard what is not working along the way.

A few years ago, a great effort was made to stake a claim that re-engineering was somehow different from other methods considered part of TQM. Some companies created new departments of re-engineering separate from the quality departmentsor continuous improvement departments. Soon these efforts were merged. In Section 6, Process Management, the history of business process management, business process quality improvement, and re-engineering are covered thoroughly.

More recently there has been an emphasis on “six sigma” and “black belt” quality training. The concept of six sigma was introduced in the 1980s by Motorola in its efforts to reduce the defects in manufactured products to only a few parts permillion. Later, Motorola extended the six-sigma concept to business processes and service operations. Motorola allowed for a process average drift by as much as 1.5 standard deviations, so their term of six sigma actually sets the targets at 4.5 standard deviations—or 3.4 parts/million (ppm)

As other companies have taken ideas from Motorola and other leading companies and added their own variations, six sigma has come to be “a program aimed at the near elimination of defects from every product, process and transaction” (Tomkins 1997, p. 22). Six sigma has thus become a disciplined, quantitative approach for improving operations in all types of industries and business functions. The six sigmainitiatives may sound quite familiar to many leading companies with successful total quality management systems but often sound quite new to those companies who have just dabbled in quality management in the past.
The basic steps of the six-sigma process are quite like the quality improvement processes and quality control processes, quality improvement, and quality control. The five basic steps are usually explained as define, measure, analyze, improve, and control. The implementation stresses leadership at the highest levels of the company. For many companies this has been the CEO, such as Jack Welch at General Electric, Bob Galvin at Motorola, and Larry Bossidy at Allied Signal. The implementation is then cascaded throughout every level of management, and clear responsibilities are understood (Hoerl 1998, p. 36).

The focus of six sigma, like many other quality initiatives, is on cost and waste reduction, yield improvements, capacity improvements, and cycle-time reductions. Heavy emphasis is put on satisfying customer needs. Organizations try to estimate
The financial impact of each operation.

These companies also establish clear performance metrics for each improvement in costs, quality, yields, and capacity improvements. Financial figures are absolutely required. The projects under- taken are usually substantial with improvements commonly in the $50,000 to $100,000 range.
Another difference in the six sigma initiatives and many total quality management programs is the assignment of full-time staff. The team leaders and facilitators (oftencalled black belts and master black belts) are chosen carefully and work 50 to 100 percent of their time on the improvement projects. The training for these people is also extensive, usually 4 or 5 weeks of intensive, highly quantitative training (Hoerl 1998, p. 36). Some companies have actually implemented training pro- gramslasting up to 6 months for their new black belts.
Over the past few years many other concepts, methods, and tools have becomepart of the overall total quality management philosophy. Many of these concepts have become part of this handbook. For thousands of years organizations have triedto learn the secrets of others’ successes, but in the past few years benchmarking has become a frequently used (and sometimes misused) management tool. Quality assurance systems have been standardized and third-party assessments have become commonplace. Organizations have extended their quality systems into their suppliers, operations creating true customer/supplier relationships. Customer service, customer satisfaction, and customer loyalty have become critical elements in all quality systems.

2.8. Fundamental of Quality Control Circles (QCC). What are QCC?

INTRODUCTION

A QC Circle is a small group consisting of first-line employees who continually controland improve the quality of their work, products, and services.

These small groups: Operate autonomously, utilize quality control concepts and techniques and other improvement tools tap members' creativity, and promote self- and mutual development.

QC Circle activities aim to develop members' capabilities and achieve self-actualization, make the workplace more pleasant, vital and satisfying, improve customer satisfaction, and contribute to society.

Executives and managers ensure that QC Circle activities contribute to improving thehealth of the enterprise by treating QC Circle activities as an important part of employee development and workplace vitalization, personally practicing company-wide improvement activities such as TQM and providing guidance and support for total participation while respecting the humanity of all employees.

2.8.1 The Basic Principles of QC Circle Activities

QC Circles activities are carried out by a small group of first-line employees who operate autonomously in solving problems found with their work, products, and services. These activities aim to promote self and mutual development of their members, enhance capabilities of all their members, and contribute to building a pleasant and vital workplace.

The basic Principles of QC Circle Activities spell out the expectations and directions of QC Circle activities for those who are involved.

2.8.1.1 Reveal Human Capabilities and Draw Out Infinite Possibilities

Human beings are blessed with unlimited capabilities, and all of us have a desire to fully reveal our own potential. When a person capable of doing a more difficult task continually performs a simple easy job, he/she may become frustrated and may evengenerate deficiencies. Alternatively, people who possess, say Level 10 capabilities, often become more motivated when they are given the tasks requiring Level 11 or 12 capabilities. Such a workplace creates a healthy tension and a lively atmosphere,and thus people find their jobs more satisfying.

Also, we human beings have a desire to enhance our individual abilities. With proper conditions, environment, and efforts, each of us has infinite possibilities to grow. When such factors combine in the workplace, they result in productivity and efficiency improvements and continuous creation of new products and services that can satisfy customers.

QC Circle members acquire job related knowledge and skills through their activities. Also, the members have many inspiring opportunities for mutual learning within their own Circle and from other Circles in the company as well as at various QC Circle conferences outside the company. Thus, both QC Circle's and its member's capabilities are developed. As QC Circle leaders and members improve their capabilities, they become increasingly good at controlling and improving their work.

Furthermore, QC Circle activities encourage Circles to study together and put their learning into practice. Being a group activity, QC Circles require their leaders to exercise leadership. Development of this leadership depends on how well the leader and the members work together while fully revealing their individual strengths. QC Circle activities contribute greatly to the accelerated development of leaders.

Human beings have unlimited capabilities to be developed. QC Circle activities motivate members to fully reveal human capabilities and eventually expose the infinite possibilities available to all of them.

2.8.1.2 Respect Humanity and Build a Pleasant, Vital, and Satisfying Workplace

The Use of the word “humanity” instead of “human” in the expression “respect for humanity” is because we emphasize the spiritual side of human beings including our traits of “autonomy” and “thinking.” A commendable workplace is one that respects these traits

QC Circle activities operate on the basis of their member’s autonomy. This is based on the nation that we become better motivated and produce better results when we think on our own and do our jobs on our own accord.

Fundamentally, human beings have a desire to be free. Freedom in the workplace, however, does not mean we act just as we please. For example, it does not mean we behave in a way that disturbs the order of the workplace. It is the freedom within the business framework that also respects other’s happiness in the workplace.

“Autonomy” requires us to change our attitudes from waiting for orders to address a problem, to taking initiatives to tackle the problem while working together with others. We feel job satisfaction and worthiness especially when we take initiatives to consider necessary actions and follow through on them. Autonomy is the state where we work in a self-directed manner, rather than feeling forced by supervisors and managers. When such autonomous actions are supported and appreciated, we become more motivated. The driving force for autonomy comes from rotating the cycle of motivation, action, and recognition. Also, the force is amplified as the cycle repeats.

In Addition to autonomy, “thinking” is another important aspect of respect for humanity. A wish to grow even a little bit more today than yesterday is also a desire of human beings.

Thinking well, tapping our creativity, and using our ingenuity to solve problems supports actions of respect humanity. If we work only as we are told to do, there is little room for respecting humanity. It is essential for us to understand the instructions and their purposes well and to think about the best way before taking actions.

As self-directed actions are possible only when we think them through our own, autonomy and thinking goes hand in hand. An important point of the QC Circle activity is that it draws creativity and ingenuity out of their members by allowing autonomy in the ways jobs are performed in the workplace.

Thus, it realizes the ideal of respect for humanity. Continuing QC Circle activities will build a pleasant, vital, and satisfying workplace.

2.8.1.3 Contribute to the Improvement and Development of the Enterprise

The purpose of business management can be broadly grouped into three categories: to achieve and improve customer satisfaction, to contribute to society. To fulfill these purposes, an enterprise must continuously provide products and services that customers are willing to purchase.

A Company's organizational constitution, or health, is determined by its ability to realize its purposes. More specifically, the organization's abilities are the aggregate of each individual member's abilities from top management to first-line employees, each department's abilities to carry out allotted business activities, synergetic abilities of all member's, and its system's overall abilities which integrate all of these abilities

A company operates its business by providing products and services to its customers. Business management does not exist without them. QC Circle activities are carried out by first-line employees in all workplaces in the company. First-line employees interact with customers who judge the quality of products and services they purchase. Therefore, QC Circle members play indispensable roles in business management.

In order for first-line employees to reveal their potential and to feel job satisfaction,QC Circle activities should provide opportunities for them to fully use their capabilitiesin their jobs. This will help build a pleasant and vital workplace and ultimately improvethe enterprise's organizational health and prosper its business.

In Summary, QC Circle activities provide their leaders and members, who are actual doers of the activities, with a platform from which they can reveal and further develop their capabilities. It also offers a hope, a motive, and a sense of purpose for buildinga pleasant, vital, and satisfying workplace. Also, through implementing QC Circle activities, an enterprise can expect to improve and further develop itself. Hence, QC Circle activities benefit both employees and management.

2.8.2 First-Line Employees

The purpose of an enterprise is to provide products and services that can satisfy customers. To fulfill this purpose, an organizational structure is created, and the necessary tasks or roles are divided within this structure.

These roles are shared among different ranks such as executives' managers, and first-line employees. Also, they are allotted to different functions such as market research, research and development, planning, design, engineering, purchasing, sub-contracting, manufacturing, assembling, installation, operations, maintenance, quality assurance, marketing and sales, customer service as well as administration, human resources, education, accounting, and finance.

A first-line workplace is where actual business of each function takes place andwhere a company interacts with its customers. Whatever name may be used for a first-line supervisor, foreman, or leader, he/she plays a pivotal role in running the workplace.

First-line employees in the workplace, centered around a supervisor, forma QC Circle, and take charge of its activities.

2.8.2.1 Quality of Work, Products and Services

Actual production and delivery of products and services that an enterprise offers to itscustomers take place in the first-line workplace. Thus, by doing their allotted functions, first-line employees activities result in the creation of products or services. Practically speaking, their work output includes products such as drawings, materials,parts, finished products and software. Also, their output may be in the form of services such as sales, food and beverage services, paperwork including filing and documentation, information services through computer data input and retrieval, customers relations, repair services, healthcare services, as well as transportation, communications, and financial services.

An individual product and services is the result of the work performed by using specified equipment and materials and following established standards and procedures.

The quality of work, products, and services is the resulting workmanship from the work performed to produce products and deliver services. The Workmanship is determined by how closely the work achieves its purpose. When standards are established, the workmanship means conformance to these standards. When standards are vague, the workmanship is determined by how closely the work performed meets the needs of its internal and external customers. Additionally, even established standards require constant review as the needs of these customers keep changing.

Although the main factor determining the quality of work, products, and services is this workmanship, quality also includes cost (price) and delivery.

2.8.2.2 Control and Improvement

Activity to control quality in the first-line workplace maintains good conditions in work processes. More specifically, this activity ensures that the quality of work, products, and services is achieved as planned, meets the standards, and satisfies customers' needs. Maintaining good conditions in work processes requires us not only to adhere to established work procedures but also to watch for abnormalities in materials and equipment used. The primary duty of the first-line workplace is to perform jobs in accordance with existing procedures. To fulfill this duty, efforts should include finding and devising better ways to achieve adherence to these procedures.

Event with these efforts, however, the work performed may result in product and service variability, defects, or defectives, and thus it may invite customer complaints. In such a case, it is necessary to check job procedures, possible material changes, and equipment failures so as to develop improvement measures to correct these unfavorable situations. Causes of variability and defects exist in work processes, so,it is essential to look into the processes to identify root causes and develop countermeasures.

Products and services may still fail to satisfy customers even when work standards and procedures are adhered to, if their needs or service level requirements have changed. In these situations, it is necessary to examine and improve materials, equipment, or work procedures from a new perspective.

More specifically, quality control and improvement activities discussed above include service level improvement, cost reduction, delivery time reduction, inventory reduction and new product and service development. Such activities are essential for any enterprise to adapt itself to environmental changes, improve its competitiveness, and continue to prosper.

While these quality control and improvement activities must be practiced at all ranks and departments of an enterprise, QC Circle leaders and members play a significant role in the activities as they know the first-line business the best. Therefore, the mission of QC Circles should be to control and improve their workplace.

2.8.2.3. Continuity

To sustain and further develop, an enterprise needs to continuously fulfill its purpose of providing products and service to customers. Activity to control and improve the quality or workmanship of work, products, and services is not a one-time event. Improvements may not always be perfect, and customer needs are constantly changing. Therefore, the activities to continuously control and improve the workplace are the key to the organization's prosperity.

The continuity principle of QC Circle activities encourages small group members, once organized, to stay and work together to continuously control and improve their workplace problems. However, if the workplace is reorganized and one or more members of the group are transferred to other workplace, it may be difficult to maintain the membership of the original group. In such a case, this principle means that these individuals continue their activities by joining other QC Circles or byforming a new group. It is important that each Circle member develops his/hercapabilities to the fullest through continuing QC Circle activities. When all members' capabilities are combined and the know-how of their jobs is accumulated, the workplace as a whole improves its capabilities and builds a pleasant and vital environment.

An enterprise does not simply expect QC Circles to conduct improvement activities and achieve results. More importantly, the enterprise expects that QC Circles' continuous quality control and improvement activities will result in employee development and in a transformed awareness. Thus, it becomes possible to collectively develop a group of enthusiastic and able employees. When such workplaces are developed, the enterprise's organizational health is strengthened.

2.8.3 Small Groups

A Workplace is where work is conducted but means more than the place. It also refers to a group of people who are organized to carry out the same or related jobs together to operate their organization's business effectively and efficiently.

While it is ultimately each individual who supports the organization, it is often a group's collective efforts that greatly help the organization become more efficient. Whit the expectation of this synergetic power that come from integrating individuals' abilities, first-line workplace are organized. This does not mean, however, that a group of people simply doing their jobs will contribute to the development of workplace capabilities.

To enhance the total powers of the workplace, its members must participate in the activities to achieve their shared goals and objectives.

Particularly in quality control and improvement activities, two heads are better than one and three heads are better than two to generate ideas that can lead to good results. Moreover, each employee develops further through cooperative teamwork

experience in a small group; the group and the workplace is strengthened by synergistic effects of this employee development.

2.8.3.1 Size of a QC Circle

The number of people in a first-line workplace where QC Circles are organized variesby enterprise and workplace. Also, the organization of workplaces may sometimes change. To promote QC Circle activities effectively in such an environment, a generalrule of thumb is to have five to seven members per QC Circle. The size group is mostappropriate for discussions. When a group is bigger, some members tend to remain quiet and not participate.

When a group is smaller, on the other hand, it is easier to conduct meetings and develop consensus, but each member must share a bigger portion of the load, and idea generation may be limited. In such a case a smaller group may include supervisors and support staff or from a joint circle with other QC Circles.

Depending on such factors as the Circle's capabilities, improvement opportunities and subjects, and workplace environment, dividing a QC Circle to form "Sub Circles" or "Mini Circles" may contribute to a more effective promotion of QC Circle activities. Another possible arrangement is to keep the QC Circle as one group, but temporarily break it into smaller groups while the Circle is working on a specific theme**.**

2.8.3.2 Joint QC Circles and Theme-Driven QC Circles

As QC Circles grow more active, they are motivated to tackle problems or themes spanning more than one workplace or QC Circle.

To solve such problems, several QC Circles may effectively form a coalition called a Joint QC Circle. Some examples of the Joint QC Circle coalition are: all member QC Circles work together as one group on a common theme; each QC Circle work separately on the same theme and exchanges information between the Circles; each QC Circle addresses a sub-divided theme; and one QC Circle sends its members to another QC Circle. In all cases, each constituent QC Circle must be sufficiently activein order for the coalition to be effective.

Additionally, people from different workplaces or management may take initiatives to form a small group to address specific problems or themes. This type of groups is called a Theme-Driven QC Circle and is dissolved when specific objectives are achieved. Each member of the dissolved Circle then forms or joins another group with appropriate membership for the next theme. Forming Theme-Driven QC Circles is an effective way to promote improvement activities. To be able to participate and operate Theme-Driven QC Circles, each member must understand the fundamental principles and operational methods of QC Circle activities.

As time passes, the methods of organizing QC Circles and the methods for operatingQC Circles such as running meetings must be adapted to changing needs so askeep QC Circles active and lively.

2.8.4 Mechanism Practices of QC Circle Activities

First-line employees form QC Circles and conduct their activities through open discussion, mutual understanding, cooperation, and teamwork QC Circles identify workplace problems through discussion and apply their knowledge and skills to control and improve the problems. At the same time, Circles improve their capabilities by continuing to deepen their understanding of their jobs and to study QC concepts and methods. QC Circles document their discussions, lessons learned, and their processes and results of controlling and improving activities. Then, upon conclusion, they make a presentation about their experience. This provides QC Circles with an opportunity to be recognized by their management and peers. By repeating the cycle of discussion, study, controlling and improving activities, presentation, and recognition, the QC Circle as members develops their capabilities. This prime step called **"Basic Principles of QC Circle Activities".**

In addition to the QC Circle activities discussed above, operational characteristics of QC Circles include self-directed operations, quality control and improvement that taps members' creativity, and group learning that promotes self-and mutual development.

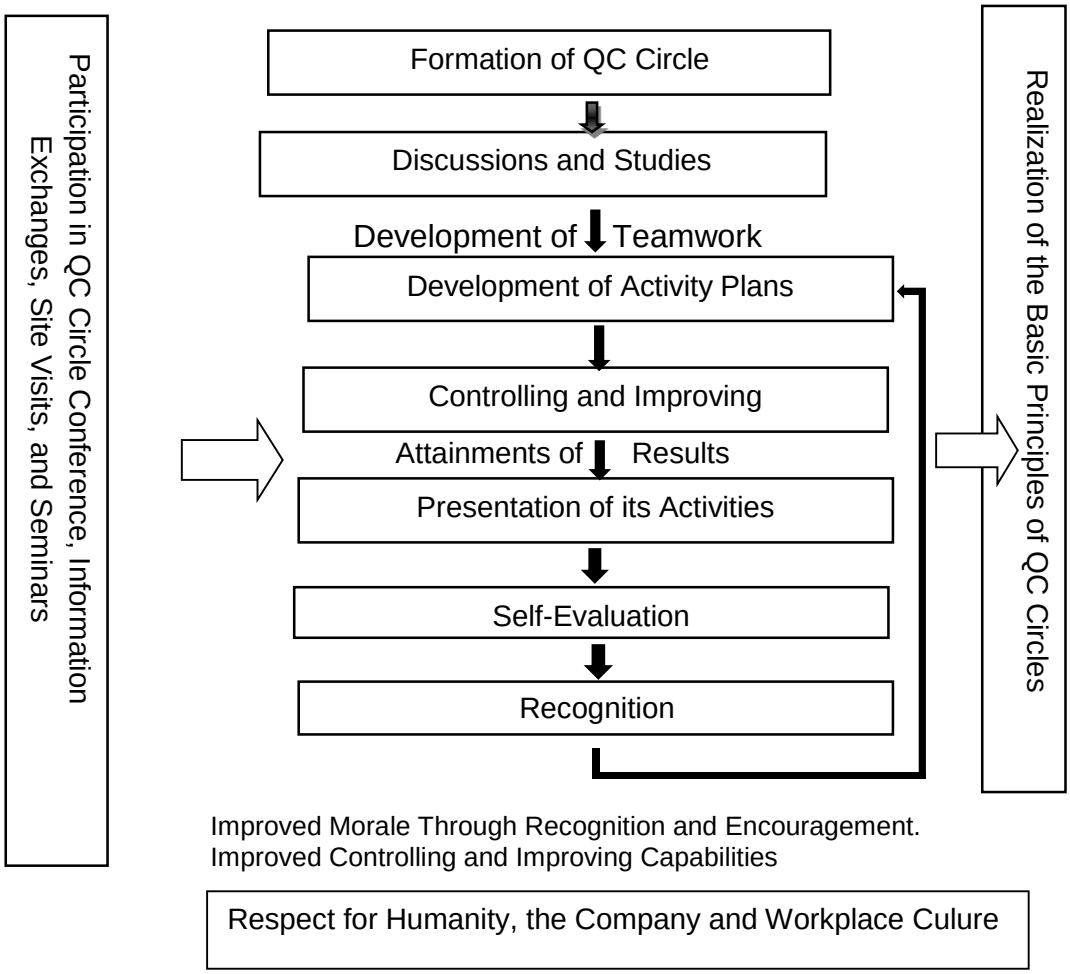


Figure 2-6 The Mechanism of QC Circle Activities

2.8.4.1 Form a QC Circle and Begin Discussion

QC Circle activities require teamwork; the foundation of the activities is mutual trust supported by understanding and buy-in among its members. In this vein, discussion plays a vital role. The following summarizes three points to remember.

2.8.4.2 Acquire job related knowledge and QC techniques.

A saying in the QC Circle activity goes “It begins with study and ends with study.” To conduct QC Circle activities is to study about job-related matters and various techniques.

Even in the jobs we do every day, we will discover many things when study them more deeply. These discoveries may be about job procedures, technology, reasons for currently established standards and procedures, relations to previous and succeeding processes, and customer wants and needs.

In a workplace where everyone’s job is different from others’, lack of knowledgeabout each other’s jobs may hamper QC Circle activities. It is beneficial when members mutually explain and understand about their jobs so as to smoothly operatetheir QC Circle activities.

In addition to deepening job knowledge, it is also important for QC Circles to studythe QC concepts and techniques, including conceptual and operational principles of controlling and improving activities**.**

2.8.4.3 Develop Activity Plans

Activity plans include both long-term and project-specific plans. A long-term activity plan describes a QC Circle’s policies, objectives, and measures. From a long-term viewpoint, a year or longer, the QC Circle develops such a plan considering what kind of QC Circle its members want to make, what goals they should strive for, and what they need to study to realize these purposes**.**

A project-specific activity plan is an action plan that includes targets, steps, member responsibilities, and time schedules.

2.8.4.4 Conduct Controlling and Improving Activities

The success of QC Circle Activities depends on the selection of improvement theme, the development of activity plans, and the controlling and improving activities according to these plans. A key to the controlling and improving activities is the members’ constant awareness of improvement opportunities and their conscious efforts to apply their job knowledge and QC techniques to activities.

2.8.4.5 Present the Results and Be Recognized

At the conclusion of an improvement project, QC Circles summarize their activities in an easy-to-understand manner to other Circles and make a presentation. This is an important process for further development of the Circles.

By making presentations, QC Circles have an opportunity to be recognized by their management, supporting staff, peers. Their bosses’ and peers’ recognition and encouragement promote QC Circles’ confidence, motivation, and active participation.

Also, QC Circles use this opportunity to reflect and evaluate themselves for the continuous improvement of their activities.

The point that should be emphasized again is that both the QC Circle and its members grow by continuously conducting QC Circle activities as outlined above.

2.8.5 Autonomous Operation of QC Circle Activities

In a nutshell, autonomous operation means “self-directed work.” Rather than waiting for others’ directions, QC Circles are expected to take the initiative to discuss issues, build consensus, and carry out necessary actions.

To self-direct their course of action, QC Circle develop targets and plans that answer such questions as what, how much, by when, and who assumes what responsibilities. In this process, it is important that all members understand and buy in. Although it is not easy to make QC Circle activities highly self-directed, it is a necessary condition for developing all members’ capabilities to the fullest. As a result, it becomes possible for QC Circle to attain their goals.

2.8.5.1 Know your members well.

Especially when a new QC Circle is formed or when new members join a QC Circle,it is important to get to know all members’ personalities and job duties. Creating a supporting atmosphere in the QC Circle is essential to promote effective discussions.Also, having a common experience among the members through recreational activities can help the Circle build a favorable atmosphere.

2.8.5.2 Discuss how to operate the QC Circle

To make QC Circle activities pleasant and enjoyable, it is essential to have constructive discussions among the Circle members and devise appropriate ways for its operations. The QC Circle should discuss how to proceed, what and how to study,and what lessons to be learned from experience.

2.8.5.3 Discuss workplace problems.

QC Circle members identify problems through talking about their workplace. There is no end to perfecting work. When discussions are centered around external and internal customers’ wants and needs, opportunities for improvement always surface.

2.8.6 Participation and Operations of QCC Circle Activities

(1) Participation

QC Circle activities respect each member’s self-directed participation. If a member feels forced and unwillingly participates, the QC Circle activity becomes painful to him/her. Therefore, it is important for Circle members to discuss constructively with their management and other members issues that they cannot understand or agree upon. QC Circle members are expected to participate in the activities with their understanding of an agreement with importance and the necessity of the activities.

As understanding and agreement may come from their experience in QC Circle activities, the members are encouraged to try the activities first.

(2) Roles of Leaders and Members

Leadership by a QC Circle leader is a necessary condition for a Circle's success. Leadership in QC Circle activities requires that the leader works with his/her members to develop understanding of an agreement with the leader's intended direction. The leader also facilities the members action to take necessary initiatives. The leader's roles include the following:

1. Bring his/her QC Circle together and set directions for its activities.
2. Promote the activities by taking the lead in meetings and setting an example.
3. Lead the Circle's study of job knowledge, technology, and QC techniques.
4. Develop the next leader.

No matter how hard the leader works, without the members' cooperation, it is impossible to carry out lively QC Circles activities. The members roles are:

1. Actively participate in QC Circle activities by sharing and exercising responsibilities
2. Attend QC Circle meetings and speak out.
3. Cooperate with the leader and develop harmony with other members.
4. Study and use their job knowledge, technology, and QC techniques**.**

(3) QC Circle Meetings

Meetings are the vehicle of QC Circles' discussions and conducting quality control and improvement activities. Therefore, how these meetings are conducted greatly influences the solving of problems. Meetings provide opportunities for discussions, information sharing, and mutual learning. Therefore, meetings should be planned to schedule a time and date when all members can attend. During a meeting everyone should be encouraged to talk, and necessary tasks should be shared among the members to facilitate a smooth operation of the meeting.

(4) Continued Study

To promote QC Circle activities effectively, both leaders and members need to continue their study on their own. Study subjects may include the following:

1. Concepts and operational methods of QC Circle Activities
2. QC Concepts and methods needed for controlling and improving activities.
3. Work procedures and necessary technology.

A study group is an effective way to sustain an individual's motivation for learning. QC Circles discuss what and how to study, develop study plans, and carry out the plans.

It is rare that QCC Circle activities go smoothly without any difficulties. QC Circles may run into a stone wall once or twice during project. This is an excellent opportunity to study the QCC Circle magazine books. When QCC Circle members' awareness of problem is high, they are likely to find hints for solving their problems in their study. The knowledge acquired from challenging experiences is ingrained deeply into the member's mind. The key is to take advantage of these difficult time times for learning.

2.8.6.1 Developing Activity

QC Circles autonomously develop and implement their own activity plans. To make QC Circle activities lively and long-lasting, members discuss how they are going to operate their activities and develop their long-term (a year or longer) activity plan. When they select a theme for improvement, they also develop an activity plan for the project.

2.8.6.2 Problem Identification, Control and Improvement (the awareness).

The carry out daily work effectively and efficiently, employees should apply the principles and operational methods learned from their QCC Circle activities to their jobs. Daily work and QC Circle activities should be integrated, and not considered as separate.

QC Circles should pay attention to the quality of their work, products, and services and sharpen their awareness of improvement opportunities. The following actionsand perspectives support QC Circle activities:

1. A self-improvement spirit in the workplace
2. Comparing the status with the target or the ideal
3. Looking for problems with the mindset that they are everywhere.
4. Paying attention to quality, cost, delivery (quantity), safety and morale
5. Accepting the challenge of stretch goals
6. Watching for changes is business or workplace environment, trends of customer needs, and technological progress.

2.8.6.3 Theme Selection for Activities

The subject or theme selected for QC Circle activities greatly influences whether or not the Circle can set its activities stay on course and achieve favorable results.

To select a theme for improvement, it is essential for Circle discussions to involve all members. The Circle members dig out problems in the workplace by examining their internal and external customers' wants and needs, their difficulties at work, and their bosses' expectations. By understanding the current situation accurately, the Circle members develop a sense of ownership as well as a spirit of self-improvement. The Circle is then able to make a conscious selection of improvement themes.

Even when a theme for improvement is prompted by management, it is important for all members of the QC Circle to discuss it fully until a full consensus is reached onthe theme being developed.

2.8.6.4 *Implementation of Quality Control and Improvement*

To implement quality control and improvement activities, QC Circles tap their members' knowledge and experience and make an effort to use newly learned QC concepts and techniques. The point is that all members stay on the lookout for improvement opportunities to draw out their creativity.

The standard tactic for improvement activities is to follow the improvement steps, but things do not always go by the book. In such a case, QC Circles may need to repeat certain steps or look at their situations from different angles. Persistence is a key.

Furthermore, QCC Circles may need to consult with their management or QC supportpersonnel. If QC Circles have a strong will to improve, they will overcome their difficulties.

2.8.6.5 Self-Evaluation

QC Circles evaluate whether their activities have proceeded as intended in their activity plans and objectives. Checking points include whether their activities went smoothly, what knowledge and skill must be developed, whether the results were satisfactory, and how their own Circle compares with others. Management's and support staff's comments and advice should also provide lessons to be learned.

Self-evaluation is performed every time a QCC Circle finishes a project or when Circle makes a presentation of its improvement case. Additionally, the Circle evaluates its activities for the past year. The results of these self-evaluations are discussed at Circle meetings to establish new goals and to develop measures for improving Circle weaknesses and further fostering Circle strengths.

2.8.7 Relationships to Management and Supporting Staff

QC Circles manage their activities in a self-directed manner within the business framework. While" do as you please" is not the mode of the QC Circles' self-directed operations, " do as management directs" does not give them autonomy, which is an important characteristic of QC Circles.

What QC Circles should do is to understand and agree with their Management's policies before acting upon time. A key is to maintain close communications with management by reporting, receiving information, and asking for help when necessary. When QC Circle activities hit a stone wall or run into troubles, the Corcle should seek help. As management and supporting staff members are observers of the QC Circle, they will consult with the Circle and providenecessary advice and support. A passive attitude does not solve problems.

Although QC Circles activities encourage autonomy, Circles should obtain necessary approvals from their management when they investigate and analyze their work processes as well as when they implement improvement measures. This is important to assure safety and quality and to avoid causing any problems for the subsequent processes.

2.8.8 Utilization of QC Concepts and Techniques

2.8.8.1 QC CONCEPTS

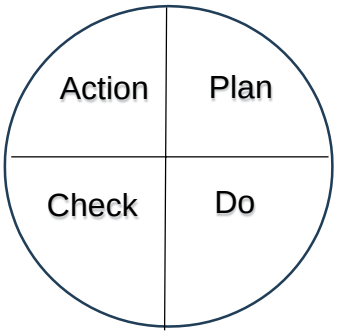
(1) Quality First

QC is practice that promotes the concepts of "quality first "and "customers first ", to produce products and deliver services from their recipients' perspectives. In daily work, these concepts translate into the principle, "the next processes are our customers." When this principle is practiced by everyone in a company, the walls between departments are removed and communication in the organization becomes more open. The flow of information becomes smoother, and people then discuss matters based on facts and data.

(2) Management Cycle

As shown in PDCA Cycles below, the management function consists of four steps, such as :

1. **Plan**
2 **Do**
3. **Check**
4. **Act**



Until the process achieves its objectives, the cycle is repeatedly rotated while each step is observed attentively. Commonly, people say “rotate the Management Cycle ”or” the PDCA cycle “ using its acronym.

The following explains the Management Cycle in more detail:

PLAN---
- Establish the objectives and targets for improvement
- -- Determine the process and the methods for achieving the objectives.
- (*standardization: technical standards, operational standards;*
- *-procedures; guidelines, manual.etc)*
- Predict and prevent troubles beforehand.

DO---
- Educate and Train Employees
- Implement the Plan

CHECK---
- Compare the results against the targets.
- When the results fall short, examine the causes

ACTION---
- Take immediate measures.
- --- Analyze the process and identify the root causes and develop
- permanent measures *(prevention of recurrence, prevention*
- *by prediction)*
- Revise the standards.

“Process control “is the name used for the quality control activity that is carried outby rotating the management Cycle Process control strives for controlling and improving work processes and procedures so as to obtain desirable results.

“Prevention of recurrence refers to activities that prevent problems from requiring. by analyzing the probable causes of the problems, identifying the root causes, and removing them. **“**Prevention by prediction are activities that predict and prevent problems before they occur. A key to both prevention of recurrence and prevention by prediction is to nail down the root causes of the problems so as to improve the work processes and procedures

(2) Management by Fact

QC Circle activities encourage their members to discuss, think, and judge necessary matters based on the facts and data. Data refers to the results obtained by measuring or observing a fact and comes in various forms such as numerical values, language data, drawings, and pictures.

Without confirming the fact and collecting data, people often make judgments based solely on their experience, intuition, and gut feeling. On the other hand, the scientific way of thinking relies on the facts and data. Main points include the following :

1. Observe actual items and symptoms on the spot.
2. Show the observed results in data.
3. Think about causes and effects while separating the two.
4. Prioritize
5. Pay attention to variability when assessing the situation.
6. Stratify and analyze data completely.

2.8.8.2 Useful Methods

(1) The Process for Solving Problems

The problem-solving process begins by recognizing that problems (deficiencies, defects, etc.) exist, then identifying the causes of the problems and taking measures to prevent their recurrence. Although there are various problems in the workplace, most of them can be solved following the problems-solving process. When the activities get stuck on certain step, it is necessary to go back to the previous step and repeat it from a different perspective. Figure 3.3 below, depicts the process for solving problems.

(2) A Process for Achieving Tasks

The workplace is faced not only with problems, to which the problem-solving process is applied, but also with new challenges or tasks. These types of tasks are “challenges for new businesses “breakthroughs” and “creation of attractive qualities”.

The process for developing necessary measures to achieve these tasks is shown in Figure 3.4, below.

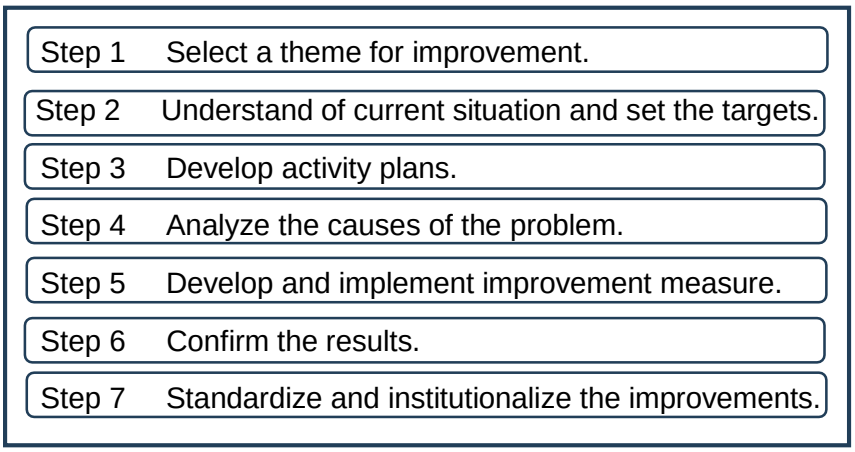


Figure 3-3 The Process for Solving Problems

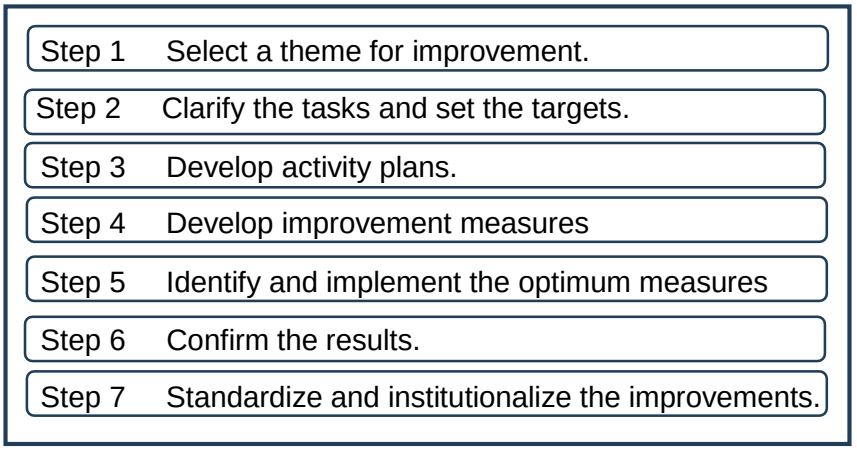


Figure 3-4 The Process for Achieving Tasks

(3) QC Techniques and others

The techniques that are frequently used for quality control and improvement activitiesinclude: the seven QC tools (Pareto diagram, Cause and effect diagram, Stratification, Check sheet, Histogram, Scatter diagram, Graph and Control chart). The Seven Management Tools for QC, called New 7 Tools (such as Relations diagram, Tree diagram, Matrix diagram; Affinity diagram/KJ methods, Activity Network diagram, PDPC and Prioritization matrix) and various statistical quality control methods (such as test, estimation, analysis of variance, and design of experiments).

Among these QC techniques, the tools most frequently used by QC Circle are the Seven QC tools (7 Tools) and they are characterized as follows:

1. Tools are simple and easy to use.
2. They present the data graphically for an easy and at-a-glance understanding.
3. They can be applied to various problems.

(4) Others Supporting the 7 QC Tools

(a) What is Brainstorming ?

Brainstorming is a tool used by teams to bring out the ideas of everyone and present them in an orderly fashion to the rest of the team. The key ingredient is to provide an environment free of criticism for creative and unrestricted exploration of options or solutions.
Brainstorming helps a team break free of old, ineffective ideas. This free-wheeling technique for generating ideas may produce some that seem half-baked, but it can lead to new and original solutions to problems.
It expands your thinking to include all aspects of a problem or a solution. You can identify a wide range of options.! Rapidly produces many ideas. By encouraging people to offer whatever ideas come to mind, it helps groups develop many ideas quickly.! Equalizes involvement by all team members. It provides a nonjudgmental environment that encourages everyone to offer ideas. All ideas are recorded.! Fosters a sense of ownership. Having all members actively participate in the Brainstorming process fosters a sense of ownership in the topic discussed and in the resulting activities. When the people on a team contribute personally to the direction of a decision, they are more likely to support it.! Provides input to other tools. You may want to affinitive the brainstormed ideas. And, if appropriate, you can work with the team to reduce the number of ideas by Multivoting. Brainstorming is useful when you want to generate many ideas about issues to tackle, possible causes of problems, approaches to use, or actions to take.

(b) What is Run Chart ?

A Run Chart is the most basic tool used to display how a process performs over time. It is a line graph of data points plotted in chronological order—that is, the sequence in which process events occurred. These data points represent measurements, counts, or percentages of process output. Run Charts are used to assess and achieve process stability by highlighting signals of special causes of variation.
Using Run Charts can help you determine whether your process is stable (free of special causes), consistent, and predictable. Unlike other tools, such as Pareto Charts or Histograms, Run Charts display data in the sequence in which they occurred. This enables you to visualize how your process is performing and helps you to detect signals of special causes of variation.
You can benefit from using a Run Chart whenever you need a graphical tool to help you. Understand variation in process performance so you can improve it. Analyze data for patterns that are not easily seen in tables or spreadsheets. Monitor process performance over time to detect signals of changes. Communicate how a process performed during a specific time period

(c) What is a Survey ?

A survey is a systematic method of collecting information from a selected group of people by asking a series of questions. Surveys can be used to collect various types of information.

They can collect information on people's behaviors, job performance, knowledge, preferences, attitudes, beliefs, feelings, etc. For a survey to provide useful information, care must be taken in its development and use for several reasons, including the cost in terms of time and money.

Although surveys are a popular method of collecting data, they must be used under the appropriate conditions. methods. Sometimes other data collection methods are preferable.

For example, to Consider using a survey when it is faster, easier, or less expensive to use than other determine the number of people using a clinic, you can simply count the number of signatures on the sign-in sheet, or examine the daily records, rather than conduct a survey to obtain this information methods. Consider using a survey when the information does not already exist in some form. Checking whether relevant and accurate data exist in archives, records, or databases can save a great deal of time, money, and effort. For example, before asking employees the names and dates of each course taken within the past year, consult their training files to obtain this information.

(5) The Tools can be used in Combinations for wider application.

Besides the QC techniques, IE (industrial engineering) and other techniques are useful to identify "strain", "waste", and "unevenness in the flow of work processes. The IE techniques for motion and time studies and improvement as well as VA/VE (value analysis and value engineering). For safety issues, the use of KYT (a Japanese training method for danger detection) is helpful to examine reliability problems, FMEA (failure modes and effect analysis) and FTA (fault tree analysis) may be used.

(6) QCC- Conventions (Conferences)

As QC Circles applied what they had learned, improved their workplace problems, andachieved results, they wanted to have an opportunity to share their experience outside their company. In Japan, the First QCC Convention was held in May 1963 at Sendai while in Indonesia, the First QCC Convention held in Jakarta, April 1985, while the 2023's QCC Convention was the 39th convention which organized by IQMA in Indonesia.

2.9 ISO 9001: 2015. Quality Management System (QMS) and ISO 19.011:2018 Audits Management System (AMS)

INTRODUCTION

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

2.9.1 ISO 9001: 2015. Quality Management System (QMS)

ISO 9001 is a globally recognized standard for quality management. It helps organizations of all sizes and sectors to improve their performance, meet customer expectations and demonstrate their commitment to quality. Its requirements define how to establish, implement, maintain, and continually improve a quality management system (QMS). Implementing ISO 9001 means the organization hasput in place effective processes and trained staff to deliver flawless products or services time after time

The Important of ISO 9001

With more than one million certificates issued to organizations in 189 countries, ISO 9001 is the most widely used quality management standard in the world. Within the ISO 9000 family, which defines seven quality management principles including a strong customer focus and continual improvement, ISO 9001 is the only standard that can be certified to.

Business benefits include:

- **Customer confidence: The standard ensures that organizations have robust quality control processes in place, leading to increased customer trust and satisfaction.**
- **Effective complaint resolution: ISO 9001 offers guidelines for resolving customer complaints efficiently, contributing to timely and satisfactory problem-solving.**
- **Process improvement: The standard helps identify and eliminate inefficiencies,reduce waste, streamline operations, and promote informed decision-making, resulting in cost savings and better outcomes.**

Ongoing optimization: Regular audits and reviews encouraged by ISO 9001 enable organizations to continually refine their quality management systems,

2.9.2 ISO 19011: Audits Management System (AMS)

Since 2011 second editions, several new management system standards have been published, many of which have a common structure, identical core requirements and common terms and core definitions.

As a result, there is a need to consider a broaderapproach to management system auditing, as well as providing guidance that is moregeneric. Audit results can provide input to the analysis aspect of business planning andcan contribute to the identification of improvement needs and activities. An audit can beconducted against a range of audit criteria, separately or in combination, including butnot limited to:

— requirements defined in one or more management system standards.
— policies and requirements specified by relevant interested parties.
— statutory andregulatory requirements.
— one or more management system processes defined by the organization.
— management system plan(s) relating to the provision of specific outputs of a management system (e.g. quality plan, project plan) stay competitive, and achieve long-term success.

This ISO 19001:2018 document provides guidance for all sizes and types of organizations and audits of varying scopes and scales, including those conducted by large audit teams, typically of larger organizations, and those by single auditors, whether in large or small organizations. This guidance should be adapted as appropriate to the scope, complexity, and scale of the audit program. their external providers and other external interested parties (second party).

This document can also be useful for external audits conducted for purposes other than thirdparty management system certification. This documentconcentrates on internal audits (first party) and audits conducted by organizations on.

This document is intended to apply to a broad range of potential users, including auditors, organizations implementing management systems and organizations needing to conduct management system audits for contractual or regulatory reasons. Users ofthis document can, however, apply this guidance in developing their own audit related. requirements. The guidance in this document can also be used for the purpose of self-declaration and can be useful to organizations involved in auditor training or personnelcertification. This document concentrates on internal audits (first party) and audits conducted by organizations on their external providers and other external interested parties (second party). This document can also be useful for external audits conductedfor purposes other than third party management system certification. ISO/IEC 17021-1 provides requirements for auditing management systems for third party certification; thisdocument can provide useful additional guidance (see Table 1

Table 2.2.9 — Different types of Audits

1st party audit	2nd party audit	3rd party audit
Internal audit	**External provider audit**	**Certification and/or accreditation audit**
	Other external interested party audit.	**Statutory, regulatory, and similar audit**

CHAPTER 3.
DATA AND METHODOLOGY

INTRODUCTION

This chapter covers the research flow diagram proposals, type of recent PDCA process applied by companies (as population), and cases study as sample, example of competitions schedule with participants QCC sampling methodology, instrumentation, instrument validity, pilot study, instrument reliability, data collecting procedure, and statistical analysis procedure.

3.1 Purpose of Methodology

This research conducts a systematic review of analyzing, designing, and developinga problem-solving methodology for Indonesian work forces in manufacturing and services, as well. The idea behind is that the "fit for use" TULTA-methodology" should have implications of such, achieving the overall performances by "practitioners" (QCC) activity, in terms of quality or process (Deming 1986). Because"TULTA methodology", which can be seen as "the right pathway" will also promotes the higher motivations for work forces in achieving operations goals; effectively. Therefore, it is important why the 2nd research, undertaken the significance of practitioners (QCC) implementation that pathway, named "TULTA" Evaluation System Methodology"; which can be stated as "Human ware"; since this auditssystem must be conducted by proficient evaluators*.* The results of QCCs performances can be quantified in "Score' as multiplications between Weigh and Marks. This further research development can be traced through Figure.1, (marked inbold type). However, conclusive evidence regarding the relationship between the variable contents between two of methodology has not been provided and therefore will not constitute the focus of this thesis.

3.2. Purpose of the Study

As explained, the non-uniformity SOP (Standard Operating Procedure) conditions was the consequence of not-yet productions technique standardized as measuring instruments. The relevant literature has been proposed that a contributor to this condition (the effective TULTA practices) is strengthen pusher and/or increased drivefor spirit to do the right things first right. In this situation, the role of "TULTA" step by step implementations is key as it regulates "PDCA" cycle, without any disruptions. Several research studies corroborate the phenomenon between the right application of processes (TULTA-Approach) and their performances (QCC-Evaluation System).(B.Scott Parsowith., and JUSE Press.Ltd et al., 2008).

3.3. Research Question

This thesis aims to answer the questions "What is the significance of the contribution of "PDCA-TULTA Approach" in increased the uniformity of production techniques" in manufacturing?" and "What are the potential implications of "QCC-Evaluation System" benefits for QCC (Quality Control Circles) and the Company evaluation goals result, achieved via quality conventions? With other words, is there an orderly right practice of "TULTA" could be correlated with the QCC measurement result; significantly?

In addition, the 2nd study research shows, that the evaluation results (identified by quality awards had received) which is conducted via company level, as same as via national level conventions (IQC held by IQMA), should be complementary with the evaluation results, obtained via international competitions, such as International Convention on QCC (ICQCC'23, Beijing, China held by CAQ – China Association for Quality).

3.4. Systematic Review of Current Research

In this systematic review we will apply a "qualitative comparative" of strength & weakness between old steps versus seven steps (TULTA). The aim is to derive conclusions about that body of further research that became the evaluations object focus of the audits. A good deal discovery of these research has been directed by thevery rigorous study done by researcher and the combination of the two methodologies will becomes standard guidelines, that researchers will be contributes to manufacturing processes in the country. The researcher thus applies the ISO 19,001: 2018: Guidelines for Auditing Management Systems (AMS) as will the foundational factors in supporting the invention of 2nd methodology, said the TULTA- "Evaluation System".

3.5. Data Collection and Analysis

Each research study that is cited in this dissertation has provided information regarding Plan, DO, Check and Action activity carried out by work forces group.

initiated by management, as researchers gather data regarding the closed relationship with processes behaviors of Indonesian manufacturing work forces, in the country. This phenomenon allows us to evaluate the linear correlations between practitioners (QCCs) and Evaluations object focus (ISO 19,001;2018; Audit Management System (AMS), ultimately.

3.6. Conclusion

As mentioned above, absence of "uniform" production processes, which identified in Figure.1, became the weakness phenomenon in achieving higher performance in manufacturing, and finally will be factors inhibiting the quality improvement achievement.

The research studies mentioned above, has been understood through clear descriptions by Shiba, Shoji and Walden. David (2001). Four Practical Revolutionsin Management. System for Creating Unique Organizational Capability.

CHAPTER 4.

CONTENTS AND RESULTS

PDCA TULTA® METHODOLOGY

An Innovative Problem-Solving to Enhance Quality Activities in Manufacturing

INTRODUCTION

Continuous changes had made the business world desperately seeking for better ways. In the TQM, there is a prefab: ***"Today should be better than yesterday and tomorrow should be better than today"***. This philosophy was popularized by Dr. Deming, as the expression of : ***PLAN-DO-CHECK-ACTION (PDCA Cycle).*** Therefore, the world named it as ***Deming Cycle***.

PDCA Cycle consist of **7 Steps activities** that utilize ***7 Statistical Quality Tools (7 QC Tools)***. This method is popular among TQM Practitioners with term **TULTA** standing for Seven Steps and Seven Tools, and in Bahasa Indonesia it is called: ***TUjuh Langkah dan Tujuh Alat.*** That is why the abbreviation become **TULTA®** ***(TULTA has been Patented by Indonesian Government in Yr.2,000, on behalf of Researcher's name).***

PDCA TULTA® is a new methodology that developed by researcher together with R/D team of IQMA and sourced from the ***WV Model of Continuous Improvement*** by Prof. Dr. Shoji Shiba in his book entitled: ***Four Practical Revolutions in Management,*** with subtitled: ***System for creating unique organizational capability***.
The **WV** model illustrates three basics of problem-solving, as shown below:

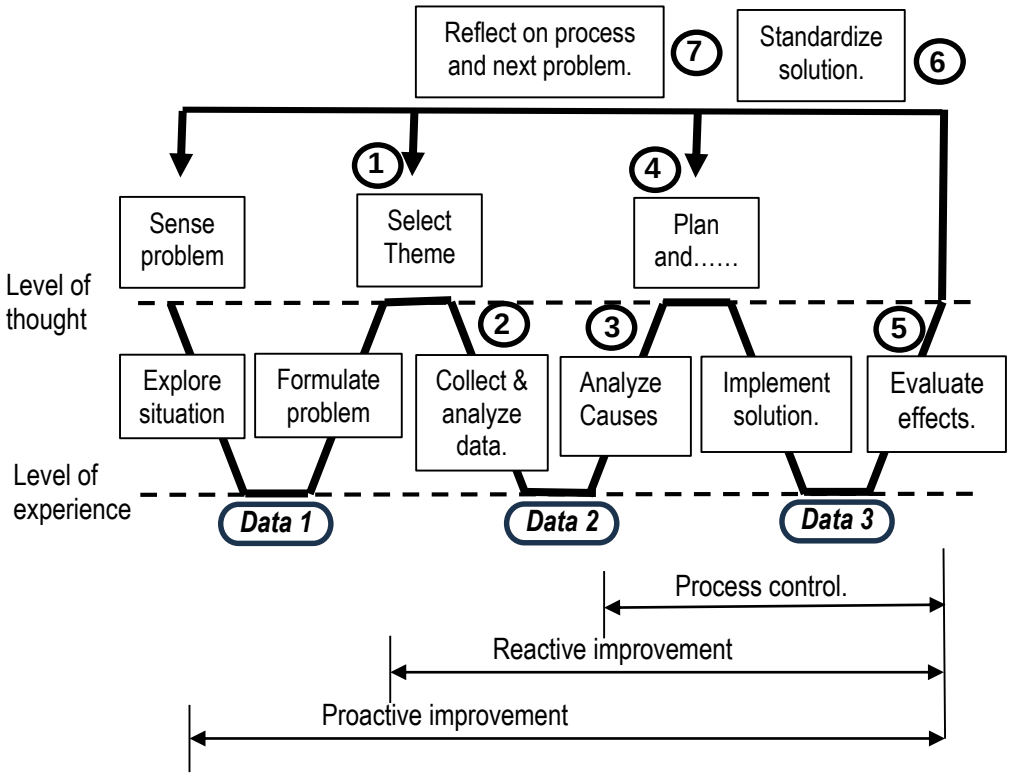


Figure 4-1. The Three Types of Problem Solving, within the WV Model.

The WV model depicts the overall of problem solving as alternation between thought (ruminating, planning, and analyzing) and experience (getting information from the real world, e.g. through collecting data, interviews, experiments, or numerical measurements). The path between these two levels over time forms the shape of a ***W*** and the a ***V***, hence, the name ***WV***. (researcher satated this as short of “waves”…”un-ending stop movement”)

The three types of improvement are described below: process control, reactive improvement, and proactive improvement. Quality management started with process control in the United States in the 1930s and in Japan in the 1950s. Reactive improvement was added in the 1960s and 1970s, followed by proactive improvement in the 1980s. In Indonesia, process control and reactive improvement were applied by Japan joint venture with Indonesia company, estimated around in the 1980s and 1990s.While reactive improvement was added in the 2000s, ultimately.

Process Control known as the SDCA (Standard, Do, Check and Action) cycle. About process control can be explained as follow : Any type of work has standards (S), which must be executed (D) and then evaluate the process and results (C).If the evaluation results show any deviation and follow up by returning to process standards (A), thus, the method is to have a standard process, to use it to check whether the product meets the specification, and then to act to bring the process back to the standard. The concept is depicted as a cycle because one continues to apply the standard as long the production procedure continues. The monitoring system of process control includes use of inspection and some of the 7 QC Tools, which utilize of Data.3 (accounting- quantitative data, mainly numbers), as shown in Figure 4-1.

Reactive improvement. The next stage of the WV model addresses the improvement of a weak process. Suppose you have a specific process that produces results that simply aren’t good enough and even if the worker corrects the process according to the manual repeatedly, but the problem still occurs. There is obviously something wrong with the process.

In this case, the worker must collect and analyze data, find the root causes of the problem, and implement appropriate countermeasures. In other words, the worker reacts to a specific problem by using a problem-solving process to make the improvement. The methodology are as follows:

1. Select a theme.
2. Collect and analyze data.
3. Analyze causes.
4. Plan and implement solution.
5. Evaluate effects.
6. Standardize solution.
7. Reflect on process and the next problem.

Proactive improvement. In many situations you do not start with a clear idea of a specific needed improvement. Rather, you have to choose a direction for the company before starting an improvement activity. For instance, you may need to decide what the customer wants, which product to develop, or which process needs improvement most. This situation is addressed by the final portion of the WV model, known as proactive improvement, as shown in Figure 4-1.

At first, you are only generally aware that there is a problem; you sense a problem. Then you explore the situation broadly to understand what is going on (what customers appear to want, what you are able to build, what processes need fixing). Having explored the situation broadly, you are in a position to formulate a problem, and then in many cases you can move into the 7 steps. The New 7 Tools and Quality Function Deployment (QFD) are useful for proactive improvement that supporting by utilize Data.1 (most often qualitative in language, not numbers; and is fuzzy).

PDCA TULTA® METHODOLOGY

The PDCA TULTA® are very useful for the improvement of sustainable work process or performance, namely a process where the previous problem may recur, for examples: machine operator job, maintenance job, administration work, customer services, health center services, financial services, and others. Therefore, the characteristic of quality problem solving is more reactive, so they are called: ***Reactive Improvement Method***.

PDCA TULTA® began to be introduced massive to business groups, quality teachers and QC Circles as practitioners in Indonesia, but for the first five years, PDCA TULTA® was implemented in the goods production sector only, by being evaluated periodically every year, and the results show that by using this methodology, QC Circles can produce new standards that are truly useful for improving QCC's performance, both processes and targets.

Infact, since ISO 9001 – 2000 revised and developed became Quality Management System (QMS) shifted from Quality Assurance Standards guidelines, the results of every quality improvement, initiated by management in the company, had become an input for standard reviews to create new performance standards.

In further development of the PDCA TULTA® implementation, it turns out that it can also be used to overcome the incidental problems, for the examples : ***preventing the risk of accidents occurring***; ***prevention of healthcare errors, etc***. The results show that PDCA TULTA® is proven to be able to overcome problems that have not yet occurred, but which have the potential to occur if they are ignored.

Therefore, it can be said that PDCA TULTA® has been proven effective for use in overcoming problems in continuous work processes as well as incidental problems.

PDCA TULTA® can be described in the activities cycle as follows :

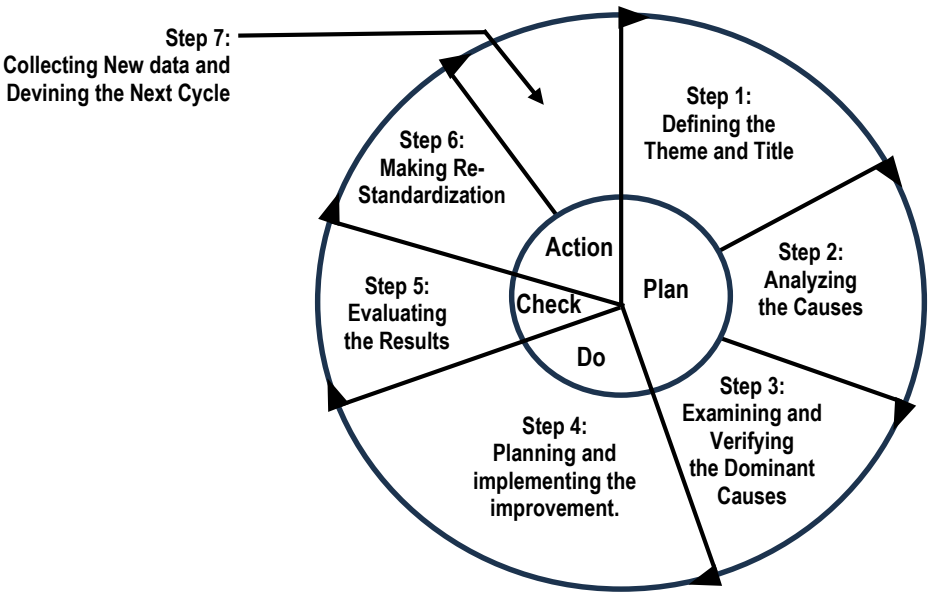


Figure 4-2. The PDCA TULTA® Cycle

As shown in the figure above, the PDCA TULTA® sequence consist of :

- Step 1: Defining the Theme and Title
- Step 2: Analyzing the Causes
- Step 3: Examining and Verifying the Dominant Causes
- Step 4: Planning and Implementing the Improvement
- Step 5: Evaluating the Results
- Step 6: Making Re-Standardization
- Step 7: Collecting New Data and Defining the Next Cycle

The cycle of PDCA TULTA® is a continuous series of activities, like an unbroken chain of bracelets, because each activity has interconnected chains and the final result of the activity (step 7) will become a connecting chain for this ciycle and determines the next plan.

From the figure above it can be seen that the plan (steps 1 - 3) is the largest piece of the pie, which is 45% of all PDCA activities. this shows a specific characteristic of the TQM management process, namely that an activity always requires quite long and careful planning, in order to accelerate and streamline the implementation process. This is the true meaning of EFFICIENT, which is “to do the right thing from the beginning”. So that the process of subsequent activities does not have to go back and forth simply because it has to revisit the previous steps

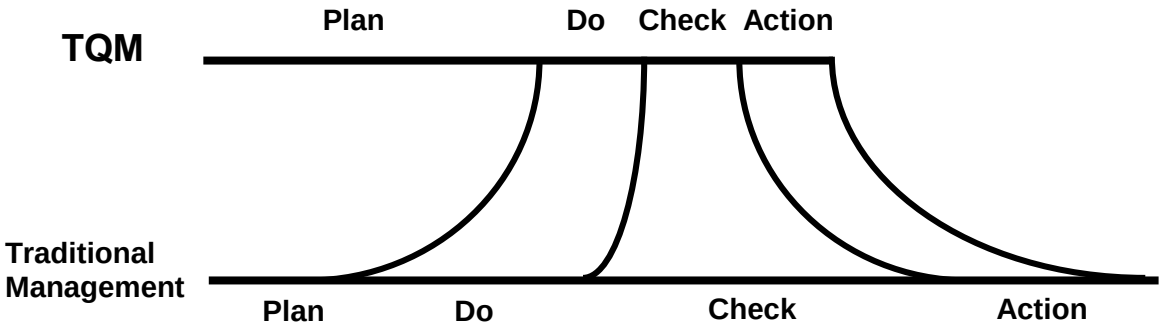


Figure 4-3. Specific character of process management by TQM

The following description is a complete explanation of the each step of PDCA TULTA® :

Step 1: Defining the Theme and Title

1.A. Defining the Theme

Defining the theme means creating a quality improvement goal that contains good intentions to address a priority quality problem, at the time, based on massive data analysis. Therefore, in order to determine the theme, first of all, it is very important to identify the priority of the problem.

Based on observations from implementations in some organizations and companies, it is shown that quality problems can stem from the following matters:

1) ***5 Evils*** against quality: (1) defects, (2) waste, (3) delay, (4) errors and(5) accidents.
2) Changes in policy management or goals that may create gaps in various process or operational lines, so this deserves to be resolved immediately.
3) Complaints from external and internal customer.
4) Management Instructions that relate to the conditions faced by the company, for example: the purchase of new machines, automation, improvement of processes and others that can create obstacles to the work process.
5) Targets that have not been achieved is also a source of important themes to be prioritized for improvement.
6) Improving targets that currently exist.
7) Obstacles arising from automation applied by management to increase productivity.
8) Improvement of Process Capability.
9) The implementation of risk management and environmental management can also be a source of themes, especially when deviations are found in their implementation.

Then the first thing QCC member must be done is collect data. Once the data has been collected, according to the source of the problem encountered, then QCC members can analyze the data using the appropriate QC tools to identify the priority of problem, and then continue by defining goals to be achieved in the form of a THEME statement. Some examples of themes: reducing product defects, reducing raw materials waste, optimizing productivity achievements etc.

1.B. Defining the Title

The title, in this case can also be called ***the initial goals***, that are expected to be achieved through the quality improvement project which will be carried out by QCC.

The statement on the title must contain a double target namely: the target of achieving the results and the estimated time period for improvement. The target of achievement should refer to 100 % or preventing priority problem from occurring again (0 %). Therefore, the target will be the control for the next steps, whereas the estimated improvement time period will be control the execution time at each subsequent step.

To define the title begins by collecting and analyzing data on the current situation of operational, in order to know the main problems encountered. The results of the data analysis will be the basis for determining the Title or Initial goals.

In this case, the relationship between Theme and Title can be described as follows : A theme is a goal that is ultimately intended to be achieved through quality improvement activities, while a title is the way or path chosen to achieve that goal. The example of theme and title :

Theme: ***Optimization of credit performance in ABC Bank – Jakarta branch.***

Title: ***Reduced delay of credit approval process, by 100 %, with an improvement period of 12 weeks.***

In accordance with the principle of continuous PDCA activities, the title will be a bridge connecting to the next step (Step 2 - Analyzing the Causes).

Some of QC Tools that can be used in the step 1 of PDCA TULTA® include:

1. Check sheets are needed in case QCC requires data collection through direct inspection from the field.
2. Pareto diagrams are needed when QCC collects data and stratifies it to identify the priority data (Pareto factors).
3. Graphs: A bar chart is needed to describe phenomenon data; Run chart to illustrate trend data; Pie chart to illustrate clarifying the part of the data that matters most,
4. Histogram is used to find out how much deviation out of standard.
5. Control chart is used to find out how far the varians out of specification of process.

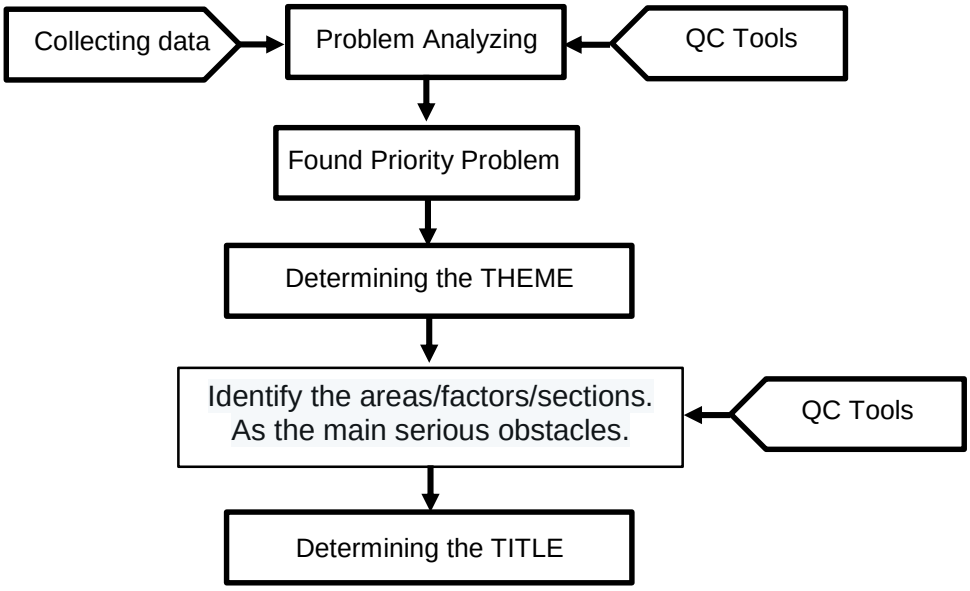


Figure 4-4. Flowchart PDCA TULTA® : Step 1 – Determining the Theme and Title

Step 2: Analyzing the Causes

The main goal to be achieved in this step is to find the root causes of the main problems to be improved. Generally, the QC tool used in this step is ***Ishikawa diagram***, or more commonly known as ***Fishbone diagrams*** or ***Cause and Effect diagrams (CED)***. Nevertheless, in its implementation, in order to obtain ideas of causes, as much as possible, so a method of creative thinking is required, namely **Nominal Group Technique (NGT)**. This is another form of brainstorming, where the collection for ideas is done silently, while the ideas are written down on pieces of paper, then be collected and stratified into 4M1E factors.

This step is very strategic, because the dominant root causes must be truly revealed, in order to be improved and prevented from recurring. Therefore, analyzing the causes must be done many times until all ideas of causes are completely exhausted. Then proceed to the next step.

The following is the sequence that must be done in order to ensure that the effort in analyzing the cause can give optimal results:

1. First, the QCC members will start the activity by specifying the topic according to the TITLE in the previous step, for example, take an example from the title above, it is : ***"Reduced delay of credit approval process, by 100 %, with an improvement period of 12 weeks"***, then the topic for which the causes will be analyzed in this step is :***"The delay of credit approval is frequent"***.

2. After determining the topic, QCC members gather as many causal ideas as possible, using creative thinking freely by using NGT approach (the idea is written down in silence). Then, proceed the ideas into 4M1E factors: MACHINE, MAN, MATERIAL, METHOD and ENVIRONMENT.

3. Next, structure the causes into the framework of ***the Ishiwaka Diagram***, according to their respective categories. At this point, QCC members can add new ideas of cause, until the root causes is truly revealed. Just a guide, the analysis of causes is said to be sharp, when it is able to find the root up to the fifth (5^{th}) layer of the cause.

4. Finally, next is voting against the root causes to determine the causes that are declared to be the dominant cause candidates.

5. Just in case the relationships between causes are quite complex, hence the use of Ishikawa diagrams and NGT can be replaced by Relation diagrams and Matrix diagrams.

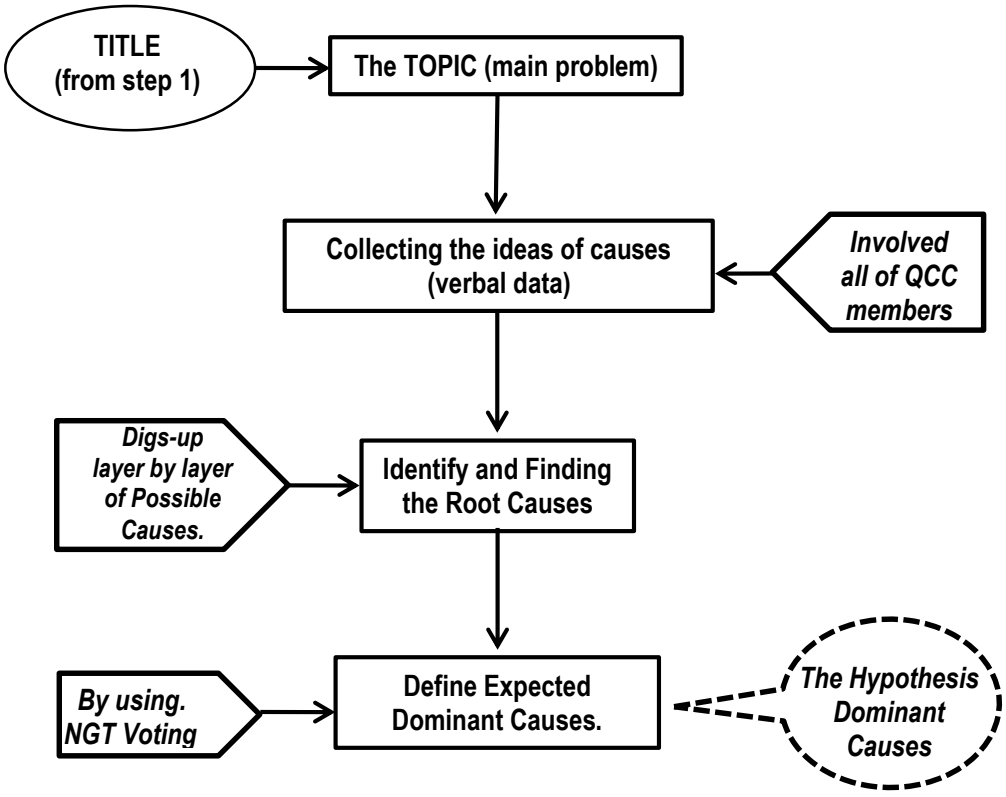
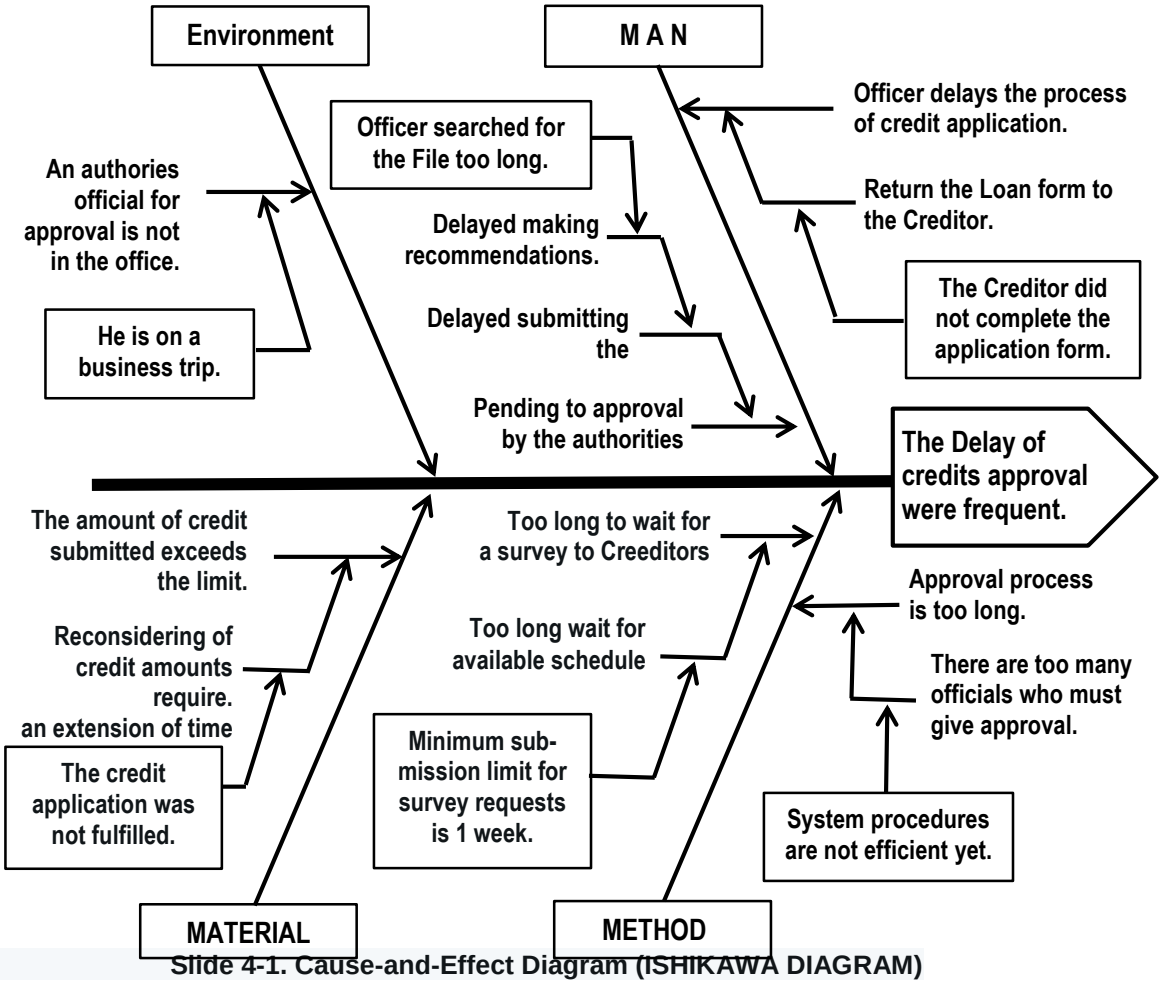


Figure 4-5. Flowchart PDCA TULTA® : Step 2 – Analyzing the Causes

Below is an example of **Ishikawa Diagram** as continuity of Theme and Title in step 1 of PDCA TULTA® above:



Slide 4-1. Cause-and-Effect Diagram (ISHIKAWA DIAGRAM)

After the member of QCC have ascertained and agreed that all the root causes have been revealed, then followed by decision making via voting to determine the roots-root cause nominated to be the dominant cause. Voting is done as follow:

- Prepare a table consisting of columns: number, causes, member name, total value and ranking.
- Put together the root causes in the table.
- Assign a score based on the total number of root causes, for example: the number of causses is 15, so the highest score is 15 and the lowest is 1.
- Each QCC member gives their individual assessment, based on the urgency of the cause to be improved, the more important it is, the higher the score given.
- In this case, the assessment can select the root cause that wants to be rated the highest first, then sequentially, assigning the score to the other root causes.
- After all members give a score, then all the scores are summed to get the total score of each root of the cause.
- Based on the total score, a ranking can be determined.

Example of Voting Table:

Nr.	Root Cause	Name of QCC member					Total Score	Rank
		An	Bn	Cn	Dn	En		
1	The authorized official is on a business trip	1	2	3	1	2	9	V
2	Officer searched for the file too long	4	3	2	4	3	(16)	IV
3	The creditor did not complete the application form.	5	6	4	5	6	(26)	II
4	System procedures are not efficient yet	6	5	5	6	5	(27)	I
5	Minimum sub-mission limit for survey request is no less than 1 week.	2	4	6	2	4	(18)	III
6	The credit application was not fulfilled.	3	1	1	3	1	9	VI

Table 4-1. Nominal Group Technique Voting Forms

- In order to make it easier to determine the measurement of the number of root causes as the dominant cause, the guideline N = 51% was created.
- Then, looking at the example above, the number of root causes is 6, so it can be said that the number of root causes to be dominant is: 51% x 6 = 4 (rounded up). This formula only applies when the number of root causes is more than 5, when the number of root causes is 5, it is recommended that the member not vote and make a statement that all root causes will be tested in the next step.

Conclusions:

The end of the activity of step 2 is to make a closing statement about the voting results, such as
the example below:

- *Based on the voting results, QCC decided that the potentially dominant causes and will be further tested in the next step, are:*

1. *System procedures are not efficient yet.*
2. *The Creditor did not complete the application form.*
3. *Minimum sub-mission limit for survey request is 1 week.*
4. *Officer searched for the file too long.*

Step 3: Examining and Verifying the Dominant Causes

If in step 2 the determination of the dominant cause produced the verbal data, then in this step 3, it will be followed up by testing the dominance of the cause by using the scatter diagram. Therefore, it requires an effort to transform the verbal data from the Ishikawa diagram into numerical data that can be analyzed using scatter diagram.

In general, Step 3 activities can be described in flowchart form as follows:

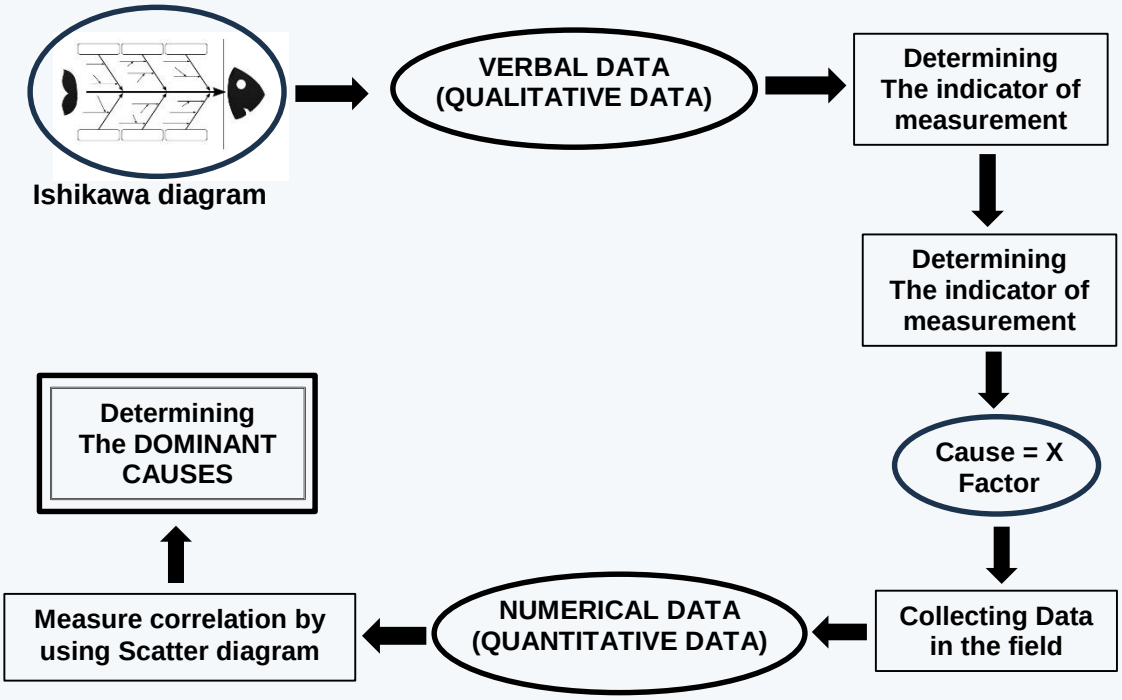


Figure 4-6. Step 3 – Examining and Verifying the Dominant Causes

1. Determining Indicators of measurement

As we now at the previous step, the causes analysis by using Ishikawa diagram generates verbal data, whereas to measure the strength of correlation between cause and effect requires numerical data.

Then the first thing to do is to look for a cause that can be used as a measurement indicator. The problem arises when the causes contain abstract sentences, so it is difficult to obtain a measurement of their quality, as for example in the sentence “less efficient”, it will be very difficult to get quantifiable numerical data. That is why, it is very important to obtain causal sentences that contain elements of measurement, such as: too long, too many, too much, etc. The method of determining the indicator can be described by using the example, as follows.

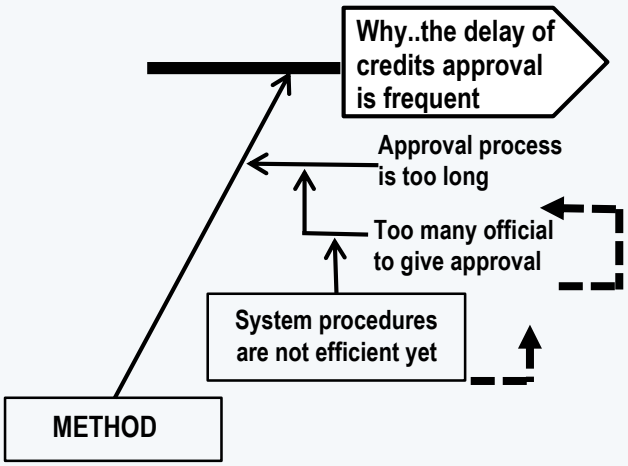


Figure 4-7. Determining of (X) vs (Y) Indicators of Root causes

In this case, to examine the correlation between ***“System procedures are not efficient”*** as

the root cause (X factor) ***and "The delay of credits approval is frequent"*** as the effect (Y factor). It can be logically understood, that the longer the approval process is given, the longer the credit will be executed. But the sentence :"not efficient" in the root cause does not indicate a measurable quality, then to be able to find a measurable indicator, it is done by looking at a layer of causes above it, as seen the example above, that is ***"Too many official to give approval"***, but even this cause cannot be measured, since the number of officials who signed has no direct effect on the delay. Then the search for the indicator is continued by tracing the causal layer on it again, that is ***"Approval process is too long"***. Then the measurement indicators can already be determined as follows:

Indicator of X Factor (cause) is: Total duration of approval.
Indicator of Y Factor (effect) is: Total duration until the execution of credit.

2. Collecting the Data

Once the indicators are determined, data collection can be done through direct observation of the work process, random sampling, but if it is not possible to obtain data in the field, then data collection can be done by simulating operational condition. for example, in one case the patient handling of an accident victim was too slow, due to the large number of types of injuries suffered. In this case, it is certainly very impossible to collect data directly at the time of the incident, but rather by simulating the conditions of the accident.

3. Measuring the relationships between indicators

The use of Scatter diagram to determine the degree of correlation between cause and effects, requires a certain amount of data to obtain accurate analysis results. Before data analysis can be computerized, 30 pairs of data (x/y) are needed to calculate the correlation using the formula:

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{\left[n\Sigma x^2 - (\Sigma x)^2\right]\left[n\Sigma y^2 - (\Sigma y)^2\right]}}$$

But once the computer applications can analyze the data is introduced, then through several simulations using SPSS applications, it found out that the most efficient and effective amount of data to test the correlation is to use only 7 pairs of data, as the example below :

X : Duration of approval (day)	**Y : Duration of execution the credits (day)**
1	2
2	5
1	3
2	4
1	2
2	4
1	3

Duration of data collection: 2 weeks

$\rho = 0,925$

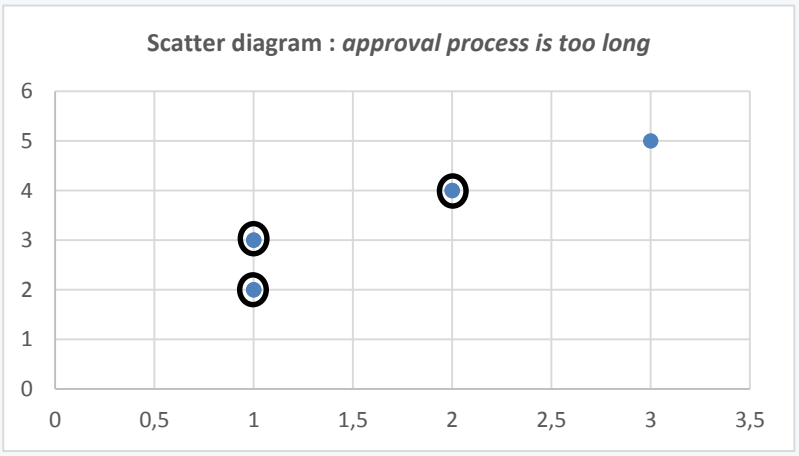


Figure 4-8. Scatter Diagram plots of X (causes) vs Y (effects)

4. Determining the Dominant Causes

In order to determine the dominant causes, we set a limit on the correlaltion value based on the phenomenon that the company policies decided by the majority shareholders, which is a minimum 51 % votes and when coverted into correlation analysis, the value of 51 % is equivalent to : $\rho^2 = 0.51$ (minimum domination value). Thus, it can be said that a cause is declared dominant when it has a minimum coefficient correlation value:

$$\rho = 0.714$$

and we called it as the ***"IDARIS Constant"***.
Continuing with the above example,from analyzing the data through the scatter diagram above, it is significantly shown that the cause is dominant

5. Conclusions of Step 3

The conclusion is in the form of statements about the causes that have proven to be dominant and should be planned for improvement in the next step, as below:

Dominant Causes	**Rho value**
1. *System procedures are not efficient yet.*	**0.925**
2. *The Creditor did not complete the application form*	**0.902**
3. *Minimum sub-mission limit for survey request is 1 week.*	**0.879**
4. *Officer searched to the file too long*	**0.902**

Table 4-8-1. Correlation Coefficient Order of Dominant Root Causes Forms.

Step 4 : Planning and Implementing the Improvement

This step is the core of all quality improvement activities, that is, solving problems by creating innovative improvements. In this case, QCC carries out two activities at once, namely creating improvement plans and carrying out trials, until achieving the optimum results.

Step 4 activities can be described in flowchart form as follows :

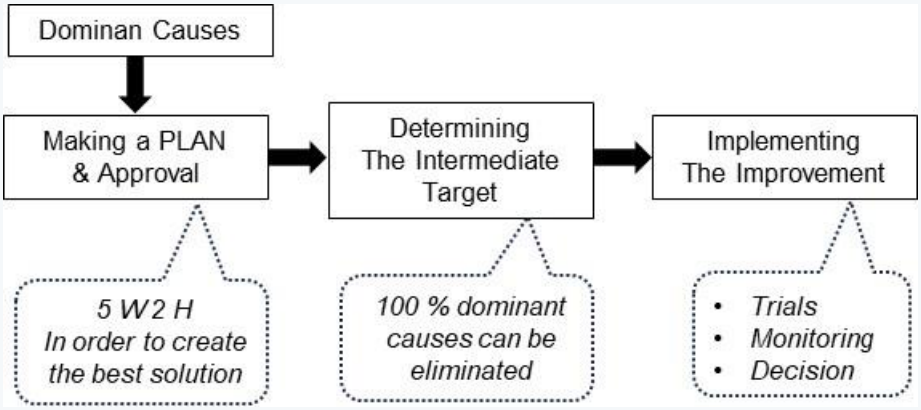


Figure 4-9. Step 4 – Planning and Implementing the Improvement

The structure of the activities in this step 4 consists of the following:

1. Making an IMPROVEMENT PLAN:

a) **5W2H – Scenario of Improvement Plan (SIP)**:

Drawing up an improvement plan is done using a table containing 5W2H guidelines, as shown below:

Dominant Cause	Why?	When?	When? Where?	How?	How much?
The cause that has been shown to be dominant	Why the dominant causes need to be improve.	What the improve-ment plan?	Estimated time and location of improve-ment	How detailed improvements are made so that the dominant causes can be eliminated.	How much targets to achieve?

Table 4-9-1. The 5W & 2H – Scenario Improvement Plan (SIP) Guidance.

b) ***Intermediate Target***

This is a guarantee that all causes will be solved completely, which is why target intermediates are always written with absolute number: ***100% of all improvement targets are achieved.***

In this case, the QCC Leader and the Facilitator sign the improvement plan, as a liability for these activities. Then the plan is submitted for approval from the management that has the authority. It would be great if management gave a positive comment that motivate the QCC to achieve best results.

Below is an example the contents of 5W2H, with continuing the case from the previous Steps.

4.1. 5W2H – Improvement Plan

Dominant Cause	Why?	What?	Where/ When/Who?	What?	How much?
System procedures are not efficient yet	*To make the credit approval process more efficient*	*To create an application to give approval through the online system*	*Secretariat* *Week 1 – 2, Feb. 2024* *Helena*	- *Designing credit application by using Excell-based.* - *Create an online credit application process flow, as follows:* ➢ *CS accepts the credit app. Form and enters the data into the computer (correctly and accurately)* ➢ *Credit Manager checking and give approvals online* ➢ *etc.*	*100 % Approval completed within (no more than) 2 working days.*

4.2. Intermediate Target: 100 % the all target can be achieved.

Table 4-9-1. The 5W & 2H of Scenario Improvement Plan (SIP) Order Forms

2. **Implementing the Plan**

The activity in this second part of Step 4 is to carry out and document all process of implementation, consisting of:

a) The details of the implementation of the improvement are carried out and documented in full.

b) Monitor the trial process to obtain real data on the achievement of results.

c) Decision making on the outcome of the trial.

Monitoring becomes an important factor in the implementation of quality improvements, because in reality that the first trials do not always immediately give satisfactory results, that is why it takes quite enough time to monitor the results of trials. When the monitoring is plotted into the run chart, it takes minimum 7 points of monitor to be able to see the trend of achievement. That is why the use of RUN CHART is the important thing, at this stage.

In the implementation on the field, some of QCC even had to revise their improvement plans many times before finally achieving targeted results. This is very natural, as the facts show that the best results of innovation in the world can be created after a long and tiring

experiment.

Below is an example of writing the process of implementing improvements from the continuation of the cases discussed above:

Implementing the Improvement:

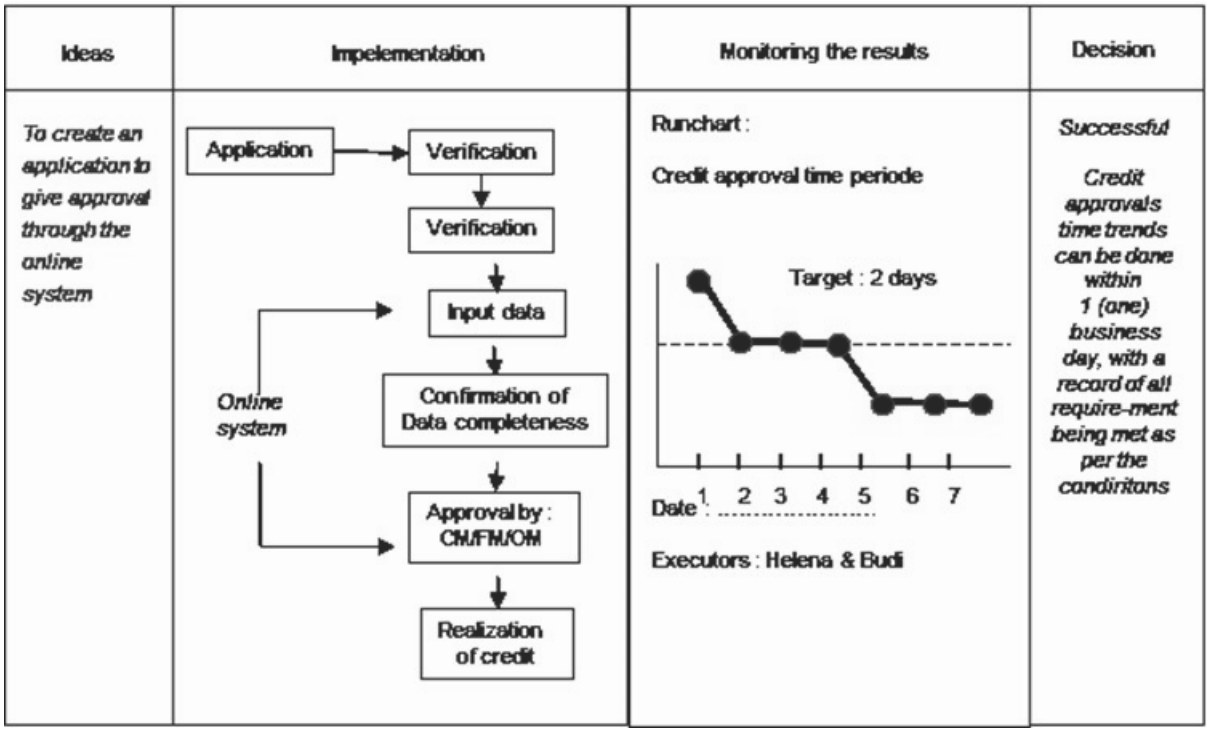


Table 4-9-2. Solution Implementations of Improvement

If it turns out that the monitoring data shows an unstable or fluctuating tendency, QCC members can extend the trial or even decide to revise their improvement plan, until the expected results are achieved.

Step 5: Evaluating the Result

In general, evaluation is carried out by looking back at the data of initial condition before improvement and comparing it with the data of final condition after implementing quality improvements. On the other hand, QCC also needs to observe the impacts arising from quality improvements. Basically, every action taken always has an impact on the surrounding environment, both positive and negative. If a negative impact occurs, the QCC is obliged to plan elimination actions as soon as possible.

Analysis of the results consists of the following 4 things:

1. Evaluate the results of improvements in overcoming dominant causes, by comparing the conditions of each DOMINANT CAUSE, before and after quality improvement. The data after improvement should show that the dominant causes no longer occur.

2. Evaluate the achievement of INITIAL GOALS (the Title), by comparing target with the result achieved.
3. Evaluate the achievement of the THEME, by comparing the condition of priority problems before and after improvement.
4. Evaluate the POSITIVE or NEGATIVE impact.

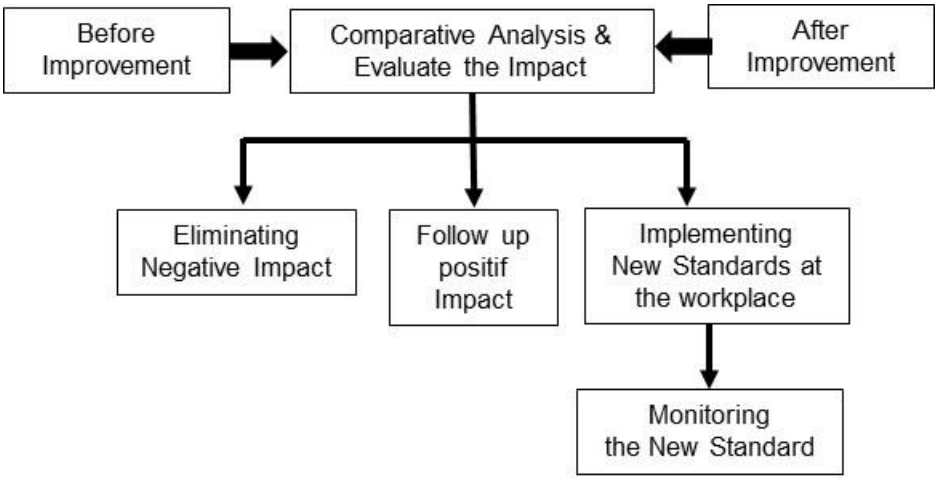


Figure 4-10. **Flowchart Step 5 – Evaluate the Result**

Positive impact can be categorized into 2 types:

1. INTANGIBLE impact, for example: developing QCC members' knowledge about group dynamics, teamwork, applying the PDCA cycle and 7 QC Tools, even increasing skills in leadership, managing meetings, quality control abilities and so on.
2. TANGIBLE impact, usually called Cost Saving, for example: speeding up work (increasing work productivity), preventing claim costs, preventing rework, preventing excessive quality assurance costs and so on.

Meanwhile, if quality improvements have a negative impact, immediate follow-up efforts are needed to create a plan to eliminate the negative impact, thereby preventing the negative impact from developing into a new quality problem. Below are examples of negative impacts and plans for their elimination:

- Quality improvements result in the implementation of automation with new work standards resulting in operators working more slowly because they do not understand the new methods. So, to overcome this problem, an elimination plan was prepared. For example, with new method training provided by QCC members to the Operators on duty, at shift change, for 30 minutes, within a 1-week period.
- Costs that arise as a result of implementing new work standards, for example: Testing the function of all streets lighting every afternoon causes additional electricity costs. So the elimination plan made by QC is to reduce the time the lighting is on in the afternoon and early morning for 30 minutes.

With the end of step 5, it can actually be said that the real activities of quality improvement have been completed, while the step 6 is the process of documenting results and step 7 is the process of monitoring the implementation of new standards in the workplace, as well as determining the next plan.

Step 6: Making Re-Standardization

Writing down what has been done and implementing what has been written down is an important part of quality improvement activities. So clarity and accuracy in writing down quality improvement results is as important as implementing them in the workplace.

6.1. Standard Procedures and Standard Results

Basically, the writing of new standards is divided into 2 types of standards that complement each other:

1. **STANDARD PROCEDURES**, written in the form of complete and clear work instructions.
2. **STANDARD RESULTS**, this is a guarantee that will be achieved if standard procedures are carried out appropriately and correctly. Written using certain quality measures usually using the initial words: Maximum or Minimum.

Documentation of new standards can be interpreted as written documentation and validation by authorized officials of the implementation in the workplace. This is very important to do, considering that new standards that are formally documented can be a guide for all similar work within the scope of the company, and all employees who work in fields of work related to these standards are obliged to carry them out without exception.

With standard documentation, the new improvement no longer belongs to QCC, but become the company standard that has tobe applied for related work. This is the point where management's role is needed to officially determine the implementation of the new standard, so that it has binding force for all related parties to comply with it consistently. Official approval has the following implications:

1. Motivate everyone concerned to carry out and fulfill these standards.
2. Everyone agrees to the existence of the standard and understands the purpose of its application.
3. The content of the standard must be clear (unbiased) and have a single meaning.
4. Standards are dynamic, meaning there are always opportunities for further improvement.

The documentation mechanism will lead to the submission and registration of new standards as a ***work instruction review*** of previously existing similar standards. So the preparation of the QC Story) will be finalized by assigning the ISO 9000 document numbers
Since the ISO 9000 Rev. 2000, Quality Improvement activities had become an inseparable part of the implementation of the ISO 9000 Standards. That is why, to observe audits both internally and externally programs, each quality improvement results must be documented.
Thus, it can be proven that quality improvement activities are able to make ISO 9000

documentation no longer rigid and fixed, but very dynamic, meaning that it can be continuously improved, in accordance with developments in the business world and customer satisfaction.

6.2. Cost and Benefit Analysis

The final part of the step 6 activity is making Cost and Benefit calculations. In this case, the QCC will not be able to do it alone, so the role of the Facilitator and Accounting Officer must be to provide assistance so that the calculations carried out are correct and accurate. The components that must be included in the calculation include:

a) All costs spent to create quality improvements are usually called investment cost.

b) Estimated Efficiency Value if the results of the improvements have an impact on savings.

c) Estimated Increase in Productivity (Effectiveness) if the results of improvements increase operational capabilities.

d) in the case of quality improvement projects with high investment costs, of course with approval from management, QCC must calculate the pay back period that can be achieved.

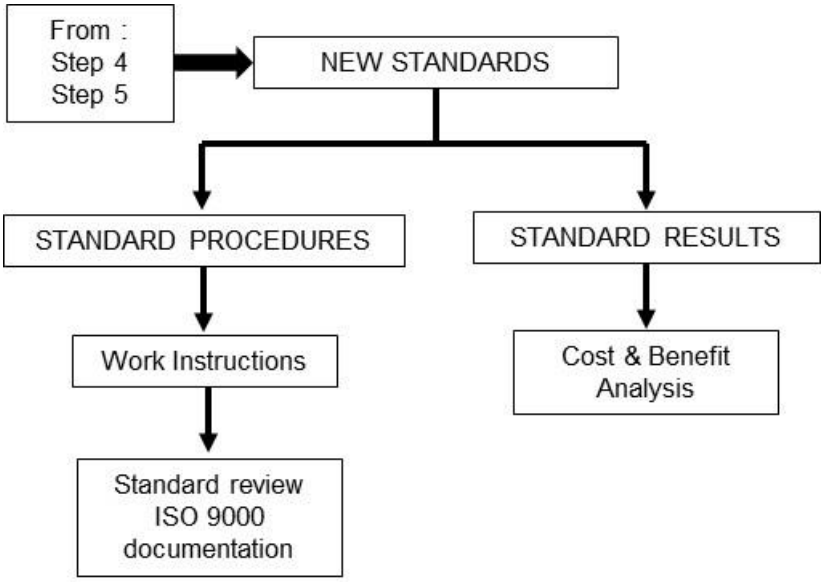


Figure 4-11. Flowchart Step 6 – Making Re-Standardization

Step 7: Collecting New data and Defining the Next Cycle

This is the final step of a PDCA TULTA® cycle, so in accordance with the philosophy in implementing TQM, it is ***Continuous Improvement***, then in this step QCC must actually

document the commitment to continue activities by determining the theme and schedule for the next plan.

The following things should be carried out in the seven step, such as:

1) Mechanisms for monitoring the implementation of new standards in the workplace, and evaluating the results and documenting it into the QCC-QC Story.
2) Adjust the implementation of the new standards; especially when data monitoring indicated there were unstable new processes conditions.
3) Disseminate the updated information about new standards status to the related parties.
4) For the company creates the policy on “new standards implementations”, firstly forming a task force for the dissemination of those new standards.
5) Collecting new data to identify new priority problems faced, to then organize them into new THEME.
6) Prepare a schedule chart for the next quality improvement plan.
7) Signing by the Facilitator, as proof of approval and commitment to remind QCC to actually carry out the next quality improvement PDCA cycle.

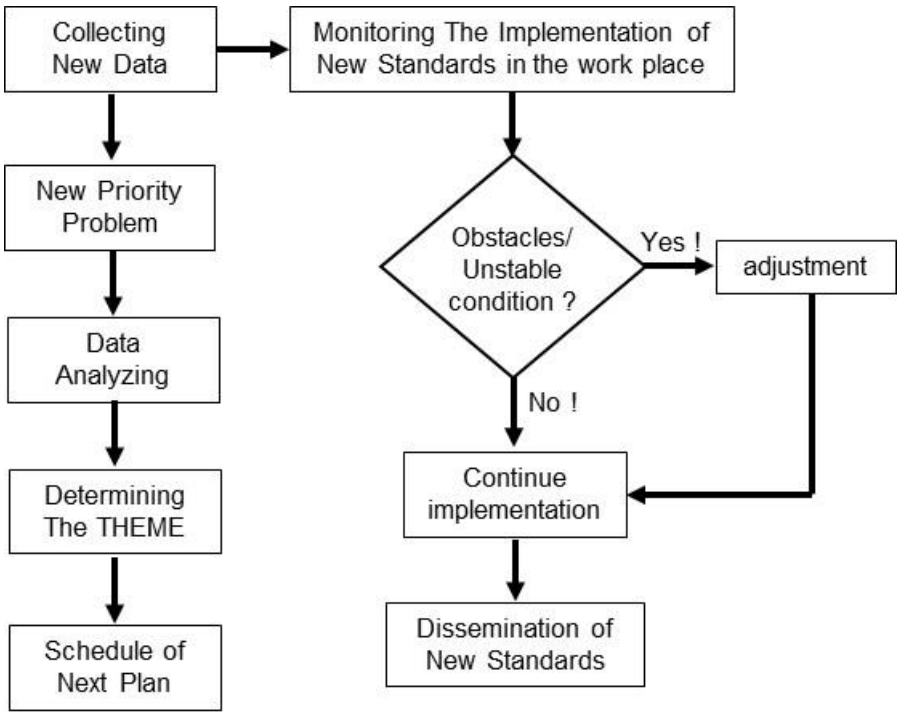


Figure 4-12. Flowchart Step 7 – Collecting New Data and Defining the Next Plan

CHAPTER 5.

DISCUSSION, CONCLUSION AND RECOMMENDATION

INTRODUCTION

In this study, I introduced two components of improvement skill: reactive improvement and proactive improvement. Proactive improvement is what we need to design new products, choose new directions, and design new systems. Reactive improvement *(the subject of this research*) deals with correcting or improving existing processes; reacting to flaws such as defects, delays, and waste. The WV model shows the connection among proactive and reactive improvement and process control. (see Figure 4-1). The essence of reactive improvement approach is standardization of the problem-solving process, using the TULTA Methodology. This reactive improvement as a standardized practice became commonly used by QC Circles in Japan, and spread throughout, in the 1980's. The methodology has been taught as part of Quality Improvement in USA, Asia and Indonesia, as well. Identification of the problem is the most important aspect of reactive problem solving. The process of identifying the problem may be divided into four parts;

1.Weakness orientation. **2.Problem exploration.**
3.Careful selection of the theme and **4. Clear statement of the theme.**

5.1 <u>DISCUSSION</u>

The role of TULTA as the standard methodology used by workforces in manufacturing, very helpful the operator enthusiasm in maintaining production performance; continuously. This is due to Plan-Do-Check-Action; TULTA steps which are arranged appropriately and lead to Quality Improvement. The proof, supported by Data & Facts obtained by TULTA Practitioners, through the QC Circle's evaluation results within quality competitions, both at company, national (IQC) and international levels (ICQCC). *<u>(Data can be seen in the case study attachment, plus the competition evaluation results sheet.)</u>*

5.2 <u>CONCLUSION</u>

The present study investigated the implementation of the PDCA function which consists of Seven Problem-Solving Steps (TUJUH LANGKAH) using Seven Statistical Quality Control (TUJUH ALAT), as explained below;

5.2.1. THE SEVEN STEPS, such as;

Diagnosing Step 1: Defining the Theme and Title
Diagnosing Step 2: Analyzing the Causes
Diagnosing Step 3: Examining and Verifying the Dominant Causes
Diagnosing Step 4: Planning and Implementing the Improvement
Diagnosing Step 5: Evaluating the Results
Diagnosing Step 6: Making Re-Standardizing
Diagnosing Step 7: Collecting New Data and Defining the Next Cycles

5.2.2. THE SEVEN QC TOOLS, consisting of;

5.2.2.1 CHECK SHEET.

To analyze problems, we must collect data that represent the facts. Forms used for easy collection of data are called "check sheet". Use check sheet to take data

systematically regarding the frequency of various effects. They are much like a set of tally marks on the back of an envelope. However, they are usually marked on forms prepared in advance, according to expected effects. Also, they are calibrated so that when taken the data, we have a running plot of frequency of effects; the check marks create a histogram.

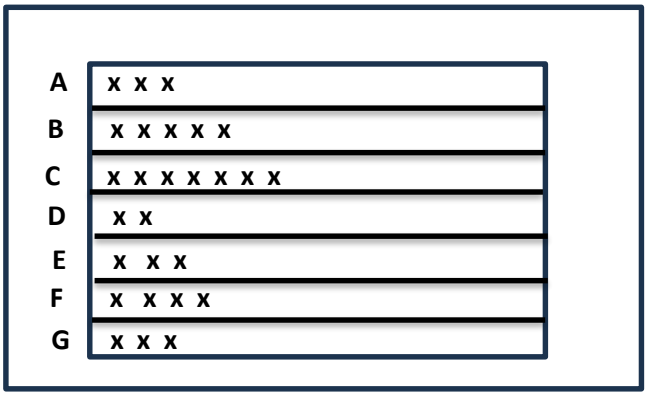


Figure 5-1 CHECK SHEET

5.2.2.2 PARETO DIAGRAM.

At any given time are many kinds of problems around you. It is not practical to attact all these problems aat the same time. Therefore, arrange the problems in order of importance and attact the bigger problems first. A bar graph tha shows the biggest problem on the left followed by the lesser problems is called Pareto diagram. Pareto diagrams help one focus on the vital few effects or causes. The absolute totals of effects are always shown on the left side, and the cumulative percentages are always shown on the right side.

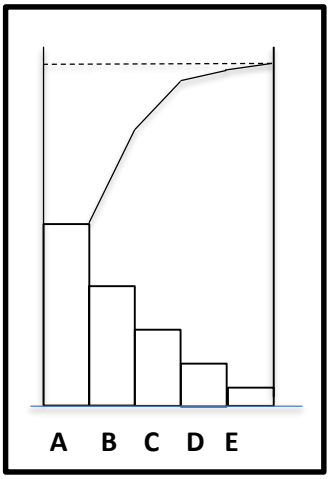


Figure 5-2 PARETO DIAGRAM

5.2.2.3 CAUSE-AND-EFFECT DIAGRAM (Ishikawa Diagram)

To solve a problem, it is important to know the real causes and the interrelation among causes. You can then identify the major causes to solve the problem. Use a cause-and-effect diagram to guide data collection and analysis to find the root cause of a problem. A cause-and-effect diagram shows an effect at the right and

the main causes are in turn effects that have subcauses, and so on, down many levels. This is not basically a statistical tool; it enumerates the variety of causes rather than the frequency of events. However, it is a useful tool for noting the frequency of events, once we have the data.

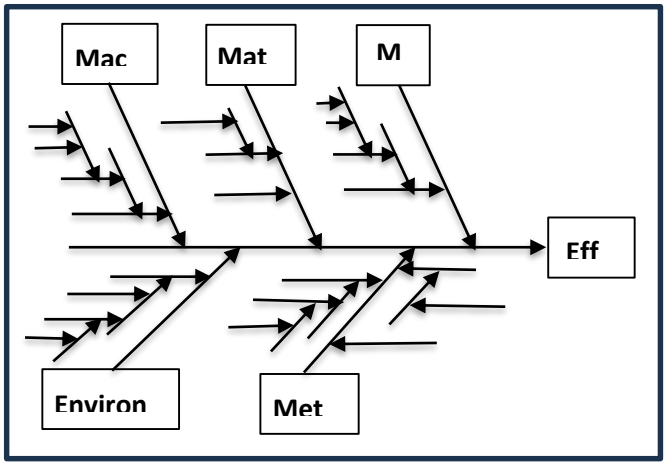


Figure 5-3 CAUSE-AND-EFFECT DIAGRAM (Ishikawa Diagram)

5.2.2.4 HISTOGRAM

We produce a large quality of products with a great number of parts and materials. Each of these products and parts cannot have the same quality but always has some amount of dispersion. A Histogram is a graph that shows dispersion of the data. From this graph, we can analyze the characteristics of the data and the cause of dispersion. Typically, a Histogram is a bar graph showing the statistical distribution over equal intervals of some measure of quality, such as defects. Histogram are used in analysis for stratification to create hypotheses for the reason defects are occurring.

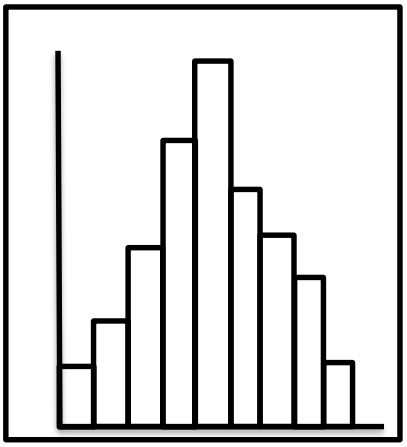


Figure 5-4 HISTOGRAM

5.2.2.5 CONTROL CHART

A Control Chart IS A GRAPH THAT SHOWS THE VARIATION IN PROCESS PERFORMANCE. It helps in spotting abnormal situation in standard manufacturing or other processes. Control charts are used to plot over time (left to right) the observed

values of a process variable or ouput variable around the mean and between upper and lower control limits. In the gigure, the circled dot is outside the cobtrol limits.

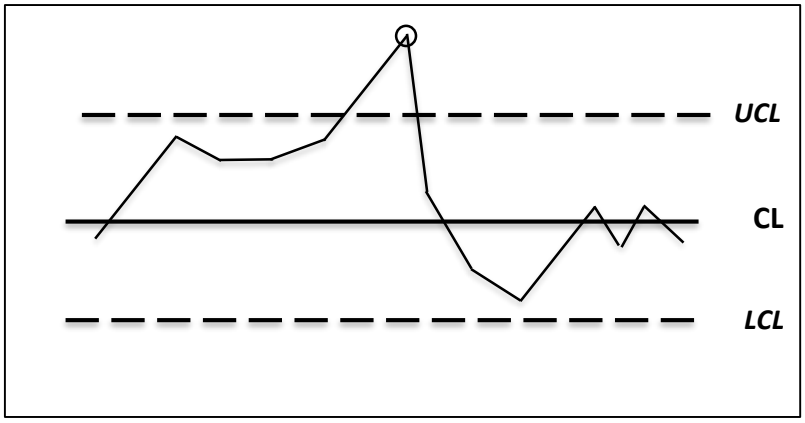


Figure 5-5 CONTROL CHART

5.2.2.6 GRAPH (Line Graphs; Bar Graphs; Circles Graphs; and Radar Charts)

Graphs display data. There are many kinds of graphs; bar graphs, line graphs, circle graphs and radar graphs are some of them. Most people are familiar with the first three types of graphs. The fourth type, a radar graph, compares several items on multiple dimensions. Suppose that for three competitive products, E1 is performance, E2 is cost, E3 is reliability and E4 is delivery; in all four dimensions, the good direction is out from the center. The above example shows that one of the products is inferior in all dimensions. Of the other two products, one wins slightly in performance and delivery, and the other wins slightly in cost and reliability**.**

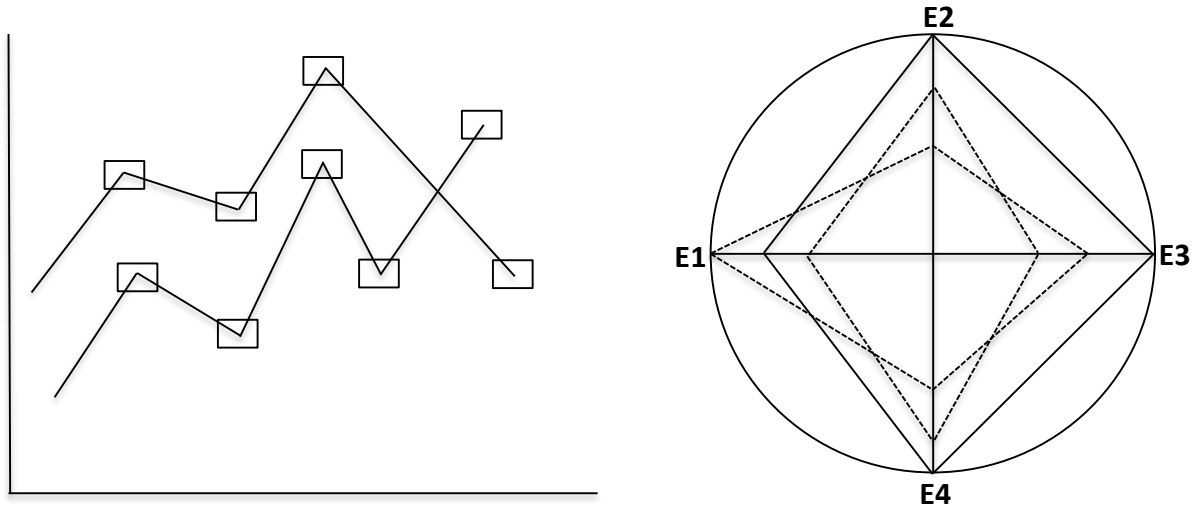


Figure 5-6 GRAPH (Line graph; Bar graph; Circles graphs; Radar chart)

5.2.2.7 SCATTER DIAGRAM

The relationship between cause and effect (for example, between illumination level and inspection mistakes) may be drawn on a graph called Scatter diagram. A scatter diagram plots many data points, typically with a measure of quality on one axis and a variable hypothesized

to influence quality on the other axis. Used in analysis to test hypotheses on cause-and-effect relations, a scatter diagram is a visual representation of a two-dimensional correlation. A diagram such as this is often very useful because it illuminates patterns of data that are not otherwise obvious.

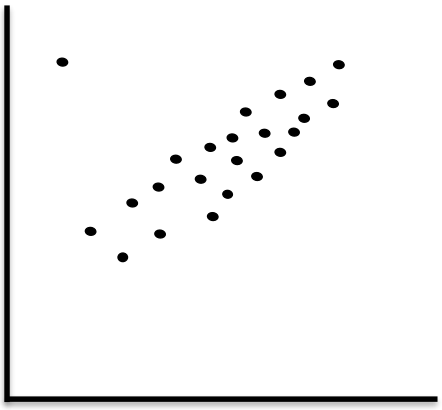


Figure 5-7 SCATTER DIAGRAM

5.3. RECOMMENDATION

As a part of companie's business activities, researchers suggest that every "QCC-TULTA" activities (within manufacturing scheme) could be contribute to society through their voluntary social services which is supported by its organizations. Furthermore, those QC Circles may select themes that serve society; for example, *to provide the quality problem-solving* (products and services) that meet society's needs, *to serve or effectively use of materials* and *to conserve natural environment.*

With such capabilities, researchers have confidence to encourage Management to providing as wide an opportunity as possible for QCC-TULTA which will also contribute to the environment; properly and successful. Therefore, realized that since TULTA Methodology has spread widely used by Indonesian companies with the promising results (see, case study!), researchers attempted to encourage the possibilities implementation at "the outbox" of manufacturing, such as in Services; Finance, Logistics, Transportation, et cetera; as well.

CASE STUDY

The PDCA "TULTA" Methodology of QCC "TERTIB" and QCC "TANGKAI"

The following case study were attaching are The Quality Problem-solving results, applied "TULTA" Methodology carried-out by Two Quality Improvement Teams or QCC, named :

1.QCC "TERTIB" and 2.QCC "TANGKAI".

Both of QCC were the "Company Quality Convention Champions from PT.Indofood CBP Sukses Makmur.Tbk. Bandung-Factory Branch and Pekanbaru-Factory Branch – INDONESIA.The Indofood company is the Biggest Noodles Manufactures in Indonesia).

Each case study illustrates How "TULTA" Methodology implemented, step by step, and all of procesesses were written into " QI Story" (Quality Improvement Story). It implicitly introduces an international standard's full paper and power-point presentation slides; that will be presented in The International Cuality Qontrol Circles Convention (ICQCC); in this case, such as;

A. **ICQCC 2022 organized by IQMA (Indonesia Quality Management Association) in Jakarta-Indonesia, and**
B. **ICQCC 2023, organized by CAQ (China Association for Quality) in Beijing-China.**

Those attachments proven, the real "quality problems" were solved by real "Quality Control Circles-QCC" using "PDCA-TULTA" Methodology, significantly.

It's important to know that the "PDCA" evaluation of QCC TANGKAI and TERTIB had been carried out by Certified "ICQCC's Judges" along the competitions.
At the end of the event, each QCC (TERTIB and TANGKAI) received the GOLD AWARD (see attachments).

Case Study 1 : QCC TANGKAI

ICQCC 2022 - Jakarta

THEME : REDUCING UTILITY COST AT THE PEKANBARU FACTORY

TITLE : REDUCING BOILER FUEL CONSUMPTION FROM 19,89 GR/PACK TO 18,67 GR/PACK IN 22 WEEKS

QCC TANGKAI
PT INDOFOOD CBP SUKSE MAKMUR TBK
INDONESIA

PT Indofood Pekanbaru branch was established in 1994, known as the top instant noodle producer. Boiler fuel consumption as the largest part (62,27%) of the utility cost is a production cost that greatly affects the selling price of the product. For this reason, it is necessary to control utility cost by reducing boiler fuel consumption. From July to December 2018, it was shown that the largest Production cost was in the cost of boiler fuel of USD 0.0009/pack equivalent to boiler fuel consumption of 19.89 gr/pack. Therefore, QCC TANGKAI chose to control boiler fuel consumption.

Analysis of the factors causing high fuel consumption was carried out by using Ishikawa diagrams and brainstorming methods through NGT. It was presumed that the dominant root causes were: Preventive maintenance of the steam trap was not available yet, the steam valve was closed after the operator prioritized to handle the machine, the location of the supply pump inverter was far from the feed water boiler area, the operator was late in opening the water valve on the bottom ash conveyor, there was only one blow down outlet pipe, and there was a lateness in boiler refuel. The results of the scatter diagram showed that the factors mentioned above were all dominant and must be solved.

The improvements made were: Inputing a preventive maintenance of the steam trap into the weekly schedule, installing an automatic steam valve on the steam pipe in the steam box, installing an indicator of the supply pump on the main water tank, installing the timer and automatic water filling device on the bottom ash conveyor tub, separating the pipe for each boiler blowdown outlet, and using the wireless button for the fuel bucket

As a result, QCC succeeded in reducing boiler fuel consumption from 19.89 gr/pack between July and December 2018 to 17.41 gr/pack in June 2019. By overcoming all dominant factors, the company can save USD 118,502.67/year

THEME : REDUCING UTILITY COST AT THE PEKANBARU FACTORY

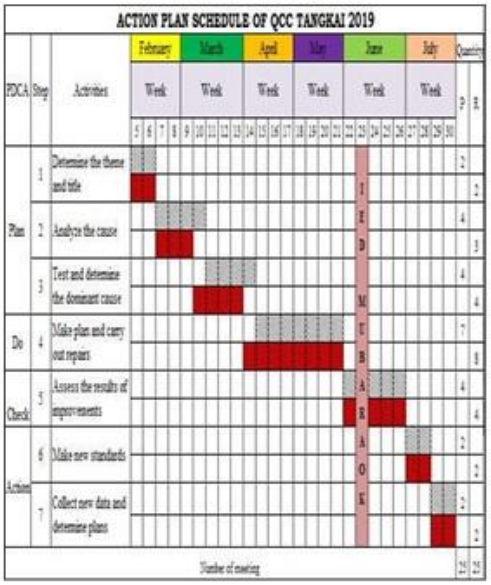
TITLE : REDUCING BOILER FUEL CONSUMPTION FROM 19,89 GR/PACK TO 18,67 GR/PACK IN 22 WEEKS

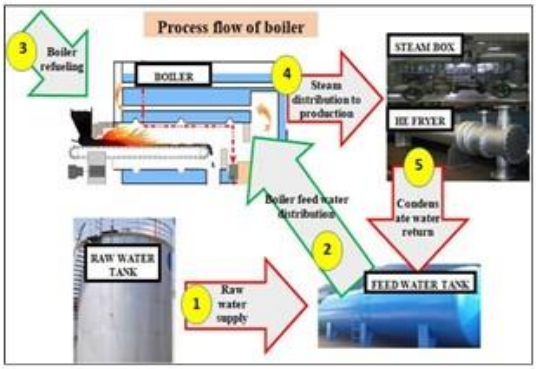
QCC TANGKAI

PT INDOFOOD CBP SUKSE MAKMUR TBK

INDONESIA

Organizational structure





Created by:
Rasidan
Team Leader

Known by:
Hendriko Sofjan
Facilitator

Circle Name: QCC Tangkai	Started: January 12, 2016
Our QC Circle consists of 8 members. (Female: 1 / Male: 7)	
Average age of our QC Circle members is 37 (Youngest: 26 / Oldest: 48)	
QC Circle meeting takes place ■ after working hours □ during working hours	
QC Circle meeting is usually held 4 times per month. Each takes 90 minutes.	
Our QC Circle has already completed 1 subject before this case report	
Address: Pekanbaru- Kaharuddin Nst St KM 12, Sub-district of Perhentian Marpoyan, Marpoyan Damai, Riau Province, Indonesia.	

STEP 1 : DETERMINING THEME AND TITLE

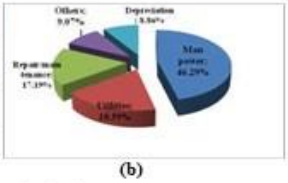
1. A Determining The Theme

1.A.1 Identifying the Priority Problem

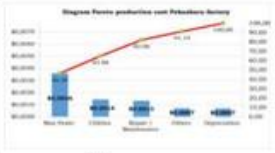
Data of production cost period January-December 2018 Pekanbaru Factory

No	Description	Cost /Pack		% Kumulatif
		Cost	%	
1	Man Power	$0.0036	46.29	46.29
2	Utilities	$0.0014	18.59	64.88
3	Repair / Maintenance	$0.0013	17.19	82.06
4	Others	$0.0007	9.07	91.14
5	Depreciation	$0.0007	8.86	100
Total		$0.0077	100	

(a)



(b)



(c)

Gbr 1 : (a) Table for production cost; (b) Pie chart of production cost; (c) Pareto diagram of production cost.

1.A.2 Making Conclusion and Formulating the Theme

Pareto Analysis to determine theme:

1. Based on production cost data, it can be seen that the highest cost was at the man power cost (USD 0.0036/pack) or 46.29% of the total production cost.
2. Man power cost was QCC out of control, then the second highest production cost was utility cost (USD 0.0014/pack) or 18.59 % of the total production cost.

From the pareto analysis, QCC Tangkai determined the theme:

"REDUCING UTILITY COST AT THE PEKANBARU FACTORY"

1. B Determining the Title

1. B.1 The Current Situation Analysis (Identification of Current Status)

Data of utility cost period July-December 2018 Pekanbaru Factory

No	Description	Cost /pack	(%)	Cumulative
1	Boiler Fuel	$0.0009	62.19	62.19
2	Electricity	$0.0005	33.93	96.12
3	Water	$0.0000	2.05	98.17
4	Solar	$0.0000	1.71	99.88
5	LPG	$0.0000	0.12	100
Total		$0.0014	100	

(a)

(b)

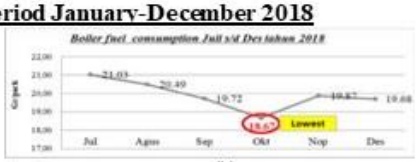
(c)

Gbr 2 : (a) Table of utility costs; (b) Pie chart of utility cost; (c) Pareto diagram of utility costs

Data of boiler fuel consumption period January-December 2018

No.	Description	Amount	Unit
1	Total usage	9.998.252	Kg
2	Price average	0.0449	$/kg
3	Cost	0.0009	$/pack
4	Consumption	19.89	gr/pack

(a)



(b)

Gbr 3 : (a) Boiler fuel consumption table; (b) Run chart of boiler fuel consumption

1.B.2 Making Conclusion and Deciding the Initial Goals (Setting Target)

Pareto Analysis to Determine the Title

1. Based on utility costs, the highest cost was the cost of boiler fuel (USD 0.0009/pack) or 62.27% of the total utility cost.
2. From the boiler fuel consumption analysis data, it can be seen that the cost of boiler fuel USD 0.0009/pack was equivalent to consumption19.89 gr/pack.
3. From the run chart diagram of boiler fuel consumption in July - December 2018, it can be seen that the lowest consumption was in October of 18.67 gr/pack, so that it was used as a target for improvement by QCC.

From the pareto analysis, we, QCC TANGKAI, agreed to decide a title:

"REDUCING BOILER FUEL CONSUMPTION FROM 19.89 GR/PACK TO 18.67 GR/PACK IN 22 WEEKS"

Initial Goals

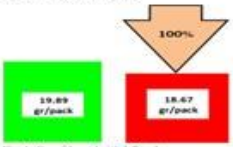
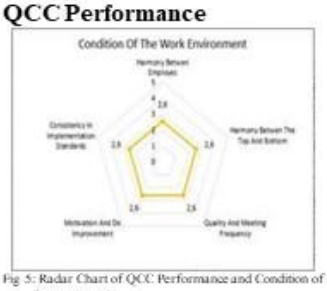


Fig 4: Bar Chart Initial Goals

Reasons for setting initial goals :
1. Optimism from all QCC members to solve problems.
2. Resuming PDCA loop (continuous improvement)
3. Full support from superiors
4. Supporting energy conservation programs and saving initiatives
5. Supporting energy management system programs and environmental mental management systems

Comment: Continue to next step to achieve the initial goal.			
Created by Isdiyarti Secretary	Responsible by Rasidan Team Leader	Known By Hendriko Sofan Facilitator	Approved by Chandra Wangi Production Manager

QCC Performance



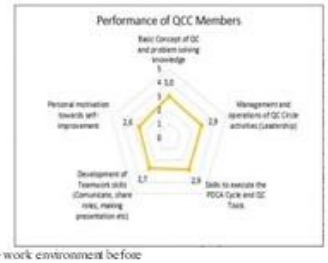


Fig 5: Radar Chart of QCC Performance and Condition of the work environment before improvement

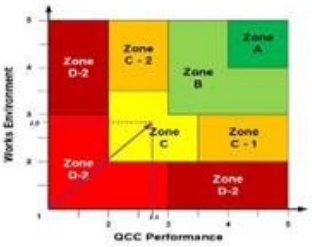


Fig 6: Rinda windows before improvement

QCC Performance was 2.6 (Zone C) and the Condition of the work Environment was 2.8, so it was in Zone C, which means: our Performance and activity qualities were still on average level

1.C Advantages to be Achieved

Productivity	Quality	Cost	Delivery	Safety	Moral
lowering boiler fuel consumption from **19.89 gr/pack to** 18.67 gr/pack	Steam pressure according to production requirements	To get a cost saving of USD 52,532.15 /year	Boiler refueling was not late	Work Accident Rate became 0 (zero accident)	The energy management system program and the environmental system

STEP 2 : ANALYSING THE CAUSE

2. 1 Ishikawa Diagram

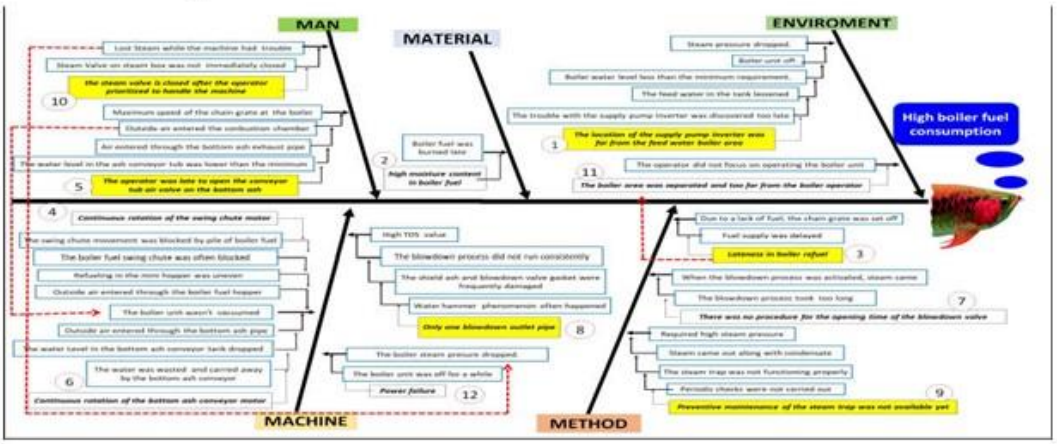


Fig 7 : Ishikawa diagram

2. 2 Nominal Group Technique (NGT)

No.	Cause	QCC Members							Total	Rank
		RS	TO	TI	AR	MF	IS	HI		
1	The location of the supply pump inverter was far from the feed water boiler area	10	9	10	10	9	10	10	68	III
2	high moisture content in boiler fuel	1	1	1	1	2	3	1	10	XII
3	There was a lateness in boiler refuel	7	7	6	7	6	6	7	46	VI
4	Continuous rotation of the swing chute motor	6	6	5	5	5	4	5	36	VIII
5	The operator was late to open the conveyor tub air valve on the bottom ash	8	10	8	8	10	7	9	60	IV
6	Continuous rotation of the bottom ash conveyor motor	4	4	2	3	4	2	2	21	IX
7	There was no procedure for the opening time of the blowdown valve	5	5	7	6	7	9	8	47	VII
8	There was only one blow down outlet pipe	9	8	9	9	8	8	6	57	V
9	Preventive maintenance of the steam trap was not available yet	12	12	12	11	11	12	12	82	I
10	the steam valve is closed after the operator prioritized to handle the machine	11	11	11	12	12	11	11	79	II
11	The boiler area was separated and too far from the boiler operator	3	2	4	4	3	5	4	25	X
12	Power failure	2	3	3	2	1	1	3	15	XI

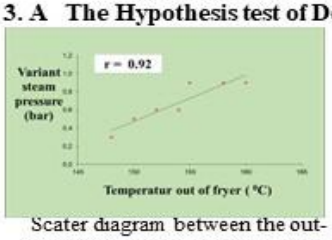
Fig 8: Tabel Nominal Group Technique (NGT)

Based on the calculation of the NGT index (51%X12=6), it is determined that there were 6 (six) factors that were suspected to be the dominant causes and must be tested in the next step, namely:

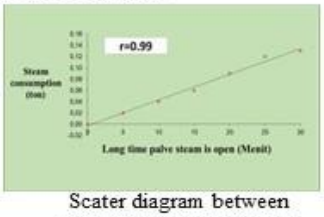
1. Preventive maintenance of the steam trap was not available yet
2. The steam valve was closed after the operator prioritized to handle the machine
3. The location of the supply pump inverter was far from the feed water boiler area
4. The operator was late to open the conveyor tub air valve on the bottom ash
5. There was only one blow down outlet pipe
6. There was a lateness in boiler refuel

STEP 3: EXAMINING AND VERIFYING THE DOMINANT CAUSES

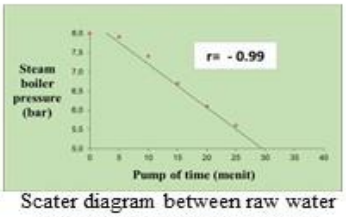
3. A The Hypothesis test of Dominant Causes



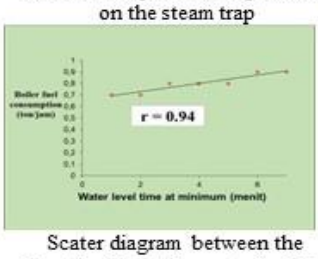
Scater diagram between the out-fryer temperature and the variant of the steam pressure requirement on the steam trap



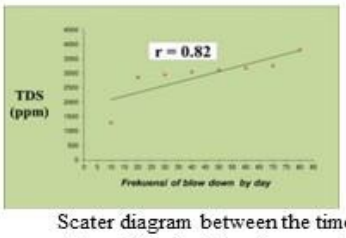
Scater diagram between palve steam open time and steam consumption



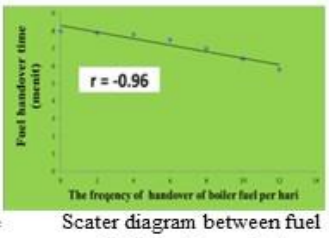
Scater diagram between raw water off pump time and steam boiler pressure



Scater diagram between the length of time the water level is below the minimum level and the boiler fuel consumption



Scater diagram between the time interval for the blow down and the TDS of the boiler feed water



Scater diagram between fuel supply delay time and steam boiler pressure

3. B Conclusion

From the hypothesis of dominant causes, we found out that all of 6 causes had strong relationship with the effect. It was proved by the value of coefficient correlation (r) ≥ 0.714, as shown in this table:

No.	Dominant Cause	r	Description
1	The steam valve was closed after the operator prioritized handle the machine	0.99	Dominant
2	The location of the supply pump inverter was far from the feed water boiler area	-0.99	Dominant
3	There was a lateness in boiler refuel	-0.96	Dominant
4	The operator was late to open the conveyor tub air valve on the bottom ash	0.94	Dominant
5	Preventive maintenance of the steam trap was not available yet	0.92	Dominant
6	There was only one blow down outlet pipe	0.82	Dominant

STEP 4: PLANNING AND IMPLEMENTING THE IMPROVEMENT

4.A Making Plans (5W2H – Innovation Solutions)

No	Dominant Causing	Why	What	When	Where	Who	How	How Much
1	Preventive maintenance of the steam trap was not available yet	To cary out periodic inspections	Creating a maintenance schedule for the steam trap	Week 14 2019	Steam distribution area	Miftah	Inserting the steam trap maintenance schedule into the report	100% The steam trap works well
2	The steam valve was closed after the operator prioritized handle the machine	To close the steam valve in the steam box is immediately	Automating the opening and closing of the steam valve in the steam box	week 15 - 16 2019	Steam box at production area	Asbon	Installing a valve that can be opened and closed automatically	100% Steam is not wasted when the machine stops
3	The location of the supply pump inverter was far from the feed water boiler area	To quickly identify if there was any trouble with the inverter of the raw water supply pumps	Creating indicator to determine the condition of the supply pump	Week 19 - 20 2019	Boiler area	Triono	Installing the indicator to determine the condition of the supply pump	100% The steam boiler's minimum pressure is 7 bar
4	The operator was late to open the conveyor tub air valve on the bottom ash	To make sure the water level in the ash tub was not lower than the minimum	Automating the opening and closing of the water valve on the bottom ash tube conveyor and install a timer on the bottom ash conveyor	Week 14 - 17 2019	Boiler area	Rasidan	Installing a valve that automatically opens and closes on the bottom ash conveyor.	100% At least the water level in the bottom ash conveyor tank is 30 cm.
5	There was only one blow down outlet pipe	To avoid the occurrence of the water hammer phenomenon	Separating the blow down out let pipe in each boiler	Week 15 - 20 2019	Boiler area	Triono	Installing the blowdown outlet pipe for each boiler	100% TDS value as a boiler water indicator below standard (3,000 ppm)
6	There was a lateness in boiler refuel	To make sure the avalailability of boiler fule supply on schedule	Creating a wireless button for the operational bucket elevator	Week 20 - 21 2019	Boiler area	Nur Hamzah	Installing a wireless button device for fuel bucket operation	100% The boiler fuel supply isn't late

4.B Determining INTERMEDIATE TARGET and Management Approval

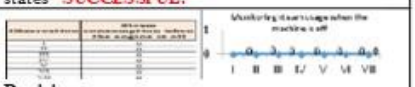
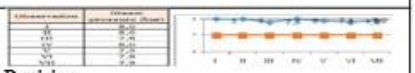
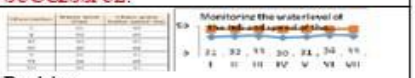
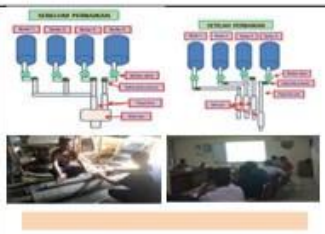
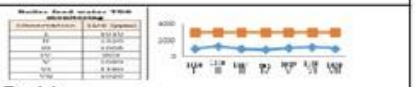
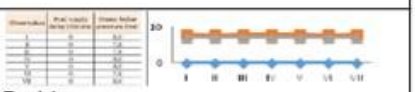
100% the Improvement targets should be achieved

Fig 9 : Bar chart intermediate target

Comment: Implement corrective action to achieve the target

Created by	Responsible by	Known By	Approved by
Isdiyarti	Rasidan	Hendriko S	Chandra W
Secretary	Team Leader	Facilitator	PM

4.C Implementing Solutions

NO	Ideas	Trials	Result and Monitoring
1	Inserted the PM steam trap schedule into the monthly PM report, Created Work Instruction maintenance steam trap and Socialized them to staff		 **Decision:** From the results of the monitoring that has been carried out, it can be decided that, after repairs have been made, the steam pressure in the fryer heat exchanger is in accordance with the needs and the good condition of the steam trap. Then the QCC states "SUCCESSFUL."
2	Installed a valve that could be opened and closed automatically and Socialized it with press and fryer operators		 **Decision:** From the results of the monitoring that has been carried out, it can be concluded that steam consumption is no longer found when the machine is off after repairs have been made. Then the QCC states SUCCESSFUL.
3	Installed the indicator to determine the condition of the supply pump and Socialized it with boiler operator.		 **Decision:** From the results of the monitoring that has been carried out, it can be decided that, after repairs are made, the steam pressure is in accordance with the needs (minimum 7 bar). Then the QCC states SUCCESSFUL.
4	Installed the automation of adding water to the bottom ash tub and Installed the inverter, timer on the bottom ash conveyor panel, and Socialized them with boiler operator.		 **Decision:** From the results of the monitoring that has been carried out, it can be concluded that, after repairs, the water level in the bottom ash conveyor tank is no longer touching the minimum value of 30 cm and speed of the chain grate is stable. Then the QCC states "SUCCESSFUL".
5	Installed the blowdown outlet pipe for each boiler and Socialized it with boiler operator		 **Decision:** According to the results of the monitoring, the average TDS value for boiler water is below the standard (maximum 3,000 ppm) after repairs are made. The blowdown process is performed every 30 minutes for 3 seconds. Then the QCC states "SUCCESSFUL".
6	Installed a wireless button device for fuel bucket operation and Socialized it with boiler operators and warehouse officers for the handover of boiler fuel.		 **Decision:** From the results of the monitoring that has been carried out, it can be concluded that, after repairs are made, the steam boiler pressure is as needed (minimum 7 bar) and the fuel supply is on time. Then the QCC states "SUCCESSFUL"
DECISION: improvement was successful			

STEP 5: EVALUATING THE RESULT

5.A Evaluating the condition of Dominant Causes, before and after Improvements

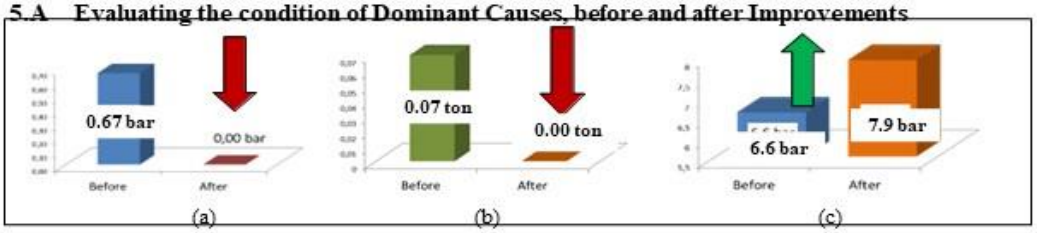


Fig10: Bar chart on comparison result before and after to the dominant cause: (a) Preventive maintenance of the steam trap is not available yet; (b) The steam valve is closed after the operator prioritized handle the machine; (c) The location of the supply pump inverter is far from the feed water boiler area; (d) The operator is too late to open the conveyor tub air valve on the bottom ash; (e) Only one blowdown outlet pipe; (f) Late in boiler refuel.

5.B Evaluate the Initial Goals Achievement

Fig 11 : Bar Chart on Evaluation on Result to Initial goals Achievement in gr/pack

Based on the bar diagram, it is seen that after the improvement, boiler fuel consumption went down by 203.28%, from 19.89 gr/pack to 17.41 gr/pack, and the improvement was **a success**.

5.C Evaluated the Theme Achievement

Fig 12: Bar Chart on Comparison on Theme

Based on the bar diagram, it is seen that after the impro vement was done, the utility cost decreased by 14.18%, from USD 0.0014 to USD 0.0012, and the improvement was declared as **a success.**

5.D Evaluating the Effects

Productivity	lowering boiler fuel consumption from **19.89 gr/pack to 17.41 gr/pack** (target 18.67 gr/pack)
Quality	Steam pressure according to production requirements
Cost	Reducing boiler fuel consumption and groundwater use could result in annual savings of USD **118,502.67.**
Delivery	Boiler refueling was not late
Safety	Work Accident Rate became 0 (zero accident)
Moral	Employees were more productive with the increase of awareness through education that had been given.
Environment	Reduced boiler waste, the cleaner working environment, and the operators were closer to the work area.
Repair	Total cost of repairs was USD 12,158.09
BEP	Break even point 2 Months
Negatif effects	An increase in electricity consumption of 0.22 kw

5.E Development of QCC member and Workplace

Fig 13: Radar Chart of QCC Performance and Condition of the work environment After improvement

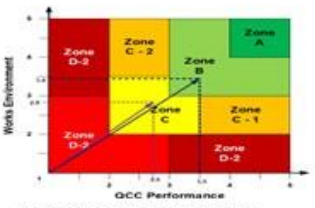


Fig 14: Rinda windows After improvement

Our current QCC Performance was 3.5 and Condition of the work Environment now was 3.4 , which is shown in rinda window, we are now in zone B, it means our performance activity qualities running good with the process PDCA activity

STEP 6: MAKING RE-STANDARDIZATION

6.1 Standard of Procedure

No	Description	Standardization	Note
1	Make sure the valve of the steam trap in the fryer area is working optimally.	Perform steam trap maintenance according to schedule and WI steam trap maintenance.	1.WI steam trap maintenance (WI 91 /NDPKB-TEK-028) 2.The steam pressure required by the fryer heat exchanger corresponds to the table of steam characteristics.
2	Make sure the steam valve on the steam box is closed when the machine is off.	Install the automatic steam valve on the steam distribution pipe in the steam box.	The steam valve in the steam box must be closed when the machine is off.
3	Make sure the operator quickly finds out if there is an error in the water supply pump to the FWT.	Install the indicator to determine the condition of the supply pump.	The boiler unit must not die due to the lack of water in the FWT.
4	Make sure the water level in the ash tub is not lower than the minimum level of 30cm.	• Install the automatic valve for water filling on the bottom ash conveyor tub. • Install a timer on the bottom ash boiler conveyor panel and set the conveyor on/off time as needed.	The boiler unit must be in a vacuum condition.
5	Make sure the blowdown frequency is set as needed (recommended every 30 minutes for 3 seconds).	In order to avoid damage to the valve axle and gasket, separate the blowdown outlet pipe for each boiler.	The TDS value is less than the standard (maximum 3,000 ppm).
6	The boiler operator performs the handover of boiler fuel with warehouse personnel once per shift.	Bucket elevator operations are carried out by warehouse personnel using a wireless button.	The handover of boiler fuel between the boiler operator and warehouse personnel only comes once per shift.

6.2 Standard of results

The standard procedure above if carried out properly will obtain standard results, namely: Boiler fuel consumption (shell) a maximum of **18.67 gr/pack**

Comment: Standard Procedure is applied consistently			
Create by	Responsible by	Known by	Approved by
Isdiyarti Secretary	Rasidan Team Leader	Hendriko Sofjan Facilitator	Chandra wangi PM

STEP 7 : COLLECTING NEW DATA & DETERMINING NEXT PROJECT (CONTINUOUS ACTIVITIES)

7.A Management Control of New Standard

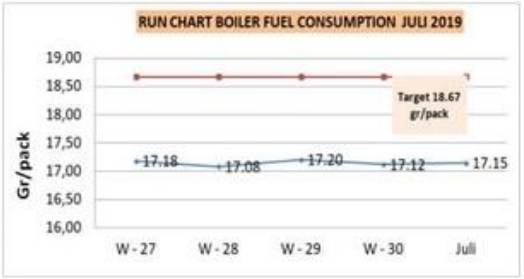


Fig 15: Run chart of boiler fuel consumption after improvement

7.B Collecting New Data

Data of factory production cost between January and June 2019

No	Description	USD/pack
1	Man Power cost	0.0043
2	Utilities Cost	0.0012
3	**Repair / Maintenance Cost**	**0.0009**
4	Depreciation Cost	0.0006
5	Other PE	0.0006
	Total	106.39

Fig 16: Table of production cost at Pekanbaru factory

7.C Defining Next Project

Pareto analysis to determine the next step:

From the Pekanbaru factory production cost table data above, it can be seen that the Man Power cost is in the first place at USD 0.0043/pack but the Man Power cost is beyond the control of the QCC. The Utility cost is USD 0.0012/pack which ranks second. From the data for 2017- 2019 trend of utility costs and boiler fuel consumption ratios decreased, so QCC TANGKAI for the next discussion chose the next priority level, namely the third rank (Repair / Maintenance Cost).

Based on pareto analysis, QCC TANGKAI detemined theme:

"Reducing Repair/Maintenance Cost at The Pekanbaru Factory"

NEXT ACTION PLAN SCHEDULE OF QCC TANGKAI

PDCA	Step	Activities	July				Augst				September				October				November				December				January				Quantity	
			Week				Week				Week				Week				Week				Week				Week				P	R
			27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	1	2	3	4		
Plan	1	Determine the theme and title																															2	
	2	Analyze the couse																															4	
	3	Test and determine the dominant cause																															3	
Do	4	Make plant and carry out repairs																															10	
Check	5	Assess the results of improvements																															5	
Action	6	Make new standars																															2	
	7	Collect new data and determine plans																															2	
Number of meeting																															28	0

Created by:	Known by:
Rasidan	Hendriko Sofjan
Team Leader	Facilitator

Case Study 2 : QCC TERTIB

ICQCC 2023 – China

Presentation title: Optimizing the Work Load Analysis (WLA) of the Operator Mixer in Plant 1 by 100% within 27 weeks

Name of team/circle: QCC TERTIB
Name of the presenter(s): Asep Suryaningrat, Aldi Syam, Irfan Anshari, Ikhwan Maulana, Setia Mulya
Presenter's affiliation & Job Title: Maintenance, Process Development and Quality Control
Company/Organization: PT Indofood CBP Sukses Makmur, Tbk - Bandung Branch
Country/Region: Indonesia

FIRST STEP : THE THEME SELECTION

1. DETERMINE THE THEME

1. Internal Memorandum

Based on the Internal Memorandum from the Factory Manager regarding Operator Optimization in Plant 1.

2. Data of Operator and Bar Chart at Plant 1

No	Operator	Total (person)
1	Process	30
2	Packing	12

Fig 1.1. Operator of Plant 1 in November 2019 (*Source : MP Planning November 2019 PROD*)

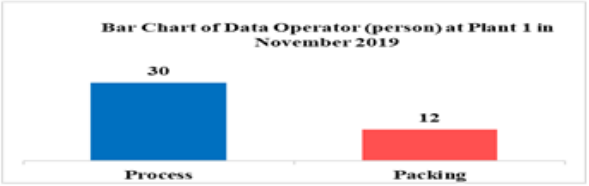


Fig 1.2. Bar Chart of Operator at Plant 1 in November 2019

1.1.3 Ratio of Workload Data at Plant 1

This table shows ratio of operator number compare to number of workload (number of machine operated by operator) and then get ratio of workload.

No	Work Area	Total of Operator (person)	Total of Workload (machine)	Ratio of Workload (person/machine)
1	Process	30	7	30/7 = 4.29
2	Packing	12	4	12/4 = 3.00

Fig 1.3. Ratio of Workload at Plant 1

Result Analysis in Define Theme of Project Taken from Pareto Analysis (data analysis taken from different factor) as follows :

1. There is a management directive regarding the optimization of operator in plant 1, specifically in the process area, while it considers its operational and process quality aspects
2. Based on the data and bar chart of the operator number at plant 1 in November 2019, it can be observed that the number of operator in the process area of Plant 1 which has 30 persons has higher number than the packing area of Plant 1 which has 12 persons only
3. The workload ratio data indicates that the process area has the higher ratio at 4.29, while the packing area is at 3.00, this shows that the greater of workload ratio , the more people are needed to operate the machine.

Therefore, the QCC TERTIB agrees to adopt the theme:

"OPTIMIZATION OF OPERATOR IN THE PROCESS AREA OF PLANT 1"

2. DETERMINE THE TITLE

1. The Data of Operator and Ratio of Workload of Plant 1 in November 2019

This table shows ratio of operator number compare to number of workload (number of machine operated by operator) and then get ratio of workload in process area plant 1 in November 2019

No	Area	Total of Operator (person)	Total of Workload (machine)	Ratio of Workload (person/machine)
1	Silo	4	Silo (1)	4/1 = 4.00
2	Mixer	7	Mixer (1)	7/1 = 7.00
3	Press	7	Press and Steam (2)	7/2 = 3.50
4	Fryer	12	Cutter, Fryer, and Cooler (3)	12/3 = 4.00

Fig 1.6. Data of Number of Operator and Ratio of Workload of Plant 1 in November 2019

2. Title Determination Based on Risk Analysis

A. Nominal Group Technique (NGT)

No	View Point	Score			
		Silo	Mixer	Press	Fryer
1	Influence on Customer Satisfaction	6	18	10	16
2	Influence on Operational Smoothness	7	19	8	16
3	The Level of Difficulty in Conducting Repairs	5	20	12	13
Total NGT Value		18	57	30	45

Fig 1.7. Recapitulation of Voting Data from QCC Members to determine the area to be repaired

Notes : **NGT Score** based on nominal group technique score by members votting

1.2.2.B. Risk Priority Number (RPN)

No	View Point	Score			
		Silo	Mixer	Press	Fryer
1	Influence on Customer Satisfaction	3	9	6	3
2	Influence on Operational Smoothness	6	9	3	3
3	The Level of Difficulty in Conducting Repairs	3	9	3	3
Total RPN Likert Scale Value		54	729	54	27

Fig 1.8. RPN Likert Scale Values to determine the area to be repaired

Notes : **RPN Likert Scale Value**

Score	Risk Potential
9	Potential to increase customer satisfaction, operational smoothness, and ease in conducting repairs
6	A little potential to increase customer satisfaction, operational smoothness, and ease in conducting repairs
3	Not potential to increase customer satisfaction, operational smoothness, and ease in conducting repairs

1.2.3. Observation Data of Input Time in Daily Production Report Online by Operators

Area	Average Observation Time
Silo	5.00
Mixer	36.58
Press	15.25
Fryer	21.75

Fig 1.9. Observation Data of Input Time in Daily Production Report Online

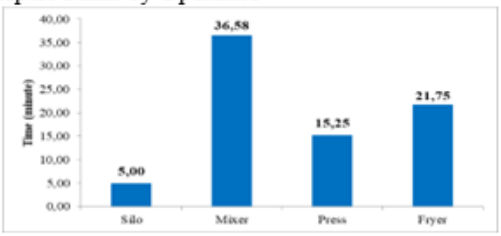


Fig 1.10. Bar Chart of Input Time in Daily Production Report Online

1.2.4. Observation Data of Inputted Parameter-Numbers in Daily Production Report Online by Operators

No	Area	Number of Parameter Fillings	Cumulative	%	% Cumulative
1	Mixer	11	11	30%	30%
2	Fryer	7	18	19%	49%
3	Press	6	24	16%	65%
4	Cooler	5	29	14%	78%
5	Others	8	37	22%	100%
Total		37		100%	

Fig 1.11. Data of Inputted Parameter-Numbers in Daily Production Report Online

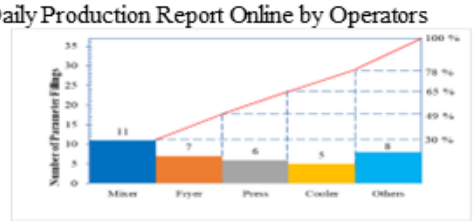


Fig 1.12. Pareto Diagram of Inputted Parameter-Numbers in Daily Prouction Report Online

1.2.5. Analysis Data of WLA Mixer Operator

No	Activity	Total Time Requirement
A	Operational	200 Minutes
B	Sanitation	159 Minutes
C	Administration	59 Minutes
Total Duration of All Activities		418 Minutes/Person
		6.96 Hours/Person

Fig 1.13. Summary Work Load Analysis (WLA) for Mixer Operator

Result Analysis in Define Theme of Project Taken from Pareto Analysis (data analysis taken from different factor) as follows:

1. Based on the data, it is evident that the fryer operator has the highest number of operator, which is 12 persons, but operates more machines, namely 3 machines (cutter, fryer, and cooler), resulting in a workload ratio of 4. The data shows that the mixer operator, with the second highest number of operator at 7 persons, operates fewer machines, specifically 1 machine (mixer), leading to a workload ratio of 7. Therefore, it can be concluded that the highest workload ratio is for the Mixer, which is 7.
2. Based on NGT voting, the highest value is for the Mixer, with a value of 57, and the highest Likert Scale RPN value is also for the Mixer, at 729. Therefore, the section with the highest priority for improvement without significant risk is the Mixer.
3. Based on the observation data on process input time, it is evident that the mixer area requires more time for collecting mixing process data, specifically 36.58 minutes.
4. Based on the number of parameter fillings data, it is clear that the Mixer section has the highest number of fillings, which is 11.
5. Based on the WLA analysis, it can be seen that 1 operator manages 2 lines (4 mixer machines Fuji W-500 or Tokyo Menki W-600) for a duration of 418 minutes or 6.96 hours per shift.

Therefore, QCC TERTIB selects the title:

"OPTIMIZING THE WORKLOAD ANALYSIS (WLA) OF THE OPERATOR MIXER IN PLANT 1 BY 100% WITHIN 27 WEEKS"

1.3.INITIAL GOAL

Based on the best possible outcome with management support and WLA analysis predictions, QCC TERTIB sets the Initial Goal to optimize the WLA of mixer operators from 6.96 hours per shift to 3.50 hours per shift.

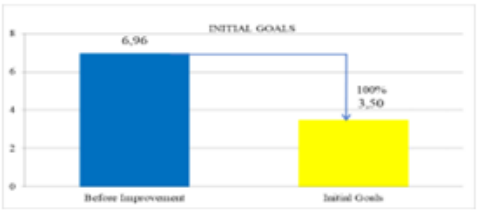


Fig 1.14. Initial Goals

Created by:		Known by:
Asep Suryaningrat		Hadi Supriadi
QCC Leader		Facilitator
Approval management in implementing improvements.		
Approve by:	Approval	Comment
Technical Manager		(Proceed to the Next Step)
Factory Manager		Semangat capai Target !!! (Spirit to Achieve the Target)

4. QCC PERFORMANCE

1. QCC Performance and Work Environment Conditions Before Activities

Members	Basic Knowledge	Management of QCC & Active Roles of Members	Implementation of PDCA & QC Tools	QCC Application Skills	Motivation/Skill Improvement	
ASEP	5	4	3	4	4	4,00
ALDI	3	4	3	2	3	3,00
IRFAN	4	3	3	4	4	3,60
IKHWAN	4	4	4	4	3	3,80
SETIA	4	4	3	4	3	3,60
Average	3,80	3,80	3,20	3,60	3,40	3,60

Fig 1.15. QCC Performance and Work Environment Conditions Before Improvement

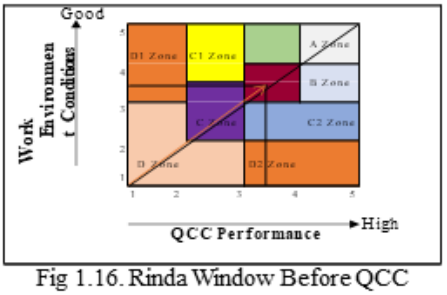


Fig 1.16. Rinda Window Before QCC

SECOND STEP: THE ANALYSIS OF CAUSES

2.1. RELATION DIAGRAM

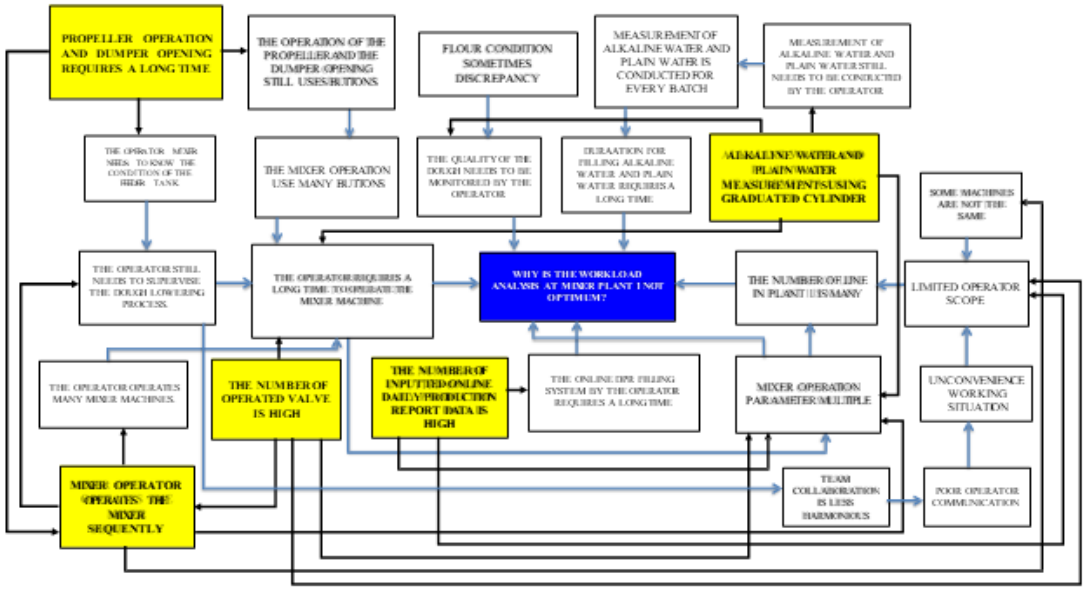


Fig 2.1. Relation Diagram

For the causal factors of Flour Condition sometimes Discrepancy, QCC TERTIB exercises control by providing information on the moisture content of flour by batch to the Mixer operator.

2.2. MATRIX DIAGRAM

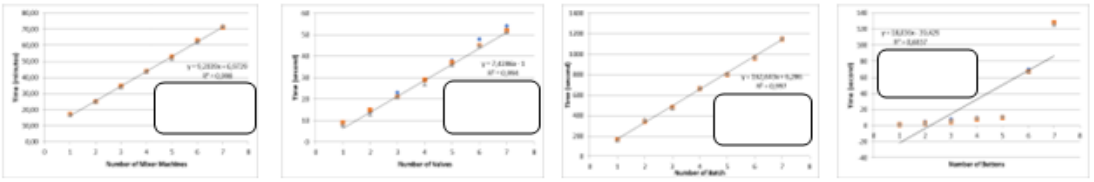
CAUSES / QCC MEMBERS	ASEP E / P	ALDI E / P	IRFAN E / P	IKHWAN E / P	SETIA E / P	TOTAL ∑E / ∑P	∑E x ∑P
PROPELLER OPERATION AND DUMPER OPENING REQUIRES A LONG TIME	3 / 2	3 / 1	3 / 1	3 / 2	3 / 3	15 / 9	135
THE NUMBER OF OPERATED VALVE IS HIGH	4 / 5	4 / 3	4 / 4	4 / 3	4 / 4	20 / 19	380
MIXER OPERATOR OPERATES THE MIXER SEQUENTLY	4 / 4	4 / 5	4 / 5	4 / 4	4 / 5	20 / 23	460
ALKALINE WATER AND PLAIN WATER MEASUREMENTS USING GRADUATED CYLINDER	4 / 3	4 / 4	4 / 2	4 / 5	4 / 2	20 / 16	320
THE NUMBER OF INPUTTED ONLINE DAILY PRODUCTION REPORT DATA IS HIGH	3 / 1	3 / 2	3 / 3	3 / 1	3 / 1	15 / 8	120

E = Efficacy (The Effectiveness of a Potential Cause)
P = Practicability (Ease of Execution by QCC)

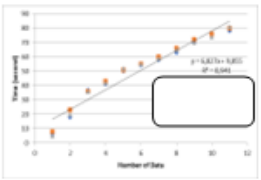
Fig 2.2. Matrix Diagram

THIRD STEP : THE DETERMINATION OF DOMINANT CAUSES

3.1. RESULT OF THE CORRELATION



(a) (b) (c) (d)



(e)

Fig 3.1. : (a) Scatter Diagram of Mixer Operator Operates The Mixer Sequently; (b) Scatter Diagram of The Number of Operated Valve is High; (c) Scatter Diagram of Alkaline Water And Plain Water Measurements Using Graduated Cylinder; (d) Scatter Diagram of Propeller Operation And Dumper Opening Requires a Long Time; (e) Scatter Diagram of The Number of Inputted Online Daily Production Report Data is High.

3.2. CONCLUSION OF TEST RESULTS

1. Mixer Operator Operates The Mixer Sequently.
2. Alkaline Water and Plain Water Measurements Using Graduated Cylinder.
3. The Number of Operated Valve is High.
4. The Number of Inputted Online Daily Production Report Data is High.
5. Propeller Operation and Dumper Opening Requires a Long Time.

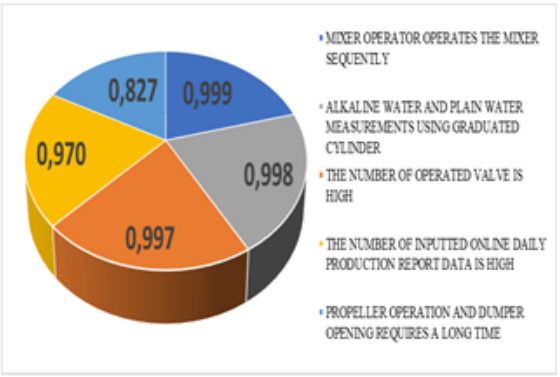


Fig 3.2. Pie Chart of Dominant Causes

FOURTH STEP: THE ACTION PLAN & THE IMPLEMENTATION

1. THE ACTION PLAN

Our QCC apply PDCA – TULTA (7 step and 7 QC tools) as main methods and supported by "7 WH-Questions" approach in countermeasures action completely.

NO	DOMINANT CAUSES	WHY	WHAT	WHERE	WHEN	WHO	HOW	HOW MUCH
1	MIXER OPERATOR OPERATES THE MIXER SEQUENTLY	So that the operation of the mixer machine can be operated simultaneously	Creating a CCI (Centralized Control Integrated) Control Room and installing the CAA (Centralized Automixing and Autorecording) system	Mixer	W - 6	Aldi	Installation of the CAA system in the CCI Control Room to operate the mixers on all line	Target for improvement: 100%
2	ALKALINE WATER AND PLAIN WATER MEASUREMENTS USING GRADUATED CYLINDER	so that the process of filling alkaline water and plain water can be faster	Replacing electronic components on the mixer machine's control panel and adding a flowmeter for the measurement of alkaline and plain water.	Mixer	W - 7	Ikhwan	Electronic components are installed on the mixer machine panel, and the flowmeter is installed on the input pipe of the alkaline and plain water weighing tank.	Target for improvement: 100%
3	THE NUMBER OF OPERATED VALVE IS HIGH	So that the valve can open faster.	Replacing the valve handle type with an automatic pneumatic butterfly valve.	Mixer	W - 8	Irfan	An automatic pneumatic butterfly valve is installed on the alkali water and plain water pipes.	Target for improvement: 100%
4	THE NUMBER OF INPUTTED ONLINE DAILY PRODUCTION REPORT DATA IS HIGH	So that data retrieval can be done more quickly.	Installing electronic equipment to be integrated with the CAA system.	Mixer	W - 9	Setia	Electronic equipment is connected to the CCI Control Room.	Target for improvement: 100%
5	PROPELLER OPERATION AND DUMPER OPENING REQUIRES A LONG TIME	So that the propellers and the dumper opening can operate faster.	Replacing and adding electronic components to the mixer machine panel.	Mixer	W - 10	Asep	Electronic components are installed on the mixer machine panel.	Target for improvement: 100%

Fig 4.1. Method of 7 WH-Questions as Innovative Solution (Week 6 s/d 10 year 2020).

1. Determine The Intermediate Target

QCC TERTIB has agreed to set an intermediate target of 100%, in the following considerations:

1. The reducement of operators's workload ratio in the mixer process area of Plant.
2. The ability to solve 5 dominant causes.
3. The gain of trust, conviction, and management

Fig 4.2. Intermediate Target

Approval management in implementing improvements		
Approve by:	Approval	Comment
Technical Manager		(The repair has been proceeding well proceed to the next step)
Factory Manager		Lakukan Perbaikan dengan Semangat !!! (Do Repairs with Spirit)

4.2. IMPLEMENTATION

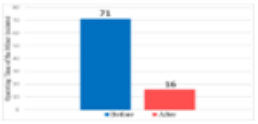
Ideas			Decision
Creating a Control Room to Operate Mixers Sequently and Automatically			SUCCESS
	System CAA (Centralized	Creating a Contol Room CCI	
Adding a Flowmeter for Activating Alkaline Water and Plain Water			SUCCESS
Replacing the Valve Handle type with an Automatic Pneumatic Butterfly Valve			SUCCESS
	Automatic Pneumatic Butterfly Valve		

Creating a Database to Collect Data for Parameters of Mixer Process	 Autorecording	 Database	
Replacing and Adding Electronic Components to the Machine Mixer Panel	 Automatic Mixer Panel	 HMI (Human Machine Interface)	

Fig 4.3. Implementation

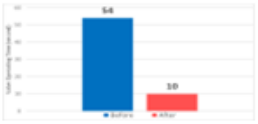
FIFTH STEP : THE CONFIRMATION OF RESULT FOR IMPROVEMENT

1. EVALUATION ON IMPROVEMENT RESULT ON DOMINANT CAUSE

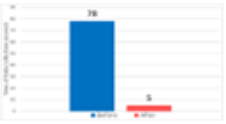


(a)

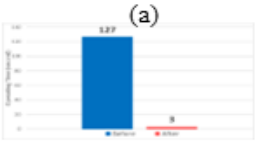
(b)



(c)



(d)



(e)

Fig 5.1.: Bar Chart of Before And After Improvement (a) Mixer Operator Operates The Mixer Sequently; (b) Alkaline Water And Plain Water Measurements Using Graduated Cylinder; (c) The Number Of Operated Valve Is High; (d) The Number Of Inputted Online Daily Production Report Data Is High; (e) Propeller Operation And Dumper Opening Requires A Long Time.

1. Evaluation On Result To Title (Initial Goal)

WLA data mixer operator in the process area of plant 1 in April 2020.

Before Improvement

No	Activity	Total Time Requirement
A	Operational	200 Minutes
B	Sanitation	159 Minutes
C	Administration	59 Minutes
Total		418 Minutes/Person
		6.96 Hours/Person

After Improvement

No	Activity	Total Time Requirement
A	Operational	12 Minutes
B	Sanitation	159 Minutes
C	Administration	24 Minutes
Total		195 Minutes/Person
		3.25 Hours/Person

Fig 5.2. Comparison Data of WLA of Mixer Operator in Process Area Plant 1

Bar Chart of comparison WLA of Mixer operator

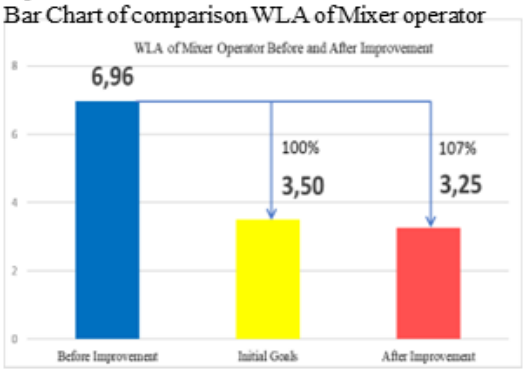


Fig 5.3. Bar Chart of WLA Mixer Operator of Plant 1 in April 2020

This table shows ratio of operator number compare to number of workload (number of machine operated by operator) and then get ratio of workload in process area plant 1 in April 2020 (after improvement).

No	Area	Total of Operator (person)	Total of Workload (machine)	Ratio of Workload (person/machine)
1	Silo	4	Silo (1)	4/1 = 4.00
2	Mixer	4	Mixer (1)	4/1 = 4.00
3	Press	7	Press and Steam (2)	7/2 = 3.50
4	Fryer	12	Cutter, Fryer, and Cooler (3)	12/3 = 4.00

Fig 5.4. Data of Number of Operator and Ratio of Workload of Plant 1 in April 2020

5.1.2. Comparison On The Theme

The available Data of Operator at Plant 1 in April 2020 is as follows:

Before Improvement

No	Operator	Total (Person)
1	Process	30
2	Packing	12

After Improvement

No	Operator	Total (Person)
1	Process	27
2	Packing	12

Fig 5.5. Operator Data in Plant 1 in April 2020.

Bar Chart of Operator Process Operator at Plant 1 in April 2020

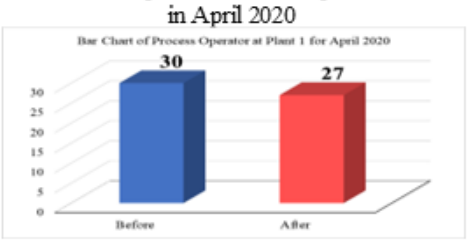


Fig 5.6. Bar Chart of Process Operator in Plant 1 in April 2020.

The workload data ratio in Plant 1 in April 2020 (after improvements):

No	Ratio of Work Area	Total of Operator (person)	Total of Workload (machine)	Ratio of Workload (person/machine)
1	Ratio of Process	27	7	27/7 = 3.86
2	Ratio of Packing	12	4	12/4 = 3.00

Fig 5.7. Ratio of Workload Data of Plant 1 in April 2020.

2. IMPACT ANALYSIS

1. Positive Impact

- The dough quality remains good.
- Mixer Plant 1 area is cleaner and tidier.
- The mixer machine can be operated with only 4 mixer operator personnel.
- Data collection is now automatic, reducing the occurrence of input errors or missing data by operators.
- The costs and benefits of reducing the operator in Mixer Plant 1 area each month are as follows:

Cost Elements	Unit	Per Person	Personel		Variance/Saving
	Person		7	4	
Operator Cost/Month	IDR	8.680.755	60.765.285	34.723.020	26.042.265
Operator Cost/Year	IDR	104.169.060	729.183.420	416.676.240	312.507.180
Total Investment	IDR				1.477.645.383
Pay Back Periode (PBP)	Year	Total Investment/(Operator Cost/Year)			4.73

Fig 5.8. Cost Element and Saving.

Impact Analysis Based on PQCDSME before and after Improvement

Factor	Before Improvement	After Improvement	Description
Productivity	The work effectiveness in the mixer area of Plant 1 for the month of April 2019 was 100%.	The effectiveness of work in the mixer area of Plant 1 in April 2020 was 100%.	The work effectiveness in Mixer Area Plant 1 before and after the improvements remains good.
Quality	The average water content of Dough Plant 1 was 32.59%.	The average water content of Dough Plant 1 is 32.98 %.	The average water content rate of dough and the uniformity of the results, both before and after the improvement, remain good.
	The quality of dough was good and homogeneous.	The quality of dough is still good and homogeneous.	
Cost Efficiency	The Labor Costs was IDR 729.183.420 There are 7 mixer operators (1 person held 2 lines or 4 mixer machines).	The Labor Cost is IDR 416.676.240 There are 4 mixer operators (1 person hold 4 lines or 8 mixer machines).	Labor costs have decreased after the improvement. Cost savings amount to IDR 312.507.180.
Delivery	The delivery of dough from the mixer to the press was good.	Sending of dough from the mixer to the press is better	The delivery of dough from the mixer to the press has improved after the improvement.
Safety	The security risk level of Mixer Plant 1 area was in the Yellow zone.	The security risk level of Mixer Plant 1 area is in the Green zone.	The security risk level of Mixer Plant 1 area has improved after the improvement.

Moral	The working atmosphere and convenience were good.	The working atmosphere and convenience are still good.	Before and after the improvement, the atmosphere and working convenience remained good.
Environment	The working environment was neat and orderly.	The work environment is still neat and tidy.	The work environment before and after the improvement remains tidy.

Fig 5.9. PQCDSME Analysis After Improvement

5.2.2. Negative Impact

• There is no negative impact from the conducted improvements.

5.2.3. Dissemination of Improvement Result

1. In order to ensure that the improvement that have been carried out on the mixer machine remain in good condition, QCC TERTIB conducts a briefing for all mixer operators regarding the repairs that have been done by QCC TERTIB, so that they are understood and executed properly and consistently.
2. Create a standard procedure for the operational use of the mixer machine to make it easier for operators to operate.

3. QCC PERFORMANCE

1. QCC Performance and Work Environment Conditions Before And After Activities

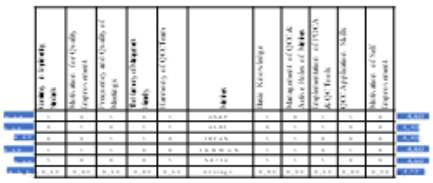


Fig 5.10. QCC Performance and Work Environment Conditions After Improvement

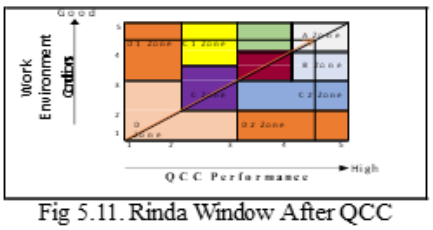


Fig 5.11. Rinda Window After QCC

SIXTH STEP : THE STANDARDIZATION

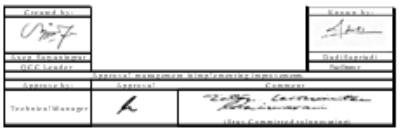
6.1. STANDARD PROCEDURE

Document Code	Before Improvement	After Improvement
NDBDG-TEK-06 / Standard Operation Procedure Preventive Maintenance Mixer	Poin 3. Scope ver. 1.3	Poin 3. Scope ver. 1.4
	Poin 6.1.2. & 6.4.2. Electrical Fuji W 500 & Tokyo Menki W 600 ver 1.3	Poin 6.1.2. & 6.4.2. Electrical Fuji W 500 & Tokyo Menki W 600 ver 1.4
	Poin 8. Problems and Solution ver. 1.3	Poin 8. Problems and Solution ver 1.4
NDBDG-TEK-21 / Collection of Forms from the Technical Department	Form TEK-065 ver 1.3	Form TEK-065 ver 1.4
	Form TEK-066 ver 1.3	Form TEK-066 ver 1.4
	Form TEK-068 ver 1.3	Form TEK-068 ver 1.4
NDBDG-PROD-06 / Standard Operation Manual Mixer	WI-03/NDBDG-PROD-06 ver. 1.9	WI-03/NDBDG-PROD-06 ver 2.0
	WI-04/NDBDG-PROD-06 ver. 1.9	WI-04/NDBDG-PROD-06 ver. 2.0
	There is no operational WI for the Automatic Mixer yet.	WI-09/NDBDG-PROD-06 ver. 1.0
	There is no WI yet for Sanitation and Maintenance of the Automixer Server in the Control Room.	WI-10/NDBDG-PROD-06 ver. 1.0
NDBDG-PROD-14 / Collection of Production Department Forms	Form PROD-012 ver 1.4	Form PROD-012 ver 1.5
	Form PROD-013 ver 1.4	Form PROD-013 ver 1.5
NDBDG-MGT-12/ Standard Operational Procedure Sanitation / SSOP	Attachment 17: Daily and Weekly Mixer Cleaning Schedule ver. 2.0	Attachment 17: Daily and Weekly Mixer Cleaning Schedule ver 2.1
	WI-09/NDBDG-MGT-12 ver 2.0	WI-09/NDBDG-MGT-12 ver 2.1
NDBDG-PDQC-12 / Standard Operational Procedure Process Quality Control Mixing	Poin 4. Examination Procedure ver 1.6	Poin 4. Examination Procedure ver 1.7

Fig 6.1. Standard Procedure

6.2. STANDARD RESULT

After the QCC activity, the standard working hours for Mixer Operators have become 3.25 hours/shift/person.



SEVENTH STEP: THE FURTHER ACTION

7.1. MONITORING OF IMPROVEMENT RESULT

Fig 7.1. Run Chart Monitoring Of Working Hours for Mixer Operator Plant 1

Based on the Run Chart Working Hours for Mixer Operator in Plant 1, it can be observed that the number decreased from 6.96 hours/shift/person in November 2019 to 3.25 hours/shift/person in April 2020 until April 2023. With the management's decision, the Automixing Project was implemented in Plant 2 in November 2021, resulting in a cost saving of IDR 454.360.732. The project will also be continued in other plants (Cirebon, Tanjung Api-Api, and Cibitung Plant 3).

7.2. DETERMINING THE NEXT PLAN

We conducted brainstorming once again and gathered new data in July 2020

No	Water for Sanitation	Usage (m^3)	Cimlative	%	% Cimlative
1	Production Sanitation	6,105.29	6,105.29	35.97	35.97
2	Coal Boiler Sanitation	5,247.50	11,352.79	30.92	66.89
3	Men/Women Toilet & Prayer Room	2,647.25	14,000.04	15.60	82.48
4	Mosque	1,975.78	15,975.82	11.64	94.12
5	Others	997.20	16,973.02	5.88	100.00
Total		16,973.02			

Fig 7.2. Water Usage for Sanitation at Plant 1 from January to June 2020.

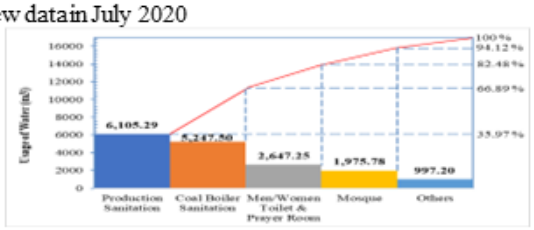


Fig 7.3. Pareto Diagram of Sanitation Water Usage in Plant 1 from January to June 2020.

Pareto Analysis:

Based on the data, water usage for sanitation in the production area is 35.97%, which is a total of 6,105.29 m3 over 6 months, or 1,017.55 m3 per month.

Therefore, based on this data and the Pareto diagram, we have determined the theme for the QCC to be:

"REDUCING SANITATION WATER USAGE IN PRODUCTION PLANT 1"

7.3. THE NEXT SCHEDULED PLAN FOR QCC TERTIB

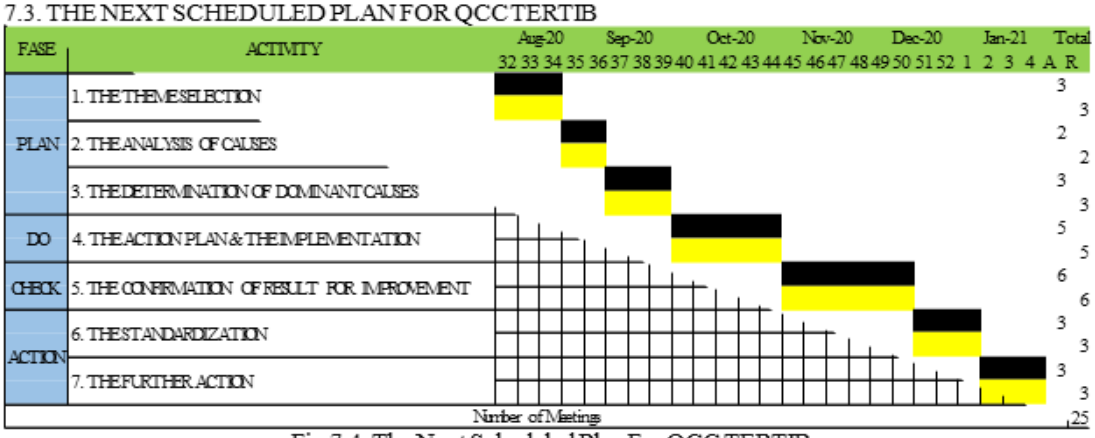


Fig 7.4. The Next Scheduled Plan For QCC TERTIB

The schedule of QCC TERTIB activities will start in week 32 of August 2020 and continue until week 4 of January 2021.

Created by:	Known by:
Asep Suryaningrat	Dadi Supriadi
QCC Leader	Facilitator

APPENDICES

APPENDIX 1. **THE PRIME GOLD MEDAL OF QCC "TANGKAI"**
(AWARDED IN ICQCC 2022, JAKARTA – INDONESIA)

APPENDIX 2 **THE GOLD AWARD CERTIFICATE OF QCC "TERTIB"**
(ACHIEVED IN ICQCC 2023, BEIJING – CHINA)

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