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Quality Assurance in VET Institutions

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This manual is intended for managers and educators, teachers and students of professional educational institutions and persons interested in mastering this topic.

Contents

MODULE 0
INTRODUCTION

1-FUNDAMENTAL PRINCIPLES BEHIND THE QM IN TVET

The primary challenge in technical and vocational education revolves around effectively managing, ensuring, and enhancing quality. Vocational education institutions must develop quality assurance mechanisms to assure the high standard of training for the skilled workers. Defining quality is complex, as it is subjective and varies among individuals and groups. Thus, establishing a universally accepted understanding of quality is essential for setting standards. Generally, quality denotes the level of excellence or superiority of a product or service, whether tangible or intangible. It also involves meeting agreed-upon standards that can be evaluated using specific criteria.

Comprehending quality within the educational framework encompasses the preconditions, educational procedures, and educational achievements. Preconditions involve assessing the factors that contribute to the educational process, including resources, infrastructure, curriculum design, and student demographics. Educational processes entail evaluating the methods, strategies, and techniques utilized in teaching and learning, encompassing instructional approaches, assessment methods, classroom management, and student engagement. On the other hand, educational outcomes involve evaluating the results or achievements of the educational process, which encompass students' knowledge, skills, attitudes, and abilities acquired as a consequence of the education. Comprehending quality within the educational framework allocates establishing a dynamic evaluation system within the context of modern world as well as the sector's demand on technical skill set from "the educated people."

Vocational education, aimed at nurturing graduates competent for the workforce, must prioritize quality. The effectiveness of vocational education is reflected in the quality of its processes. This quality is shaped by numerous factors, not solely reliant on the initial input quality, as conventionally presumed, but significantly influenced by the educational process. Consequently, the teaching and learning process plays a pivotal role in evaluating the quality of educational outcomes.

What is Technical and Vocational Education?

What are the fundamental differences between Vocational Education and Formal Education?

Technical and vocational education, also known as technical or career education, focuses on providing individuals with specific skills and training related to a particular occupation or industry. Unlike traditional academic education, which often emphasizes general knowledge and theory, vocational education is practical and hands-on, aiming to prepare students for employment in a specific trade or profession.

Vocational education programs can vary widely in duration and scope, ranging from short-term courses or certifications to comprehensive degree programs. These programs typically offer training in areas such as mechanics, construction, textiles, healthcare, design, product manufacturing, culinary arts, information technology, cosmetology, and many others, depending on the needs of the job market and the interests of the students.

The goal of vocational education is to equip individuals with the practical skills, technical knowledge, and industry-specific competencies needed to enter the workforce directly or to advance within their chosen career paths. It often involves a combination of classroom instruction, hands-on training, internships, and apprenticeships, allowing students to gain real-world experience and develop the skills demanded by employers in their respective fields. Vocational education needs to adopt adaptable and dynamic management principles to evolve in line with its inherent potential and meet external demands. A strategic approach to quality management in education involves positioning educational institutions as service providers aligned with the objectives of various stakeholders, such as enterprises, society, or parents. Stakeholders invariably anticipate top-tier services to achieve significant results and satisfaction. Thus, to establish high standards for vocational education institutions, an appropriate quality management framework is essential.

Implementing education clearly necessitates effective quality assurance management. A robust quality management system is crucial for enhancing the effectiveness of vocational education systems in cultivating dedicated, committed, and professional human resources. Additionally, graduates from Vocational and Technical Education and Training (TVET) programs are expected to possess knowledge, skills, and attitudes that meet the demands of both businesses and industries. In this regard, the quality assurance system plays a significant role in upholding elevated standards of vocational education and training.

The main goal of the quality management system is to ensure satisfaction among both internal and external customers. In vocational education, internal customers include principals, teachers, students, staff, and organizers, while external customers comprise the community, government bodies, businesses, and industries. Education quality involves imparting knowledge tailored to educational needs and effectively applying it to meet service users' expectations. Stakeholders like students, teachers, and employers are interested in education quality, which requires meeting predetermined standards while addressing customer needs and ensuring satisfaction.

Which factors does the quality of education in TVET depend upon?

The quality of education in TVET depend upon 8 factors (Fig.01). These are;

1-Curriculum and Instruction

2-Leadership and Management

3-Teachers and Staff

4-Facilities and Resources

5-Assessment and Evaluation

6-Support Services

7-Student Experience

8-Industry Partnerships

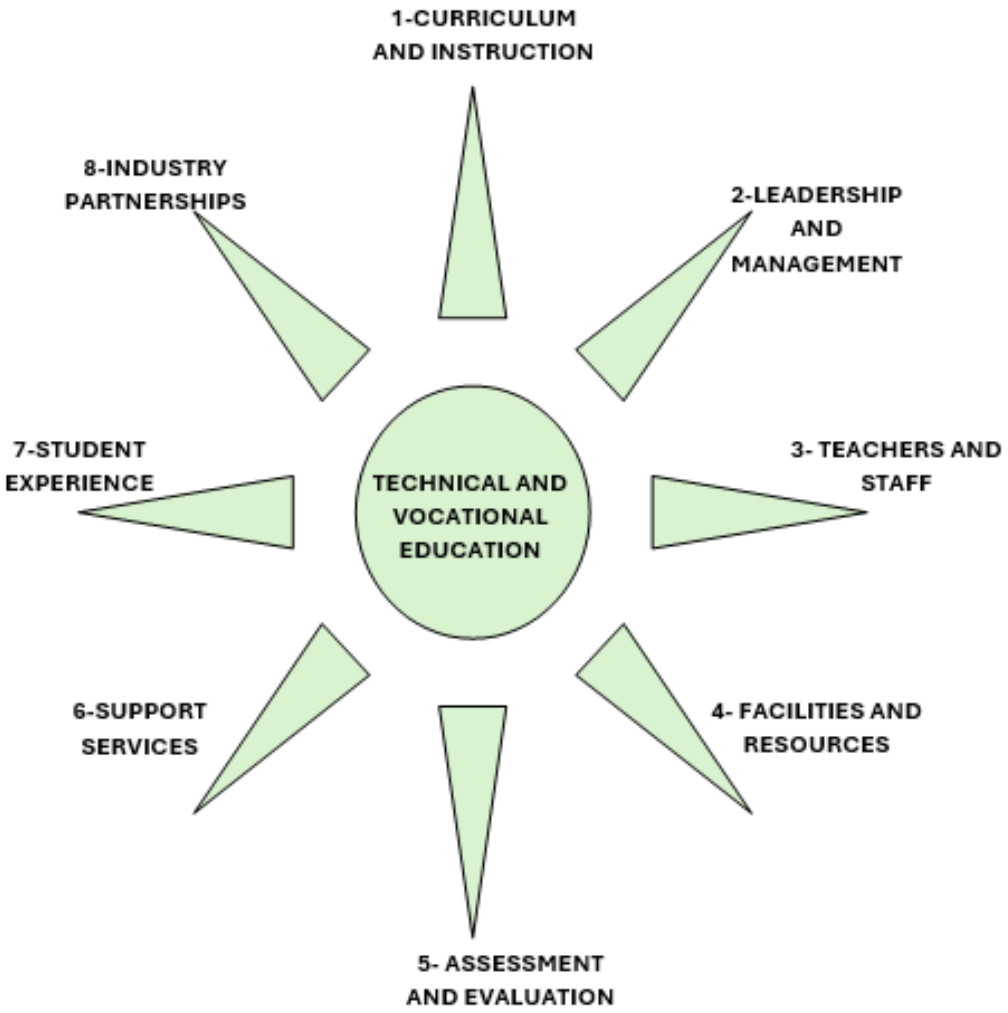


Figure.0.1-The factors contributing to the quality of TVET

Let’s study these factors in detail:

1-Quality of Curriculum and Instruction: This factor is to ensure that the curriculum is relevant, up-to-date, and aligned with industry standards, as well as employing effective instructional methods to facilitate learning. The most important criterion for this is that the quality of curriculum and instruction should pursue the vision and values of an educational institution in several ways. As listed below the quality of curriculum and instruction depends upon 6 aspects:

1.1. Alignment with Mission: The curriculum and instructional practices should reflect the mission and values of the institution. For example, if the institution prioritizes holistic development and social responsibility, the curriculum may include components focusing on ethics, diversity, and community engagement.

1.2. Integration of Core Values: The curriculum and instructional practices should integrate the institution's core values, such as integrity, respect, and accountability. This integration may be evident through the selection of course content, instructional methods, and assessment criteria that promote ethical behaviour, critical thinking, and responsible citizenship.

1.3. Focus on Student-Centred Learning: Since the organization of teaching and learning should be done through modern instruction methods corresponding with the customer-focus approach, the institution should value student-centred learning, the curriculum and instructional strategies may prioritize active learning, collaboration, and personalized approaches that cater to diverse student needs and interests.

1.4. Emphasis on Innovation and Excellence: The institution should emphasize innovation and excellence. Thus, the curriculum should incorporate cutting-edge content, pedagogical approaches, and technologies to ensure students receive a high-quality education that prepares them for future challenges and opportunities.

1.5. Commitment to Continuous Improvement: The institution's vision may include a commitment to continuous improvement and excellence in education. In this case, the curriculum and instructional practices should undergo regular review, evaluation, and enhancement to ensure they align with evolving educational standards, best practices, and stakeholder expectations.

1.6. Outcomes: The quality of outcomes in vocational education programs should refer to measurable achievements and competencies that graduates acquire as a result of their education and training. Ensuring that graduates of vocational education programs possess the knowledge, skills, and competencies needed to succeed in the workforce and make meaningful contributions to their chosen fields.

Quality of outcomes factor ensure that graduates possess the relevant knowledge and understanding of theoretical concepts, technical principles, and industry-specific practices related to their chosen fields. Graduates should demonstrate proficiency in core subjects, as well as be equipped with the practical skills and hands-on abilities necessary to perform effectively in the workforce. This may include technical skills, such as operating machinery, using tools and equipment, performing specific tasks, and applying industry-specific techniques. It also encompasses transferable skills (communication, problem-solving, critical thinking, teamwork, and adaptability), professional competencies (ethical decision-making, professionalism, time management, and customer service) and industry-specific competencies (compliance with regulations, safety protocols, and quality standards).

Quality of outcomes in vocational education programs prepare graduates for successful entry into the workforce and career advancement opportunities. This factor promotes a culture of lifelong learning and professional development among graduates. Graduates

should be encouraged to continue learning, growing, and advancing their skills and knowledge throughout their careers. They should be equipped with the skills and mindset necessary to adapt to emerging technologies, changing job requirements, and evolving industry trends. By focusing on knowledge acquisition, skill development, competency attainment, workforce readiness, industry relevance, and lifelong learning, vocational education programs can deliver high-quality outcomes that benefit graduates, employers, industries, and society as a whole.

By aligning the vision and values of an educational institution with the quality of curriculum and instruction, the institution can create a cohesive educational experience that fosters student success, promotes institutional excellence, and upholds its core principles and beliefs.

2-Quality of Leadership and Management: Effective leadership sets the tone and direction for management practices, while management arrangements provide the structure and mechanisms for implementing the institution's vision and goals. Together, they contribute to the overall quality of management within an educational institution. The quality of management in an educational institution is closely related to 2 aspects such as:

2.1. Leadership: Effective leadership plays a critical role in shaping the quality of management within an educational institution. Leaders set the vision, mission, and goals of the organization, establish the organizational culture, and inspire and motivate staff to achieve excellence. They provide direction, guidance, and support to ensure that management practices align with the institution's objectives and values.

2.2. Management Arrangements: Management arrangements refer to the organizational structures, processes, and systems put in place to facilitate the effective functioning of the institution. This includes aspects such as decision-making processes, communication channels, roles and responsibilities, resource allocation, and performance management. Management arrangements are chosen by the members of the organization to help them conduct their affairs and realize their aims. The quality of management is reflected in the effectiveness, efficiency, and responsiveness of these management arrangements. A well-designed and implemented management framework enables the institution to operate smoothly, allocate resources effectively, respond to challenges and opportunities promptly, and achieve its goals efficiently. Additionally, management arrangements should be flexible and adaptable to accommodate changing needs and circumstances within the organization and the broader educational landscape.

3-Quality of Teachers and Staff: The quality of teachers and staff is fundamental to the success of any educational institution. Employing qualified instructors and staff who have expertise in their respective fields and are dedicated to providing high-quality education and support to students. This factor can be explained as:

3.1. Qualified Instructors: Employing qualified instructors means hiring individuals who possess the necessary credentials, expertise, and experience in their respective fields. These instructors should have relevant educational qualifications, such as degrees, certifications, or licenses, as well as specialized knowledge and skills in the subjects they teach. Additionally, they should stay updated with developments in their fields to ensure the content they deliver is accurate, relevant, and current.

3.2. Expertise in Respective Fields: Quality teachers and staff should be experts in their respective fields, possessing in-depth knowledge and understanding of the subject matter they teach or the roles they fulfill within the institution. They should be able to convey complex concepts in a clear and accessible manner, engage students effectively, and foster critical thinking, problem-solving, and creativity.

3.3. Dedication to Providing High-Quality Education: Quality teachers and staff should be dedicated professionals who are committed to providing high-quality education

and support to students. They should prioritize student learning and well-being, create a supportive and inclusive learning environment, and go above and beyond to meet the needs of diverse learners. They should demonstrate passion, enthusiasm, and a genuine interest in helping students succeed academically, socially, and emotionally.

3.4. Staff Development: Staff development refers to the ongoing process of enhancing the knowledge, skills, and abilities of teachers and staff to improve their effectiveness in their roles and contribute to the overall success of the educational institution. Staff development is essential for enhancing the quality of teachers and staff by promoting their professional growth, keeping pace with changes in education, fostering collaboration and innovation, and enhancing job satisfaction and retention. By investing in staff development, educational institutions can cultivate a highly skilled and motivated workforce that is dedicated to providing high-quality education and support to students.

3.4.1. Professional Growth: Staff development opportunities, such as workshops, seminars, conferences, and professional development programs, provide teachers and staff with opportunities to expand their knowledge, develop new skills, and stay updated with best practices in education. This continuous learning process enables them to grow both personally and professionally and enhances their effectiveness in the classroom or in their respective roles.

3.4.2. Keeping Pace with Changes: The field of education is constantly evolving, with new technologies, pedagogical approaches, and educational trends emerging regularly. Staff development ensures that teachers and staff are equipped to adapt to these changes and incorporate them into their practice. By staying current with developments in education, teachers and staff can provide students with relevant and meaningful learning experiences that prepare them for success in the 21st century.

3.4.3. Promoting Collaboration and Sharing of Best Practices: Staff development activities often encourage collaboration and the sharing of best practices among teachers and staff. This collaborative learning environment fosters a culture of innovation, creativity, and continuous improvement, where teachers and staff can learn from each other, exchange ideas, and implement new strategies to enhance student learning outcomes.

3.4.4. Enhancing Job Satisfaction and Retention: Investing in staff development demonstrates the institution's commitment to the professional growth and well-being of its employees. By providing opportunities for staff to develop their skills and advance their careers, the institution can increase job satisfaction, morale, and retention rates, reducing turnover and ensuring continuity and stability in the teaching and learning environment.

4-Quality of Facilities and Resources: This factor is to provide adequate facilities, equipment, and resources to support hands-on learning experiences and practical training in vocational fields. The quality of facilities and resources in Technical and Vocational Education and Training (TVET) is crucial for ensuring effective learning experiences and preparing students for success in their chosen careers. This factor depends on 7 aspects such as:

4.1. Adequate and Up-to-Date Equipment: TVET institutions should have access to modern and up-to-date equipment, tools, and technologies relevant to the fields of study offered. This includes machinery, computers, software, laboratory equipment, and other resources necessary for hands-on training and practical skill development.

4.2. Well-Maintained Infrastructure: The physical infrastructure of TVET institutions, including classrooms, workshops, laboratories, and other learning spaces, should be well-maintained, safe, and conducive to learning. Adequate ventilation, lighting, seating

arrangements, and safety measures should be in place to create a comfortable and secure learning environment for students and staff.

4.3. Accessible Facilities: Facilities should be designed and equipped to accommodate students with diverse needs, including those with disabilities or special requirements. This may include wheelchair ramps, elevators, accessible restrooms, and other accommodations to ensure equal access to education for all students.

4.4. Industry-Relevant Simulated Work Environments: TVET institutions may incorporate simulated work environments, such as mock workshops or industry-standard laboratories, to provide students with hands-on training experiences that mirror real-world workplace settings. This allows students to practice their skills in a controlled environment before entering the workforce. Collaboration with industry partners can enhance the quality of facilities and resources by providing access to state-of-the-art equipment, industry experts, and internship opportunities for students. Industry partnerships can also help ensure that the curriculum remains relevant and aligned with current industry standards and practices.

4.5. Library and Information Resources: Access to a well-stocked library with a diverse collection of books, journals, multimedia resources, and online databases is essential for supporting research, study, and self-directed learning among students and faculty members.

4.6. Qualified and Adequate Staff: TVET institutions should employ qualified instructors, technicians, and support staff who have the expertise and experience to effectively utilize the facilities and resources available. Staff should receive appropriate training and professional development opportunities to stay updated with industry trends and best practices.

4.7. Continuous Improvement: TVET institutions should regularly assess and evaluate the quality of their facilities and resources to identify areas for improvement and invest in upgrades or renovations as needed. This may involve seeking feedback from students, staff, employers, and other stakeholders to ensure that facilities and resources meet the evolving needs of the workforce and industry.

Overall, the quality of facilities and resources in TVET plays a critical role in providing students with the hands-on training, practical skills, and industry-relevant experiences they need to succeed in their chosen careers. By investing in high-quality facilities and resources, TVET institutions can enhance the learning outcomes and employability of their graduates.

5-Quality of Assessment and Evaluation: The quality of assessment and evaluation is essential for ensuring that students are making progress in their learning and that educational programs are effective in achieving their intended outcomes. Implementing fair and valid assessment methods to measure student learning outcomes and evaluate the effectiveness of educational programs. This factor depends upon 6 aspects:

5.1. Fairness: Fair assessment ensures that all students are given equal opportunities to demonstrate their knowledge, skills, and abilities. This involves using assessment methods that are free from bias, discrimination, or unfair advantages. Fair assessments should also consider factors such as students' diverse backgrounds, learning styles, and abilities, and provide accommodations or adjustments as needed to ensure equitable participation and outcomes.

5.2. Validity: Valid-assessment measures accurately assess the intended learning outcomes, align with the curriculum objectives and content, reflect the depth and breadth of learning, and are appropriate for the level of the students. They should measure what they are intended to measure and provide reliable and consistent results.

5.3. Reliability: Reliable assessment produces consistent results when administered multiple times or by different assessors. Reliable assessments yield dependable data that can be used to make informed decisions about student progress, instructional effectiveness, and program improvement. Reliability ensures that assessment results are trustworthy and can be used with confidence to inform educational practices and policies.

5.4. Alignment with Learning Outcomes: Assessments should be closely aligned with the learning outcomes and objectives of the educational program or course. This alignment ensures that assessments measure what students are expected to know, understand, and be able to do as a result of their learning experiences. Assessments should cover a range of cognitive levels and skills, including knowledge recall, comprehension, application, analysis, synthesis, and evaluation.

5.5. Formative and Summative Assessment: Quality assessment includes both formative and summative assessment methods. Formative assessment occurs during the learning process and provides ongoing feedback to students and instructors about progress toward learning goals. Summative assessment occurs at the end of a learning period and evaluates students' overall achievement of learning outcomes. Both types of assessment are valuable for informing instruction, guiding learning, and evaluating program effectiveness.

5.6. Use of Multiple Assessment Methods: Quality assessment involves using a variety of assessment methods and tools to gather multiple sources of evidence about student learning. This may include written tests, performance tasks, projects, presentations, portfolios, observations, interviews, and peer or self-assessment. Using multiple assessment methods provides a more comprehensive and accurate picture of students' learning and allows for a more holistic evaluation of their progress and achievement.

The quality of assessment and evaluation is essential for promoting student learning, ensuring educational effectiveness, and making informed decisions about teaching, learning, and program improvement. By implementing fair, valid, reliable, and aligned assessment practices, educators can better support student success and continuous improvement in educational programs.

6-Quality of Support Services: Offering comprehensive support services, such as career counselling, academic advising, and student mentoring, to help students succeed in their vocational education programs. The quality of support services is crucial for ensuring that students in vocational education programs have the resources, guidance, and assistance they need to succeed academically, professionally, and personally. The factor depends upon 6 aspects such as:

6.1. Career Counselling: Career counselling services help students explore their interests, strengths, and goals, and make informed decisions about their educational and career pathways. Career counsellors provide guidance on career exploration, job search strategies, resume writing, interview preparation, and career development opportunities. They help students identify their skills, interests, and values, and align them with potential career options in their chosen fields.

6.2. Academic Advising: Academic advising services assist students in planning their academic coursework, selecting appropriate courses and programs, and meeting their educational goals. Academic advisors help students develop academic plans, navigate degree requirements, and resolve academic challenges or concerns. They provide guidance on course selection, academic policies, transfer opportunities, and academic support resources, such as tutoring services or study skills workshops.

6.3. Student Mentoring: Student mentoring programs pair students with mentors who provide guidance, support, and encouragement throughout their educational journey. Mentors may be faculty members, staff, alumni, or industry professionals who offer valuable insights, advice, and networking opportunities. Mentoring relationships help students develop confidence, motivation, and self-awareness, as well as build professional networks and connections in their chosen fields.

6.4. Personal Support Services: Personal support services address students' non-academic needs and concerns, such as health and wellness, financial assistance, housing, transportation, childcare, and social integration. These services help students navigate personal challenges, access community resources, and maintain overall well-being and stability. Personal support services may include counselling, health services, financial aid advising, housing assistance, and campus activities or clubs.

6.5. Accessibility and Inclusivity: Quality support services are accessible to all students, regardless of their background, abilities, or circumstances. Institutions should provide accommodations and support services for students with disabilities or special needs to ensure equal access to education and opportunities. Additionally, support services should be inclusive and culturally responsive, recognizing and respecting the diversity of students' backgrounds, identities, and experiences.

6.6. Evaluation and Continuous Improvement: Institutions should regularly evaluate the effectiveness of their support services and gather feedback from students to identify areas for improvement. This may involve assessing student satisfaction, tracking outcomes and success metrics, and conducting surveys or focus groups to gather input from students and stakeholders. Continuous improvement efforts aim to enhance the quality, accessibility, and responsiveness of support services to better meet students' needs and promote their success.

Quality support services are essential for fostering student success, retention, and completion in vocational education programs. By offering comprehensive support services that address students' academic, career, personal, and social needs, institutions can create a supportive and inclusive learning environment where all students can thrive and achieve their educational and professional goals.

7-Quality of Student Experience: The quality of student experience encompasses the overall environment and atmosphere in which students engage in their educational journey. Creating a positive and supportive learning environment where students feel engaged, motivated, and empowered to achieve their educational and career goals. The factor depends upon 6 aspects as defined below:

7.1. Positive Learning Environment: A positive learning environment is one where students feel safe, respected, and valued. It fosters a sense of belonging and community, encourages collaboration and mutual support among students and faculty, and promotes open communication and constructive feedback. A positive learning environment is characterized by supportive relationships, inclusive practices, and a culture of trust, empathy, and respect.

7.2. Engaging Instructional Practices: Quality student experience involves engaging instructional practices that stimulate curiosity, critical thinking, and active participation among students. This may include interactive lectures, hands-on activities, group discussions, problem-solving tasks, project-based learning, and real-world applications of learning. Engaging instructional practices help students stay motivated, focused, and invested in their learning, leading to deeper understanding and retention of course content.

7.3. Personalized Support and Guidance: Quality student experience includes personalized support and guidance that address students' individual needs, interests,

and goals. This may involve academic advising, career counselling, mentoring, tutoring, and support services tailored to meet students' unique circumstances and challenges. Personalized support helps students navigate academic and personal challenges, identify their strengths and areas for growth, and develop strategies for success.

7.4. Opportunities for Growth and Development: Quality student experience provides opportunities for students to explore their interests, develop new skills, and pursue their passions. This may include internships, co-op programs, research projects, study abroad experiences, extracurricular activities, and leadership opportunities. These experiences allow students to apply their learning in real-world contexts, expand their horizons, and develop transferable skills that are valuable for their educational and career advancement.

7.5. Empowerment and Agency: Quality student experience empowers students to take ownership of their learning and make informed decisions about their educational and career pathways. It encourages students to set goals, seek out resources, advocate for their needs, and actively participate in their educational journey. Empowered students feel confident, motivated, and capable of achieving their educational and career aspirations, leading to greater satisfaction and success.

7.6. Continuous Feedback and Improvement: Quality student experience involves soliciting feedback from students and using it to continuously improve the educational environment and practices. This may include collecting feedback through surveys, focus groups, course evaluations, and one-on-one discussions with students. Institutions should listen to student voices, address concerns and suggestions, and make changes as needed to enhance the overall student experience.

The quality student experience is essential for creating a positive, supportive, and enriching learning environment where students feel engaged, motivated, and empowered to achieve their educational and career goals. By prioritizing student well-being, engagement, and success, institutions can create a culture of excellence and cultivate lifelong learners who are prepared to thrive in a rapidly changing world.

8-Quality of Industry Partnerships: The quality of industry partnerships in vocational education programs is crucial for providing students with valuable real-world experiences, enhancing their learning outcomes, and preparing them for successful careers. The factor depends upon 4 aspects:

8.1. Real-World Experiences: Industry partnerships allow vocational education programs to offer students opportunities to engage in real-world experiences, such as internships, co-op programs, apprenticeships, and industry-based projects. Through these experiences, students gain hands-on exposure to industry practices, workflows, technologies, and workplace cultures, which complement their classroom learning and help them develop practical skills and competencies valued by employers.

8.2. Industry-Relevant Curriculum: Collaborating with businesses, industries, and community organizations ensures that vocational education programs maintain relevance and alignment with current industry needs, trends, and best practices. Industry partners provide input, feedback, and expertise to help shape the curriculum, update course content, and integrate industry-specific skills and competencies into the program offerings. This ensures that graduates are well-prepared and equipped to meet the demands of the workforce upon completion of their studies.

8.3. Internship and Job Placement Opportunities: Industry partnerships facilitate the provision of internship and job placement opportunities for students, enabling them to gain valuable work experience, build professional networks, and explore career pathways in their chosen fields. Industry partners may offer internships, cooperative education programs, or entry-level positions to students, providing them with valuable

exposure to the workplace environment and potential employment opportunities upon graduation. Collaborating with industry partners enhances students' career readiness by providing them with practical insights, industry connections, and career development opportunities. Students gain a better understanding of industry expectations, requirements, and pathways, which helps them make informed decisions about their career goals and aspirations. Industry partnerships also help students develop essential employability skills, such as communication, teamwork, problem-solving, and adaptability, which are highly valued by employers.

8.4. Relationship with the Community and the District: Relationship with the community and the district should enrich the cultural, humanitarian experiences that the students share. The industry partners should become valuable stakeholders and advocates for vocational education, supporting program initiatives, promoting student success, and contributing to the economic development and prosperity of the community. Additionally, this factor may be fulfilled by the help of industry partners to create opportunities for community engagement, outreach, and involvement in vocational education initiatives, such as advisory boards, guest lectures, mentorship programs, and career fairs. This aspect can also be done with the cooperation of the local, civil organisations. By leveraging the expertise, resources, and opportunities provided by industry partners, vocational education programs can deliver high-quality education that meets the needs of students, employers, and society as a whole.

2-INSTRUCTIONAL TECHNIQUES BEHIND THE TVET CURRICULUM?

In Technical and Vocational Education and Training (TVET), several fundamental instructional techniques are commonly employed to effectively deliver practical, hands-on learning experiences that prepare students for careers in various technical fields. Here are some fundamental instructional techniques used in TVET:

Hands-on Learning: TVET emphasizes hands-on learning, where students actively engage in practical activities, experiments, simulations, and projects related to their chosen vocational fields. This approach allows students to develop technical skills, problem-solving abilities, and critical thinking skills through direct experience and application.

-Hands-on learning encourages students to actively participate in the learning process by engaging in practical activities, experiments, demonstrations, and projects. Instead of passively receiving information through lectures or readings, students actively manipulate objects, perform tasks, and interact with their environment to acquire knowledge and skills.

-Hands-on learning provides students with direct, firsthand experience of technical concepts, procedures, and applications. Rather than learning solely from textbooks or theoretical explanations, students gain experiential knowledge by working with physical objects, conducting experiments, and troubleshooting real-world problems.

-Hands-on learning enables students to apply theoretical knowledge to real-world situations and contexts. By engaging in hands-on activities, students gain practical experience and develop the skills necessary to perform tasks, solve problems, and complete projects relevant to their vocational fields.

-Hands-on learning fosters the development of technical skills, manual dexterity, and hand-eye coordination essential for success in technical careers. Through repeated practice and hands-on experience, students refine their skills, gain confidence in their abilities, and master the techniques required to perform tasks effectively.

-Hands-on learning promotes critical thinking, problem-solving, and decision-making skills as students encounter challenges, errors, and unexpected outcomes during practical activities. By engaging in hands-on experimentation and troubleshooting, students learn to analyse problems, identify solutions, and adapt their approaches accordingly.

-Hands-on learning is inherently engaging and motivating for students, as it offers tangible, concrete experiences that capture their interest and curiosity. By actively participating in hands-on activities, students become more invested in their learning, develop a deeper understanding of concepts, and experience a sense of accomplishment and satisfaction from their achievements

-Hands-on learning helps bridge the gap between classroom learning and real-world applications by providing students with authentic, industry-relevant experiences. By working with actual equipment, tools, and materials used in their chosen vocations, students gain insight into the practical challenges, requirements, and expectations of the workplace

Work-Based Learning: Work-based learning integrates classroom instruction with on-the-job training experiences, such as internships, apprenticeships, cooperative education programs, and industry placements. Students gain valuable work experience, industry insights, and professional connections while applying theoretical knowledge in real-world settings.

-TVET programs often include laboratory and workshop sessions where students have access to specialized equipment, tools, and facilities to practice technical skills, conduct experiments, and complete hands-on projects. These sessions provide opportunities for students to develop proficiency in using industry-standard equipment and techniques.

-Instructors may conduct demonstrations and experiments to illustrate key concepts, principles, and procedures in technical subjects. This allows students to observe demonstrations, ask questions, and participate in hands-on activities to reinforce their understanding of theoretical concepts and practical applications.

-TVET programs may incorporate industry-relevant projects, assignments, and tasks that simulate real-world scenarios and challenges encountered in the workplace. Students work individually or in teams to design, develop, and implement solutions to practical problems, thereby gaining practical experience and building portfolio-worthy projects.

Problem-Based Learning: Problem-based learning involves presenting students with authentic, real-world problems or challenges related to their vocational fields and guiding them through the process of solving these problems collaboratively. This approach encourages critical thinking, teamwork, and creative problem-solving skills while addressing practical issues encountered in the workplace.

-TVET instructors often use interactive instructional methods, such as group discussions, case studies, role-playing exercises, and peer-to-peer learning activities, to engage students actively in the learning process. These methods encourage participation, collaboration, and knowledge sharing among students while fostering a supportive learning environment.

-TVET instruction may leverage multimedia resources, technology tools, and e-learning platforms to enhance teaching and learning experiences. This may include interactive multimedia presentations, virtual simulations, online tutorials, and computer-based training modules that provide additional resources and support for students' learning.

Active Learning: Active learning is an instructional approach that emphasizes student engagement, participation, and involvement in the learning process. In active learning, students take an active role in constructing their understanding of concepts, solving problems, and applying knowledge through a variety of interactive and experiential activities. Here's a detailed explanation of the instructional approaches that active learning uses:

-Active learning shifts the focus of instruction from the teacher to the student, placing greater emphasis on learners' active involvement and responsibility for their learning. Rather than passively receiving information through lectures or readings, students actively engage with course content, materials, and tasks, which promotes deeper understanding and retention. **(Student-Centred Approach)**

-Active learning involves a diverse range of interactive learning activities designed to engage students in meaningful ways. These activities may include group discussions, debates, peer teaching, case studies, problem-solving exercises, simulations, role-playing, and collaborative projects. Through active participation in these activities, students develop critical thinking, communication, and teamwork skills. **(Interactive Learning Activities)**

-Active learning provides students with opportunities for experiential learning, where they gain firsthand experience through hands-on activities, experiments, demonstrations, and real-world applications. Experiential learning allows students to explore concepts, test hypotheses, and make connections between theory and practice, which enhances their understanding and retention of knowledge. **(Experiential Learning Opportunities)**

-Active learning often incorporates inquiry-based learning approaches, where students are encouraged to ask questions, seek answers, and explore topics independently. By posing questions, conducting research, and investigating solutions, students become active participants in the learning process and develop a sense of curiosity, discovery, and ownership of their learning. (**Inquiry-Based Learning)**

-Active learning encourages students to reflect on their learning experiences, think critically about their thinking (metacognition), and assess their understanding of concepts

and skills. Through reflection, students consolidate their learning, identify areas for improvement, and set goals for future learning, which enhances their self-awareness and self-regulation as learners. **(Reflection and Metacognition)**

-Active learning often leverages technology tools and resources to enhance engagement and interactivity in the learning environment. This may include multimedia presentations, online discussions, interactive simulations, virtual labs, and educational games that provide students with dynamic and immersive learning experiences. **(Technology Integration)**

-Active learning emphasizes timely and constructive feedback to guide students' learning progress and inform their next steps. Instructors provide feedback on students' participation, performance, and understanding of concepts, which helps students identify strengths and weaknesses and adjust their learning strategies accordingly. (**Feedback and Assessment)**

By employing these fundamental instructional techniques, TVET programs can effectively prepare students for success in their chosen technical fields by providing practical, hands-on learning experiences that are relevant, engaging, and aligned with industry needs and standards.

Please answer the questions of Session#1 in Workbook1

MODULE 1
QUALITY & QUALITY CONTROL

CHAPTER 1-BIRTH OF QUALITY

1.1-INTRODUCTION

Ensuring maximum customer satisfaction stands as a paramount necessity for anything done, given, bought, or sold in the financial world. Hence, it is imperative for products and services to meet customer expectations to enhance their market share. Whenever customers engage in product purchases, they find themselves assessing its worth. They are faced with a decision to proceed with the purchase or refrain from it. The operational aspect of quality entails ensuring that products or services are manufactured or produced in accordance with tailored specifications corresponding to their prices. Only through effective operational procedures that adhere to standards can customers receive the anticipated value from the product or service.

So, what kind of a collective understanding urges customers to decide upon purchasing that product or service?

This collective understanding is called quality.

Quality embodies the anticipated level of service being realized. Prior to making a purchase, customers engage in an evaluation process to ascertain the product's or service's worth, pondering over whether the value matches the monetary exchange they are about to make. For this reason, quality is essentially the perception that a customer holds upon receiving a product or service.

Marketing and sales play a pivotal role in shaping customers' opinions and their perception of quality, largely contingent upon the product's standards and quality. However, quality does not solely hinge on the efforts of the operations or manufacturing team. Customer expectations also has an influence over the quality of a product or service.

It is for sure that neglecting customer expectations or preferences shall result in low demand and poor sales performance. Additionally, disregarding customer feedback and preferences can lead to a disconnection between the producer and the target market, making it difficult to build brand loyalty and retain customers. Without insights into customer preferences, producers shall struggle to identify opportunities for improvement or to create innovative solutions that resonate with their target audience. The producers shall risk losing market share, damaging their brand reputation, and missing out on valuable opportunities for growth and success in an increasingly competitive marketplace. It is therefore essential for producers to prioritize customer-centricity and actively engage with their target audience to ensure that their products and services meet and exceed customer expectations.

Since quality is the effect of a certain customer’s view on something as they receive it, customers indulge themselves in comparing the received product with their own expectation for that particular product/service. This is regardless of the manufacturer’s perception of quality for that product/service. Customer dissatisfaction ensues when the delivered product fails to meet the promises made by the sales and marketing teams, indicating a lack of quality. Consequently, this discrepancy exacerbates the divide between the operations or manufacturing team and the sales and marketing team. So, customer expectations should be

fulfilled by the quality of the product or service. Customers also expect that product they are purchasing should be as they want, and the service should be properly carried out by an authentic dealer from where he purchased the product.

1.2-THE DEFINITION OF QUALITY

Thus, the definition of quality is “Ensuring customer satisfaction and loyalty.” Hence, Quality can be defined in various ways, but among many meanings of the word “quality,” two are of critical importance to managing for quality:

-Quality means those features of products which meet customer needs and thereby provide customer satisfaction. In this sense, the meaning of quality is oriented to income. The purpose of such higher quality is to provide greater customer satisfaction and, one hopes, to increase income. However, providing more and/or better-quality features usually requires an investment and hence usually involves increases in costs. Higher quality in this sense usually “costs more.”

-Quality means freedom from deficiencies-freedom from errors that require doing workover again (rework) or that result in field failures, customer dissatisfaction, customer claims, and so on. In this sense, the meaning of quality is oriented to costs, and higher quality usually “costs less.”[1]

Other definitions of Quality:

-Quality is defined as degree of excellence.

-Executing tasks correctly and efficiently.

-Delivering a product that meets its intended purpose.

-Offering a product with acceptable quality at a reasonable cost.

-Establishing a standard acceptable to both suppliers and customers.

-Incorporating all features or characteristics of a product contributing to its ability to fulfill a specific need.

-Demonstrating fitness for use.

-A quality process or product is fit for its purpose.

-In manufacturing, a measure of excellence or a state of being free from defects and deficiencies is called “quality.”

-According to Crosby (1979) “Quality is conformance to requirements/specifications[2].”

This is an ideal definition for quality control teams that need to validate processes, systems, services, and product quality. Depending on the requirements, they can easily validate compliance and identify nonconformities. The problematic part of this definition is that it can offer a biased and subjective view of quality. In many cases, the requirements are little more than the ideas of the business stakeholders. Often there is no objective validation that these ideas give a quality result.

[1] Badr Eldin, A. I. (2011) *IA-Quality - General Concepts and Definitions*. Available from: https://www.researchgate.net/publication/221919328_IA-Quality_-_General_Concepts_and_Definitions#fullTextFileContent [accessed Apr 14 2024].
[2] Crosby, P. B. (1979). *Quality Is Free: The Art of Making Quality Certain* (Vol. 94). McGraw-Hill, New York.

-Deming stated that the definition of quality is "meeting or exceeding customer expectations[3]."

-According to Juran (1979) "Quality is a measure of fitness for use[4]."

-In the mathematical method, quality is defined as the ratio of performance to expectation.

$$\text{Quality}\,(Q) = \frac{\text{Performance}\,(P)}{\text{Expectation}\,(E)}$$

Case1. If, $P > E$ it means quality is best
Case2. If, $P = E$ it means quality is good
Case3. If, $P < E$ it means quality is worst

-QUALITY also stands for

Q = Quest for excellence
U = Understanding customers' needs
A = Action to achieve customer appreciation
L = Leadership
I = Involving all people
T = Team spirit for common goal
Y = Yardstick to measure progress[5]

-Quality is price.

It is the price that customers might be willing to pay for a product or a service. Quality is a crucial part of many business models. Different definitions of quality have been put forth by economists. According to some economists, quality is synonymous with the expensiveness of the product. In other words, the bigger the price of the product, the higher would be its quality.

-Quality is a satisfying experience.

As savings moved from one product to another, marketers looked for quality definitions that would explain why customers buy services.

1.3-THE CONCEPT OF QUALITY

The concept of quality is multifaceted and can be interpreted in various ways depending on the context, industry, and stakeholders involved. At its core, quality refers to the degree of excellence or superiority inherent in a product, service, process, or experience. It encompasses several dimensions and attributes that contribute to overall satisfaction, value, and effectiveness. Here are some key aspects of the concept of quality:

1.Fitness for Purpose: Quality entails meeting or exceeding the requirements, needs, and expectations of customers or stakeholders. A product or service is considered of high quality if it performs its intended function reliably, efficiently, and effectively. Fundamental aspect of quality is the ability of a product or service to be fit for the intended purpose.

1.1-Alignment with Requirements: Fitness for purpose entails aligning the characteristics, features, and performance of a product or service with the specific requirements, specifications, and purposes for which it was designed or intended. This

[3] Deming, W. E. (1981). Improvement of quality and productivity through action by management. *National Productivity Review*, *1*(1), 12–22.
[4] Juran, J. M. (1979). *Quality Control Handbook*, 3rd edn. McGraw-Hill, New York, 5–12.
[5] Luthra S, Garg D, Agarwal A & Mangla SK (2021) Total Quality Management (TQM) CRC Press, Boca Raton.

involves understanding the functional, performance, and usability requirements of users and ensuring that the product or service effectively addresses those needs.

1.2-Functionality and Performance: A product or service is considered fit for purpose if it possesses the necessary functionality and performance capabilities to accomplish its intended tasks, functions, or goals. This includes factors such as reliability, accuracy, speed, efficiency, and compatibility with other systems or components.

1.3-User-Centric Design: Fitness for purpose requires a user-centric approach to design and development, where the needs, preferences, and capabilities of end-users are carefully considered and incorporated into the product or service design. User research, usability testing, and feedback mechanisms are essential tools for ensuring that the product or service meets user needs and expectations.

1.4-Contextual Relevance: Fitness for purpose also considers the context in which the product or service will be used, including the environment, conditions, and constraints that may impact its performance or usability. Products or services must be designed and tested to function effectively in real-world scenarios and conditions relevant to their intended use.

In some cases, fitness for purpose may require products or services to be adaptable and flexible, capable of accommodating diverse user needs, preferences, and usage scenarios. This may involve providing customization options, configurability, or interoperability with other systems to enhance versatility and utility.

2.Meeting Specifications: Quality involves adhering to predefined standards, specifications, or criteria established by industry regulations, or organizational policies. Compliance with specifications ensures consistency, reliability, and interoperability of products and services. Meeting specifications is a critical aspect of quality management that focuses on ensuring that a product or service adheres to predefined standards, requirements, or criteria.

2.1-Established Standards: Meeting specifications involves aligning the attributes, features, and performance of a product or service with established standards, specifications, or criteria. These standards can be internal, set by the organization itself, or external, defined by industry regulations, international standards bodies, or customer expectations.

2.2-Compliance and Conformance: It entails verifying that the product or service meets all specified requirements and parameters, such as dimensions, materials, functionality, performance metrics, safety standards, and legal regulations. Compliance ensures that the product or service conforms to predefined norms and guidelines, reducing the risk of defects, errors, or non-compliance issues.

2.3-Quality Control Processes: Meeting specifications often involves implementing robust quality control processes throughout the product lifecycle, from design and development to manufacturing, testing, and delivery. Quality control measures, such as inspections, audits, testing procedures, and documentation reviews, are employed to verify compliance with specifications and identify any deviations or non-conformities.

2.4-Documentation and Traceability: It includes documenting and tracking all relevant specifications, requirements, and changes associated with the product or service. This documentation ensures transparency, accountability, and traceability throughout the production process, enabling stakeholders to monitor progress, assess performance, and address any deviations from specifications promptly.

3.Excellence and Superiority: Quality represents a commitment to excellence and superiority in all aspects of operations, including design, manufacturing, delivery, and customer service. It entails striving for perfection and consistently seeking ways to enhance performance, features, and value. Excellence and superiority refer to the pursuit of exceptional performance,

superiority, and distinction in products, services, processes, or organizational practices. Here's a detailed explanation:

3.1-Commitment to Excellence: Excellence involves a relentless commitment to achieving the highest standards of quality, performance, and customer satisfaction. It requires setting ambitious goals, fostering a culture of continuous improvement, and striving for excellence in all aspects of operations and service delivery.

3.2-Benchmarking and Best Practices: Pursuing excellence often entails benchmarking against industry leaders and adopting best practices from top-performing organizations. It involves studying competitors, market trends, and industry benchmarks to identify areas for improvement and emulate successful strategies, processes, or innovations that can elevate performance and competitiveness.

3.3-Innovation and Creativity: Excellence fosters a spirit of innovation, creativity, and risk-taking, where organizations encourage experimentation, exploration, and entrepreneurial thinking. It involves investing in research and development, fostering collaboration and idea-sharing, and creating an environment where new ideas can flourish and drive breakthroughs in products, services, or processes.

3.4-Customer-Centricity: Excellence is closely linked to customer-centricity, where organizations prioritize understanding and fulfilling customer needs, preferences, and expectations. It involves listening to customer feedback, anticipating future trends, and proactively innovating to deliver products, services, and experiences that exceed customer expectations and create lasting value.

3.5-Measurable Results: Excellence is a tangible outcome that can be measured, evaluated, and recognized. It involves defining key performance indicators (KPIs), tracking progress against goals, and celebrating achievements to reinforce a culture of excellence and motivate further improvement.

Excellence and superiority represent a commitment to surpassing expectations, driving innovation, and continuously raising the bar for performance, quality, and customer satisfaction. By embracing excellence as a core value and strategic imperative, organizations can differentiate themselves, build competitive advantage, and sustain long-term success in today's dynamic and competitive business environment.

4.Customer Satisfaction: Quality is closely linked to customer satisfaction and loyalty. It focuses on understanding and fulfilling customer needs, preferences, and expectations to deliver products and services that delight and exceed customer expectations. Customer satisfaction is a fundamental concept that emphasizes meeting or exceeding the expectations and requirements of customers.

4.1-Focus on Customer Needs: This factor places a strong emphasis on understanding and fulfilling customer needs, preferences, and expectations. It involves actively listening to customers, soliciting feedback, and incorporating customer input into product design, development, and service delivery processes.

4.2-Meeting Customer Requirements: It aims to ensure that products and services meet the specified requirements and standards set by customers. This involves aligning the features, performance, and quality attributes of products and services with the needs and expectations of target customer segments.

4.3-Delivering Value: Customer satisfaction is not solely about meeting technical specifications but also delivering value that exceeds the customer's perceived benefits relative to the price paid. It involves providing superior benefits, features, and experiences that justify the customer's investment and contribute to long-term loyalty and retention.

4.4-Continuous Improvement: It is a continuous process of improvement aimed at enhancing customer satisfaction and loyalty. It involves monitoring customer feedback,

analysing performance metrics, and identifying opportunities for improvement in products, services, and processes to better meet customer needs and expectations over time.

4.5-Quality of Service: Customer satisfaction emphasizes delivering high-quality service experiences that leave a positive impression on customers. This includes aspects such as responsiveness, reliability, professionalism, empathy, and attention to detail in customer interactions, inquiries, complaints handling, and problem resolution.

4.6-Customer Relationship Management: It involves building and nurturing strong relationships with customers based on trust, transparency, and mutual respect. It entails fostering open communication channels, anticipating customer needs, and proactively addressing issues to enhance satisfaction and loyalty.

4.7-Measuring Customer Satisfaction: Customer satisfaction utilizes various tools and techniques to measure and assess customer satisfaction levels objectively. This may include surveys, feedback forms, Net Promoter Score (NPS), customer satisfaction scores (CSAT), and other quantitative and qualitative methods to gauge customer perceptions and sentiments accurately.

This factor engages and motivates employees in delivering superior customer satisfaction. It involves investing in employee training, empowerment, and recognition programs to enable frontline staff to deliver exceptional service experiences that delight customers and foster loyalty.

5.Value Proposition: Quality involves providing customers with superior benefits, advantages, and experiences that justify their investment and contribute to long-term relationships and loyalty. Value proposition is a promise that articulates the unique value and benefits that a product, service, or offering provides to its target customers. It serves as a compelling reason why customers should choose a particular solution over competing alternatives. It serves as a strategic tool for organizations to differentiate their offerings, attract customers, and create sustainable competitive advantage in the marketplace. By clearly communicating the unique value and benefits of their products or services, organizations can effectively engage customers, drive purchase decisions, and build long-term relationships and loyalty.

5.1-Identification of Customer Needs: Value proposition begins with a deep understanding of the needs, challenges, and preferences of the target customer segment. By identifying and analysing customer pain points, desires, and unmet needs, organizations can develop solutions that address specific customer problems and deliver tangible benefits.

5.2-Unique Value Proposition: Value proposition highlights the distinctive features, attributes, or benefits that set a product or service apart from competitors. It emphasizes what makes the offering unique, relevant, and valuable to customers, positioning it as the preferred choice in the marketplace.

5.3-Customer-Centric Approach: Value proposition is customer-centric, focusing on meeting the needs and preferences of the target audience. It evolves based on customer feedback, market insights, and changes in customer preferences, ensuring that the offering remains relevant and compelling over time.

5.4-Alignment with Customer Values: Value proposition aligns with the values, beliefs, and aspirations of the target customer segment. It appeals to their emotions, motivations, and aspirations, creating an emotional connection and fostering loyalty and advocacy for the brand.

5.5-Clear and Compelling Message: Value proposition communicates the key benefits and value propositions of the offering in a clear, concise, and compelling manner. It uses simple language and resonates with the target audience, capturing their attention and motivating them to learn more or take action. A value proposition

addresses specific pain points or challenges faced by customers, demonstrating how the offering can alleviate these problems and improve their lives or businesses. It focuses on delivering meaningful solutions and outcomes that resonate with customer needs and priorities.

5.6-Tangible Benefits and Outcomes: Value proposition emphasizes the tangible benefits, outcomes, or results that customers can expect to achieve by using the product or service. It highlights the value proposition in terms of cost savings, efficiency gains, revenue growth, risk reduction, convenience, or other measurable metrics that demonstrate the value of the offering.

Value proposition places the product or service as a superior choice compared to competing alternatives in the market. It highlights the unique selling points, competitive advantages, and reasons why customers should choose the offering over rival products or services.

6.Reliability and Consistency: The reliability and consistency of products and services ensure that products perform consistently over time, under different conditions, and across various use cases without defects or deviations from expected performance levels. It refers to the ability of a product, service, or process to perform consistently and dependably over time, under various conditions, and across multiple instances.

6.1-Consistent Performance: Reliability and consistency entail delivering uniform and predictable performance across different situations, environments, and usage scenarios. It involves ensuring that the product or service consistently meets or exceeds specified standards, requirements, or expectations without significant fluctuations or deviations.

6.2-Dependability and Trustworthiness: Reliability emphasizes the dependability and trustworthiness of a product or service to perform as expected without unexpected failures, errors, or breakdowns. It involves instilling confidence and trust in customers, stakeholders, and users that the product or service will deliver consistent results over time.

6.3-Robustness and Resilience: Reliability involves designing products, services, and processes to be robust and resilient in the face of changing conditions, stresses, or challenges. It entails anticipating potential failure modes, mitigating risks, and implementing contingency plans to maintain performance and functionality in adverse situations.

6.4-Long-Term Performance: Reliability and consistency extend beyond short-term performance to encompass the long-term durability, stability, and sustainability of products, services, or processes. It involves designing for longevity, reliability-centred maintenance, and lifecycle management to ensure sustained performance and value over time.

6.5-Customer Satisfaction and Loyalty: Reliability and consistency are closely linked to customer satisfaction and loyalty. Consistently delivering reliable products or services that meet or exceed customer expectations fosters trust, satisfaction, and loyalty, leading to repeat purchases, and long-term relationships with customers.

Reliability and consistency are essential attributes of quality that ensure products, services, or processes perform consistently, dependably, and predictably over time, thereby instilling confidence, trust, and satisfaction in customers and stakeholders. Organizations that prioritize reliability and consistency can enhance their competitiveness, reputation, and success in the marketplace.

7.Continuous Improvement: Quality is a journey of continuous improvement and innovation. It involves fostering a culture of learning, feedback, and adaptation to identify opportunities for enhancement, address weaknesses, and drive ongoing progress and excellence. Continuous improvement, also known as continual improvement or continuous improvement process

(CIP), is a fundamental principle in quality management and organizational development. It involves ongoing efforts to enhance processes, products, services, or practices incrementally over time. Here's a detailed explanation of continuous improvement:

7.1-Iterative Approach: Continuous improvement is based on an iterative approach, where organizations systematically identify opportunities for improvement, implement changes, evaluate outcomes, and then repeat the process to make further refinements. It emphasizes a cycle of planning, implementing, measuring, and adjusting to drive ongoing progress and innovation.

7.2-Kaizen Philosophy: Continuous improvement is rooted in the Kaizen philosophy, which originated in Japan and emphasizes the importance of small, incremental changes made by all employees to improve efficiency, quality, and productivity. It involves empowering employees at all levels to identify problems, propose solutions, and participate in improvement initiatives.

7.3-Quality Management Systems: Continuous improvement is a core component of quality management systems such as Total Quality Management (TQM), Lean Six Sigma, and ISO 9001. These systems provide frameworks, methodologies, and tools for systematically identifying, analysing, and addressing opportunities for improvement to enhance organizational performance and customer satisfaction.

7.4-Data-Driven Decision Making: Continuous improvement relies on data-driven decision making, where organizations collect, analyse, and utilize data to identify trends, patterns, and areas for improvement. It involves using metrics, key performance indicators (KPIs), and feedback mechanisms to measure performance, track progress, and identify opportunities for optimization.

7.5-Employee Involvement and Engagement: Continuous improvement fosters a culture of employee involvement, empowerment, and engagement, where all members of the organization are encouraged to contribute ideas, provide feedback, and participate in improvement initiatives. It involves creating a supportive environment that values innovation, creativity, and collaboration.

7.6-Customer Focus: Continuous improvement is driven by a customer-centric mindset, where organizations prioritize understanding and fulfilling customer needs, preferences, and expectations. It involves soliciting customer feedback, identifying areas for improvement in products, services, or experiences, and implementing changes to enhance customer satisfaction and loyalty.

7.7-Lean Principles: Continuous improvement often incorporates Lean principles, which focus on eliminating waste, optimizing processes, and maximizing value for customers. It involves identifying and eliminating non-value-added activities, streamlining workflows, and improving efficiency to deliver higher quality products or services at lower costs.

7.8-Cultural Transformation: Continuous improvement requires a cultural transformation within organizations, where improvement becomes ingrained in the organizational DNA. It involves leadership commitment, employee training, communication, and recognition programs to promote a mindset of continuous learning, innovation, and excellence.

Continuous improvement is a dynamic and iterative process that drives organizational excellence, innovation, and competitiveness. By fostering a culture of continuous learning, adaptation, and improvement, organizations can achieve sustained success and meet the evolving needs and expectations of customers and stakeholders.

8.Risk Management: Quality includes managing risks and mitigating potential issues or failures that could compromise product performance, safety, or customer satisfaction. It involves proactive identification, assessment, and mitigation of risks throughout the product

lifecycle. Risk management involves identifying, assessing, mitigating, and monitoring risks that may impact the quality, performance, or success of products, services, or processes.

8.1-Identification of Risks: Risk management begins with identifying potential risks or threats that could affect the quality, safety, or compliance of products, services, or processes. This involves systematically analysing all aspects of the organization's operations, including design, development, manufacturing, testing, distribution, and use, to identify potential sources of risk.

8.2-Risk Assessment: Once risks are identified, they are assessed based on their likelihood of occurrence, potential impact, and severity. This involves quantifying and prioritizing risks based on factors such as probability, severity, detectability, and potential consequences to determine which risks pose the greatest threat to quality and require immediate attention.

8.3-Risk Mitigation Strategies: After assessing risks, mitigation strategies are developed to reduce or eliminate the likelihood and impact of identified risks. This may involve implementing preventive measures, controls, or safeguards to mitigate risks, such as improving processes, enhancing quality control measures, implementing redundancy or backup systems, or providing additional training or resources to employees.

8.4-Monitoring and Control: Risk management is an ongoing process that requires continuous monitoring and control to track the effectiveness of mitigation strategies and identify emerging risks. This involves establishing key performance indicators (KPIs), thresholds, or triggers to monitor risk levels, conducting regular audits, inspections, or assessments to identify deviations or non-conformities, and taking corrective action as needed to address issues and maintain compliance with quality standards.

8.5-Documentation and Reporting: Risk management involves documenting all aspects of the risk management process, including risk identification, assessment, mitigation strategies, and monitoring activities. This documentation provides a comprehensive record of risks and their management, facilitates communication and collaboration among stakeholders, and ensures transparency and accountability in decision-making.

8.6-Continuous Improvement: Finally, risk management is a continuous process that requires ongoing evaluation, review, and improvement to adapt to changing circumstances, emerging risks, and lessons learned from past experiences. This involves conducting post-implementation reviews, analysing root causes of issues or failures, and implementing corrective actions to prevent recurrence and enhance the effectiveness of risk management practices.

Risk management is essential for ensuring the quality, safety, and compliance of products, services, or processes by systematically identifying, assessing, mitigating, and monitoring risks throughout the product lifecycle. By proactively managing risks, organizations can minimize disruptions, protect their reputation, and enhance customer satisfaction and trust.

The concept of quality is dynamic, holistic, and multifaceted, encompassing various dimensions, perspectives, and stakeholders' interests. It represents a commitment to excellence, customer satisfaction, and continuous improvement in all aspects of business operations and product/service delivery.

Please make the puzzles in Session#2 in Workbook1

MODULE 1
QUALITY & QUALITY CONTROL

CHAPTER 1-BIRTH OF QUALITY

1.4- DIMENSIONS OF QUALITY

In his influential work "What Does 'Product Quality' Really Mean?" published in the Harvard Business Review in 1984, David A. Garvin proposed eight dimensions to define and measure quality. These dimensions are:

1-Performance: This dimension refers to the primary operating characteristics of a product or service, including its main functions and features. Performance quality answers the question, "How well does the product or service perform its intended function?"

2-Features: Features pertain to the additional characteristics or attributes of a product or service beyond its basic function. These may include secondary functions, added benefits, or enhancements that differentiate the product or service from others in the market. The tendency of customers is usually to go for a product with more and more value-added features. This can go beyond the basic criteria to enter the market. Characteristics are also the fundamental dimension of product quality. A feature can also be defined as an additional or secondary attached feature and complements the main function of a product. An example of a car provides clarity, where the stereo of the car can be considered as a feature and the main function of the car remains transport.

3-Reliability: Reliability concerns the consistency and dependability of a product or service's performance over time and under various conditions. It reflects the likelihood of the product or service to function as intended without failure or breakdown.

4-Conformance to Standards: Conformance refers to the degree to which a product or service meets established standards, specifications, or requirements. It assesses whether the product or service conforms to predefined criteria or expectations. Compliance with standards is also a fundamental dimension of quality. Conformance to quality provides the standard for value.

5-Durability: Durability evaluates the longevity and resistance to wear and tear of a product or service over its lifespan. It measures the ability of the product or service to withstand repeated use or exposure to adverse conditions without deterioration. Durability is the effective life or longevity of the product before it is declared unusable. Repair is not possible after this phase of life. This means that when the product is not sustainable, it completes its useful life.

6-Serviceability: Serviceability relates to the ease, speed, and cost-effectiveness of maintenance, repair, and support for a product or service. It assesses the accessibility of service and the efficiency of resolving issues or addressing customer needs. This is the ability to provide a service to customers. The customer's opinion of quality is also influenced by the speed and economic profitability of a routine maintenance activity. Show how much your company is serious about your product services. For example: a) time taken to rectify an error in a credit card statement issued by a bank? b) time to correct an error in your Aadhar card statement (UIP) by the service provider?

7-Aesthetics: Aesthetics refers to the sensory appeal or attractiveness of a product or service, including its design, appearance, and style. It considers the visual, tactile, and auditory elements that contribute to the overall impression and appeal of the product or service. This concerns the visual appearance or the appearance of the product, often taking into account factors such as model, colour, style, packaging, tactile characteristics, and other sensory characteristics. For example, when I want to buy a car, I take into account all aspects of aesthetics.

8-Perceived Quality: Perceived quality encompasses the customer's subjective perceptions, impressions, and beliefs about the quality of a product or service. It reflects the reputation, brand image, and customer satisfaction associated with the product or service based on past experiences, word of mouth, and marketing communications. This signifies the reaction of a customer after the use of the product and/or service. The product must have a perceived quality that enhances customer satisfaction. This dimension is directly affected by any product failure that is highly visible to the public or by the way the service is delivered to the customer when a product quality issue is resolved. Customer loyalty and brand loyalty are closely tied to perceived quality. For example, if an airline is usually late and often loses baggage in transit, then in such a scenario, a frequent flyer might not prefer that airline to travel and would rather take up another airline which provides better facilities in terms of punctuality and safe transit of the checked-in baggage. The reason here can be linked clearly to the perceived quality. The loyalty here is clearly linked to the quality provided by the airline and so perceived by the flyer. Therefore, it will qualify this very small dimension for the said operator, which also decreases its market in this area.

1.5-HISTORY OF QUALITY

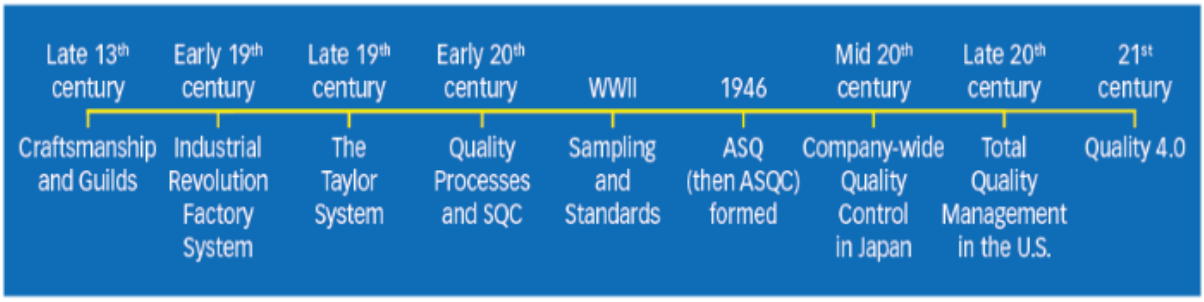


Figure 1.1-Timeline of quality[6]

Ensuring maximum customer satisfaction stands as a paramount necessity for anything done, given, bought, or sold in the financial world. Therefore, in order for a company to increase its market share, it must ensure that its products and services meet customer expectations or needs. The reason for this is that companies are aware of the importance of customers' decision about whether the product is worth the money they will spend to buy whenever they engage in purchasing decision. If it is worth it they are faced with the decision to proceed with the purchase. If not, they refrain from doing so. This is the vital role of the customers' expectations over the product or service. Therefore, the operational dimension of quality reveals the worthiness of products or services are produced in accordance with customer expectations or needs.

The history of quality was also related with the worthiness of the product or service in the ancient civilizations where craftsmen and artisans took pride in their workmanship and strived to produce goods of the highest quality. In ancient Egypt, for example, strict quality control measures were implemented in the construction of monumental structures such as the pyramids, ensuring precision and durability in every aspect of their design and construction.

[6] https://asq.org/quality-resources/history-of-quality

Similarly, in ancient Greece, philosophers such as Plato and Aristotle emphasized the importance of excellence and craftsmanship in the production of goods, laying the foundation for early quality management principles.

Craftsmanship and Guilds

The late 13th century craftsmen began organizing into associations known as guilds, which played a crucial role in establishing rigorous standards for the quality of products and services. Oversight committees within the guilds were tasked with ensuring compliance with these standards, often by affixing a special mark or symbol to flawless goods. In addition to the guild-imposed marks, craftsmen themselves began using secondary marks on their products. Initially, these marks were intended to identify the source of any defective items. However, over time, these marks evolved to symbolize the reputation of the craftsmen themselves. Both the inspection marks imposed by guilds and the individual craftsmen's marks served as tangible evidence of quality for consumers across medieval Europe. This system of quality control remained prevalent until the onset of the Industrial Revolution in the early 19th century. With the advent of mass production and mechanized manufacturing processes, the traditional guild-based approach to ensuring quality gradually gave way to new methods and standards. Nonetheless, the guilds' emphasis on quality and reputation laid the groundwork for subsequent developments in quality management and the modern quality movement.

The Turkish Ahi Organization was a professional organization that understood the importance of quality during the Middle Ages and took pioneering steps in this regard. Ahi Order has made significant contributions to determining quality standards, protecting professional ethics and developing a culture of solidarity among artisans. This organization was a professional organization formed by tradesmen and craftsmen in Anatolia and other Turkish regions in the Middle Ages and played an important role in issues such as regulation of economic activities, professional ethics and solidarity.

The origins of the Ahiism date back to the Seljuk and Anatolian Seljuk periods, but it experienced its brightest period during the Turkmen principalities established in Anatolia and the Ottoman Empire. Ahi Order not only supervised vocational training and production processes, but also contributed to determining quality standards. Ahiism encouraged its members to maintain high quality in production processes and ensure customer satisfaction. This has made the products famous for their durability, aesthetic value and quality of workmanship, especially among the craftsmen who adhere to the rules and principles of Ahiism. Members of the Ahi organization supported each other, helped in emergencies and shared their professional knowledge and experiences. The importance given to quality by the Ahi Order and the principles it implements are similar to today's quality management principles. As a result, the past experiences of the Ahi Organization are considered an important reference point in understanding and developing today's quality management practices.

The Industrial Revolution-Factory System

Until the early 19th century, manufacturing in the industrialized world predominantly favoured the craftsmanship model originating from medieval Europe. This model emphasized meticulous attention to detail and quality by individual craftsmen. On the other hand, the factory system in Great Britain in the mid-1750s marked a significant shift in specialization of tasks, dividing craftsmen's trades into specialized roles within large-scale production facilities. Later in the early 1800s, the Industrial Revolution propelled a massive transformation with many factories emerging causing manufacturing processes become mechanized. Although during this transformation, guilds tried to set and enforce their quality standards with flawless goods and detailed craftsmanship, they could not prevent inevitable. Quality assurance in this modern system relied on the skill of labourers, supplemented by audits and inspections, with defective products being either reworked or discarded. Pioneers such as **Eli Whitney** and **Frederick Winslow Taylor** played key roles in developing early Quality Management Techniques aimed at standardizing processes and improving efficiency in production.

The Taylor System

In the United States during the early 19th century, manufacturing continued to mirror the craftsmanship model prevalent in Europe. Craftsmen maintained a strong personal stake in meeting customers' quality needs, as failure to do so risked losing valuable clientele. Masters upheld quality control by inspecting goods before sale, ensuring high standards were met. However, the late 19th century saw a departure from traditional European practices with the adoption of Taylor's management approach. **Frederick Winslow Taylor** (1856–1915) was an American mechanical engineer and a management theorist. Taylor's time and motion studies in the 1920s revolutionized the way industries approached productivity and efficiency. Since he contributed his efforts to the growth of industrial management, he is often regarded as the father of scientific management. In fact, Taylor's main concern was to increase production efficiency, not only to reduce costs and increase profits, but also to increase workers' wages through increased productivity. Taylor aimed to increase productivity without relying on skilled craftsmen, instead assigning specialised engineers for factory planning. In Taylor's factories, craftsmen and supervisors transitioned into inspectors and managers, executing plans devised by engineers. The fundamental principles that Taylor saw underlying the scientific approach to management may be summarised as follows:

1. Replace the working methods of the golden rule with methods based on a scientific study of tasks.
2. Select and train each of the workers scientifically instead of promoting passive training.
3. Cooperation is required for ensuring the implementation of scientifically developed methods.
4. Dividing the work among workers and managers such that the managers are able to use the principles of scientific management for planning of the work, while workers execute the assigned tasks.

Taylor was a proponent of productivity and wages based on productivity achieved by the workers. He focused on the study of time and motion and other techniques for measuring work. His ideas were humanistic, with the thought of protecting the interests of every employee of the firm by ensuring harmony among the different stakeholders. While Taylor's system led to significant increases in productivity, it came at the expense of quality. The newfound emphasis on productivity overshadowed concerns for quality, resulting in a decline in product standards. To address this decline, inspection departments were established within factories to prevent defective products from reaching customers, marking a pivotal moment in the evolution of quality practices in manufacturing.

The Quality processes

The history of quality is rich with contributions from pioneering individuals who shaped the discipline through their innovative ideas and methodologies like **William Sealy Gosset** (1876-1937), also known as "Student," who made significant contributions to statistical control with his development of the Student's T-distribution, which is a key component of Statistical Process Control(SPC), which refers to a set of techniques used to monitor and control processes to ensure they operate consistently and meet quality standards. Gosset worked as a statistician for the Guinness brewery in the early 20th century. He recognized the limitations of using normal distribution tables for small sample sizes in statistical analysis. To address this issue, he set out to develop a more accurate probability distribution for small samples. In 1908, Gosset introduced what became known as the Student's T-distribution. This distribution is similar to the normal distribution but is better suited for small sample sizes and situations where the population standard deviation is unknown. The T-distribution accounts for the variability inherent in small samples, providing more accurate confidence intervals and hypothesis tests. The development of the Student's T-distribution revolutionized statistical analysis, particularly in quality control and process improvement. By providing a more accurate probability distribution for small samples, Gosset's work enabled practitioners to make more reliable

inferences about process performance and quality. In the context of statistical control, the T-distribution is used to calculate control limits and assess process stability. Gosset's development of the Student's T-distribution paved the way for more accurate and reliable statistical analysis, particularly in quality control and process improvement. His work remains foundational to the field of statistics and continues to be widely used in various industries to ensure processes operate within specified quality parameters.

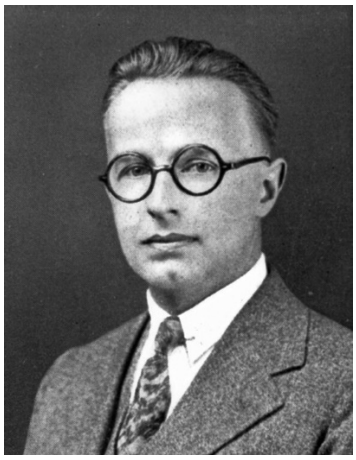


Figure 1.2- Photograph of Walter A. Shewhart in 1926[7]

Sampling and Standards in WWII

During World War II, the United States implemented legislation aimed at aligning the civilian economy with military production demands. This period saw quality emerge as a pivotal aspect of the war effort, with safety considerations gaining paramount importance. The impermissibility of unsafe military equipment underscored the necessity for stringent quality measures, leading to extensive inspections of virtually every unit produced to ensure operational safety. However, the sheer scale of this inspection process posed challenges in recruiting and retaining competent inspection personnel. To address these challenges without compromising safety standards, the armed forces transitioned from unit-by-unit inspection to sampling inspection. Collaborating with industry consultants, notably from **Bell Laboratories**, they adapted sampling tables and formalized them into a military standard known as **Mil-Std-105**. These standardized tables were integrated into military contracts, providing suppliers with clear guidelines regarding production expectations. Furthermore, the armed forces facilitated quality improvement among suppliers by sponsoring training programs focused on Walter Shewhart's statistical quality control (SQC) techniques. These initiatives aimed to equip suppliers with the necessary tools and knowledge to enhance their quality management practices and meet the rigorous standards set by military contracts.

Quality in the Early 20th Century

In the early 20th century, there was a significant shift in quality practices with the integration of "processes." A process refers to a series of activities that transform inputs into outputs while adding value. In the mid-1920s, **Walter Andrew Shewhart** (1891-1967), an American physicist and engineer, worked at Bell Laboratories on controlling processes which led to the development and invention of control charts. His studies went on to be recognised as benefitting manufacturing processes and used to support the production of munitions for World War II and in many other areas. This transition made quality not only applicable to the final product but also to the processes involved in its creation. In the 1920s, Shewhart developed the concept of statistical process control (SPC) to monitor and improve manufacturing processes. His groundbreaking work laid the foundation for modern quality control practices,

[7] Courtesy of AT&T Archives and History Centre. Reprinted with permission https://www.researchgate.net/publication/334143828_Information_in_an_Industrial_Culture_Walter_A_Shewhart_and_the_Evolution_of_the_Control_Chart_1917-1954/figures?lo=1

emphasizing the importance of statistical analysis in managing variation and achieving consistent product quality. Walter Shewhart, known by all as the “father of statistical process control”, became famous, not only for being the master of Deming, but especially for his contributions in the field of statistics and for having developed the theory of common and special causes of variations.

As the creator of Statistical Process Control (SPC), and the PDCA (Plan-Do-Check-Act) cycle, his ground-breaking work helped shape the methodologies and thinking that we use today in QI. It would be true to say that his ground-breaking work launched ‘Quality’ as a profession and that Shewhart created a ‘quality revolution’. Shewhart is also the originator of the PDCA cycle (Plan-Do-Check-Act) which we still use today. This was the precursor to the PDSA cycle (Plan-Do-Study-Act), which was developed from the PDCA cycle by W. Edwards Deming.

Both PDSA and PDCA methodologies are widely used for problem-solving and helping to create quality process improvements, using cyclical processes to measure and repeat while supporting an organisation-wide approach to improvement. The PDCA model was the pre-cursor to the PDSA model, but still a preferred method for many. The key difference being one stage in the cycle – the Check stage. This stage is where those working on the project assess whether what they intended to achieve has actually happened. At this point, practitioners would check expected results with the actual results. Therefore, PDCA encourages you to check during every cycle of the process.’

The Total Quality Management in Japan

The inception of total quality management in the United States was a direct response to Japan's quality revolution following World War II, during which major Japanese manufacturers shifted their focus from producing military goods for domestic use to manufacturing civilian goods for international trade. Initially, Japan faced a widespread reputation for producing inferior exports, leading to rejection by global markets. This prompted Japanese organizations to reassess their approach to quality. Japan welcomed insights from foreign companies and educators, particularly three American quality specialists:

W. Edwards Deming, one of these experts, went to Japan in 1949 and gave hundreds of quality seminars. Deming donated the copyrights of these seminars to the "Japanese Society of Engineers and Scientists" (JUSE). JUSE started to award the "Deming Quality Award" in honour of this expert with the income it earned from the seminars. It has been awarded to companies that have been successful in the field of Total Quality Management since 1951 and is the most important Quality award given all over the world.

The other quality experts who went to Japan and whose reputation has spread all over the world were **Dr. Juran** and **Dr. Feigenbaum**. In his seminars, Dr. Juran emphasized that quality was the "Responsibility of Management" and said that "Quality" was such a vital and fundamental factor that it could not be delegated to any department. Quality policy, philosophy and goals should have been determined by top management.

Joseph Moses Juran, who anticipated that the quality of Japanese goods would surpass that of American products by the mid-1970s due to Japan's remarkable pace of quality enhancement. **Armand V. Feigenbaum** first introduced the concept of Total Quality Control into literature. According to Feigenbaum, all functions (production, sales, supply, design, service...) affected quality. Japan's adoption of new strategies embodied the emerging concept of "total quality." Rather than solely relying on product inspection, Japanese manufacturers prioritized enhancing all organizational processes, empowering their workforce in the process. Consequently, Japan achieved higher-quality exports at competitive prices, benefiting consumers worldwide.

In 1962, Ishikava saw that quality improvement could only be achieved with the participation of all employees and introduced the concept of Quality Circles. He saw that quality improvement could be achieved through a group, not an individual. The Japanese quickly took

part in world trade; The long-term economic restructuring, which started by imitating the world leadership in the optics industry in the 1960s, the electronics industry in the 70s, and the automotive industry in the 80s, was replaced by a completely competitive economy that focused on the customer, ensured workforce efficiency, and with the quality trainings carried out all over the country.

American System for Total Quality Management

America, which won the war in 1946, quickly started producing products necessary for daily life. However, since most of the production was shifted to war needs during the 6-year war period, 4 years of which were spent actively, the reality was faced with the end of the war: "supply deficit". This condition had destroyed the quality concept that was intended to be established, quality was pushed to the background and the general objective turned into production in larger quantities. This is the reason for the 1950s and 60s, which are described as the Mass Production and Mass Consumption era in world industrial history.

U.S. manufacturers persisted in their belief that Japanese success stemmed primarily from pricing strategies. Consequently, they responded to Japanese competition by implementing tactics aimed at reducing domestic production costs and imposing import restrictions. Regrettably, these measures proved ineffective in enhancing American competitiveness in terms of quality. As time passed, the significance of price-based competition waned, while competition focused on quality continued to escalate. In response, CEOs of major U.S. corporations assumed a proactive role in championing the quality movement. This American approach, emphasizing comprehensive organizational strategies rather than mere statistical methods, came to be known as Total Quality Management (TQM).

Western countries, which only became aware of the developments in Japan in the early 80s, began to investigate the reasons for the Japanese miracle. American companies realized that the magic of the Japanese Quality Renaissance was first discovered and exploited in principle and practice in the United States. For example, Statistical Quality Control, which was used in American material companies during World War II, was developed by Edward Deming and Dr. Juran and was implemented in Japan in the early 1950s. And suddenly, large companies in the American industry began to implement these ideas. When Ford and General Motors, who quickly realized the importance of “Continuous Improvement” adopted the Deming philosophy into their companies, the change in quality began in the USA. The concept of the Quality Imperative developed and spread throughout America.

Subsequently, numerous other quality initiatives emerged. For example, in 1987, the ISO 9000 series of **Quality-Management Standards** was introduced. Concurrently, the U.S. Congress established the Baldrige National Quality Program and the prestigious Malcolm Baldrige National Quality Award. In 1988, the Malcolm Baldridge Quality Award began to be given to companies that were successful in Total Quality Management. Initially met with hesitation, American companies eventually recognized the importance of adopting these standards, integrating them into their quality management frameworks.

European System for Total Quality Management

The successes achieved by the Japanese forced the European Community countries to establish their own quality standards. Therefore, in 1979, representatives of various nations, including the United States, and a group from the International Standards Organization (ISO) came together and began codifying this set of conflicting standards.

The task of this committee was to define comprehensive quality standards for all companies. These standards should neither be so strict that only a few companies can achieve them, nor should they be so easy that any company can easily pass them. Thus, the ISO 9000 series gained validity and spread rapidly to all European countries. These standards are remarkable in that they include key elements of both Quality Control and quality assurance and are flexible to cover different businesses and products.

The studies carried out in the field of quality in Europe did not only stop there, the European Foundation for Quality Management (EFQM) was established in 1988 and the European Quality Award started to be given since 1991. The winners of this award, supported by the European Commission, are among the most successful organizations in Europe in providing business excellence.

Quality 4.0

As the 21st century begins, the quality movement has matured. New quality systems have evolved beyond the foundations laid by Deming, Juran, and the early Japanese practitioners of quality. Some examples of this maturation in Quality Management include:

-Most recently in 2015, the ISO 9001 standard was revised to increase emphasis on risk management.

-In 2000, the ISO 9000 series of quality management standards was revised to increase emphasis on customer satisfaction.

-Beginning in 1995, the Malcolm Baldrige National Quality Award added a business results criterion to its measures of applicant success.

-Six Sigma, a methodology developed by Motorola to improve its business processes by minimizing defects, evolved into an organizational approach that achieved breakthroughs and significant bottom-line results.

-Quality Function Deployment was developed by Dr. Yoji Akao as a process for focusing on customer wants or needs in the design or redesign of a product or service.

-Sector-specific versions of the ISO 9000 series of quality management standards were developed for such industries as automotive (QS-9000 and ISO/TS 16949), aerospace (AS9000) and telecommunications (TL 9000) and for environmental management (ISO 14000).

-Quality has moved beyond the manufacturing sector into such areas as service, healthcare, education, and government.

-The Malcolm Baldrige National Quality Award has added education and healthcare to its original categories: manufacturing, small business, and service. Many advocates are pressing for the adoption of a "nonprofit organization" category as well.

Quality 4.0 refers to the integration of advanced digital technologies into quality management processes to enhance efficiency, effectiveness, and innovation. It represents a paradigm shift in how quality is managed, leveraging the capabilities of Industry 4.0 technologies to drive continuous improvement and ensure product and service excellence.

At its core, Quality 4.0 builds upon the principles of traditional quality management while harnessing the power of emerging technologies such as artificial intelligence (AI), big data analytics, the Internet of Things (IoT), cloud computing, and advanced robotics. These technologies enable real-time data collection, analysis, and decision-making, providing organizations with deeper insights into their processes and products.

One key aspect of Quality 4.0 is predictive quality management, where data-driven analytics and AI algorithms are used to anticipate and prevent quality issues before they occur. By analysing historical data and identifying patterns, organizations can proactively address potential defects or deviations, minimizing risks and optimizing product quality.

Another important component of Quality 4.0 is the concept of interconnected quality ecosystems. This involves integrating quality management systems with other functions such as supply chain management, production, and customer relationship management. By connecting various stakeholders and processes, organizations can achieve end-to-end visibility and collaboration, facilitating faster decision-making and problem-solving.

Furthermore, Quality 4.0 emphasizes the importance of customer-centricity and personalized experiences. By leveraging data analytics and IoT sensors, organizations can gather real-time feedback from customers and incorporate their preferences into product design and service delivery. This enables organizations to tailor their offerings to meet evolving customer needs and expectations. Quality 4.0 represents a transformative approach to quality management, driven by digital technologies and data-driven insights. By embracing Quality 4.0 principles, organizations can improve operational efficiency, product quality, and customer satisfaction, ultimately driving competitive advantage in today's rapidly evolving business landscape.

Table.1.1-History of Quality

HISTORY OF QUALITY	
1700-1900	Quality was determined mostly by the personal efforts of the craftsmen.
1875	Frederick W. Taylor made the first application of more complex products and processes by dividing jobs into smaller and more easily done parts. Gilbreth and Gantt later contributed. The goal was productivity.
1900-1930	Henry Ford - the assembly plant - implemented more refined work methods to improve productivity and quality. He developed the concepts of error-free assembly, self-inspection and process inspection.
1901	The first standards laboratories were established in Great Britain.
1907-1908	AT&T began systematic inspection and testing of products and materials.
1908	W. S. Gosset introduced the T-distribution in his work at Guinness Beers.
1915-1919	WWI-British government started the “Supplier Certificate Programme”.
1919	"Technical Inspection Institution" was established in England. This institution later became the "Quality Assurance Institute".
1920s	AT&T Bell laboratories established quality departments to emphasize quality, inspection and testing, and product reliability.
	B.P.Dudding used statistical methods for quality control of electric light bulbs at General Electric in England.
1922-1923	R.A.Fisher has published a series of foundational papers on experimental design and applications in agronomy.
1924	W.A. Shewhart introduced the concept of control charts in their technical notes at Bell laboratories.
1924	Juran graduated as an engineer and participated in Western Electric Hawtrone studies.
1927	Deming learnt the concept of control charts from Shewhart at Bell Labs.
1928	Acceptable sampling methodology was developed and refined by H. F. Dodge and H.C. Roming at Bell laboratories.
1931	W.A. Shewhart published "Economic control of the quality of manufactured products" outlining the use of statistical methods in production and control chart methods.
1932	W.A. Shewhart taught statistical methods in production and control diagrams at the University of London.
1932-1933	The British textile and wood industry and the German chemical industry began to use experimental design for product/process development.
1933	The royal statistical institute established the "Department of Industrial and Agricultural Research".
1938	W.E. Deming invited Shewart to give seminars on control charts to the U.S. Department of Agriculture.
1940	The US War Department published a guide to the use of control charts in analysing process information.
1940-1943	Bell laboratories developed a military standard sampling plan for the US military.
1942	Ministry of supply and consultancy was established on statistical methods and quality control in Great Britain.
1942-1946	Quality control training courses were offered in industry and more than fifteen institutions were established in North America.
1944	"Industrial Quality Control" magazine started its publications.
	Feigenbaum began working on the quality of Jet engines at GE. Here he developed the "Total Quality Control" approach. He created the concept of "Cost of Poor Quality".
1946	The American Quality Control Institution was established by the merger of different quality institutions.
1946	Deming was invited to Japan by the Economic and Scientific Service of the American War Department to assist in reconstruction in Japan.
1946	The Union of Japanese engineers and scientists was established.
1946-1949	Deming was invited to give seminars on Statistical Quality Control in Japanese industry.

1948	Professor G. Taguchi started experimental design studies.
1950	Deming began training Japanese industrial managers, and the method of statistical quality control became prevalent in Japanese thought.
1950	Professor K.Ishikawa introduced “cause and effect diagrams”.
1950s	Classic tests in statistical quality control were introduced by Eugene Grant and A.J.Duncan.
1951	Dr. A.V.Feigenbaum published the first edition of his book “Total quality control”.
1951	JUSE established the Deming Prize to be awarded to those who excel in product control and quality methodology.
1951	G.E.P Box and K.B.Wilson published a fundamental study on the use of experimental design for process optimization. Thereafter, applications evolved steadily in the chemical industry.
1954	Dr Joseph M. Juran was invited to Japan to provide some quality improvement and management training.
1957	J.M.Juran and F.M.Gryna's "Quality Control Manual" was published for the first time.
1959	Technometrics (a statistical journal for physical, chemical and engineering sciences) was founded and its editor was J.Stuart Hunter.
1959	America's human spaceflight program informs industry about the need for reliable products, and reliability engineering evolves from there.
1960	G.E.P Box and J.S. Hunter; They wrote a basic paper on 2^{k-p} factorial design.
1961	The concept of Total Quality Circles was introduced in Japan by K.Ishikawa.
1960s	The International Council for Quality and Productivity was founded in Great Britain as a division of the British Productivity Council.
	Taguchi won the Deming prize for his work in statistical quality control. He won this award three more times for various reasons.
	Zero defect programs have been introduced in certain American industries.
1965	Crosby first started working at ITT in the USA as "Vice President of Quality".
1969	The publication of the "Industrial Quality Control" magazine stopped and was replaced by the "Quality process and Quality technology" magazine (Editor Dr. L.S. Nelson).
1970s	In Great Britain, NCQP and the "Quality Assurance Institute" merged to become the British Quality Institute (BSI).
1975-1978	Books on experimental design were oriented toward engineers and scientists.
	In North America, interest in “Quality Circles” began. This evolved into Total Quality Management.
1979	The Juran Institute was founded.
	Crosby began consulting on the theme of "Quality is Free".
1980s	The industrial design method was introduced and adapted by large organizations.
	Professor G.Taguchi's experimental design works were seen for the first time in America.
1984	The American Statistical Association (ASA) established the Ad Hoc committee on quality and efficiency. This later became a division of ASA.
1988	The Malcom Baldrige International Awards were established by the American Congress.
1989	“Quality Engineering” magazine was launched.
1990s	Interest in ISO 9000 certifications is growing in the American industry, Baldrige applicants are constantly increasing, and some sponsors are basing their quality awards on Baldrige criteria.

1.6- QUALITY HEROES

Throughout history, visionary leaders and their ground-breaking ideas have realised the evolution of Quality Management. They contributed to the organizations regarding policies, methods, tools, standards, and materials necessary to achieve excellence in quality. They are no doubt more in number, but this lesson will cover only the most important professionals:

DR. W. EDWARDS DEMING

Prior to World War II, American engineer **William R. Gorham** played a key role in setting up the first factories and promoted a distinctive manufacturing philosophy. After 1945 quality

control expert **W. Edwards Deming** (1900-1993) showed a passion for quality at a time when American automobile executives seemingly cared less. Deming was another influential figure in the history of quality management. He was an American statistician, engineer, and management consultant and played a pivotal role in post-World War II Japan's economic recovery by introducing his principles of Total Quality Management (TQM).

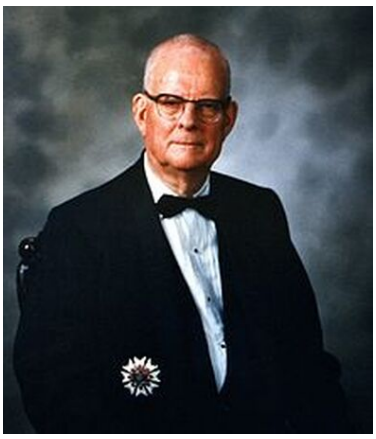


Figure 1.3- W. Edwards Deming[8].

Following World War II, the emphasis started on quality. The industries aimed to recover and reclaim their competitiveness on the global stage. The triumph of Japanese firms in delivering top-notch products at competitive rates piqued global interest in quality management methodologies, prompting the adoption of approaches like Lean, Six Sigma, and ISO standards across various sectors to enhance both quality and operational effectiveness. Japanese enterprises like Toyota with quality management ideologies, known as the Toyota Production System (TPS) was an example of this success.

Greater productivity leads to long-term competitiveness in the market which is a result of achieving higher quality in all the processes, as said by Dr Deming.

W. Edwards Deming formulated his famous **14 Points for Management** in the early 1980s. He first presented them in his book "Out of the Crisis," which was published in 1982. Deming's principles gained widespread recognition and influence, particularly in Japan and later in the United States, as organizations sought to improve their quality management practices. Deming's work significantly contributed to the development of Total Quality Management (TQM) and continues to shape quality management theory and practice to this day.

1. First, create reliability of purpose toward enhancement of product and service, with the aim of becoming competitive, remaining in business, and providing jobs.

2. Adopt the new philosophy. Western management must be stimulated by the challenge, must learn their responsibilities, and take on leadership for change.

3. End dependence on mass inspection; build quality into the product from the beginning.

4. End the practice of granting business on the basis of price tag alone. Instead, minimise total cost. Select based on a long-term connection of loyalty and trust.

5. Improve continuously and forever the system of production and service to improve quality and reduce waste.

6. Introduce training and retraining.

7. Institute leadership. The aim of observation should be to lead and aid people in discharging their duties better.

[8] Photo credit to: Wikipedia.org

8. Drive out fear so that everyone may work effectively for the company.

9. Remove the hurdles step-by-step between various departments like research, design, sales, and production to help them work cohesively, more as a group, to predict and solve problems in production.

10. Eliminate slogans, exhortations, and targets for the workforce, as they do not necessarily achieve their aims.

11. Eliminate numerical quotas in order to take account of quality and methods, rather than just numbers.

12. Remove barriers to pride of workmanship.

13. Introduce a dynamic programme of education and re-training for both the management and the workforce.

14. Management and workforce must work together.

Dr. Deming's best known 14-point theories were a part of his extensive knowledge system. Your knowledge and contribution to quality improves the growth of an organisation. Deming's knowledge system consisted of four theories, namely, theory of optimisation, variation, knowledge, and psychology.

Explanations of these four knowledge-based interrelated parts are given below.

Theory of optimisation

Deming's optimisation theory suggests optimisation for the entire system. The objective of an organisation or company is the optimisation of the entire system, which includes all the parts and not the optimisation of individual subsystems. The complete system includes all components: Customers, employees, suppliers, distributors, manufacturers, shareholders, community, and environment. The long-term goal of a company is to create a win–win situation for all its partners.

Theory of variation

Dr. Deming estimated that variation was a major cause of poor quality. This means a variation in a product belongs to poor built-in quality. In mechanical assemblies, for example, variations in the dimensional specifications of the parts can lead to more wear and tear and further result in premature failure and inconsistent performance. Dr. Deming emphasised and taught how to determine whether a process was in statistical control. Statistical process control with control charts was taught by Dr. Deming to observe the deviations in a process. His students also learned how to optimise the results of statistical process control.

Theory of knowledge

Deming believed that knowledge generation was possible only with theory and experience in conjunction. Thorough knowledge of the theory describes the system and provides experience after a long time. Its practice and subsequently its experience can describe that a theory can be validated with experience and on its own without experience cannot help in its administration. The theory on the other hand shows causality (Ishikawa diagram), is a beneficial tool for making predictions for the future. Unless the theory is understood in a contextually appropriate setting, benchmarking may lead to it affecting the overall performance causing a variety of problems.

Theory of psychology

A scientific study of psychology aids in understanding people and their interactions among themselves and others under different circumstances or conditions, and interactions within the hierarchy of any management system. Psychology connects the people that make up the management system. Therefore, people management requires knowledge of psychology. It also requires knowledge of what motivates people. With due motivation, they can

work more efficiently. Job satisfaction and motivation to excel are part of the need. Reward and recognition are extrinsic; it does not mean a need, but a motivation. Therefore, management must create the right combination of intrinsic and extrinsic factors to motivate employees.

The Deming Cycle

Shewhart invented the concept of Plan-Do-Check-Act (PDCA cycle). Deming later advocated for a systemic approach to quality management, focusing on reducing process variation through statistical process control (SPC). Deming's philosophy is often summarized by the PDCA (Plan-Do-Check-Act) cycle. This cycle provides the complete information of evaluation and basic ideas. An improvement idea needs testing on a smaller scale before it can be utilised for full-scale implementation. By doing small-scale testing, validation of its benefit is possible before large-scale implementation is undertaken. Furthermore, resistance from the employees is also reduced owing to more time being available for them to accept and adjust to the newer methods. This way it is more likely that employees will support such initiatives.

The Deming **PDCA Cycle** (Figure 1.5) provides opportunities for continuous evaluation and improvement.

The steps in the Deming PDCA or PDSA Cycle as shown here.

1. First step is to make a plan for an improvement causing change or test (P).

2. Second step is to do it (D). To conduct small-scale testing of the planned improvement change.

3. Third step is to check it (C). To check the effects arising from the conducted test. It is also called ‘study’ sometimes (S).

4. Next and last step is to act on learning from the first step (A).

5. Keep repeating Step 1, with knowledge generated from previous steps.

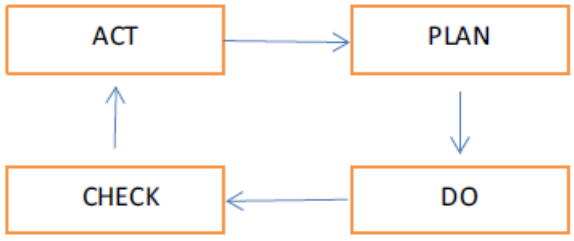


Figure 1.4- PDCA cycle[9]

DR. JOSEPH JURAN

Joseph Moses Juran (1904-2008), an American engineer and management consultant, is widely regarded as one of the important experts in Quality Management. His quality management approach is based on three key principles such as;

-the Pareto principle;

-quality management principles and;

-the Juran Trilogy.

[9] Luthra et al (2018) pg9

In the 1950s, Juran introduced the concept of the "Quality Trilogy" or “Juran Trilogy” which emphasized three key processes such as;

-Quality Planning;

-Quality Control, and;

-Quality Improvement.

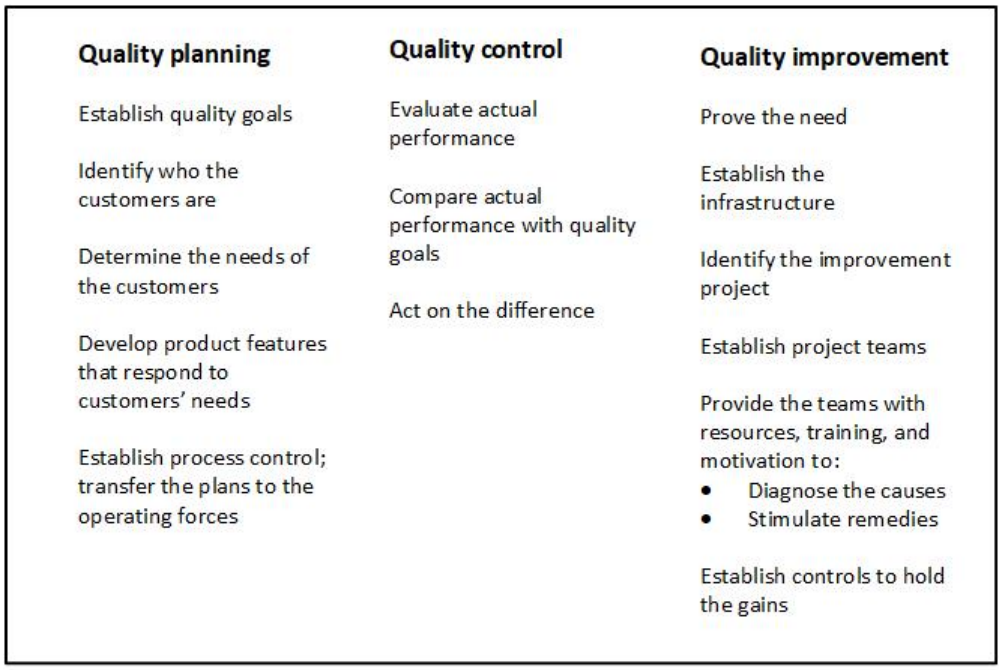


Figure 1.5-Juran Trilogy[10]

Juran's philosophy of "fitness for use" and his focus on empowering employees to take ownership of quality helped shape modern Quality Management principles and practices. In 1924 he went to work at Western Electric’s Hawthorne Works in the Complaint department, where he began to learn about quality control techniques, and he started to work on statistical sampling. Joseph Juran worked at Hawthorne Works till 1941. So, Shewhart and the pioneering work going on Western Electric at the time should have influenced his work. In 1941, Juran came across the work of economist Vilfredo Pareto, known as the Pareto Principle, (or as the 80/20 rule). Juran started applying the Pareto Principle to quality issues. He came up with the phrase: “the vital few and the trivial many” to demonstrate that a small percentage of causes can lead to a higher percentage of issues. ‘In later years, Juran preferred "the vital few and the useful many" to signal that the remaining 80% of the causes should not be totally ignored.’

[10] https://q.health.org.uk/blog-post/the-meaning-of-quality-and-the-juran-trilogy/

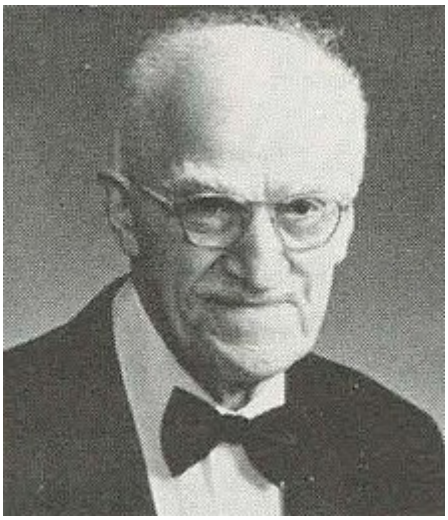


Figure 1.6- Joseph M. Juran[11]

Juran went on to teach quality control at New York University after the WWII and it was during this time that his work attracted attention in Japan. In 1954 Dr. Juran was invited to Japan by the Union of Japanese Scientists and Engineers to teach the principles of quality management as the economy recovered from World War II. Along with his colleague W. Edwards Deming, Juran would receive the Second Order of the Sacred Treasure award from the Emperor Hirohito of Japan.

Dr. Juran later published the lectures he gave in Japan in a book entitled: **The Managerial Breakthrough.** Dr. Joseph Juran founded the Juran Institute in 1979 with a mission to "create a global community of practice to empower organizations and people to push beyond their limits". Joseph Juran emphasized that quality should be managed like any other business function and stressed the importance of top management's commitment to quality.

PHILIP CROSBY

Philip Crosby (1926-2001) proposed various dimensions of quality and instructed on its essence through factors like defects, prevention, requirements, and the cost of nonconformance. Crosby advocated for a quality management approach centered on his idea of "Zero Defects," advocating that organizations aim for flawlessness and refuse to tolerate any level of defects. He formulated the "Four Absolutes of Quality Management" and introduced the concept of the "Quality Vaccine," guiding principles intended to assist organizations in fostering a culture of quality.

Crosby also stressed the importance of prevention over inspection.

1. Quality is conforming, not to goodness, but to the requirement.

2. Quality is defined as a system where prevention leads to quality, and not the appraisal.

3. The performance standard must be 'no defects at all,' instead of the standard being 'close enough.'

[11] https://tr.wikipedia.org/wiki/Joseph_M._Juran

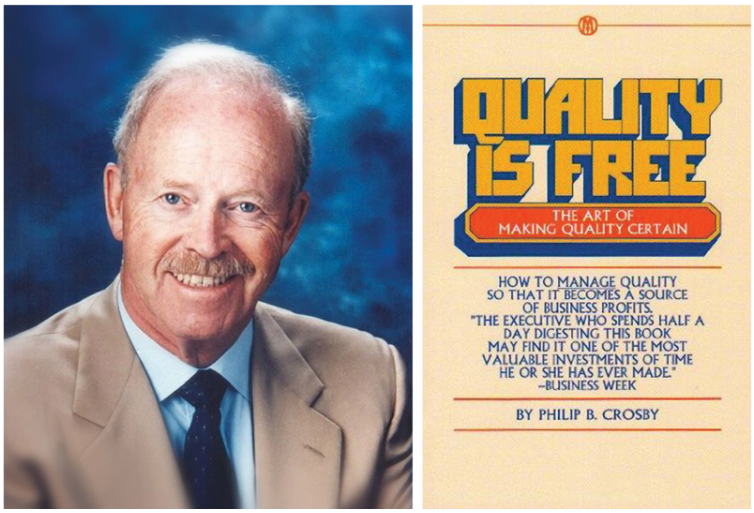


Figure 1.7-Philip Crosby and his famous book cover "Quality is Free"[12]

He was the founder of Philip Crosby Associates, where he developed his 14 Steps for Quality Improvement and published them in his 1979 book called "Quality is Free." Crosby recognized early on that quality in an organization is everybody's responsibility, not just that of a quality control manager.

The Fourteen Steps to Quality Improvement published by Crosby:

1. Management Commitment; Make it clear that management is committed to quality.

2. Quality Improvement Teams; Form Quality Improvement Teams with senior representatives from each department.

3. Measure Processes; Measure processes to determine where current and potential quality problems lie.

4. Cost of Quality; Evaluate the cost of quality and explain its use as a management tool.

5. Quality Awareness; Raise the quality awareness and personal concern of all employees.

6. Correct Problems; Take actions to correct problems identified through previous steps.

7. Monitor Progress; Establish progress monitoring for the improvement process.

8. Train Supervisors; Train supervisors to actively carry out their part of the quality improvement program.

9. Zero Defects Day; Hold a Zero Defects Day to reaffirm management commitment.

10. Establish Improvement Goals; Encourage individuals to establish improvement goals for themselves and their group.

11. Remove Fear; Encourage employees to tell management about obstacles to quality improvement.

12. Recognize; Recognize and appreciate those who participate.

13. Quality Councils; Establish Quality Councils to communicate on a regular basis.

14. Repeat the Cycle; Do it all over again to emphasize that the quality improvement process never ends.

[12] https://winterparkmag.com/2018/10/04/the-quality-revolutionary/

GENICHI TAGUCHI

Genichi Taguchi (1924-2012) was a Japanese engineer and statistician known for his significant contributions to quality engineering and robust design methods. His work has had a profound impact on various industries worldwide. He initially studied textile engineering at Kiryu Technical College with the intention of entering the family kimono business. However, with the escalation of World War II in 1942, he was inducted into the Astronomical Department of the Navigation Institute of the Imperial Japanese Navy. After the war, in 1948 Mr. Taguchi joined the Ministry of Public Health and Welfare, where he came under the influence of eminent statistician Matosaburo Masuyama. During the 1950s, he was visiting professor at the Indian Statistical Institute, where he worked with C. R. Rao, Ronald Fisher, and Walter A. Shewhart. During his visits to ISI, he got an opportunity to deep dive into the topic of orthogonal arrays invented by C. R. Rao, which was instrumental in enabling him to develop the foundation blocks of what is today known as Taguchi methods.

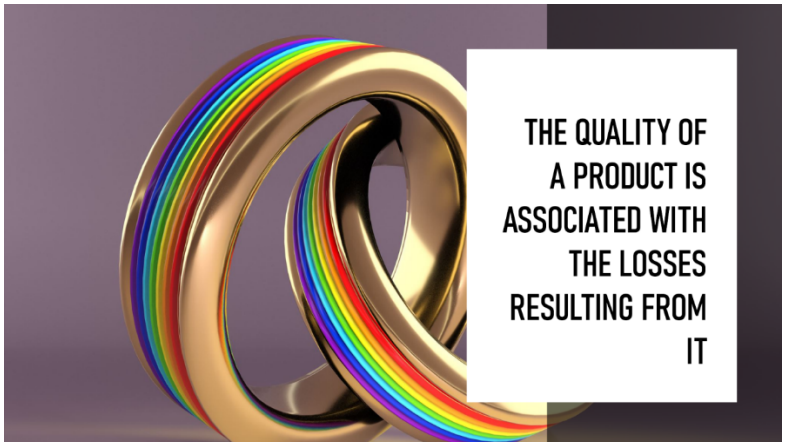


Figure 1.8-Geniche Taguchi's motto[13]

Taguchi's primary contribution to quality was the development of robust design methods. He advocated for designing products and processes that are robust or insensitive to variations in manufacturing, usage, and environmental conditions. He developed methods such as Taguchi Methods and Parameter Design to optimize product performance and reliability while minimizing sensitivity to variation. Taguchi methods emphasize the use of efficient experimental designs to identify and optimize the factors that affect product quality and performance.

By careful and purposeful consideration of these factors, the reduction of failures in the field, and, ultimately, Taguchi's methodologies help to ensure client satisfaction. Taguchi product development includes three stages:

1. System design -In the system design, the non-statistical stage for engineering, marketing, customer, and other knowledge is determined.

2. Parameter stage – Determines how the product should be run against the defined parameters. For example, to optimise the material removal rate result, use different parameters such as cutting speed, feed rate, depth of cut, and so on.

3. Tolerance design – It determines the balance between manufacturing cost and loss.

Taguchi introduced the concept of the "Quality Loss Function," which quantifies the economic loss to society caused by deviation from the target value in product characteristics. He also explained that the use of cross-functional teams involving engineers, designers, production personnel, and suppliers to address quality issues collaboratively would be very effective. He believed that quality improvement is a collective effort that requires the involvement of all

[13] https://www.linkedin.com/pulse/episode-4-quality-founding-fathers-genichi-taguchi-karunakar-k-dk--vizgf/

stakeholders. He emphasized the importance of designing quality into products and processes from the outset, rather than relying on inspection and rework.

ARMAND V. FEIGENBAUM

The American expert in quality control is the man behind the concept of Total Quality Control (TQC). Already in the 1950s, Feigenbaum had warned against the costly effects of not producing good quality for the first time, an idea shared by all subsequent quality concepts.

Armand Vallin Feigenbaum (1920-2014), an American quality control expert, introduced the concept of Total Quality Control (TQC) in the 1950s. While he was working as a quality control manager, he decided to continue his education and received his doctorate in Economics at the Massachusetts Institute of Technology (MIT). He introduced the concept of 'Total Quality Control' for the first time in an article in 1946. In 1951, while he was a doctoral student at MIT, he wrote his book "Total Quality Control". With his book, he created the principles of Total Quality Management (TQM), which is a quality and profitability approach that deeply affects the management strategy and productivity in competition for the world markets of the USA, Europe, Asia, the Middle East and Latin America. Total quality control: He said that it is an effective system that integrates the efforts of various groups in an organization to develop, maintain and improve quality to provide production and service at the most economical level to ensure full customer satisfaction.

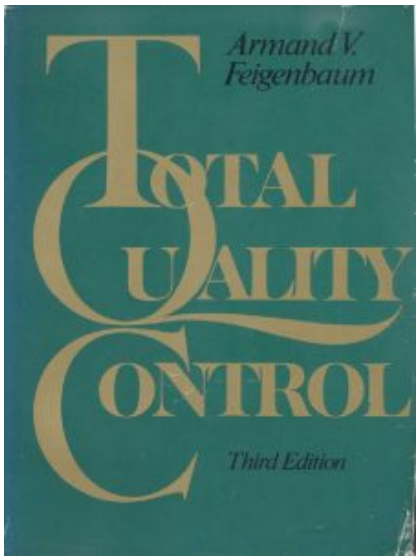


Figure 1.9-Feigenbaum's famous book cover[14]

Feigenbaum's TQC approach emphasized the involvement of all employees in quality improvement efforts and the integration of quality management into all aspects of organizational operations. His influential book, "Total Quality Control," helped popularize the concept of TQC and laid the groundwork for later developments in Total Quality Management. Armand V. Feigenbaum is often regarded as a quality control hero for his significant contributions to the field of Quality Management. Feigenbaum introduced the concept of TQC, which emphasizes the responsibility of every individual in an organization to contribute to quality improvement efforts. He believed that quality should be integrated into every aspect of an organization's operations, from product design to customer service. He developed the concept of the "Cost of Quality," which recognizes that both the cost of poor quality (e.g., scrap, rework, warranty claims) and the cost of good quality (e.g., prevention, training, quality improvement programs) impact an organization's bottom line. Understanding these costs is crucial for making informed decisions about quality improvement initiatives.

[14] https://archive.org/details/totalqualitycont00feig_0/page/n7/mode/2up

Feigenbaum emphasized the importance of strong leadership in driving quality improvement initiatives. He believed that top management should be actively involved in setting quality goals, providing resources, and creating a culture of continuous improvement. He promoted the use of Quality Circles, small groups of employees who meet regularly to identify and solve quality-related problems. These circles encourage employee involvement and empowerment in the quality improvement process. His books, including "Total Quality Control" and "The Power of Management Capital," have been translated into multiple languages and have been influential in shaping quality management practices around the world.

DR. KAORU ISHIKAWA

Kaoru Ishikawa (1915–1989) was a Japanese professor, and influential quality management expert. He developed Ishikawa cause-and-effect diagram (fishbone diagram) for the quality management practices, particularly in Japan, and his ideas continue to have a lasting impact worldwide. This diagram is a graphical tool used to identify and organize potential causes of a problem or quality issue, allowing teams to analyse complex problems systematically and identify root causes. He believed in problem-solving, and that teamwork has been instrumental in promoting a culture of quality and continuous improvement in organizations worldwide. Ishikawa also popularized the concept of "quality circles," small groups of employees who meet regularly to identify, analyse, and solve quality-related problems in their work areas. Quality circles promote employee involvement, empowerment, and continuous improvement, and they have been widely adopted by organizations around the world.

Please answer the questions in Session#3 in Workbook1

MODULE 1
QUALITY & QUALITY CONTROL

CHAPTER 2-BASICS OF QUALITY CONTROL

2.1-INTRODUCTION

Quality Control can broadly be described as an industrial management approach used to manufacture products meeting predefined quality standards. Unlike simply identifying and rejecting faulty products, Quality control focuses on satisfactory quality level. At its simplest quality control is a level of continuous quality achieved through inspection. It is a systematic control of various factors such as material, tools, machines, type of labour, working conditions, measuring instruments, etc. that affect the quality of the product. Quality control can be defined as the entire collection of activities which ensures that the operation will produce the optimum quality products at minimum cost.

The 1990s brought about Europe's efforts to integrate into a single market, the intensification of global competition, the rapid participation of newly industrializing countries in world markets, increased environmental awareness, consumer awareness, and the need for more efficient and effective use of scarce resources, as well as the search for a new management approach in businesses. These searches have widened to the specifics of products or services resulting in standardization and systematic controls over production. Quality control involves setting standards about how much variation is acceptable. For example, in a manufacturing business, trained inspectors examine samples of work-in-progress and finished goods to ensure standards are being met. This method checks the quality of completed products for faults. Quality inspectors measure or test every product, sample from each batch, or random samples- as appropriate to the kind of product produced. In today's context the main objective of quality control is to ensure not only the products' but also the business' achieving to highest standards.

2.2-BENEFITS OF QUALITY CONTROL

Quality control offers several advantages to organizations across various industries such as:

1-Implementing quality control processes assure that products meet predetermined standards consistently. This consistency is important for the system since it enhances customer satisfaction and builds trust in the brand.

2-Quality control helps minimize waste, rework, and scrap, resulting in cost savings for the organization.

3-Quality control consolidates production processes and increases efficiency and productivity. Thus, employees can focus on value-added tasks rather than correcting mistakes.

4-Quality control ensures that products meet regulatory requirements, avoiding fines, penalties, and legal issues.

5-Quality security is seen as the essence of quality control, and most companies declare such security as their goal or ideal. With new-fashion quality control, old-fashioned quality control is not aimed at short-term profit. Its main aim is "quality first". Quality control ensuring quality safety can win customer trust; This ultimately leads to long-term profit.

6-Quality control helps companies to achieve the highest quality and developing new products for this purpose.

7-Standard of quality of a product is easily acceptable to the customer and at the same time this standard should be economical to maintain.

8-Quality control take different measures to improve the standard of quality of product, because in a continuous improvement atmosphere within organizations it urges monitoring and evaluating product quality regularly. Organizations can identify areas for improvement, implement corrective actions, and strive for excellence in all aspects of the manufacture.

9-Quality control saves time and raw material losses. One of the natural results of the principle of doing a job once without error - with the support of Quality Control Circles - is a 40% saving in time and raw material losses.

10- Quality control improves manufacturer and consumer relations.

11-Quality of product is improved which in turn increases sales.

12-Scrap rejection and rework are minimized thus reducing wastage. So the cost of manufacturing reduces.

13-Good quality product improves reputation.

14-Uniformity in quality can be achieved.

2.3-FACTORS AFFECTING QUALITY CONTROL

Quality control is applied in many areas, from various manufacturing industries to service industries such as supermarkets, public transportation, postal services, hospital, and hotel management. Although the details of each approach vary across industries and businesses, the basic principles are the same. Outcome quality provided as a result of quality control is generally affected by the following factors:

Market and consumer characteristics

Consumer demands and needs are carefully analysed, and new and improved products are offered to the market. Consumers demand these products, which are products of new technologies, in increasing quantities to meet their needs. Understanding customer expectations and gathering feedback is essential for effective quality control. Customer preferences, perceptions, and feedback can provide valuable insights into product quality and areas for improvement. Organizations should actively solicit customer feedback, monitor customer satisfaction metrics, and use this information to drive continuous improvement efforts. For this reason, markets not only grow in scope but also specialize functionally in terms of the goods and services offered. In order to meet the needs and demands of the consumers, organisations carry out long-term and intensive studies both within and outside the company.

Financing opportunities

Companies' profits are decreasing due to many parameters such as economic turmoil as well as competition in many areas. Moreover, the financing requirement for new equipment and processes forces the company to achieve the highest possible savings in quality control costs due to automation and mechanization. On the contrary, quality control activities, which are involved both with prevention costs (investments in processes and systems to prevent defects) and with appraisal costs (costs associated with evaluating product quality), only require initial investment. They are commonly balanced by decreases in failure costs, which include

expenses related to defects and errors, such as scrap, rework, warranty claims, and customer returns. By implementing effective quality control measures, organizations can reduce failure costs and improve overall financial performance.

Management

Today's complex businesses require that responsibility for quality be distributed among various expert groups. The task of ensuring coordination between these groups and directing them to ensure quality falls on the management. Top management has a conscious and specific perspective on quality. By implementing quality control measures, conducting inspections, and analysing quality data, management can identify and address quality issues promptly to prevent defects and ensure compliance with standards.

Humanpower

The rapidly increasing complexity of technical knowledge and developments in the field of computers require some new experts. In addition, due to the increasing complexity of the product mass, the obligation for every employee to contribute to quality requires all employees to be trained and motivated with quality awareness. Training and guidance activities are carried out to increase the contribution of company employees to the development of the company's quality system.

Technology

The increasingly complex mass of products can only be provided with advanced technologies. Timely renewal of technologies is of great importance in order to increase efficiency, reduce costs and produce quality products that will compete in the international market.

Material

Production costs and quality requirements have made it necessary to show more sensitivity about materials. For this purpose, it is an inevitable necessity to establish inspection and testing laboratories equipped with modern equipment.

Machinery and equipment

The use of modern machinery and equipment is a basic condition in order to achieve the desired quality level. In addition, in order to achieve good quality, the production cost must be reduced by operating the machinery and equipment at full capacity.

Modern informatics methods

As a result of the rapid evolution of computer technology, the activities of collecting, storing and using information have been affected to an extent that was previously unimaginable. These developments in information technology have provided great opportunity to ensure quality both during and after manufacturing.

Cultural structure

The cultural structure, customs and traditions of the employees are an important factor in creating quality. The great success of the quality control circle in Japan can only be explained by the social and cultural structure of the Japanese society. The cultural framework within an organization directly impacts the efficiency of quality control practices. This is influenced by both workers' and management's perspectives on quality and their dedication to excellence. Below is how cultural elements can affect QC:

-Encouraging a culture of permanent enhancement motivates employees to explore opportunities for innovation and efficiency improvements in QC procedures. Workers feel empowered to challenge conventional methods, experiment with novel concepts, and adopt best practices to continually enhance QC efficiency.

-Organizational culture forms employees' perceptions and attitudes regarding quality. A culture that esteems excellence and continuous improvement is more inclined to support QC

applications. Conversely, a culture that prioritizes speed or cost reductions over quality may undermine QC initiatives.

-A culture showing commitment to excellence inspires employees to assume ownership of quality and strive for zero fault performance in their tasks. In such an environment, QC practices are more likely to be embraced and executed effectively, leading to elevated product quality and heightened customer satisfaction.

-Culture influences communication dynamics and collaborative efforts among employees. A culture promoting transparent communication, teamwork, and knowledge exchange facilitates effective QC by enabling employees to collectively identify and address quality concerns.

-Leadership plays a pivotal role in moulding organizational culture and establishing the tone for QC. Leaders who prioritize quality, articulate clear expectations, and lead by example inspire employees to prioritize quality in their endeavours and rally behind QC initiatives.

Laws of the country

Laws regarding both consumer protection, human rights, environmental regulations, and standardization have significant effects on quality control activities. Laws and regulations within a community or country have a direct impact on QC practices by establishing quality standards, regulatory requirements, consumer protections, and legal obligations that organizations must adhere to. Compliance with these laws is essential for maintaining legal compliance, market access, and consumer trust.

2.4-STATISTICAL QUALITY CONTROL (SQC)

Statistics means data to obtain reliable results. The science of statistics handles this data to draw certain conclusions. Statistical quality control is a quality control system employing the statistical techniques to control quality by performing inspection, testing and analysis. The basic aim of SQC is to conclude whether the quality of the product ensures the defined quality standards. Using statistical techniques, S.Q.C. collects and analyses data in assessing and controlling product quality.

The technique of S.Q.C. was developed in 1924 by Dr. Walter A. Shewart. But it got recognition in industry only during WWII.

Statistical quality control can be simply defined as an economic & effective system of maintaining & improving the quality of outputs throughout the whole operating process of specification, production & inspection based on continuous testing with random samples."

YA LUN CHOU

Statistical quality control should be viewed as a kit of tools which may influence decisions to the functions of specification, production, or inspection.

EUGENE L. GRANT[15]

In the highly competitive market today, the main objective of manufacturers or producers is to achieve quality assurance in manufacturing and service organisations. To achieve this objective, different statistical tools have been developed, which are useful for controlling the quality of products vis-avis the specifications or standard.

Statistical quality control is defined as the technique of applying statistical methods based on the theory of probability and sampling to establish quality standard and to maintain it in the most economical manner. The fundamental basis of S.Q.C. is the theory of probability. According to the theories of probability, the dimensions of the components made on the same machine and in one batch (if measured accurately) vary from component to component. This may be due to inherent machine characteristics or the environmental conditions. The chance

[15] https://asq.org/about-asq/honorary-members/grant

or condition that a sample will represent the entire batch or population is developed from the theory of probability. Relying itself on the probability theory, S.Q.C. evaluates batch quality and controls the quality of processes and products.

2.4.1-ADVANTAGES OF STATISTICAL QUALITY CONTROL

The following are the main elements of SQC:

We know that 100% inspection needs huge expenditure of time, money, labour and resources. Further, if the nature of the product is such that it is destroyed during the process of inspection, e.g., a bulb, candle, ammunition, food, etc., 100% inspection is not practicable. Therefore, SQC is based on sampling inspection. In sampling inspection method, some items or units (called sample) are randomly selected from the process and then each and every unit of the sample is inspected.

Some commonly used statistical tools such as random sampling, mean, range, standard deviation, mean deviation, standard error and concepts such as probability, binomial distribution, Poisson distribution, normal distribution, etc., are used in SQC. Since, quality control method involves extensive use of statistics, it is termed as Statistical Quality Control.

The fundamental objective of SQC is to decide whether the unit produced is according to its specifications or not. If the unit produced is not according to its specifications and there is a variation in quality, it becomes necessary to trace the causes of variation and eliminate them if possible.

With the help of SQC, we decide whether the quality of the product or the process of manufacturing/producing goods is under control or not.

Production and Inspection SQC method helps in deciding about the specifications, production and inspection of a product.

When a lot of items/units is manufactured, the manufacturer has two methods to check the quality of the lot: firstly, he/she could check each and every item and decide about the quality of the product, i.e., 100% inspection. Secondly, he/she could use the statistical quality control methods, i.e., inspect a small number of items and decide about the quality of the entire lot of the produced product. SQC has many advantages over 100% inspections, which are listed below:

-An excellent feature of statistical quality control is that it is easy to apply. While developing the statistical methods for quality control, skilled and intelligent persons are required. However, even those persons who have not had extensive specialised training can apply statistical methods easily.

-The cost of inspection is reduced. In SQC as only a part or fraction of a lot is taken and inspected. Since only a fractional output is inspected, hence cost of inspection is greatly reduced.

-Inspection of every item is bound to reduce the efficiency of a quality control inspectors because of dullness. Inspectors are more alert while using. SQC as only a part is inspected. It requires lesser time and boredom as compared to the 100 percent inspection and hence the efficiency increases.

-Specifications can easily be predicted for the future, which is not possible even with 100 percent inspection. In cases where destruction of product is necessary for inspecting it, 100 percent inspection is not possible (which will spoil all the products), sampling inspection is resorted to.

-The moment a sample point falls outside the control limits, it is taken as a danger signal and necessary corrective measures are taken. Whereas in 100 percent inspection, unwanted variations in quality may be detected after large number of defective items have already been produced. Thus by using the control charts, we can know from graphic picture that how the production is proceeding and where corrective action is required and where it is not required. SQC consists of continuous checking of the quality of the product. When a sample point falls outside the control limits it gives the signal that the process is not under statistical control. If some assignable causes are present in the process, necessary corrective action can be taken. Therefore, SQC ensures an early detection of faults and results in minimum wastage of items.

Using SQC, we can find out whether the produced item is under control or not, that is, whether the item meets the specifications within the tolerance limits or not. If the variation is beyond the tolerance limits, SQC gives a danger signal and necessary corrective action can be taken. So, as long as statistical control continues, specifications can be accurately predicted for the future, which cannot be guaranteed by 100% inspection.

-SQC methods ensure coordination between managers managing specifications, production and inspection. It provides a basis to resolve the differences arising among the various interests in an organisation.

-With the help of control charts, we can easily detect whether or not a change in the production process results in a significant change in the quality.

-Equilibrium in Consumer's and Producer's Risk Methods such as quality control and acceptance sampling help in maintaining equilibrium between the consumer's risk and producer's risk.

-It is not only useful in the examination of items produced in small numbers, but also when bulk production has to be done. Statistical quality control is helpful for those items that get destroyed on being examined for a given quality characteristic, for example, the intensity of match sticks, average life of compact fluorescent lamp (CFL), strength of glass, etc., In such cases, 100% inspection will spoil the entire lot and create a huge loss.

2.4.2-ADVANTAGES AND LIMITATIONS OF STATISTICAL QUALITY CONTROL

However, SQC also has some limitations, which are described below:

-When a sample of the items drawn from the lot is not a true representative of the entire lot, does not have the same characteristics as the lot from which it is drawn. Then a good lot may be rejected and a bad one may be accepted. This is the main limitation of SQC.

-SQC cannot be used mechanically for any production process without studying the process and without adequate knowledge about it.

-SQC applied on a production process provides only the information that the process is under control or out-of-control. It cannot take any action for improvement.

While Statistical Quality Control (SQC) offers many benefits for monitoring and improving product and process quality, it also has some limitations as:

-SQC relies heavily on data collection and analysis. Gathering sufficient data can be challenging, especially for complex processes or products with limited production runs. Inadequate or unreliable data can lead to inaccurate conclusions and ineffective quality control decisions.

-Many statistical techniques used in SQC, such as control charts and process capability analysis, assume that process data follow a normal distribution. In reality, process data may not always conform to this assumption, leading to potential inaccuracies in analysis and interpretation.

-Control charts are effective for detecting large shifts or deviations in process performance. However, they may not be sensitive enough to detect smaller, gradual changes or variations in the process. As a result, subtle quality issues or trends may go unnoticed until they escalate into significant problems.

-SQC primarily focuses on monitoring and controlling processes using statistical methods. While this approach is effective for identifying and addressing common cause variation within the process, it may not always capture external factors or influences that can affect product quality, such as changes in raw materials, equipment malfunctions, or environmental conditions.

-Implementing SQC requires specialized knowledge of statistical methods, data analysis techniques, and quality improvement principles. Organizations may face challenges in training personnel, interpreting statistical results, and integrating SQC practices into existing quality management systems.

-SQC can be resource-intensive in terms of time, personnel, and equipment required for data collection, analysis, and implementation of quality control measures. Small businesses or organizations with limited resources may find it challenging to implement comprehensive SQC programs.

-Implementing SQC may require changes to existing processes, procedures, and organizational culture. Resistance to change from employees or management can hinder the adoption and effectiveness of SQC initiatives, limiting their impact on improving product and process quality.

-SQC tools and techniques are valuable for analysing process data and identifying quality issues. However, relying solely on statistical methods without considering other qualitative factors or insights from frontline employees can lead to incomplete or biased assessments of process performance and quality.

2.4.3-TECHNIQUES OF STATISTICAL QUALITY CONTROL

A process is a series of operations or actions that transforms input to output. It is said to be stable or repeatable if the resulting output product is of the given specifications or standard quality. But sometimes, due to certain causes such as poor quality of raw material, change in the machine settings, use of unskilled work force, improper machine, etc., the stable process is disturbed. In such situations, we require a tool or technique through which we can control the process. This technique is known as statistical process control (SPC). Statistical process control is a technique used for understanding and monitoring the process by collecting data on quality characteristics periodically from the process, analysing them and taking suitable actions whenever there is a difference between actual quality and the specifications or standard.The important techniques used for statistical quality control can be broadly classified into two categories Statistical Process Control (SPC) or simply Process Control, and Product Control. These techniques are further classified into different categories as shown in Fig.2.1.

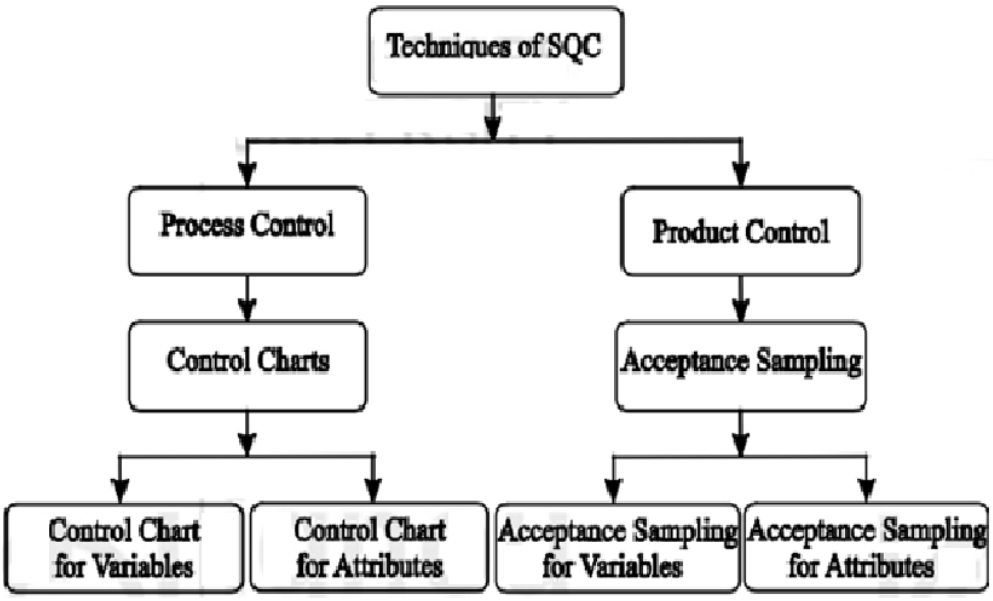
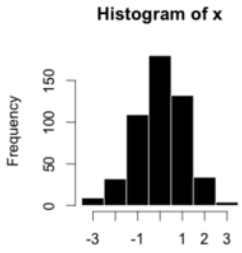
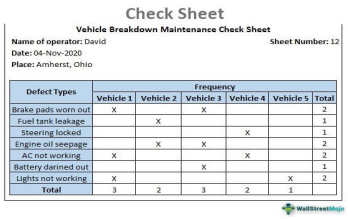
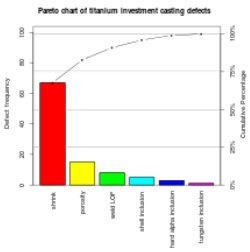
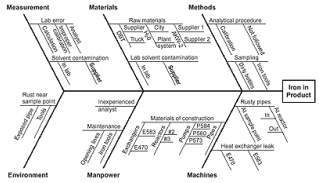
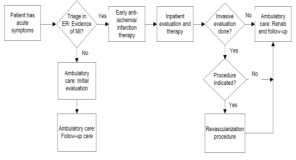
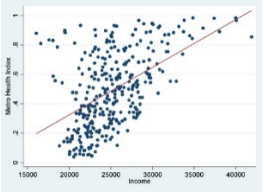


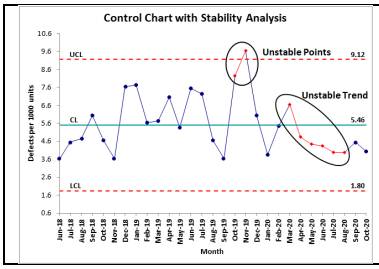
Figure 2.1-Techniques of Statistical Quality Control[16]

Statistical process control technique is widely used in almost all manufacturing processes for achieving process stability and making continuous improvements in product quality. Its major tools are:

Table 2.1- Statistical process control tools

1. Histogram[17] 	**2. Check sheet**[18]  Check Sheet Vehicle Breakdown Maintenance Check Sheet Name of operator: David Sheet Number: 12 Date: 04-Nov-2020 Place: Amherst, Ohio Defect Types / Frequency / Vehicle 1 / Vehicle 2 / Vehicle 3 / Vehicle 4 / Vehicle 5 / Total Brake pads worn out: X, X, 2 Fuel tank leakage: X, 1 Steering locked: X, 1 Engine oil seepage: X, X, 2 AC not working: X, X, 2 Battery darined out: X, 1 Lights not working: X, X, 2 Total: 3, 2, 3, 2, 1	**3. Pareto chart**[19] 
4. Cause and effect diagram[20] 	**5. Process flow diagram**[21] 	**6. Scatter diagram**[22] 
7. Control chart[23]		

[16] https://egyankosh.ac.in/bitstream/123456789/20753/1/Unit-1.pdf
[17] https://en.wikipedia.org/wiki/Histogram
[18] https://asq.org/quality-resources/check-sheet#:~:text=Also%20called%3A%20defect%20concentration%20diagram,the%20seven%20basic%20quality%20tools.
[19] https://en.wikipedia.org/wiki/Pareto_chart
[20] https://asq.org/quality-resources/fishbone
[21] https://www.med.unc.edu/neurosurgery/wp-content/uploads/sites/460/2018/10/Flow-chart-Process-Flow.pdf
[22] https://www.health.state.mn.us/communities/practice/resources/phqitoolbox/scatterplot.html
[23] https://www.qimacros.com/control-chart/stability-analysis-control-chart-rules/

2.5-HOW TO IMPROVE QUALITY?

The quality control system consists of many subsystems. These subsystems can be defined as:

1. Production item quality assessment;
2. Product and process quality planning;
3. Quality planning, evaluation and control of purchased materials;
4. Product and process quality evaluation and control;
5. Quality informatics feedback;
6. Quality IT equipment;
7. Quality education guidance and workforce development;
8. Customer service after production;
9. Management of quality control function;
10. Custom quality reviews.

The control function measures the quality characteristics of raw materials and other production expenses, compares them with standards or tolerances, and makes an acceptance or rejection decision. Raw materials or other production inputs that are accepted are sent to the manufacturing department, and those that are rejected are returned. On the other hand, the features related to product quality determined by the quality design engineering function come to the acceptance control function and the manufacturing department in case of a new design. In the manufacturing department, Regarding the actual production, product and process quality levels are measured and compared with standards or tolerances. Making an acceptance decision indicates that the eligibility decision has been made. If a rejection decision is made, the necessary corrections are carried out or those that cannot be corrected are discarded. As a result of the analysis and evaluation of quality control activities, information flows to quality design engineering and acceptance control functions to improve quality.

Poor quality in production occurs for two main reasons: "specific" and "general". A special cause is defined as a cause that can be detected by simple statistical tests and is caused by the worker's error and can be corrected by the worker. General or environmental reasons are errors of the system and are general for all workers and affect them all equally. They show their effects until the general causes are corrected. Their presence can be detected and measured using simple statistical tests. It is possible to eliminate and reduce common causes through management efforts.

Preventing, reducing, or eliminating poor quality; It is possible by carrying out quality control and correction processes. The following procedures must be carried out to control quality:

1. Control of Manufacturing Information;
2. Control of supply and stocking of raw materials;
3. Control of the manufacturing process;

4. Control of measuring and testing instruments;

5. Control of the correction process.

Quality improvement can be achieved by performing the following operations:

1. The magnitude of defective parts, rejected parts, parts needing correction, or other unsuitable conditions is determined;

2. Information about the features is collected by making comparisons regarding the production style;

3. Defective parts that need to be fixed are analysed with a critical approach;

4. Thoughts and opinions regarding the causes of undesirable conditions are determined;

5. Information is collected for process adequacy and/or process performance reviews;

6. Corrective actions are taken by ensuring that the causes of errors are understood.

Please answer the questions of Session#5 in Workbook1

MODULE 2

TOTAL QUALITY MANAGEMENT & QUALITY IMPROVEMENT

CHAPTER 3-TOTAL QUALITY MANAGEMENT AND KAIZEN

3.1-INTRODUCTION

Total Quality Management (TQM) has turned into an indispensable paradigm at the end of the 20th century. It emerged primarily in the 1980s and became widespread in the 1990s. It emphasized a holistic approach to quality management involving all members of an organization in a continuous effort to improve quality and meet customer expectations.

TQM focused on processes, systems, and cultural aspects within an organization to achieve quality excellence. For over 40 years, TQM has been discussed thoroughly and preferred by great majority in the professional world from large international companies to small local businesses. Today, there is almost no field left where Total Quality Management and its techniques are not included. From politics to the smallest industrial enterprises, the concept of Total Quality Management is becoming increasingly widespread.

The biggest responsibility of TQM, which has become such widespread all around the private and the public sector, falls on people and their qualities. Quality and doing qualified work are almost as old as human history. But it was necessary to wait until the 20th century for this activity to gain an official title, to be addressed from the perspective of science, and to establish its norms.

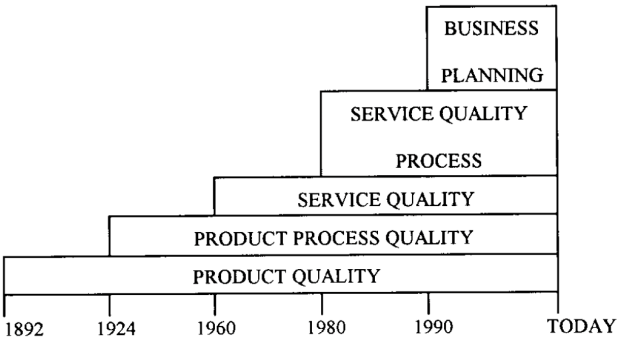


Figure.3.1-The evolution of Total Quality

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[24]

[24] Juran, JM and Godfrey,AB (1999) Juran's Quality Handbook.5th Ed. McGraw-Hill: Newyork. pgs 14.14-14.25

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 the product 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 a truly new product their inputs are ambiguous and somewhat vague[25].

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 right the 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 the assembly than to go back and try to find the problems[26].

Service Quality. The next phase for some industries began in the early 1960s. We suspect for 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 providing 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 outcome[27].

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 of these 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[28].

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 major thrust 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[29].

Strategic Planning. It is a systematic approach to defining long-term business goals and identifying the means to achieve them. Once an organization has established its long-term goals, effective strategic planning enables it, year by year, to create an annual business plan which includes the necessary annual goals, resources, and actions needed to move toward that future[30].

Almost every institution feels obliged to take some initiatives regarding Total Quality Management. It begins with quality control, which means freedom from error. The passage from has brought about a democratic management approach in organizations, which has developed over time by covering all kinds of organizational behaviours. Later, TQM Philosophy has gained new dimensions in parallel with the change and innovation experienced by humanity. It is a fact that this philosophy, which constantly renews itself, will also pioneer future management philosophies.

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[25] *ibid.* pg.14.14
[26] *ibid.* pg.14.15
[27] *ibid.* pg.14.15
[28] *ibid.* pg.14.16
[29] *ibid.* pg.14.16
[30] *ibid.* pg 13.1

From another perspective, Although the understanding of Total Quality Management has turned into concrete applicable techniques, one of the biggest difficulties encountered in practice is human attitudes and behaviours towards Total Quality Management. It is extremely difficult to establish this understanding and achieve success with individuals who do not believe in the Total Quality Management approach.

3.2-THE MEANING OF TOTAL QUALITY MANAGEMENT

Thanks to the different meanings and specifications given to this concept throughout the process, many definitions used regarding quality have emerged. If we want to give some examples of these;

- Quality is fitness for use. (J.M. JURAN)

- Quality is compliance with requirements. (R.B. CROSBY)

- Quality is a production system that produces products or services in an economical way and responds to consumer demands.

The concept of quality is a concept that people hear because it is used very frequently. However, very few people analyse and evaluate the importance of this concept today. Because today, quality is not seen as a technical method, but as a business management tool aimed at satisfying the customers of the business and ensuring the optimization of all units within the business.

Total Quality Management (TQM) seeks to integrate all organisational functions, such as marketing, finance, design, engineering, production, customer service, etc. to focus on meeting customer needs and organisational objectives. Thus, TQM is defined as:

Total = Made up of the whole.

Quality = Degree of excellence of product/service provider.

Management = Art of handling, controlling, and directing.

In addition, quality appears as a concept that contributes to the development of "Social Responsibility" awareness in businesses. Thus, while quality was previously a concept used only for product inspection, it was later considered as a "Strategy tool" and was associated with management. As a result, we see that the concept of Total Quality Management has emerged.

Total Quality Management Philosophy is a set of principles and methods. At the core of this philosophy, we can find:

- Preventing errors is easier, cheaper, and safer than finding and fixing them later.

- Statistics are needed to distinguish normal from abnormal, natural from unnatural.

- Benefiting from the ideas of every employee produces more successful results than benefiting from the ideas of only a few people.

- If guided well, group work improves things more quickly.

- For the success of the business, it is necessary to take into account the preferences of the customers.

- Quality management is possible with quality people.

- Assuring quality is a system issue.

- It is preferable to do things planned rather than unplanned.

- If unity of goal is achieved, results can be achieved in a shorter time and more confidently.

- In order to provide quality service to the consumer, the units and individuals within the business must also be able to provide quality service to each other.

- If we want high quality in the goods and services we provide from outside, we must take our suppliers on our side.

If we consider these concepts that make up the Total Quality Management Philosophy, we can see that TQM consists of product and service quality, working and life quality and organizational quality. In other words, TQM extends from the individual to the organizations and from there to the quality of the society. In the TQM Philosophy, which is a holistic approach, we can see dynamism (self-renewal), simplicity (distinguishing between details and details), proactiveness (initiating developments), and creativity.

3.3-CHARACTERISTICS OF AN INDIVIDUAL WITH A TOTAL QUALITY MANAGEMENT UNDERSTANDING

One of the most distinctive features of Total Quality Management is "respect for people". In TQM people have a very important place as a customer or organizational employee. People are at the core of Deming's philosophy, which played an important role in the understanding of TQM maturing in Japan and spreading throughout the world. Deming, who believes that most of the problems in institutions can be solved by encouraging people, argues that in order to increase the quality in production and service, it is necessary for employees to be proud of their work.

In this context, the characteristics of an individual with a TQM approach, which is considered to be very important, can be described as follows.

-Must believe in TQM. Individuals in organizations, from the highest-level manager to the lowest-level employee, must believe that Total Quality Management is important in corporate and individual development. In organizations where this belief is not established, everything will remain in words and positive developments will not be achieved.

-Must have self-confidence. Employees must have confidence in themselves and therefore in their projects. An employee who lacks self-confidence will try to maintain the status quo and will try to be overly cautious against new initiatives.

-Must have gained a sense of belonging to the organization he/she is in. When employees cannot gain a sense of belonging to the institution they work for, they will only maintain the current situation and do their jobs without enjoying them, as they cannot feel like a part of the organization. This situation will negatively affect the dynamism and motivation of the organization.

-Must believe that education is a lifelong process. The employee should encourage himself and his friends to follow new developments and have an intrinsic motivation to learn and teach new things. Regardless of age, one should believe that there are always new things to learn. For this, he must continue to improve whether through formal or non-formal education.

-Must have democratic attitudes and values. Employees must have adopted democratic attitudes and values as a philosophy of life. For individuals who do not have a democratic philosophy of life, Total Quality Management will be nothing more than a nominal activity. Employees will only pretend that they believe in Total Quality Management.

-Must be aware of their responsibilities. Employees should feel responsible for their institutions and areas of expertise and should be able to fulfill this responsibility without anyone reminding them.

-Must be a sharer. Employees should be willing to share their management, knowledge, and experience and should see this as a prerequisite for development and democratic institutionalization.

-Must be open to self-criticism and criticism. Employees should first be able to criticize themselves in their work within the organization. When criticizing others, one should not personalize facts and events or judge them. The person who is criticized should be able to feel

that criticism is an effort towards institutional development and finding what is good and beautiful.

-Must be in communication with organization members. Employees should communicate within the corporate atmosphere of the organization, without exceeding their personal boundaries. This should be seen as a very important phenomenon, from how employees address each other to their relationships outside the organization.

-Must know that unfair competition is one of the obstacles to the establishment of the Total Quality Management approach. Employees should not encourage unfair competition for their individual or corporate interests and should believe that the good and the deserving should win, within or outside the organization.

-Scientific thinking should be seen as a philosophy of life. Employees should be able to think analytically, away from prejudices, with scientific data and values, in a cause-effect relationship.

-Must be sensitive to problems. Employees should be sensitive to the problems of the organization and its employees and should consider that "what they call me" problems may, over time, directly or indirectly affect them and their organization.

-Must seek perfection but must be able to foresee that mistakes may occur in this search. One should be able to see errors as a factor that needs to be corrected and precautions need to be taken to prevent them from recurring. Individuals always aim to be perfect; this is a characteristic that comes from their nature. However, when attending an event, it is often impossible to consider all the details about the event, no matter how professional you are. Therefore, the way to be free from mistakes is to first accept that no one can be mistake-free. This understanding will enable individuals to adopt teamwork without prejudice. Teamwork minimizes errors caused by individuals.

-Must know that powers should be distributed fairly. Employees should always be able to assume that there will be people who will use the authority they have better than themselves. In this regard, he/she should be able to see his authority as a tool to improve the organization and himself.

-Must believe that others are at least as intelligent as himself.

-Must have ethical values. He/she must be able to honestly defend and protect the values he believes to be true by combining the values of the organizational and national culture he is in with his personality traits.

-Must believe that the problem should be solved with the individuals involved in the problem.

-Must believe that the goods and services produced should reach the highest possible level of customer satisfaction.

-Must value the customer's feelings and thoughts. The reason for the existence of the organization is the customer. Any opinions and suggestions that may come from the customer should be taken into primary consideration.

-Must be open to innovations to improve himself and his organization.

-Must be aware that he is a public individual. Although the organization in which it is a part of constitutes the basis of life, it must strive to ensure that its activities are beneficial and serve useful purposes towards humanity at the national and universal level.

-Must be aware that there may be problems that he cannot overcome.

-Must try to keep his promises and not take initiatives that he cannot fulfill.

-Must be able to empathize. An individual who cannot empathize may not be able to make sound decisions on facts and events.

-Must be able to share success as well as share problems, responsibilities, authorities, and failures.

-Must be able to follow local and global developments, especially in their field of expertise. Being aware of the development points of the world will ensure that the projects to be developed are consistent and functional. Every new development should be perceived as a new idea and project to be born.

-Must be creative. Creativity will add continuity and dynamism to the organization. Therefore, individuals should be open to activities that will support both their own creativity and the creativity of other employees. What such activities will be like may vary depending on the cognitive and affective capacities of the employees and the climate of the organizational culture. For example, before starting work in the morning, it can be considered as an alternative for employees to freely discuss among themselves the previous day's events in the country and the world (without any topic restrictions) for 15 minutes.

-Aesthetic tastes must be developed. Accordingly, aesthetic needs are one of the most important features in describing the self-actualizing individual.

-Must be able to plan the future. Employees should not be stuck in yesterday and today, they should be supported in making predictions about the future, especially the scope of activity of the organization.

-Must be open to inspection. What is meant by control here should be understood as openness to all kinds of control, from employees to third parties and institutions, rather than a bureaucratic or formal control. This will increase the reliability of the organization and its employees.

-Teamwork should be accepted as the main principle in working life.

-Must be able to review their plans and change plans when necessary.

-When starting a job, one should think about possible mistakes.

-Must not only be respectful of different beliefs and values, but also enjoy coexistence. Individuals mostly support democracy; They describe it as being respectful of differences. This is true but incomplete. Because this is the result of a necessity imposed by law. However, the important thing is to love differences. It means being able to experience differences without being disturbed by being together. When the organization consists of different individuals, held together only by formal boundaries of respect, it can be very difficult to establish a concept of total quality.

-Must be peaceful and conciliatory. Employees should first develop an optimistic perspective on facts and events, take the negative aspects into consideration and highlight the positive ones.

-Must be able to turn conflict and competition into a positive one.

-Must be able to share life with organizational employees outside the organization (without bringing them in-organization status into private life).

-Must be willing and exemplary in using time effectively.

-Must be punctual in working life.

-Must know how to motivate himself and others. One should learn how and in what way to be motivated by knowing himself and others well.

MODULE 2
TOTAL QUALITY MANAGEMENT & QUALITY IMPROVEMENT

CHAPTER 3-TOTAL QUALITY MANAGEMENT AND KAIZEN

3.4-THE OVERALL PICTURE OF TOTAL QUALITY MANAGEMENT

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 the equivalent term "Companywide Quality Management" in his recent book (Kondo 1995)[31].

In 1997, Union of Japanese Scientists and Engineers (JUSE) announced a formal change from the term 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[32].

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 3.2. According to the figure, the TQM has the elements of:

1-vision, strategy, and leadership,

2-concepts and values,

3-scientific methods,

4-human resources,

5-information,

6-management system,

7-quality assurance system,

8-cross-functional management systems,

9a-core technology,

9b-customer relations, employee relations, social relations, supplier relations, stockholder relations

10-realization of corporate objectives, attainment of mission, building respectable presence, securing profits

[31] Juran, JM and Godfrey,AB (1999) Juran's Quality Handbook.5th Ed. McGraw-Hill: Newyork. pg.14.3
[32] *ibid.* pg.14.3

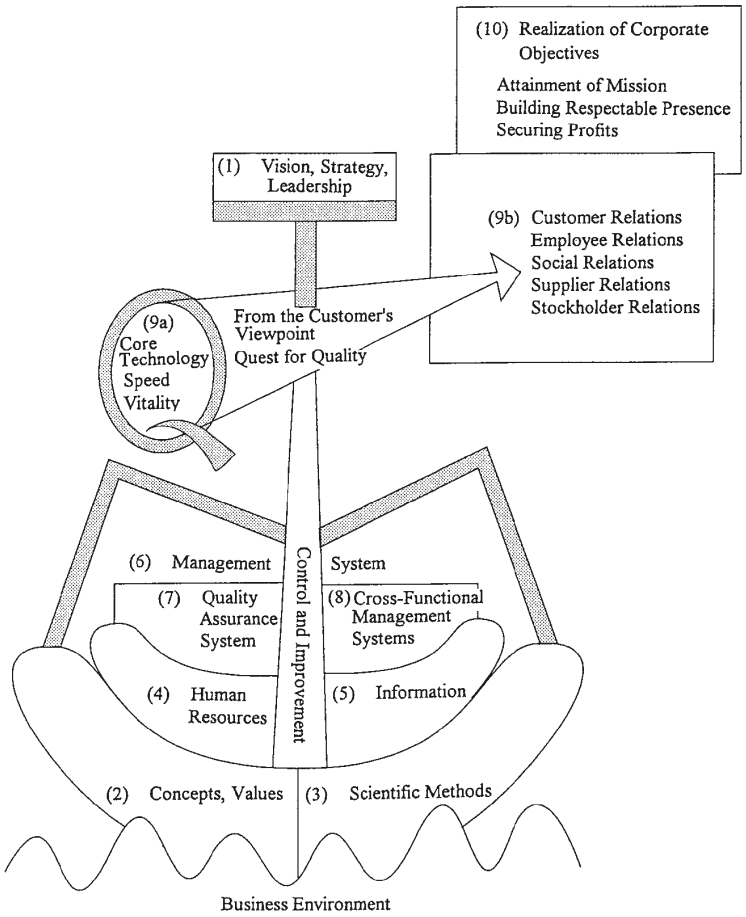

FIGURE 14.2 The overall picture of TQM. *The TQM Committee 1997a, p. 4.*)

Figure.3.2-The overall picture of Total Quality Management (TQM Committee 1997a,p.4)[33]

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

1-Under strong top-management leadership, establish clear mid- and long-term vision and strategies.

2-Properly utilize the concepts, values, and scientific methods of TQM.

3-Regard human resources and information as vital organizational infrastructures.

4-Under an appropriate management system, effectively operate a quality assurance system and other cross-functional management systems such as cost, delivery, environment, and safety.

5-Supported by fundamental organizational powers, such as core technology, speed, and vitality, ensure sound relationships with customers, employees, society, suppliers, and stockholders.

6-Continuously realize corporate objectives in the form of achieving an organization's mission, building an organization with a respectable presence, and continuously securing profits.[34]

[33] *ibid*, pg.14.5
[34] *ibid*, pg.14.3

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**.

3.4.1-THE RESULTS WE EXPECT OF TOTAL QUALITY MANAGEMENT

The almost universally accepted goals of total quality are **lower costs, higher revenues, delighted customers**, and **empowered employees.** These goals need little explanation. 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[35].

-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 preventing errors during design are 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[36].

-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[37].

-Delighted Customers

"Delighted" customers are customers who buy over and over again, customers who advertise your goods and services for you, customers who 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)[38].

-Empowered Employees

For many years' organizations viewed empowered employees 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[39].

3.4.2-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.**

[35] *ibid*, pg.14.5
[36] *ibid*, pg.14.5
[37] *ibid*, pg.14.5
[38] *ibid*, pg.14.5
[39] *ibid*, pg.14.5

-Customer Focus

That customer focus is a fundamental concept of quality management perhaps seems obvious. More and more companies are finding that keeping customers (reducing the churn) is far 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[40].

-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 similar approaches to create improvements by the hundreds and even thousands[41].

-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, managers, or engineers are planning all the steps of every process, defining carefully worded job descriptions, and enforcing the unthinking following of instructions[42].

3.4.3-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 on the most important issues—it must have the 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[43].

-Alignment

A recent study by the Association of Management Consulting Firms in 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)[44]. 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 achieved if the company is to realize its vision.

[40] *ibid*, pg.14.8
[41] *ibid*, pg.14.8
[42] *ibid*, pg.14.8
[43] *ibid*, pg.14.8
[44] *ibid*, pg.14.8

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)[45].

So, the strategy must align with the vision and key objectives and also performance indicators have to be chosen as a proof of this alignment.

-Linkage (Process Management or Systems Thinking)

As companies have rediscovered the importance of linking their activities across all functions and departments in the company, they have also rediscovered how critical it 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[46].

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 statistical process 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[47].

The first step is identifying the organization's key processes. There are numerous methods for doing this, but the 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[48].

The second key to managing processes is to determine exactly what value is added by each step in the process. (…) 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[49].

The third critical area of managing the critical linkages is the realization that almost all key processes cut across many different areas of the company. To manage these processes successfully 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[50].

-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[51]. When we address replication, we are learning first-hand about resistance to change, the dreaded not-invented-here syndrome, the entrenched beliefs that every location is 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 disappointments in results. The successful companies take action; they make things happen[52].

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

[45] *ibid*, pg.14.8
[46] *ibid*, pg.14.9
[47] *ibid*, pg.14.9
[48] *ibid*, pg.14.9
[49] *ibid*, pg.14.10
[50] *ibid*, pg.14.10
[51] *ibid*, pg.14.10
[52] *ibid*, pg.14.10

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[53].

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[54].

3.4.4-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. These are **quality planning, quality control,** and **quality improvement.**

-Quality Planning

The logical place to start is quality planning. Quality planning consists 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 processes 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[55]

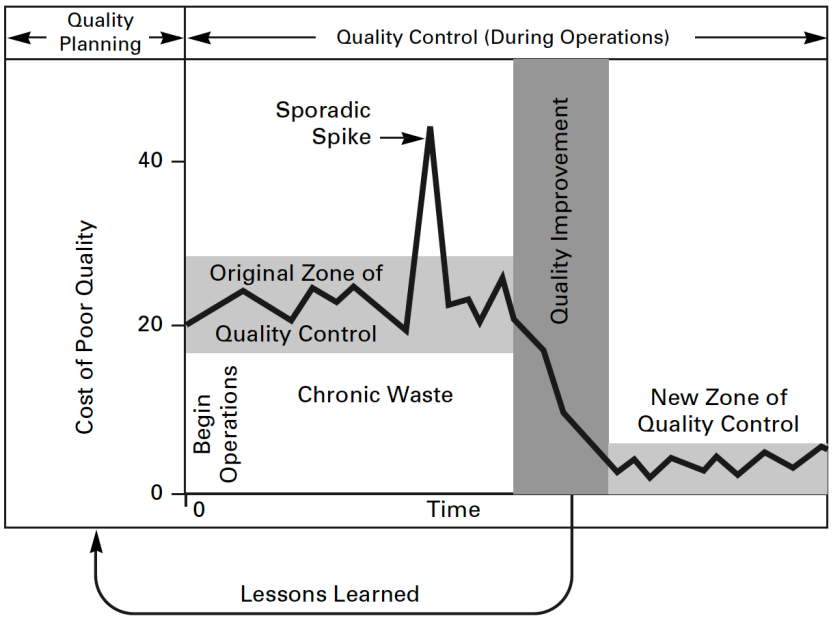

Figure.3.3-Juran's trilogy (Juran Institute, Inc.,Wilton, CT)[56]

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

[53] *ibid*, pg.14.11
[54] *ibid*, pg.14.11
[55] *ibid*, pg.14.11
[56] *ibid*, pg.14.12

could be even harder to see. Examples of hard-to-detect costs are work-in-process inventory, non-value-added work, underutilized capacity, and unnecessary delays and hand-offs[57].

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 3.3 we see a sporadic spike, a major deviation from our planned level of performance. In this example, the quality control system seems to be working well. Since this point is a spike, it indicates that the problem was detected quickly, the cause 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[58].

-Quality Control

What the operating forces can do is minimize this waste. They do this 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 compare with the target; and a way to take action, to adjust the process if necessary[59].

-Quality Improvement

But all of 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 cause detected by a point out of control” (our sporadic spike in Figure 3.3). “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)[60].”

If we want to implement TQM in an organization, it is necessary to comply with the principles of this model. TQM is not a management style that occurs suddenly in organizations, but a management style that can be formed in the long term, which envisages the change of the entire company culture from individuals to the organization. For this reason, many businesses complain about TQM and give up on implementing it. If TQM is not implemented thoughtfully in the long term, it will be natural to complain because the result will not be achieved. In many companies, it has been observed that this management style, which is implemented with long-term consideration and training and patience, brings leadership and profit to companies in the long term. If we want to implement TQM in a business; First of all, we should put people and universal principles, not work, at the centre of life. These are personal integrity, fairness, consistency, honesty, human dignity, service, quality, development, process, potential, unconditional love, patience, helping, supporting, encouraging, etc. These principles express aspects of human nature that are applicable and valid in every culture, every environment, and every age. Then, we can fully apply the rules that constitute the essence of philosophy in the organization. Of course, it will not be difficult for people and organizations that place universal principles at their core to achieve Total Quality.

As long as the importance of people is known, no management style is difficult to implement. Management styles that do not have people at the centre must also be left behind. The reason why TQM is given great importance and gained as a result is that it has the human factor at its core.

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[57] *ibid*, pg.14.12
[58] *ibid*, pg.14.12
[59] *ibid*, pg.14.12
[60] *ibid*, pg.14.12

3.4.5-THE KEY ELEMENTS OF QUALITY INFRASTRUCTURE

Total Quality Management is also defined as a customer-driven process and goals for continuous improvement of business operations. It ensures that all related work (in particular the work of the employees) is directed towards the common objectives of improving the quality of the product or the quality of the service, as well as the production or execution process of the services. However, the focus is on evidence-based decision-making, with the use of performance measures to monitor progress (Deming). TQM is a business concept that aims to meet the customer's current and future expectations fully and economically. There are critical elements required for the successful implementation of TQM.

Figure 3.4 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.

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 as well as other elements of TQM. Again the ISO 9000 series of standards provides a good starting point for contractual relationships by adding a solid quality management structure.

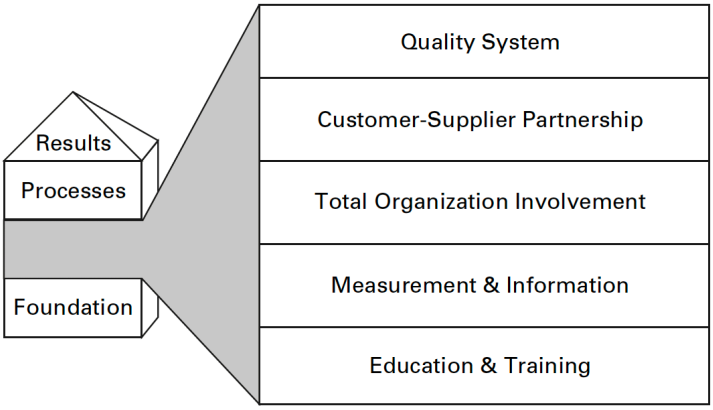

Figure.3.4-The total quality infrastructure. (Leadership for the Quality Century, 1997, Juran Institute, Inc., Wilton)[61]

The total quality infrastructure will be summarised in 5 Cs such as commitment, culture, continuous improvement, customer focus, and control.

-Commitment

Quality improvement (in all aspects) must be the work of all members of the organisation. A clear commitment on the part of management must be provided, removing barriers to continuous quality improvement and the steps necessary to create an environment conducive to attitudinal change. Training and support in this regard should be expanded.

- Leadership commitment
- Encouraging employee involvement (Human resources management)
- Setting clear objectives and goals
- creating a TQM implementation plan
- Establishing TQM processes and systems
- Implementing Kai-zen philosophy into the culture of the organisation

[61] *ibid*, pg.14.13

- Participation of all functions
- Policy-strategy diffusion
- Management evaluation
- Communication

-Culture

Culture is a step for successful implantation of TQM. Therefore, before changes take effect in the culture and attitude of the organisation, suitable training and awareness is necessary.

- Proactive organisational culture (training and education, Progressing Human resources)
- employee involvement and empowerment,
- Excellence for teams
- Suggestion scheme.

-Continuous Improvement

Improvement needs to be understood as not only a one-time affair. Rather, it is a process that is continuous in nature. It is basically a need of the customer, as well as of the service provider.

- Education and training (human resources management)
- Kaizen
- Process approach (modulated implementation, problem solving approach)
- obstacles to implementing TQM
- Continuous improvement-development (Zero error and PUKO)
- Excellence teams.
- Cross-functional process management.
- Attain, maintain, improve standards.
- Customer Focus
- Partnership with suppliers.
- Service relationship with internal customers.
- Customer-driven standards.
- Never compromise quality.

-Customer Focus

A customer-oriented approach ensures the intention of the organisation is to attain perfection with no defects and giving comprehensive satisfaction to the end-user. The users could be internal to the company or external.

- Responsive behaviour (customer focus, supplier relationships)
- customer involvement
- Cooperation with suppliers

-Control

A process control exercise through monitoring and regular checks ensures no deviation from the intended course of implementation

- Assessment of current state (financial sources, current status)
- Working with goals
- Monitoring and measuring performance- Systematic measurement.
- Celebrating successes, recognizing and appreciating achievements
- Data-driven decision making (measurement and feedback)
- cost of failure

3.5-GENERAL PRACTICES USED IN TQM APPLICATIONS

In Total Quality Management (TQM), continuous improvement, idea generation, and problem analysis are fundamental practices aimed at enhancing organizational performance and achieving excellence:

-Continuous Improvement

This cornerstone principle emphasizes the ongoing effort to enhance processes, products, and services incrementally. It is often expressed as **Kaizen** principle. It involves identifying areas for improvement, implementing changes, measuring their impact, and then repeating the cycle. Continuous improvement fosters a culture of innovation, efficiency, and adaptability within an organization, ensuring that it evolves and remains competitive over time.

-Idea Generation

Idea generation techniques in TQM encourage employees at all levels to contribute creative solutions and innovative ideas to address challenges and improve processes. These techniques can include **brainstorming sessions**, **suggestion programs**, **quality circles**, and benchmarking against industry best practices. By harnessing the collective intelligence of the workforce, organizations can tap into a diverse range of perspectives and insights to drive positive change.

-Problem Analysis

Problem analysis techniques are used to systematically identify, analyse, and resolve issues that impede organizational performance or quality standards. These techniques often involve structured problem-solving methodologies such as root cause analysis, fishbone diagrams (Ishikawa diagrams), Pareto analysis, and failure mode and effects analysis (FMEA). By thoroughly understanding the root causes of problems, organizations can implement targeted solutions to prevent recurrence and improve overall efficiency and quality.

Together, these TQM concepts and practices form a cohesive framework for driving continuous improvement, fostering innovation, and effectively addressing challenges to achieve organizational excellence.

TQM sees an organisation as a set of processes. It argues that organisations must strive to continually improve these processes by integrating the knowledge and experiences of workers. The simple goal of TQM is ‘To do things right, the first time, always.’ TQM is infinitely variable and adaptable. This management approach covers several areas, although it was originally applied to manufacturing operations. For several years, it has only been used in this field. From now on, TQM is identified as a generic management tool, which also applies to services (health and safety), industrial enterprises, and the public sector. There is a series of evolutionary units, with different sectors creating their own versions of the common predecessor.

Total Quality Management, in other words, can also be expressed as total perfection. Total quality management started in the USA but matured in Japan, then came to the agenda again in the USA in the 1980s and influenced Western Management thought in the early 1990s.

The main philosophy behind the spread of the Total Quality Management approach is; It is the concept of "zero error in production". The principle of zero error production, which is tried to be achieved in production, has attracted the attention of the whole world. Therefore, it can be said that the interest in Total Quality Management was, at least in the beginning, with a purely pragmatic approach.

The Total Quality Management approach requires a fundamentally new culture and philosophy. Therefore, this approach is closely related to organizational culture and management philosophy in the organization. Quality is very important for individuals who benefit from the products and services of a social institution. Quality includes the physical quality, efficiency level, reliability of produced goods and services and the most rational use of

resources to produce them. While in traditional management, errors and waste are tolerated as long as they do not exceed the specified standards and conditions, in Total Quality Management, the aim is to produce goods and services with zero errors, that is, to achieve perfection. If the products of social institutions arising from social needs do not have the qualities desired by the society, after a while the demand for their products decreases and the existence of the institution is in danger. This simple fact has facilitated every institution's orientation towards the concept of total quality.

As it is known, TQM is not only about product and service quality, but also a modern management approach. Quality Control, which was previously on the agenda in the production sector, has gradually begun to be replaced by quality management systems that can be adapted to various areas of both the production and service sectors, with the development of methods to be used to control quality. When we say TQM today, we are talking about a much different subject than quality control; Quality Control controls and inspects the quality of the finished product. With the Total Quality approach, it is aimed to produce and plan error-free products and services and eliminate the need for quality control. Total quality management is a management approach that must be adopted in order to maximize efficiency in a business, approach zero defects and ensure 100% customer satisfaction, with full participation within the company.

3.6- THE PHILOSOPHY OF KAIZEN

Kaizen, a term originating from Japan, embodies the ongoing enhancement of processes, work culture, and various organizational aspects to ensure continuous quality refinement. An integral aspect of kaizen revolves around the perpetual pursuit of improvement. Notably, introducing innovative products or technologies into an organization isn't inherently challenging; rather, the true difficulty lies in maintaining established procedures while consistently pursuing improvement. Numerous organizations have endeavoured to initiate initiatives such as Quality Circles (QCs), re-engineering, and lean manufacturing. However, success rates have been varied, with many encountering obstacles primarily due to identifiable reasons. For instance, despite efforts by numerous foreign organizations to implement QCs by integrating workers, the majority failed to embrace this concept. This failure stemmed from the necessity for new infrastructure, internal facilities, systems, and measures to ensure the continuity of QC actions. Such occurrences often result from a lack of understanding of the kaizen philosophy.

These are the basic elements of kaizen[62]:

-Kanban includes customer focus.

-Systematic approach for managing quality programmes.

-Continuous improvement of processes.

-Zero-defects policies for defect reduction.

-Effectiveness of procedure activities for quality improvement.

-Proper networking of each facility of the organisation.

For proper implementation of above elements, the following activities must be carried out in the kaizen philosophy:

-Proper customer orientation.

-Implementation of Six Sigma.

-Total productivity maintenance for continuous improvement.

[62] Luthra S, Garg D, Agarwal A and Mangla SK (2021). Total Quality Management (TQM) Principles, Methods, Applications.CRC Press. Boca Raton, p121.

-Just-in-time approach.

-Automation of organisation facilities.

-Poka yoke, which means flexibility.

Kaizen essentially comprises six key elements or pillars, represented metaphorically as an umbrella in Figure 3.5.

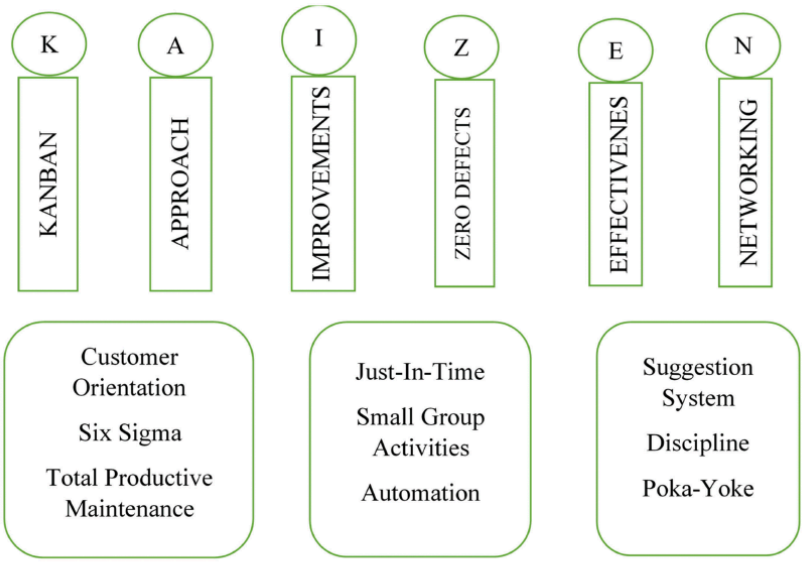

Figure.3.5-The six pillars of kaizen[63]

It is a process-oriented, small-step, human-based, knowledge-sharing effort to constantly seek the good. The main motto of Kaizen is: "The best is the enemy of the good." Not hiding or covering up problems is a prerequisite for Kaizen applications. During the problem-solving phase, Kaizen teams formed from different areas of expertise are assigned. Rather than finding a solution to problems in a short time, it is preferable to find a solution that will solve the problem at its root. The aim is not to save the day with temporary, palliative measures, but to save tomorrow with permanent solutions. Otherwise, the problem will show itself again after a short time.

While Western societies have always focused their attention on inventions, major breakthroughs and results, Japan has achieved more positive results by directing its attention to progress and processes through small steps. Although, there is almost no significant technology (computer, electronics, atom, genetics, etc.)

Even though they were not developed in Japan, the best practitioners of these technologies were the Japanese. The Japanese took these technologies from the West and took them further with small but sure steps. The two main elements of management in Japan are protection and improvement. Management first determines the necessary company policies, rules, instructions, and procedures for all main operations and then tries to ensure that everyone complies with these standards.

Then the Japanese management approach can be summarized with a single rule: "To maintain and improve standards." Improvement is perceived as kaizen and innovation. Kaizen refers to small-scale improvements in the current situation as a result of continuous efforts. Innovation, on the other hand, is the radical change of the current situation as a result of large investments in new technology and/or tools. The starting point for improvement is the recognition of the need for improvement. If there is no problem noticed, there is no need for improvement. Being content with the current situation is the arch enemy of Kaizen.

[63] *ibid,* p122.

Once identified, the problem must be solved. By solving the problem. Together, the improvement reaches a more advanced level each time. In order to consolidate the new level reached, the improvement provided must be standardized. To achieve continuous improvement, three basic conditions must be met:

1- Finding the current situation inadequate: Even if a system works perfectly, methods to improve it can definitely be found. Moreover, developments in science and technology and customer expectations move the "efficiency" criterion forward every day.

2- Developing the human factor: It is the "human" who does everything. Human resources are the most valuable asset for an organization. The use of this resource in the conventional management style is quite insufficient. However, it is necessary to make every employee a member of these development activities.

3-Using problem-solving techniques widely: The biggest mistake made in solving problems is to focus on the symptoms and not see the underlying causes of the problems. In order to solve the problems well, it is necessary to trace every problem to its most extreme cause and solve the underlying problem so that it does not arise again. While investigating the cause of the problem, asking why five times usually gives good results and the real cause of the problem, rather than the visible cause, can be revealed.

If we list the benefits of continuous development;

-A vitality occurs in all activities of the organization.

-It is ensured that the group works towards the same goal and target.

-Departments carry out their own business more effectively and efficiently.

-Problems of interacting departments are solved quickly and permanently. ·

The basis of kaizen is the ‘5S’ model, as introduced by Japanese experts as a combination of goods, customs, and behaviour, taken from the conventional approach to behaviour in home and education institutions. Basically the ‘5S’ concept is taken from the five Japanese words. The five 5S concept is explained briefly as follows:

-Seiri means selection: This includes appropriate selection of a place of work, behaviour, and proper instrumentation facilities of work, with the removal of everything which is unwanted or useless.

-Seito means a proper ordering system or systemic approach: Compactness of a workplace and having every necessary tool and technique for making them simple and quickly used.

-Seiso means clearness or cleaned-up work environment: A clean work environment enhances work safety to avoid injuries and gives better control of equipment and enhanced accountability for the resources of manufacturing.

-Seiketsu means standardising: There should be set of standards for an organisation for its culture and facility utilisation based on which each worker performs their duties. It helps in taking care of equipment and maintaining workplace in order.

-Shitsuke means sustain: This is the capability of workers to maintain self-discipline without managing by the top authority. Adjustments by workers based on the standards followed by the organization will definitely avoid bad habits and give guidance.

The proper adoption of the 5S concept allows the perfect implementation of the kaizen philosophy. In this, continuous improvement performed by all the workers participates in practices of changing the whole organisation. The block diagram of the 5S concept based on innovation is shown in Figure 3.6.

The comparison of the basic features of kaizen philosophy and innovation is demonstrated in Table 7.2.

Figure.3.6. The six pillars of kaizen[64]

Figure.3.6. The six pillars of kaizen[65]

Table.3.1-The Comparison of Basic Features of Innovation and Kaizen Philosophy

Innovation	Kaizen
1. Creative form of production	1. Capable of adapting
2. Needs individual work	2. Requires teamwork
3. Needs specialist worker	3. There is no such need
4. Needs great knowledge on general topics	4. Needs great knowledge of details
5. Focused on techniques	5. Focused on workers
6. Information will flow toward a specific person	6. Information will flow through a specific channel
7. Focused on individual section	7. Focused on entire department
8. Searching for new technologies	8. Based on existing technologies
9. Limited feedback	9. Strong feedback
10. Short-term effect	10. Long-term effect
11. Involvement of specific chosen top management	11. Involvement of all workers
12. Adapting to fast-rising market of any country	12. Adapting to slow-rising market of any country
13. Requires huge investment	13. Requires small investment
14. Results are in the form of specific benefits	14. There is no specific output or unpredicted benefits

Please answer the questions in Session#7 in Workbook1

[64] *ibid,* p123.
[65] *ibid,* p123.

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Quality Assurance in VET Institutions

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