ANALYSIS OF EXISTING QUALITY ASSURANCE SYSTEM OF EME BASE WORKSHOPS (EMER- H-409) AND REVISE IT, ON THE BASES OF TOTAL QUALITY MANAGEMENT (TQM) PHILOSOPHIES

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ABSTRACT

In order to control and assure Quality in any Base / Regional Workshop under taking overhauling projects, it was observed that different departments of Workshops are not working as per latest TQM Techniques. So, a need arises to organize different departments especially QAD as per currently used worldwide Quality standards and TQM Techniques. Although EMER H-409 is a useful source of guidance for QC and QQ in the Base Workshops, but it was published in late 80's when organizations were having less knowledge of TQM Philosophies. Due to latest developments, Inspection, Control and Assurance have been combined by TQM, and highlights awareness among all stakeholder of an organization (including suppliers, organizations, service providers and users). Modern TQM philosophies are comprehensive and adopted by world leading organizations to achieve maximum productivity and customer satisfaction.

Upon analyzing the existing EMER H-409, it is found that,

- It is based on general policy and broad guidelines for the functioning and organizing QAD of workshops undertaking overhauling projects, which require incorporation of current TQM Techniques.
- It prescribes adequate systems and procedures to be maintained for QC and QA without providing adequate guideline for preparation of SOPs.
- It has centralized organizational structure with rigid lines of authority.
- Quality is mainly dependent on top management vision.
- Training on Quality is not considered as a future investment and involvement of workforce is not motivated.

However, with the passage of time, due to emergence of TQM philosophies, all stakeholders got involved in inspection, QC and QA, thus suggesting revision of existing EMER in order to streamline Quality procedures and practices of Base workshop. This will make organizational structure more flexible and focused on team work with the perception that HR is an asset and training is not a cost but an investment. It will also provide ways of managing the Quality in workshops at all level to achieve users' satisfaction by involving Officers (Engineers), JCOs (Supervisors) and NCOs / Soldiers (technicians) in a process of Continuous Quality Improvement (CQI).

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AC	Air Conditioning
APIC	Army Performance Improvement Criteria
ASQ	American Society for Quality
Brig	Brigadier
CAPA	Corrective and Preventive Action
Capt	Captain
CI	Continuous Improvement
CIP	Continuous Improvement Process
COAS	Chief of Army Staff
CPM	Critical Path Method
CQI	Company Quality Improvement
CUSUM	Cumulative Sum
CWQC	Company Wide Quality Control
DG	Director General
Dr	Doctor
EBW	Electronic Base Workshop
EME	Electrical and Mechanical Engineering
EMER	Electrical and Mechanical Engineering Regulations
EWMA	Exponentially Weighted Moving Average
GE	General Engineering
GHQ	General Head Quarters
GMP	Good Manufacturing Process
HR	Human Resource
IEME	Indian Electrical and Mechanical Engineers
ISO	International Standard Organization
JCO	Junior Commissioned Officer
JD	Job Description
Lt Col	Lieutenant Colonel
Maj	Major

MTO	Mechanical Transport Officer
NCO	Non Commissioned Officer
No	Number
OIC	Officer Incharge
OJT	On Job Training
PDCA	Plan Do Check and Act
PEME	Pakistan Electrical and Mechanical Engineers
PERT	Project Evaluation Review Techniques
PNQA	Pakistan National Quality
QA	Quality Assurance
QC	Quality Control
QAD	Quality Assurance Department
QAL	Quality Assurance Laboratory
QAT	Quality Assurance Team
QCC	Quality Control Circle
QIT	Quality Improvement Team
QM	Quality Management
QMS	Quality Management System
QP	Quality Policy
REME	Royal Electrical and Mechanical Engineers
RIAOC	Royal Indian Army Ordnance Corps
RIASC	Royal Indian Army Service Corps
SOP	Standing Operating Procedure
TM	Technical Manual
TQM	Total Quality Management
UK	United Kingdom
VAL	Vehicles Assembly Line
VIP	Very Important Person
WW-II	Second World War

CHAPTER 1

INTRODUCTION

1.1 Background

Pakistan Army in its present form is a large organization with more than 50,000 technical tradesmen with over 2000 Engineers and correspondingly possesses a heterogeneous inventory. It has a large collection of vehicles and equipment with varying origins and varieties. The quality of over hauling certainly depends upon the inspection and its verdict which plays a decisive role for subsequent action for readiness and satisfaction of user units of Army. In view of technological development in modern equipment, the overall responsibility of Corps of EME has increased manifolds with regard to repair, maintenance and inspection which warrant frequent revision of EMER.

Quality of overhauled vehicles and equipment is not only of vital importance from the stand point of functional reliability but it is also an essential pre requisite to justify the cost of overhaul and allows gaining confidence of all dependent formations. Inadequate QC always results in wastage of material, HR and time resulting to high rate of product rejection. Therefore creation of dedicated, technically equipped and functionally independent department is inevitable which can be tasked to ensure the specified standards of production. The importance of necessary documents to have an up to date and accurate record for quality control in the workshop cannot be over emphasized and so EMER are useful source of guidance and references for quality assurance and control in the workshops under taking Base overhaul assignments. With the passage of time, the concept of inspection, control and assurance start encompassing TQM philosophies which highlights awareness among all the stakeholders i.e. suppliers, service providers and users. Similarly provision of better work environment, availability of requisite work facilities, high quality tools, adequate and precise training and job satisfaction of the internal customers enhances the quality of work and services and in turn will increase the satisfaction level of external customer.

Keeping above in view, it is imperative to revise and modify current EMER on QA, which does not contain TQM philosophies in order to lay down general policy and broad guide lines for the functioning of EME Base Workshops. It should also prescribe systems and procedures and records to be maintained to establish quality audit trails so

that failures can be traced to the errant operator machine, material and process level in order to have accurate corrective and preventive actions. If Workshop adhere strictly and implement intelligently all the current and up to date instructions contained in the revised / modified EMER, then it will help in reducing waste, improve resource utilization, increase productivity, ensure quality and guarantee good reputation of the workshop.

1.2 Prerequisites for QA in Base Workshop Based on TQM

Following consideration need to be taken into account while enforcing Quality Assurance in EME Base and Regional Workshops.

- Quality culture
- Quality strategy and QP
- Mission statement related to QA
- Aim and Objective as per QA
- Difference between traditional approach and TQM approach
- Characteristics of TQM
- Improvement in Quality through different TQM tools and techniques
- JD of Commandant, Deputy Commandant, QA officers and supervisors
- JD QC and QA sections
- Functions of statistics and record office
- Functioning of central store and spare sections
- HR management
- Comprehensive and detail inspection procedure
- Record keeping and its presentation
- Flow process charts, checklist and quality audits
- Organizing Quality Assurance department (QAD)

1.3 Research Aim and Objectives

The purpose of this research study is to carry out an in depth analysis of existing EMER H-409 on Quality Assurance System of EME Base Workshops which is not in line with new Total Quality Management (TQM) Philosophies. These TQM Philosophies will be study thoroughly and then utilize to make new SOPs of different sections of Base and Regional Workshops in order to enhance its productivity and user satisfaction.

1.3.1 Research Aim

The aim is to revise the current EMER H-409 on Quality Assurance in the Base Workshops, according to latest Total Quality Management (TQM) Philosophies.

1.3.2 Research Objectives

The main Objectives of this work will be as follows;

- To analysis thoroughly current EMER H-409 on QA of Base Workshops.
- To study the latest TQM Philosophies in detail.
- To highlight different TQM Tools and Techniques applicable.
- Critical analysis of EMER H-409 and highlight anomalies observed.
- To suggest a revised EMER H-409 by incorporating different TQM techniques.

1.4 Research Approach / Methodology

A logical research approach adopted throughout this work is defined as follow and explained in Figure 1.1.

- Comprehensive literature review about TQM Philosophies / Techniques.
- Overview of Quality Control (QC) and Quality Assurance (QA).
- Thorough study of existing EMER H-409 on Quality Assurance (QA).
- Critical analysis to know the shortcomings / anomalies observed.
- Circulation of a Questionnaire to all Base / Regional Workshops.
- Highlight those areas need to be improved based on the feedback received.
- Revision of existing EMER H-409 based on Critical Analysis.

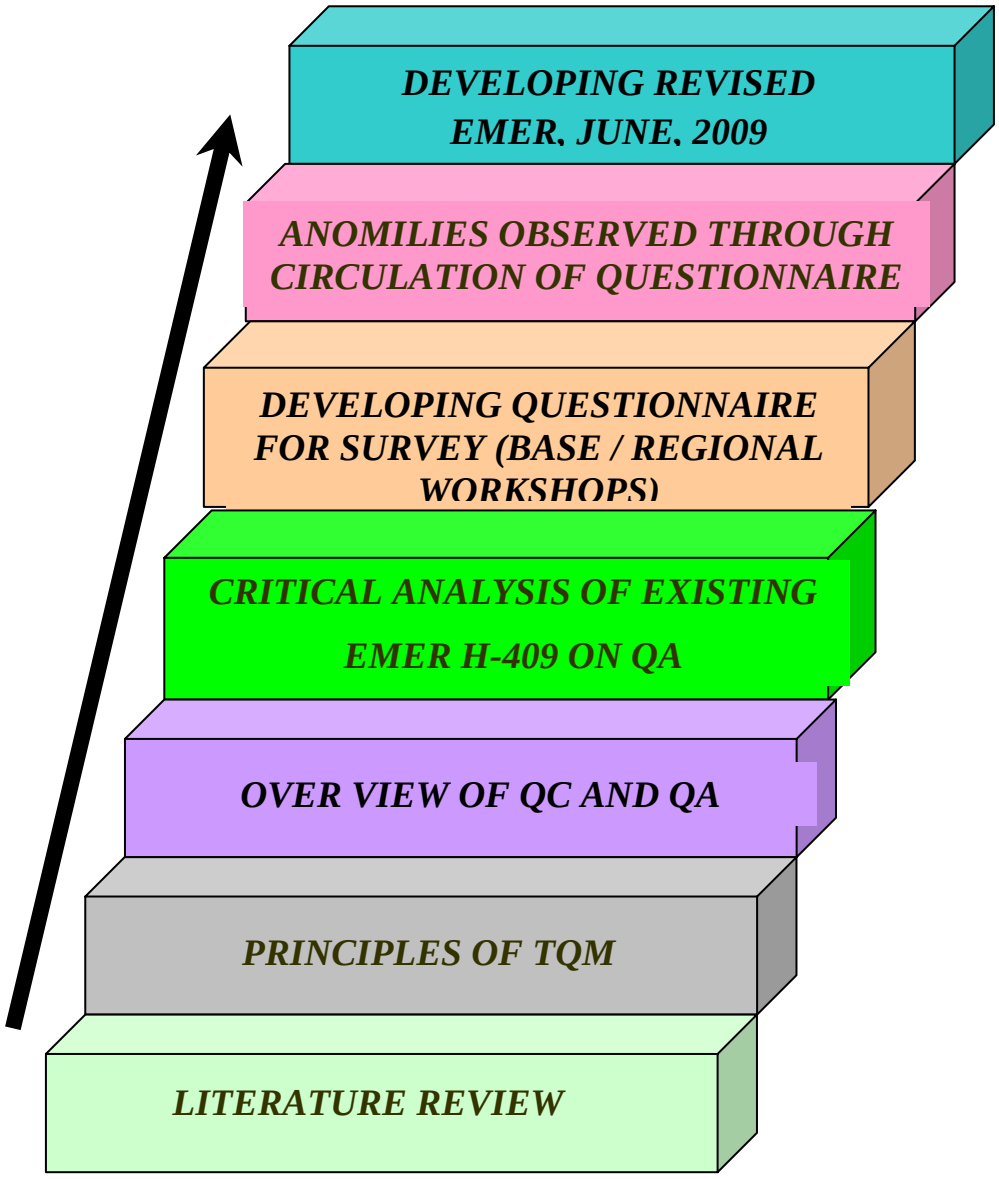

Figure.1.1. Research Methodology / Approach

Source: Conceived through the lectures of Professor Brig Dr Nawar Khan on TQM, delivered to the Students of Master of Subject in Engineering Management, Department of Engineering Management, College of E& ME, National University of Science and Technology (NUST), Islamabad, Pakistan

1.5 History of EMER

1.5.1 Royal Electrical & Mechanical Engineers Corps (REME)

In 1942, Royal British Army introduces Royal Electrical and Mechanical Engineers Corps in order to keep vehicles, armament, tanks and different equipment participating in World War II in battle worthy condition. This corps at the time of its raising was deployed in war zone in order to accomplish the assigned task.[1].

1.5.2 Indian Electrical and Mechanical Engineers Corps (IEME)

Before the partition of sub continent, Royal British Army introduced Royal Indian Army Ordnance Corps (RIAOC) and Royal Indian Army Services Corps (RIASC) in the sub continent. The task of these corps was to keep the large inventory of equipment and vehicles in a battle worthy condition. The task was divided as RIAOC was given the responsibility of maintaining tanks and armaments while RIASC was given the responsibility of maintaining all types of vehicles. With the advancement and progress new and new vehicles, armaments and tanks get inducted into Royal army and so higher authorities considered that a better and reliable system of maintaining these equipment is necessary. This idea was given due consideration and so workshop branches of RIAOC and RIASC were merged and a new corps with the name of Indian Electrical and Mechanical Engineers Corp (IEME) was raised on First May 1943 [1]. This newly raised corps faced many problems at the beginning as acute shortage of men power and availability of different tools. Moreover there were no proper procedures set for the maintenance of all types of equipment and vehicles. As the maintenance activities of different type of vehicles and equipment went on, it was strongly felt that proper regulations should be adopted in order to streamline the repair and recovery procedure adopted during peace and war. Officers of this newly corps worked continuously and succeeded in formulating different regulations about usage and maintenance of vehicles, equipment and tools. These regulations also cover aspect of HR (men power) authorized to different workshop establishments. These regulations were then named as ‘Electrical and Mechanical Engineering Workshops working Regulations’. With the passage of time, these regulations were also kept on revision / modifications in order to cope up with new and new induction.

1.5.3 Pakistan Electrical and Mechanical Engineers Corps (PEME)

In 1947, partition of sub continent took place and India divided into two sovereign nations as Pakistan and India, and so Indian Electrical and Mechanical Engineers (IEME) Corps was also segregated as Indian Electrical and Mechanical Engineers and Pakistan Electrical and Mechanical Engineers (PEME) Corps [1]. In Pakistan Army, this corps performs the most demanding responsibility of keeping the Army's equipment in the highest state of readiness along with recovery of damaged vehicles, tanks and equipment during any operation. The name of the corps as Pakistan Electrical and Mechanical Engineers (PEME) was re designated as Corps of Electrical and Mechanical Engineers (EME) in 1956 and thus a new era of improvement as far as corps of EME is concern started. Since, Pakistan's share of EME resources and installations was very less as compared to IEME at that time, but the moral and courage was much more at that time and due to this high moral and courage, the corps was progress beyond the imagination. Even very less number of officers and technical personnel were transferred to Pakistan, but they were highly motivated and technically sound and worked day and night to bring the corps up to the required standards [2].

1.5.4 EMER

At the time of partition, some workshop regulations were exist with REME, but it was not sufficient to suite the requirement of PEME. Moreover it was not possible to transfer all regulations to Pakistan due to hostile environment. It was reached in the hand of PEME after a lapse of 18 months. Senior management of PEME at that time agreed to run the corps as per the following agenda;

- Royal British workshop regulations will be used for the time being for currently held vehicles and equipment.
- Efforts will be made to write and publish new regulations to suite Pakistan' environment keeping in mind Pakistan Army capability and mission..
- To streamline already held procedures and SOPs according to Pakistan Army state of equipment and HR.

The task of formulating new regulation completely in line with Pakistan Army requirement was not an easy task due to the shortage of officers, but high morale and dedication was there, and so it was done in an excellent manner [2]. Finally, they were

come up with different regulations regarding working of different EME establishment, HR, provision of spares and different tools and maintenance, repair and overhauling procedures of all types of vehicles and equipment. These regulations were named as 'Electrical and Mechanical Engineering Regulations (EMER)'. Since, induction of new equipment and vehicles in the Army is continuous so these EMER are also need to be updated regularly in order to suite the requirements of the corps.

1.6 Existing EMER H-409 on QA in Base Workshops

Existing EMER H-409 on Quality Assurance [3] currently used by EME Base / Regional Workshops was published in February, 1989 and is attached as Annexure 'A' in its original form.

CHAPTER 2

LITERATURE REVIEW

2.1 Chronological Perception of Quality

The impression that QC through statistical methods can save costs and enhance product serviceability was originally conceived and developed by the great Dr. Walter A. Shewhart in 1920. He described this as “An indication of the direction in which future development may be expected to take place” [4]. QC was authorized and promoted by different Armies of the world as a mean of saving vital resources and ensure requisite quality procurements. It is important to note here that QC measures were the main contributors towards the winning of World War II, because these method work efficiently during that era and earn promising results.

When United States enter into World War II, they made quality a critical component and all efforts were diverted to quality. They tried to build new standards of quality so as to keep standardization of the equipment and material. This efforts suite their requirement and they achieved alarming success. United States Army also changed the method of inspection as initially every unit was inspected which was not possible and so they turn to sample and surprise inspection without compromising quality and safety aspect [4]. Total Quality was introduce in United States through Japanese Quality revolution and W. Edwards Deming and Joseph M. Juran were the persons who worked on quality and focused on improving all organizational processes through the involvement of people.

2.2 Explanation of Different Terms of Quality

2.2.1 Quality

“Quality is first and foremost about meeting needs and expectations of customers. It is a degree of excellence and the extent to which something fit to its intended purpose”.

It can also be defined as, “Conformance with requirement, freedom from defects or contamination and simply a degree of customer satisfaction” [5].

QM define quality as, “The totality of characteristics of a product or service that bears on its ability to satisfy its stated and implied needs”[6].

Crosby describe quality as, “Quality is conformance to requirements or specifications” [7].

Juran a guru of quality, define quality as, “Quality is fitness for use” [7]. Some other definitions are as under.

- Quality is a Habit not an act, stated by Aristotle [7].
- Quality is a degree of user Satisfaction [8].
- “The quality of a product or service is the fitness of that product or service for meeting or exceeding its intended use as required by the customer” [8].

2.2.2 Basics of Quality

Quality can be divided into following basic fields.

- Inspection
- Quality Control
- Quality Assurance
- Quality System Accreditation

2.2.3 Quality Control (QC)

QC defined by American Society of Quality (ASQ) as, “It is a system that is used to maintain a desired level of quality in a product or service [9]”. This task may be achieved through different measures as planning, design, use of proper equipment, procedures, inspection and taking corrective actions if deviation observed between output and specified standard. QC is concern with detecting defective output rather than preventing it so it is an expensive process.

2.2.4 Quality Assurance (QA)

QA is about how a business should design the way a product or service to produce or deliver to minimize the chances that output will be sub standard. The focus of QA is, therefore on the product design and development stage. Everyone involves directly or indirectly in the production of an item is responsible for QA.

2.2.5 Objective of QA

The objective of QA is to have a formal system that continually surveys the effectiveness of quality philosophy of an organization [10]. It is related to all planned actions necessary to provide confidence in a product or service [11]”.

2.2.6 QC versus QA

QC emphasizes testing and blocking the release of defective products while QA is about improving and stabilizing production and associated processes to avoid or at least minimize issues that led to the defects in the first place. QA does not eliminate QC because some product parameters are so critical that it requires testing [11] .

2.2.7 Quality Management (QM)

QM is concern with different controlling activities to ensure that products and services produced are compatible with its intended use and meets requisite specifications. If we fit this QM perception in Workshop then it says that output of the workshop must fit to its intended purpose and should meet customer satisfaction.

2.2.8 Cost of Quality

There are four categories of costs that are associated with producing poor-quality products or services:

- **Prevention costs** - Incurred to keep failure / appraisal costs to a minimum.
- **Appraisal costs** - Incurred to determine the degree of conformance to quality requirements.
- **Internal failure costs -** Associated with defects found before the customer receives the product or service.
- **External failure costs** - Associated with defects found after the customer receives the product or service.

2.2.9 Quality Circle

A Quality Circle is a volunteer group composed of workers who meet to talk about workplace improvement, and make presentations to management with their ideas, especially relating to quality of output in order to improve the performance of the organization, and motivate and enrich the work of employees.

2.2.10 Zero Defects

Zero Defects is to cut costs by reducing quality inspection processes and demanding that suppliers dramatically improve the quality of their supplies. This eventually results in demands for the "Zero Defects" standard [11].

2.2.11 Corrective and Preventive Actions (CAPA)

These actions focus on systematic investigation of discrepancies (failures or deviations) and try to stop them to recurrence. In order to ensure effectiveness of these CAPA proper investigation of failure is pivotal in identifying the corrective and preventive actions undertaken.

2.2.12 Quality Audit

The aim of quality audit is to have an efficient and independent examination in order to determine that whether quality actions and related results comply with planned arrangements, and weather these arrangements are implemented effectively to achieve quality objectives [11].

2.3 Standardization

The aim of standardization is to provide equality and consistency to a unit and ensures ease of replication. It sets those standards which are consistent with customer requirements, and to prescribe the requirements or specifications through standard documents to which processes, products and services have to conform [11].

2.4 Main Concepts of Quality

TQM is a comprehensive integrated management system which has been adopted by leading organizations. It is a way of managing workshop in order to achieve user satisfaction by involving engineers (Officers), supervisors and technicians (Junior Commissioned Officers / Soldiers) in a process of continuous improvement to enhance quality of the product delivered to the customers. These concepts of quality play a significant role in addressing different problems as follows;

- How well the process is design to have consideration and reliability.
- Physical component of many services is important as how well service is designed and produced does make a difference [11].
- QC system should have a set of alternate plans for optimal conditions.
- Quality of product is being judged on the basis of meeting expectations [12].

2.5 Variation between Conventional Approach and TQM Approach

Conventional approach of management is different than TQM Approach in many ways. The main differences are enlisted in Table 2.1 for reference purpose only.

2.6 Different TQM Philosophies and Concepts

The general spectrum of quality progression is depicted in Figure 2.1 and later on, all these techniques and systems were integrated under the umbrella of TQM which emerged as competitive business quality philosophy provides basis to all processes and functions on which production of excellent quality product and provision of superior services depends [12]. Several experts have contributed to the field of quality in different times. These people are known as Quality Guru and their contribution made organization aware about TQM. Different philosophies presented by different Quality Guru in their times are as presented below in order to implement them in true letter and spirit.

2.8.1 Deming's Concepts of TQM

Deming's famous points of TQM are presented below;

2.8.1.1 Create and Communicate Aim and Plan of the organization to Everyone Concerned and Establish Consistency between them

Organization must first decide aim clearly, and then publish it in order to communicate it to everyone and make sure that it should be in the language easy to understand by everyone. Then come the phase of implementation and it is the duty of top and middle management to demonstrate their commitment to the aim.

2.8.1.2 Gradually Reduce Dependence on Inspections and Inspectors

Purpose of inspection is to get information about process and product acceptance and on basis of this information management may take certain steps to improve process so as to reduce waste and cost of production. The ultimate aim of inspection should be to improve the system and to enhance competency level [13].

2.8.1.3 Reduce / Decrease Process and System Variation

Management must go for focused analysis of problems by active participation and correction in processes to enhance quality and productivity continually and reduce production costs. The focus must be on the process, which produces products and not on the product itself, which is the outcome of that process.

Table 2.1. Traditional Approach versus TQM Approach

S.No.	Conventional Approach	TQM Approach
1.	Focus is on maintaining the status quo.	Focus is on continuous improvement of the system and processes.
2.	Hierarchical organizational structure with rigid lines of authority	Less hierarchical and more flexible organizational structure.
3.	Relationship of supervisor and subordinate are related to dependency, fear and control.	Relationship of supervisor and subordinate are related to trust and mutual commitment.
4.	Supervisors act as bosses or cops.	Supervisor act as coaches and facilitators and manager as a leader.
5.	Employee's effort is individual effort and workers considered themselves as competitors.	Employees' efforts shifted to team effort and workers considered themselves as team mates.
6.	In this approach management determine quality.	In this approach customer define quality.
7.	Decisions are based on management self will and instinct.	Decisions are totally based on feedback and data received and are govern by customer.
8.	Management thinks labor and training as a cost.	Management considers labor as asset and training not a wasted but an investment.

Source: Adapted from Professor Brig Dr Nawar Khan lectures on TQM to MS students of Department of Engineering Management in College of Electrical and Mechanical Engineering, National University of Science and Technology, Islamabad, Pakistan.

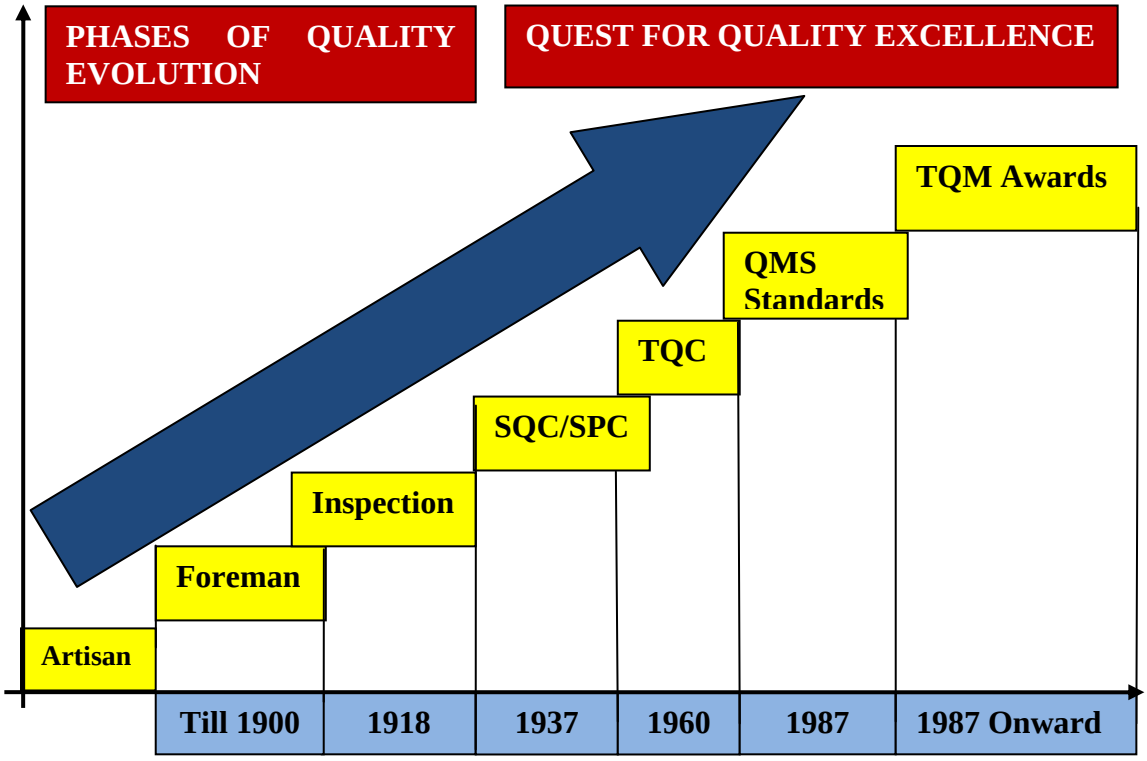

Figure 2.1. Quality Evolution Spectrum

Source: Adapted from Dr Nawar Khan "Total Quality Management (Concepts, Tools, Systems and Awards)", NUST publishing Islamabad, Pakistan, 2008.

2.8.1.4 Remove the Quota Barrier to Increase Productivity

Expert workers can get benefit of producing more of high quality products than standard rate of production estimates but it should not mean to compromise on quality parameters and features. It is pay by result concept which place challenge to every employee for continuous quality improvement in his performance and beneficial to both.

2.8.1.5 Break down Barriers between Departments

There are different departments with different responsibilities and all are independent of each other and due to lack of coordination, there exist layoffs. It is the job of management to eliminate these layoffs, which exist among no man's land and no one accounts himself responsible. TQM suggest cross functional management through close coordination, clear responsibilities and communication.

2.8.1.6 Institute Regular Education and Training for Everyone

Competent HR is necessary for improvement and so, all activities should start and end with education and training. Education enhances awareness and learning process while training perfects the skills. Different methods of training are shown as below.

- Lectures, Seminars, Conferences and OJT
- Case study / Incidents / Special technical quality cadres
- Audiovisual Instructions / Role Playing/ Simulation / Modeling

2.8.1.7 Drive out Fear and Create Environment of Trust / Confidence

Fear of darkness and silence is a very well known phenomenon. Same is the case of fear of unknown in the mind of managers and workers in a Workshop because of their lack of awareness about TQM concepts. It may be due to the following reasons;

- Loss of job / position / status / appointment incentives,
- Expected poor performance under new concepts and change over in system
- Ignorance to the organization new goals and responsibilities,
- No team working by the managers / No training for the new system,
- No surety of the good performance in the newly adopted system of TQM,
- Lack of communication by Workshop managers / control by supervisors.

2.8.1.8 Change Work Environments / Methods to Improve Productivity

Productivity can be improved not only by requesting the workforce to do more but by providing the requisite working environment, methods, tools, equipment, infrastructure and training. Supportive and encouraging environments in a Workshop facilitate improvement and motivation. Work force must be equipped with new tools and techniques and motivated to enhance their performance.

2.8.1.9 Use Team Synergy

Management of the Workshop must optimize efforts of teamwork. Teams can produce synergy effect rather than groups of workforce. Here team members compensate for each other's weaknesses and take advantages of strength. Members of team preferably must have mental, social, cultural, religious and economic harmony with comradeship.

2.8.1.10 Eliminate Exhortations for the workforce

Exhortations that ask for increased productivity without providing specific improvement method and techniques show a handicapped management so, management of the workshop must first provide requisite facilities to workers and supervisors and then ask for increased productivity otherwise management in a workshop consider handicap.

2.8.1.11 Restore the pride in the Workmanship

Every individual should own the organization and take pride in the workmanship of the organization. In the Base Workshop, worker pride in his job will let him to own the organization. Top management should introduce such steps which enhance worker involvement in workshop activities and a sense of pride in workmanship.

2.8.1.12 Empowerment of Workers and Supervisors

Workers at all levels should be considered as assets and their full potential and involvement enables management to tap their abilities and use them for maximum benefit. It can be done through following;

- Recognition / Respect and trust to workers and knowing worker's ability.
- Understand that all workers desire to do good job and extend full support.
- Empowering each I/C section for stage inspection of his concern section.
- Praise or certificate of recognition by the commandant.
- Displaying of good individuals name and photograph in information room.

2.8.1.13 Repeat the Cycle of Continuous Improvements

Improvement is a never ending process and so Management of workshop should always try to find out different ways to improve procedures to enhance productivity. Cycle of continuous improvement should not stop and it should be moving.\

2.8.2 Juran's Concepts of TQM

Juran an American Quality Guru suggested following steps to quality improvements applicable to Workshop to improve productivity and quality [14].

2.8.2.1 Build Awareness of Opportunities to Improve

It is concern with the change in the mindset of Top Management of Workshop and Quality culture through enhanced awareness. This can be improved and appreciated through continuous education, training and allotting priority to quality improvement.

2.8.2.2 Set Goals for Improvement

In a Workshop goals for achievement are set with a proper monitoring and measuring standards. Initial goals should be simple, easy to achieve and have highest probability of success, followed by a challenging goal if time and resources available.

2.8.2.3 Organize to Reach at Goals

In order to achieve goals managers need to have adequate resources with strong and decentralized organizational structure. To achieve defined goals Workshop should be set with team of skill manpower, machines, tools and financial resources.

2.8.2.4 Provide Training

As already discussed, improvement activities start and end with education and training of workforce. Education enhances quality awareness while training perfects the skill and Top Management of Workshop must be committed to training and education.

2.8.2.5 Carryout Projects to Solve Problems

Problems faced by managers in a Base Workshop should not consider as burden, but it should be consider as opportunity for improvement. A workshop manager should take interest in solving problem and consider it as a project. He should plan properly for the solution of any problem faced and arrange for specific team, resources and time.

2.8.2.6 Report Progress

It enables learning and experience to be shared, so good results should be celebrated to give a positive message to other departments. Numerical figures of success should be highlighted through newsletters, notices, circulars and rewards ceremonies and progress should be monitor at every stage of production

2.8.2.7 Give Recognition

Each minor and major achievement by any worker in the Workshop must be recorded and celebrated. Timely appreciation to workers is necessary for motivational factor, which encourages the employees to work with more enthusiasm and zeal.

2.8.2.8 Communicate Results

In the Workshop, this may be a mean to share the joy of the success. Managers must use all the formal and informal means to communicate results to encourage those who achieved it and to motivate others.

2.8.2.9 Keep Score

Improvement projects in a workshop should be recorded as an aid to learning and data for reference. A separate record should be kept through every possible means.

2.8.2.10 Maintain Momentum

A regular improvement system should be established to provide opportunity to give progress of continuous quality improvement. This system will provide review and set new goals for next cycle to generate momentum for quality improvement.

2.8.3 Feigenbaum's Concepts of TQM

He is best known for introducing Total Quality Control (TQC) in the United States of America [15]. His steps towards Quality are discussed briefly as follow;

2.8.3.1 Quality Leadership

Quality leadership establishes vision, unity of purpose, direction and excellent working environments to be fully involved in achieving workshop's quality mission.

2.8.3.2 Modern Quality Technology

In order to resolve 80 to 90 percent of small quality problems, workshop managers need integration of management and shop floor workers in the process who continually evaluate and implement new techniques to satisfy customer's quality needs.

2.8.3.3 Organizational Commitment

In a Workshop this comes through Top management support, approval and workforce participation and involvement. Continuous education, training and motivation of the entire workforce in the workshop indicate importance and priority given to encourage competency level and raising quality.

2.8.4 Crosby's Concept of TQM

Crosby is one of the most famous American Quality experts. He introduced 14 concepts of quality improvements [16] which are shown in Table 2.2.

2.8.5 Dr. Ishikawa's Concepts of TQM

He is best known for Japanese Quality revolution. He was instrumental in development of broad outline of Japanese quality strategy of CWQC (Company Wide Concept of Quality Control) [17]. His concepts are presented in Table 2.3.

2.8.6 Genichi Taguchi's Concept of TQM

He was Japanese Quality Guru. His principles are enlisted in Table 2.4 [18].

2.8.7 Oakland's Concept of TQM

Key characteristics of Oakland Philosophy of TQM [19] are enlisted in Table 2.5 while his key characteristics of TQM are shown in Table 2.6.

2.8.8 Contribution of Professor Dr Nawar Khan to TQM

Professor Dr Nawar Khan is very well known for his tremendous contribution in the field of TQM Philosophy. His contribution to TQM is summarized in Table 2.7.

2.8.9 Common Concepts of TQM Philosophy

Table 2.8 shows Common Concepts of TQM presented by different experts which can be incorporated while revising existing EMER H-409.

Table 2.2. Phillips B. Crosby's Concept of TQM

Concept Number	Concept
Concept 1	Commitment by the Management
Concept 2	Quality Improvement Team
Concept 3	Different measures for Quality
Concept 4	Cost of Quality
Concept 5	Quality Awareness
Concept 6	Corrective action
Concept 7	Planning for Zero Defects
Concept 8	Training of the Supervisors
Concept 9	Zero Defect Day
Concept 10	Goal Setting
Concept 11	Error Cause Removal
Concept 12	Recognition
Concept 13	Quality Councils
Concept 14	Do it All over Again

Table 2.3. Dr Kaoru Ishikawa's Commitments of TQM

Concept Number	Concept
Concept 1	Quality begins with education and it ends with education
Concept 2	First step in Quality is to know the Requirements of Customers
Concept 3	Ideal state of QC Occurs when Inspection is no Longer Necessary
Concept 4	Remove the Root Cause, not the Symptoms
Concept 5	Quality Control is the Responsibility of All Workers / Divisions
Concept 6	Put Quality First and Set Your Sights on Long Term Profits
Concept 7	Marketing is the Entrance and Exit of Quality
Concept 8	Management Must Not Show Anger When Facts are Presented
Concept 9	95% Problems can be Solved with Simple Tools of analysis

Source: Adapted from lectures of Dr Nawar Khan on Total Quality Management, College of E & ME, National University of Science and Technology, Islamabad, Pakistan.

Table 2.4. Dr Genichi Taguchi's Principles of TQM

Principle Number	Principles
Principle 1	Communication
Principle 2	Control
Principle 3	Efficiency
Principle 4	Effectiveness
Principle 5	Efficacy
Principle 6	Emphasis on Locating and Eliminating Causes of Error
Principle 7	Emphasis on Design Control
Principle 8	Emphasis on Environmental Analysis

Table 2.5. John S. Oakland's Key Points of TQM

Point Number	Key Points of TQM for Senior Mangers
Point. 1	Long term commitment
Point. 2	Change the culture to "right the first time"
Point. 3	Train the people to understand customer supplier relationship
Point. 4	Buy product and service on total cost
Point. 5	Recognize that systems improvement must be managed
Point. 6	Adopt modern methods of supervision and training and eliminate fear
Point. 7	Eliminate barriers, improve communication and teamwork
Point.8	Eliminate arbitrary goals and barriers to pride of Workman.
Point.9	Constantly Educate and retain the in house experts
Point.10	Utilize a Systematic Approach to TQM Implementation

Source: Adapted from lectures of Dr Nawar Khan on Total Quality Management, College of E & ME, National University of Science and Technology, Islamabad, Pakistan.

Table 2.6. John S. Oakland's Key Characteristics of TQM

Characteristic Number	Characteristics
Characteristic 1	Quality is meeting the Customer Requirements
Characteristic 2	Most Quality Problems are inter.departmental
Characteristic 3	Quality Control is monitoring, finding and eliminating the cases of Quality Problems
Characteristic 4	Quality Assurance rests on prevention, Management System and Effective Audit
Characteristic 5	Quality must be Managed, it does not just happen
Characteristic 6	Focus must be on prevention and not on cure
Characteristic 7	Reliability is an extension of Quality and enables us to "delight the customer"

Table 2.7. Professor Dr Nawar Khan Contribution to TQM

Contribution	Reference
Spectrum of Quality Evolution	[8]
Common Concepts of TQM	Feigenbaum TQM Philosophy [24]
TQM Universal Transformation Techniques	[8]
6 Sigma (Matrices) and 6 Sigma (Techniques)	[8]
Information Flow Chain	[8]
The AZD Concept	[8]
Integrated Lean Management	[8]
IQA Model	[8]
Contribution to PNQA Scheme	[8]
TQM IQA Model House	[8]
Self Assessment Practice with IQA Model	[8]

Source: Adapted from lectures of Dr Nawar Khan on Total Quality Management, College of E & ME, National University of Science and Technology, Islamabad, Pakistan.

Table 2.8. Common Concepts of Different TQM Philosophies

S.No.	TQM Factors	TQM Elements
1	Top Management Roles	Leadership (Vision, Style)
		Commitment (Involvement and Participation)
		Teamwork, Communication
2	Market and Customer Focus	Market Focus, Customer Focus
3	Quality Mission and Policy	Quality Mission, Policy and Objectives
4	Quality Planning	Short Term/ Long Term Quality Planning
5	Quality Assurance	QMS, Data and Information Management
		Quality Losses, Cross functional Management
		Standardization, Products and Services Quality
		Measurement and Control, Audit
		Integrated System Approach
		(Suppliers, Producers, Customers)
6	Resources Management	HR (Education, Training(Quality/Job)
		Involvement, Participation, Team Work
		Empowerment, Reward and Recognition
		Motivation, Financial Resources Material Resource (Technology, equipment, Infrastructure, Support/ Maintenance)
7	Quality Culture	Quality Awareness and Promotion
		Corporate quality Culture
8	Protection	Health, Safety and Environmental Protection
9	Continuous Quality Improvement	Review, Quality Improvement Activities, Creativity, Innovation and Design
10	Satisfaction of all Stakeholders	Customers, Employees (Including Management), Society, Shareholders and Government

Source: Adapted from lectures of Dr Nawar Khan on Total Quality Management, College of E & ME, National University of Science and Technology, Islamabad, Pakistan.

CHAPTER 3

CHARACTERISTICS OF QC AND QA

3.1 Characteristics of Quality

"Elements which define intended quality level of a product are known as quality characteristics". Quality characteristics [20] can be categorized as follows;

3.1.1 Structural Characteristics

It includes structural elements of a product or substance in order to depict its quality characteristics. It includes length of a product produced, the weight, the strength and the viscosity of a fluid.

3.1.2 Sensory Characteristics

It is related to sensing features, through which we can describe its quality. It includes taste, smell and beauty etc.

3.1.3 Time Oriented Characteristics

It includes time based features of a product which shows how a product is qualitatively based on Time length. It includes warranty, reliability and maintainability.

3.1.4 Ethical Characteristics

It is related to ethical Qualities which should be shown by the management of the Workshop in its behavior. It includes honesty, courtesy and friendliness.

3.2 Quality Aspects

There are three aspects which are usually associated with the definition of quality [21].

3.2.1 Quality of Design

- Quality of design deals with stringent conditions that a product or service produced must minimally possess to satisfy customer requirements.
- Product offered must be designed to meet minimal needs of consumer. An increase in designed quality level is to increase cost at an exponential rate.
- The value of the product, however, increases at a decreasing rate, with the rate of increase approaching zero beyond a certain designed quality level.

3.2.2 Quality of Conformance

Quality of conformance [22] implies that the product or the service rendered by the Workshop must meet the standards selected in the design phase. It consists of;

- **Defect Finding** It deals with locating defects, which is conducted through inspection, test, and statistical analysis of data from the process.
- **Defect Prevention** As name suggests, it deals with the means of detecting the occurrence of defects which can be achieved by using statistical process control techniques.
- **Defect Analysis and Rectification** It deals with investigation of causes behind the presence of defects and taking corrective actions to rectify it.

3.2.3 Quality of Performance

- It is concerned with how well product offered performs when put to use.
- It measures the degree to which product / service offered satisfy customer. The final test of product / service acceptance always lies with customers and meeting the expectations of the customers should be the major goal.
- If a product does not function well enough to meet expectations/standards, then adjustments need to be made in the design or conformance phase.
- Feedback from performance to design phase may prompt change in design because current design cannot produce product that performs adequately.

3.3 Quality Control (QC)

All actions taken within a Workshop, which measure products offered, compare them with specifications, correct every discrepancy, ensure that all nonconformities are eliminated prematurely and corrective actions taken to eliminate the causes of their nonconformities is known as Quality Control" [22]. Following action will be ensured;

- Correct specifications of the product.
- Design of the product to meet these specifications.
- Inspection in order to determine conformance of the product to these specifications.
- Getting feedback in order to revise these specifications if needed.

3.3.1 QC Charts

Different QC charts discussed below are available with the management of the workshop in order to make the decision basing on data received. Usage of these charts is also shown in Figure 3.1 [22].

- $\bar{X}$ Chart is used when data of only one batch is available and used.
- $\bar{\bar{X}}$ Chart is used when data of a number of batches is available and used.
- R Chart is used for a single batch data.
- $\bar{R}$ (Mean of all sample ranges) chart is used for a multiple batches.
- *S* Chart is used when the data per batch is more than ten.
- P Chart is used for non conforming fraction.
- nP chart is used for non conforming number.
- C chart is used for number of non conformities.
- U chart is used for number of non conformities per product.

3.3.2 Benefits of QC [22]

- Improvement in the Quality of products and services.
- System continually evaluated to meet changing need of customer.
- Guarantees improved productivity through reduction of scrap and rework.
- Reduces costs in longer run with fewer nonconforming items production.
- With improved productivity, the lead time for producing parts and subassemblies is reduced results in improved delivery dates.
- It maintains an "improvement" environment where everyone strives for improved quality and productivity to keep workshop productive.

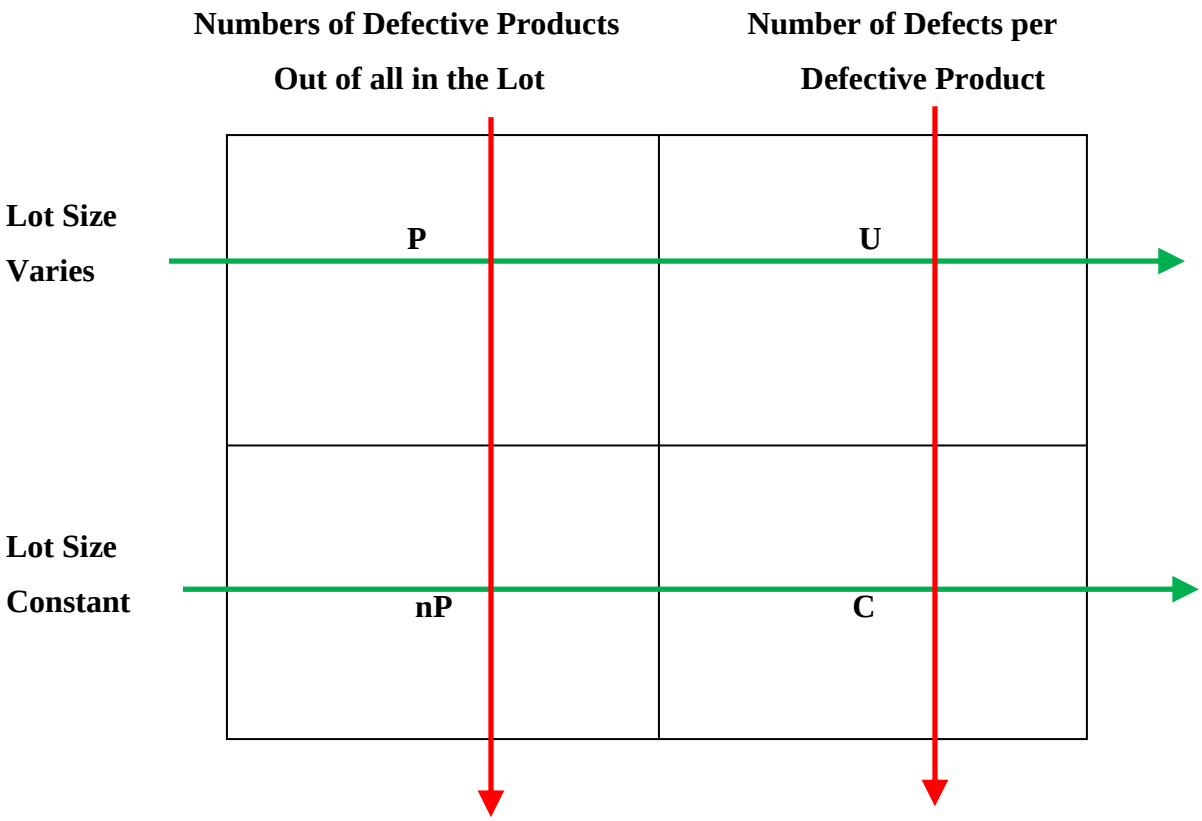

Figure 3.1. QC Grid for Discrete Data charts

Source: Adapted from Dr Nawar Khan "Total Quality Management (Concepts, Tools, Systems and Awards)" NUST publishing Rawalpindi, 2008.

3.4 Quality Assurance (QA)

"All policies, procedures and activities which constitute an Organization's efforts to ensure that standard of product delivered to customers is maintained and enhanced in an excellent manner to include QC procedures that are in used. It also involves quality checks undertaken by agencies (internal or external) to the organization".

3.4.1 Aim of QA

The main aim of Quality Assurance [22] in a Base Workshop may be;

- To assure the Quality of processes, products and services through a planned and effective Quality Management System (QMS).
- To allocate roles, responsibilities and commensuration authorities and a system of procedures for Quality activities in the workshop.

3.4.2 Scope of QA Approach in EME Base Workshops

- It includes vendors/contractors, Producers, distributors and customers.
- It uses partnership concept among all stakeholders for the quality.
- Forward link Workshop is distributors which include dealers, wholesalers and retailers dealing with logistic of the products and services.
- Working relationships among members of a larger system of QMS.
- Reduce suppliers to a few reliable ones.
- Award contracts on the basis of quality rather than price tag alone.
- Working relationship with other members and partners.
- Partnership with suppliers in quality training and recognition system.
- Producer need to create internal partnership with employees and external partnership with suppliers, distributors and customers.

3.4.3 Different Systems of QA

3.4.3.1 Quality Management System (QMS)

This system aim to arrange organizational structure, procedures, processes and resources needed to implement quality in the Base Workshop. Its scope will be;

- Approach and design of a QMS.
- Management function that determine quality objectives and responsibilities.

- To implement system such as quality planning, control and improvement.
- Adoption of proven standards of QMS, preferably of international level.

3.4.3.2 Data and Information Management System

It provides information which will act as lifeblood to record, collect and analyze data generated by all processes and functions and generate awareness and interest.

- Management for collection and dissemination of current, valid and reliable internal and external data and information on products/services.
- Information processing, analysis and utilization for quality improvement and its communication to all within and outside an organization.
- Quality information is required for effective decision making both at management and workforce level.
- Information technology appropriation and its effective use.
- Establish management information system.
- Assure accuracy, timeliness and easy access to data and information.

3.4.3.3 Quality Losses

Aim is to utilize most effectively and efficiently potential of human, financial and material resources in all processes to have a true measure of quality efforts [23].

- Seek opportunity to reduce losses due to poor quality.
- Quality losses must be linked to the processes causing them loss.
- Tangible and intangible losses through poor quality must be segregated.
- Put emphasis on cost of quality concept.
- Focus on life cycles costs of a product or service rather than price tag.
- Identification of cost saving areas and availing of these opportunities.

3.4.3.4 Cross Functional Management

It is to eliminate barriers between physical and functional boundaries through cross functional management so as to assure quality of processes and avoid delay in delivery of products. It improves communication and teamwork among different departments to assure solution of cross functional problems. The scope is as follows;

- Establish the cross functional management concept.
- Eliminate functional barriers by managing processes

- Improve communications, coordination and teamwork for effectiveness.
- Multi functional teams are formed for the solution of such problems.

3.4.3.5 Process Quality

It is to transform a set of inputs into output that satisfies customer's needs and expectations in the form of quality products and services. The scope is as follows;

- Process appropriation, design, selection, layout, analysis and control.
- Economic and value added aspects of processes.
- Efficiency and variations control in processes.
- Standardization and improvement of processes

3.4.3.6 Standardization

Aim is to provide uniformity and consistency and ensures ease of replication. It sets those standards which are consistent with customer requirements and to prescribe specifications through standard documents [37]. Its scope in a Workshop is as follows;

- A system of standards and its contents.
- Methods of establishing, revising and even abolishing standards.
- Requirements of standards, their use and maintenance.
- Traceability to a national or international level and ease of replication.

3.4.3.7 Product and Services Quality

Aim of this QA in Base Workshop is to have consistent processes that result in providing quality products to customers (external/internal customers). Its scope may be;

- Products and services quality selection, its strategy and processing.
- Compliance to external requirements and standards.
- Standardization of the requisite products and services and their replication.
- Products and services identification codes, trade and standard marks.
- Product quality, reliability, maintainability, supports supply, equipment and customer services. Its training, delivery, billing and marketing.

3.4.4 Measurement and Control

It checks progress and improvement of hard aspect (System/Technology) and soft aspect (HR) of quality through measurement, inspection and survey and traces standards of national or international level to confirm actual performances. Measurement

provides consistent, predictable, accurate and precise performances to high standards in all areas, while control reduces variation, non conformance and inconsistency [23].

- Measuring quality for accuracy and precision.
- Measurement traceability through calibration to an international level.
- Appraisal of an individual or group, assessment of quality processes.
- Periodic evaluation and qualification of measurements.
- Control policy, plans and methodology.
- Control system, techniques, procedures and effectiveness.
- Control strategy for prevention rather than detection of problems
- Adoption of self control by operators than external control by inspectors.
- Variation in performance of the hard and soft aspects of quality processes.

3.4.5 Quality Audits

Aim is to have a systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and objectives.

- Audit concept, policy and management system.
- Audit conduct, reports and effectiveness.
- Corrective and preventive actions and their records.
- Checking methods and systems.
- Investigation and follow up procedures.
- Audit of all common factors and elements of the TQM philosophy.

3.5 Quality Assurance (QA) System in the Corp of EME

In the Corps of E & ME, QA falls in the direct purview of DG EME, who ensures Quality with the help of inspector EME and ADEME QA in EME directorate.

- EME directorate issues overall policy for Quality Assurance
- These policies are issued in the form of EMER and DGEME's directives
- QC and QA in the Base / Regional Workshop fall directly within the domain of the Commandant
- OIC QAD on behalf of Commandant is responsible for QC and QA
- QA is being done by OIC QAD with the help of dedicated team.

CHAPTER 4

CRITICAL / DETAIL ANALYSIS OF EXISTING EMER H-409 AND HIGHLIGHTING AREAS OF IMPROVEMENTS

In order to evaluate current EMER H-409 and its practices in Base Workshops, a questionnaire attached as Annexure 'B' developed for obtaining feedback from Base Workshops under the worthy guidance of Professor Brigadier Dr Nawar Khan. This questionnaire was then circulated to all Base / Regional Workshops of Corps of EME undertaking Base repair. The survey got good response and provided current feedback about workshop practices of procedures and SOPs in the light of EMER H-409 on Quality Assurance. It also provides valuable suggestions through visits to different Base / Regional Workshops and through conduct of interviews of different tiers / appointments in different workshops (Valuable suggestions are attached as Annexure 'C'). These different aspects are covered in this chapter as follows;

- Shortcomings Observed in Existing EMER H-409.
- Design of Questionnaire for survey.
- Data Extracted from feedback received through survey questionnaire
- Graphical presentation of data and its interpretation
- Suggestion received through visits and conduct of interviews

4.1 Shortcomings Observed in Existing EMER H-409

Upon critically analyzing existing EMER H-409, following different shortcomings observed. These shortcomings have been observed during visits to different Base / Regional Workshops and also during conduct of interviews to different appointments in the workshops.

4.1.1 Title Page not defined

It is observed that currently used EMER is not having any title page to show that this is used in Base / Regional Workshops for Quality Assurance. This aspect need to be addressed in the revision phase so a new title page showing different activities being carried out in Base / Regional Workshops has been incorporated.

4.1.2 Unawareness of TQM Philosophies

It is observed that workers and supervisors are unaware of TQM Philosophies, because TQM techniques were not been incorporated in current EMER H-409, resulting in poor quality product. In order to enhance quality activities, it is necessary to educate workers and supervisors about TQM so that they should be quality conscious. This can be done by incorporating TQM Philosophies during revision phase of EMER H-409.

4.1.3 No Revision of EMER H-409 According to TQM Techniques

Current EMER H-409 was developed in 1989, when organizations were not aware of TQM Philosophies. Last two decays witness emerging of TQM rapidly enhancing quality productivity. Today it is require that workers at different tiers in workshops of EME should be fully aware of TQM, which is only possible through continuous quality education and availability of excellent material on TQM. Existing EMER H-409 was prepared to assist workshop management for QC through different SOPs emphasizing inspection. It covers monitoring of different production activities at all levels in order to achieve require standards of product.

4.1.4 Aim and Objectives not defined

Aim and Objectives are not specified in current EMER H-409 which is imperative for any organization. TQM philosophy focuses on clear indication of Aim and Objectives to make every worker aware about workshop objective for its existence.

4.1.5 Quality Mission and Strategy Statement is missing

Current EMER H-409 does not define any Quality Mission and Strategy Statement which is necessary in order to implement Quality Policy in the Workshop. How can top management of any workshop can impalement Quality Policy in the workshop if EMER does not define these? So this statement must be included in the revision phase of Current EMER.

4.1.6 No action plan for continuous Quality Improvement

Current EMER H-409 does not provide any plan for continuous Quality Improvement which should be the basic characteristic of any Base Workshop providing Qualitative product. A comprehensive plan for continuous quality improvement has to be incorporated during the revision phase of EMER H-409.

4.1.7 Impractical Mission Statement for QAD

Mission Statement given in existing EMER engulfs only inspection and provision of laboratory facilities for testing for failure / rejection analysis. It is worth mentioning here that earlier workshops were and still are dependent of 100 % inspection, which is contrary to TQM Philosophies. TQM Philosophies focused on self / automated inspection with random sampling, where each worker is responsible for his work and product. This warrants revision of mission statement in the existing EMER H-409.

4.1.8 Centralized Organization Structure of QAD

Organizational Structure of QAD in existing EMER shows centralized and authoritative approach, while TQM promotes decentralized approach with authority at different levels. This approach also requires to be changed during the revision phase.

4.1.9 Irrational Charter of Duties

Although Charter of Duties given in existing EMER H-409 covers duties of OIC QAD, Statistic and Record Office and Quality Assurance Laboratory, but these are not comprehensive and do not cover different aspects of QC and QA. Due to emergence of TQM Philosophies charter of duties of different appointments in the Base / Regional Workshops are require to be revised totally in line with TQM Philosophies.

4.1.10 Insufficient Manpower for QAD

Manpower given for QAD in existing EMER is not sufficient to coordinate all the activities related to QAD to assure Quality. In order to revise Charter of Duties for QAD according to new TQM Philosophies, manpower for QAD should also be revised and it should be competent with reasonable strength to assure Quality.

4.1.11 Impractical Procedures for Failure and Rejection Analysis

Current EMER H-409 covers a brief and impracticable procedure about failure and rejection analysis in the Base / Regional workshops. This failure and rejection analysis procedure is old and outdated which need to be revised as per latest TQM Philosophies. This revision will enables workshop supervisors to eliminate root causes of failure analysis in order to avoid its recurrence.

4.1.12 Focused on Inspection

Current EMER H-409 focused on 100 % inspection as the only tool available to supervisors / inspectors of Base / Regional Workshops. This is contrary to TQM Philosophies which stress on automated inspection without disturbing process. In order to revise current EMER according to TQM Philosophies inspection need to be automated with enhanced workers capabilities leading to less consumption of resources.

4.1.13 Re inspection of Main Equipment at Assembly Line

Current EMER H-409 lays down procedures for Main Equipment Assembly Line inspection and final assembly inspection of main equipments received from different sections. This re inspection of main equipment at assembly line is superfluous which need to be removed during revision of current EMER phase.

4.1.14 Conventional Methods of Maintaining Records

Existing EMER H-409 focused on maintaining of record in a very conventional manner without suggesting any computerization and automation. This makes retrieval of records difficult at the time of need. During the revision phase of EMER it is suggested that record should be maintained with latest methods as computerization and automation.

4.1.15 Low Manpower versus Working Man Hour Ratio

A Technician in a Workshop remains on different duties in a year as;

- Technical Duties 160 days
- Administration Duties 60 days
- Leave 90 days
- Courses 30 days
- Miscellaneous Reasons 1 25 days
- **Total** **365 days (365 x 24 = 8760 Hours)**

If we convert availability of technician on Technical duties in Man Hours;

- Number of Hours available in a day 6 Hours (from 0800 to 1400)
- Total Number of available Hours per year 365 x 6 = 2190
- Number of useful Technical Hours in a day 4.5(1.5 hour tea/lunch break)
- Number of useful Technical Hours per year 160 x 4.5 = 720
- % of useful technical hours For a technician 720 x100/ 2190 = **32.88 %**

It shows that a technician is available only 32.88 % of the total time in the whole year to the Base / Regional Workshops which is alarming. In the revision phase of current EMER, this needs to be improved through applying TQM techniques in order to enhance productivity.

4.1.16 Improper Functioning of Quality Assurance Laboratory (QAL)

Although current EMER H-409 provide basis for establishment and functioning of QAL in the Workshop, but it is limited in scope and restricted to only inspection at various levels. It is imperative that QAL should be functioning properly according to latest requirements to enhance productivity and user satisfaction.

4.1.17 Inappropriate Functioning of Failure Analysis Section

Current EMER H-409 provide basis for establishment of Failure Analysis section with qualified persons, but it provides vague procedure for the functioning and retaining of manpower in this section. Just calling representative to study the failure will not provide any solution until all requisite equipment and resources not provided.

4.1.18 Redundant Inspection of Minor and Major Assembly

Current EMER H-409 suggests unnecessary inspections of all minor and major assembly at different levels by separately assigned inspectors. TQM Philosophy suggests procedure of self inspection to avoid loss of valuable time and resources.

4.1.19 Re Inspection of Main Equipment Assembly

After qualifying inspection at different stages by all minor and major assemblies, this re inspection given in current EMER is redundant. During revision of EMER H-409, it is necessary to incorporate latest TQM philosophy about inspection considering inspection no longer require and emphasis on self / automated inspection.

4.1.20 Lengthy Inspection Form

Inspection forms provided in Current EMER H-409 covers too many superfluous objects, making procedure of inspection lengthy and not implementable. Revised EMER should suggest that this aspect should be cover in a way suggested by latest TQM philosophies.

4.2.21 Obsolete Check Sheet

Check sheets in existing EMER H-409 are old and are difficult to understand and implement by common worker of Base / Regional Workshop. This check sheet needs to be revised in accordance with latest Management Techniques making it easily implementable.

4.2.22 Acquiring Modern and Latest Equipment

Current EMER H-409 does not suggest any means for the induction of modern and latest equipment. This era is an era of modern technology, so revised EMER should incorporate latest equipment for Base Workshop.

4.3 Anomalies Observed through Survey Questionnaire

Results obtained through circulation of survey questionnaire along with suggestions received through visits to different Base / Regional Workshops and through conduct of interview to different people in these workshops are represented graphically in order to have an idea of different anomalies. These anomalies are enlisted below which are being cater during the revision phase of the current EMER H-409.

4.3.1 General Aspects regarding Strength/ Weaknesses in the Content of EMER H-409

Following results obtained through survey Questionnaire about strength and weaknesses in the content of EMER. These results are shown graphically in Figure 4.1.

4.3.1.1 Obsolete SOPs on Quality Assurance

SOPs available for QA are old which has not been updated in the light of TQM concepts. Revised EMER should emphasis on preparation of SOPs according to TQM concepts to organize the workshop leading to enhanced productivity and user satisfaction.

4.3.1.2 EMER H-409 difficult to understand by Common Workers

Survey results pointed out that current EMER is difficult to understand by a common worker, so top management should make arrangements for the translation of different EMER and SOPs into Urdu for better understanding by a common worker. There should be some special classes / training session for workers about understanding of EMER. Results show that understanding of EMER by officers and top management is good, so they can be tasked to delivered special lectures to workers about EMER.

4.3.2 Organizational Structure shown in EMER

Figure 4.2 shows results about organizational structure in the content of EMER, which is explained as follows.

4.3.2.1 Organizational Structure not Suitable to QAD

Although QAD is established in all Base Workshops as per current EMER H-409, but its mandate is limited to only inspection and running of Quality assurance Laboratory without the availability of proper equipment.

4.3.2.2 Less Contribution from Top Management in QA Activities

Surveys results show that however top management want to assure Quality in the workshops, but they provide no guideline to middle and lower tiers of management.

4.3.2.3 Lacking of Motivation / driving force by Senior Leadership

Results show that Leadership Driving force / motivation is available at a very small scale / level. This is because top and middle management have very little knowledge about TQM, which is necessary in today's era.

4.3.3 Strategic Planning in the content of EMER

Figure 4.3 shows result regarding Strategic Planning in the content of EMER which is explained as follows.

4.3.3.1 Vague Quality Mission and Vision Statement

EMER H-409 do not present Quality mission and vision statement and describe only traditional mission statement focusing on inspection and provision of QAL facilities.

4.3.3.2 Vague Quality Objectives

Quality Objectives are not defined properly. These objectives need to be addressed during revision phase according to latest TQM Techniques.

4.3.3.3 Ignoring Strategic Planning

Results show that there is no Strategic Planning being done in the workshop as this aspect is totally ignored in workshop practices.

4.3.3.4 Ambiguous Mandate of QAD and Duties of OIC QAD

Existing EMER show ambiguous mandate of QAD and put too many responsibilities to be performed by OIC QAD. OIC QAD should only be having overall responsibility for QA in the workshop through respective section incharges.

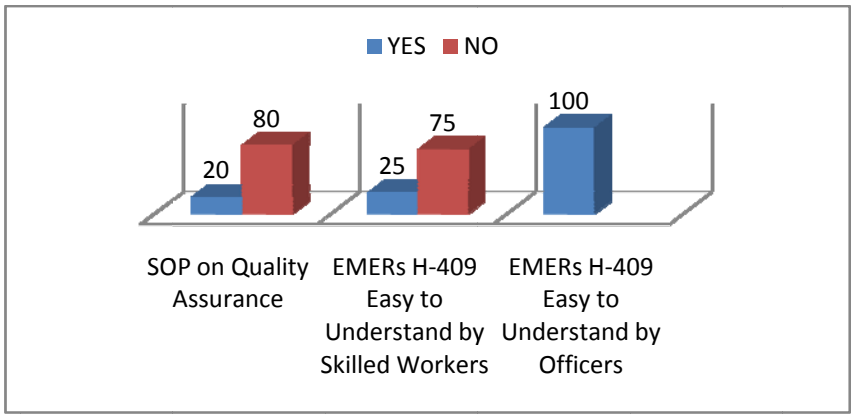

Figure 4.1. General Aspects in the Contents of EMER

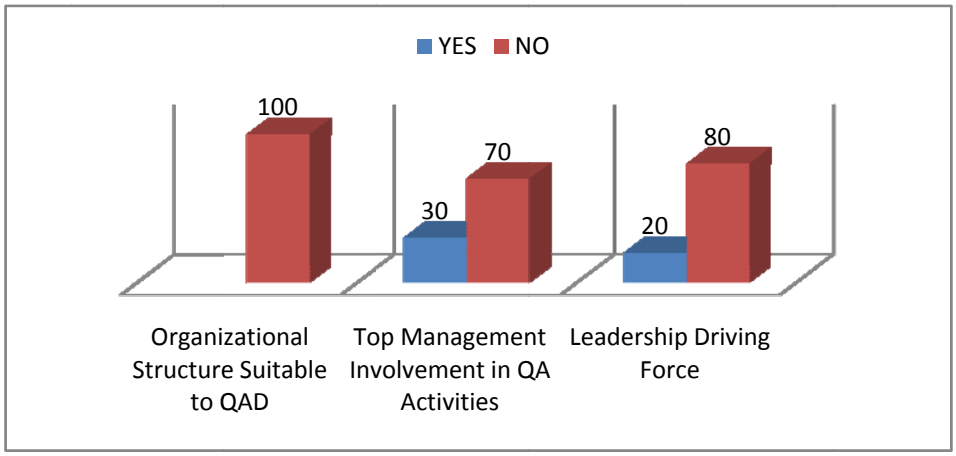

Figure 4.2. Organizationl Strucute Shown in the Content of EMER

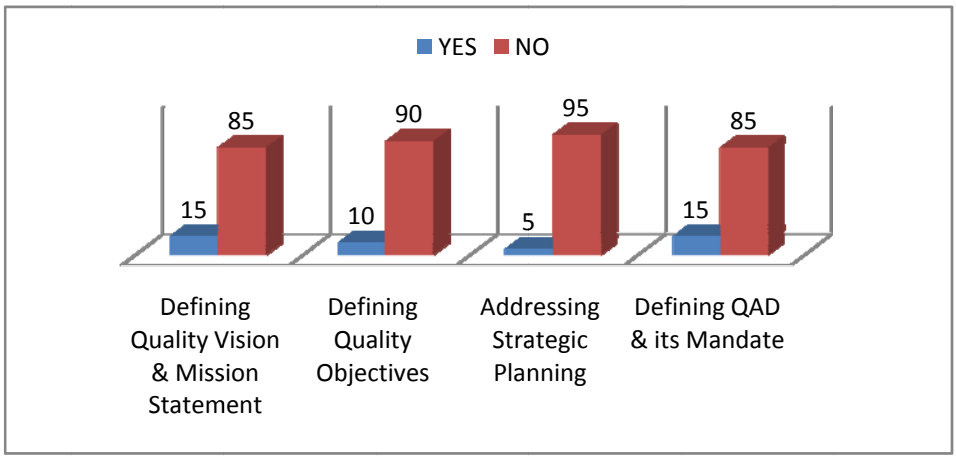

Figure 4.3. Strategic Planning in the Contents of EMER

Source: Constructed from the data received through circulation of Questionnaire to all EME Base / Regional Workshops about EMER H-409 and Workshop practices.

4.3.4 Using of TQM / SPC / SQC Tools and Techniques

Figure 4.4 shows result regarding using of TQM Tools and Concepts as far as content of EMER is concern. These are also explained as follows.

4.3.4.1 Ignorance of TQM Concepts, Tools and Techniques

Most of the workshops are ignorant of TQM Tools and Techniques which results in wastage of sufficient and valuable human and other resources. It is strongly suggested that revised EMER should focus on incorporating TQM concepts, tools and techniques to enhance workers productivity.

4.3.4.2 No Practice of Using Flow Process Sheet on Shop Floor

Workers do not know how to use flow process sheets on the shop floor so all workers and supervisors need to be educated and trained about this aspect. This will enhance workers efficiency on the assembly line leading to improve productivity.

4.3.4.3 Lacking of QC and QA Measures

Existing EMER H-409 put slight focus on QC measures with no focus on QA. In fact, both are different terms and so in the revision phase two separate sections for both QC and QA should be established.

4.3.4.4 Important of Flow Process Charts

Results revealed that flow process charts available in the workshops are old and not in use. These charts should be revised as per latest techniques and should be mentioned in revised EMER for regular consultation by all workers as a regular practice.

4.3.5 HR Management in the Content of EMER

Figure 4.5 show results regarding HR Management in different Base / Regional Workshops in the content of EMER and are explained as follows.

4.3.5.1 Obsolete / Non Availability of Job Description (JD)

Results revealed that JD of every worker is not written and available. Moreover workers are not aware of consulting these JD on the workshop floor. These JD are obsolete which have not been up dated as per current TQM Techniques.

4.3.5.2 Lacking Worker Empowerment Concept

TQM advocated concept of worker empowerment but survey results shows that there is no concept of worker empowerment and team work concept. Senior Management

of workshop must consider worker empowerment and team work concepts in routine activities to enhance productivity and worker as well as user satisfaction.

4.3.5.3 Lacking Team Work Concept

Survey pointed out that maximum workshops lack team work concept as they are ignorant of the advantage of team work. This concept needs to be included in the revised EMER to get maximum benefit of competent human resource available.

4.3.5.4 Poor System of Rewards and Recognition

Results pointed out that there is no system of Reward and Recognition but incentives like extra leave / local appointment is being practiced which are not enough to motivate workers. Revised EMER should focus on a system of Reward and Recognition for the motivation of a common worker / supervisor.

4.3.6 User / Supplier Interactive Management

Figure 4.6 shows result regarding User Supplier Interactive Management in the content of existing EMER. These are explained below for easy understanding.

4.3.6.1 Customer Involvement and User Satisfaction Ignored

Survey results pointed out that workshops do not emphasis on customer involvement and user satisfaction which are important factors of TQM philosophies. These factors must be given high priority to suggest customer driven Quality policies.

4.3.6.2 Ignoring Users and Suppliers Education towards Quality Aspect

Survey results suggest that users and suppliers should also be educated about the Quality aspect. This will inculcate quality culture not only in the workshop but among all the stakeholders resulting high quality output.

4.3.6.3 Ignoring Supplier / Vendor Importance for Quality Production

Suppliers / Vendors importance in different workshops activities should be given importance resulting in improving Base / Regional Workshops output.

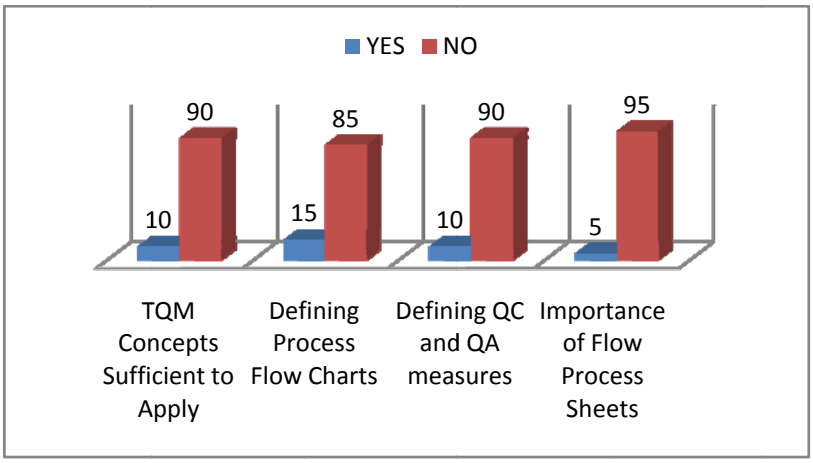

Figure 4.4. Using of TQM Tools and Techniques in the Contents of EMER

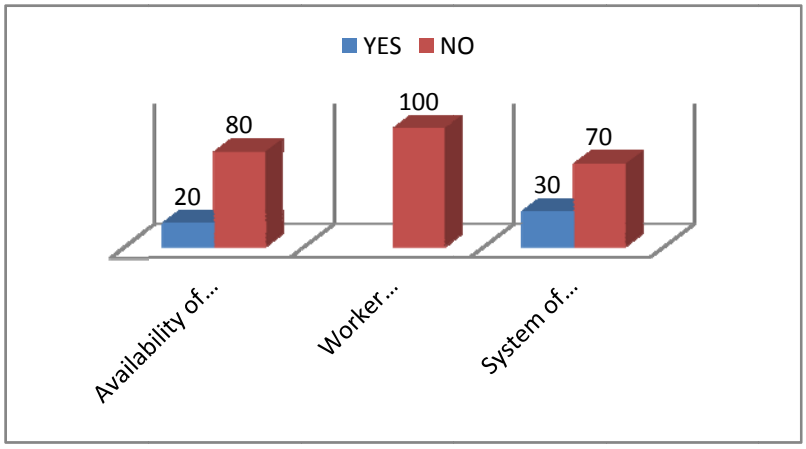

Figure 4.5. HR Management in the Contents of EMER

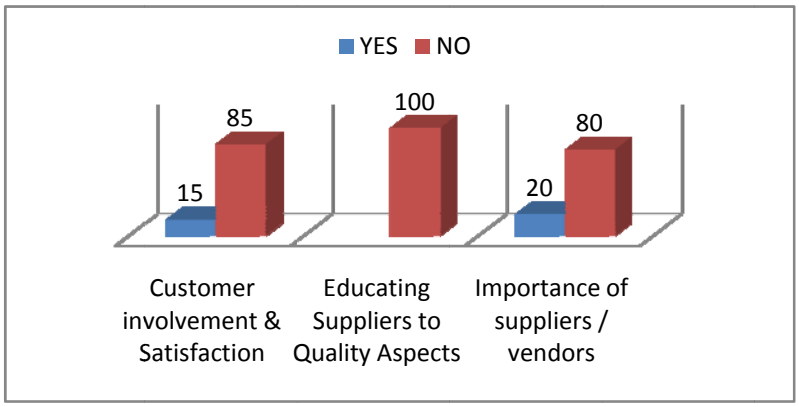

Figure 4.6. Users/Suppliers Interactive Management in the Contents of EMER

Source: Constructed from the data received through circulation of Questionnaire to all EME Base / Regional Workshops about EMER H-409 and Workshop practices.

4.3.7 General Aspects Regarding Functioning of Workshop

Figure 4.7 shows all results regarding this aspect and is explain as follows.

4.3.7.1 EMER H-409 not practicable to be used in Base Workshops

This point was brought forward by many workshops that consultation of EMER during work is not being practices because it is not practicable to be used.

4.3.7.2 Insufficient Copies of EMER in Workshop

Results show that insufficient numbers of copies of EMER H-409 are available in the Workshops. It is suggested that sufficient copies of EMER should be published and made available in the workshop floor for easy and regular consultation.

4.3.7.3 Irregular Consultation of EMER H-409

There is no system of consultation of EMER H-409 during the work on the shop floor, which need to be improved.

4.3.7.4 Addressing IEME Observations

Inspector EME visits are regularly plan to all workshops for judging their ability to production as per requirement but results pointed out that slight emphasis is given to IEME observations in workshops routine activities.

4.3.7.5 Preparation of Syllabus for Quality Training Ignored

Top Management should take keen interest in preparing Quality syllabus for the training of common workers. The syllabus should cover all the relevant aspects of QC and QA and regular classes should be arranged at local level to enhance workers skill.

4.3.8 Organizational Structure Regarding Functioning of Workshop

Figure 4.8 shows result regarding Organizational Structure in the context of functioning of Workshop as per EMER H-409. These results are explained as follows.

4.3.8.1 Top Management is not Focus on Quality Objectives

There is no provision of training of workers and supervisors for Quality aspect in the existing EMER. Regular training of middle level management on Quality aspect is necessary and it should be reflected by the Top/Senior Management in training syllabus.

4.3.8.2 Centralized Structure of Organization

The organizational structure of workshop is centralized and authoritative where as TQM philosophies focus on decentralize and supportive approach.

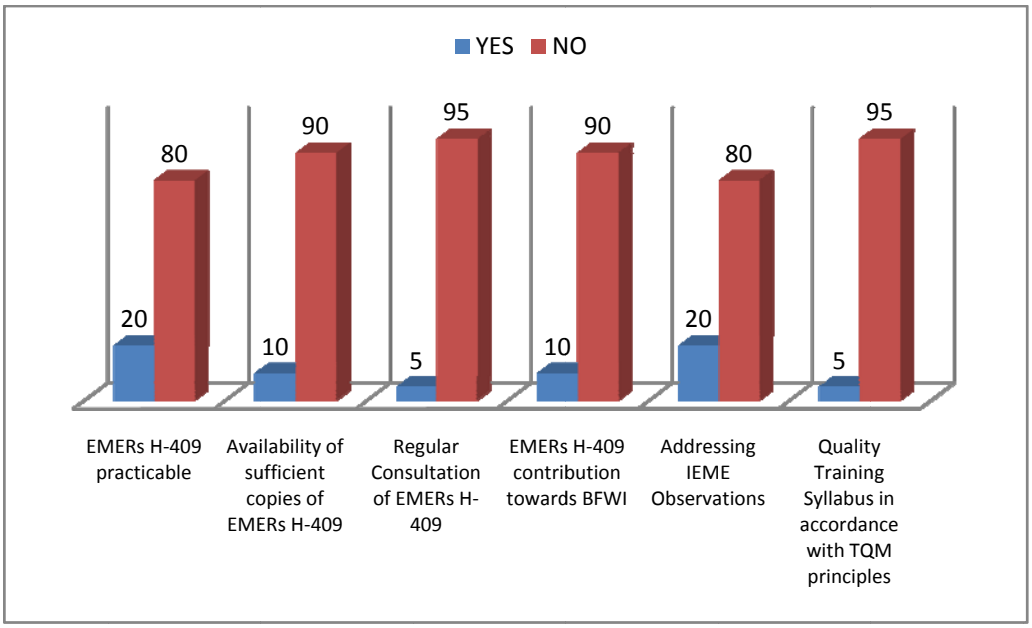

Figure 4.7.General Aspects about Functioning of Workshop as per Existing EMER

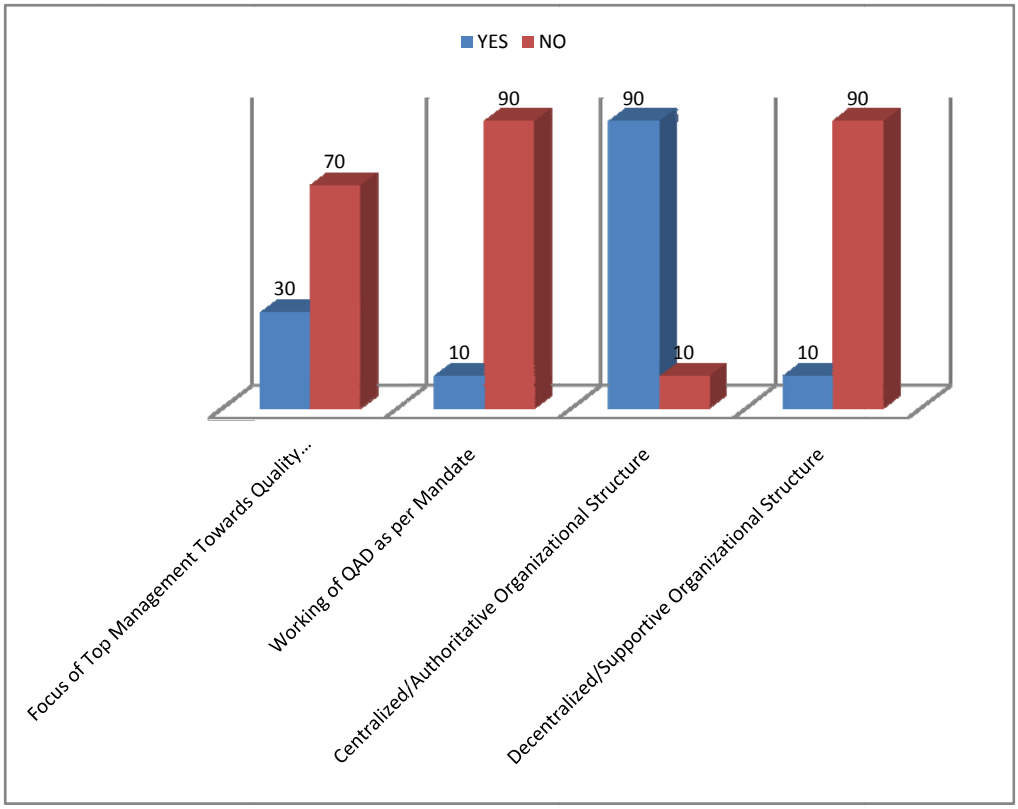

Figure 4.8.Organizational Structure , Functioning of Workshop as per Existing EMER

Source: Constructed from the data received through circulation of Questionnaire to all EME Base / Regional Workshops about EMER H-409 and Workshop practices.

4.3.9 HR Management regarding Functioning of Workshop

Figure 4.9 shows result regarding Human Resource Management as far as functioning of Workshop according to existing EMER H-409 is concerned.

4.3.9.1 Lack of Knowledge of TQM Philosophy

Officers have some knowledge about TQM but it is theoretical while workers and supervisors do not have any knowledge about TQM resulting running of workshop in a very conventional way. Revised EMER should suggest measures to enhance knowledge of officers, workers and supervisors about TQM through training.

4.3.9.2 Empowering middle level Leadership (Supervisors) Ignored

Results revealed that there is no concept of supervisor's empowerment in their respective areas of responsibilities. Since, this is contrary to TQM Philosophies so revise EMER should adopted policy of empowering middle level leadership in order to enhance productivity.

4.3.9.3 Availability of Sufficient Human Resource

Result shows that reasonable HR is available in the workshop but their utility is not planned so man hour of technician are wasted (Result already shows that only 33 % of the technician man hour are available in a year)

4.3.9.4 Workers performance as per JD

Results revealed that JD for each worker is old and outdated, and workers do not work as per JD. JD for each worker need to be revised and it should be in line with latest TQM techniques. It should also describe some system for gauging performance of workers according to JD.

4.3.9.5 Unrealistic System of Rewards and Recognition

Survey results revealed that there is no system of Reward and Recognition; however some awards like extra leave and local promotion for good workers exists, based on personal will of the management. Revised EMER should suggest a comprehensive system of Reward and Recognition for motivation of a common worker and supervisor.

4.3.9.6 Existence of Conducive Working Environment

TQM emphasis on conducive working environment in order to achieve desire Quality objectives but Base / Regional do not provide conducive environment.

4.3.10 Ignorance of TQM Tools and Techniques

Figure 4.10 shows result regarding utilization of TQM Concepts / Tools as per existing EMER H-409. These results are explained as follows.

4.3.10.1Inappropriate Utilization of SQC Charts / Tools

Results revealed that workshops do not pay any attention to SQC tools which are essential for efficient working of different sections. Revised EMER should suggest different SQC tools to be used by Workshop management to enhance its production.

4.3.10.2Most Decision do not Based on Tangible / Factual Data

Survey results pointed out that existing EMER do not address issue of sound and effective decision making based on logical analysis of reliable and tangible data. Revised EMER should emphasis on the availability of reliable and current data to relevant sections to facilitate them in sound and effective decision making properly.

4.3.10.3Utilization of Obsolete Checklist and Forms by QAD

Results show that QAD is working without using checklist and forms. Quality in different departments can be achieved by using different checklist and forms.

4.3.10.4Lengthy Workflow Process

Results revealed that assembly line in the production department have lengthy workflow consuming time. Revised EMER should suggest that this overhauling time can be reduced by introducing proper workflow charts to all workers along with their JD.

4.3.10.5Inadequate Utilization of Technical Manuals (TMs)

Results show that there is no emphasis on using of relevant and up to date TMs. Workshop Management should work on provisioning of all concern TMs and their proper utilization in the workshop.

4.3.10.6Poor Maintenance of Fault Trend Charts

Survey results pointed out that workshops are not maintaining fault trend charts properly and worker making entries to fault trend charts seem casual without proper training leading to collection of wrong data.

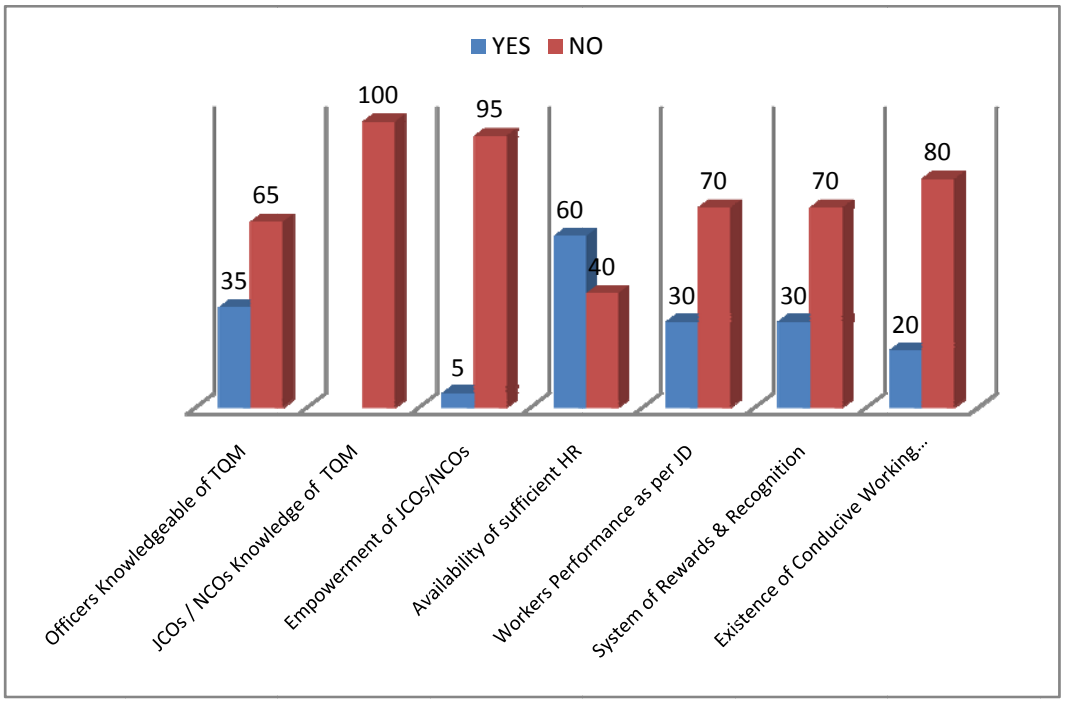

Figure 4.9. Workforce Management, Functioning of Workshop as per Existing EMER

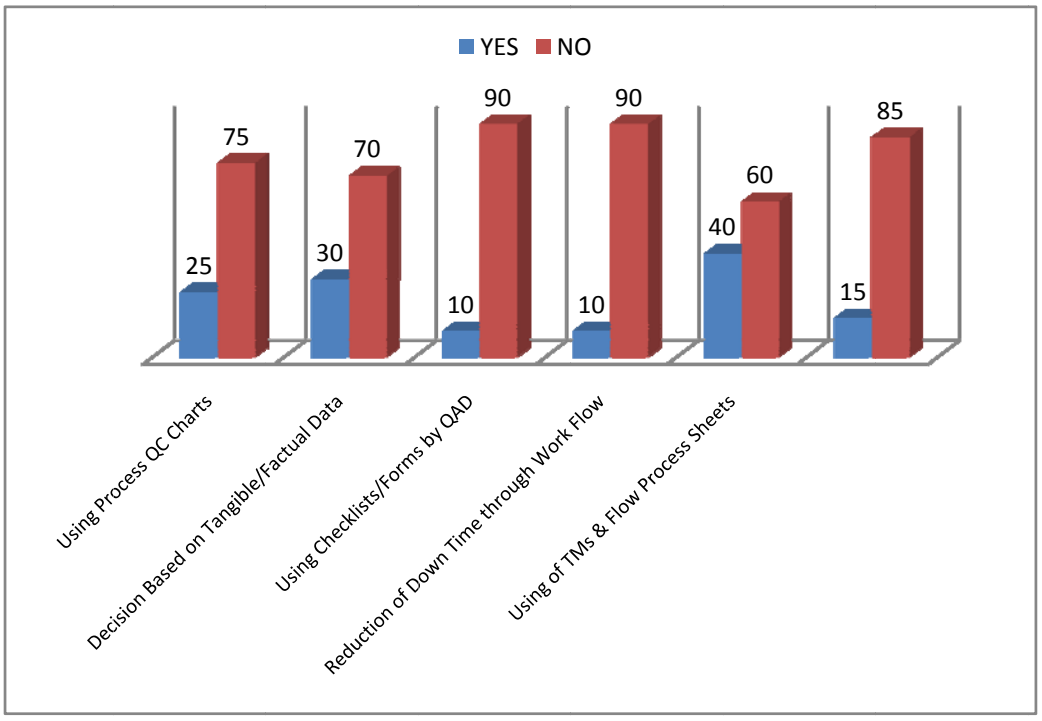

Figure 4.10. Result Regarding Utilization of TQM Tools in Base Workshops

Source: Constructed from the data received through circulation of Questionnaire to all EME Base / Regional Workshops about EMER H-409 and Workshop practices.

4.3.11 Functioning of QAL in Workshop as per Existing EMER

Figure 4.11 shows result regarding functioning of QAL in different Base / Regional Workshops as per existing EMER H-409.

4.3.11.1Availability of QAL

Results show that QAL are available in most of the workshop, but these are not functioning as per its defined mandate. All workshop management should put their maximum efforts to make QAL available in order to ensure Quality.

4.3.11.2Improper Functioning of QAL

Results revealed that QAL in most of the workshops are not equipped with latest testing facilities thus making QAL non functional. Revised EMER should suggest following facilities in Base / Regional workshop for efficient functioning of QAL;

- Hardness testing, Micro structure material examination
- Crack detection, Chemical analysis
- Mechanical testing, Examination of rubber/other non ferrous materials.

4.3.11.3Inadequate Equipment in QAL

Results revealed that QAL is not equipped with latest test equipment resulting in poor performance. Revised EMER should suggest provisioning procedure of different necessary equipment for efficient working of QAL.

4.3.11.4Inferior Competency Level of Technicians of QAL

Survey results show that technicians working in the QAL are not competent enough because there is no system available for the training of QAL technicians.

4.3.12 Users Suppliers Interactive Management

Figure 4.12 shows result regarding managing of users and suppliers relationship as per existing EMER H-409. These results are explained as follows.

4.3.12.1No Focus on Customer Based Quality Policy

Survey results pointed out that the policy of workshop is not customer driven. TQM emphasis on the customer focuses approach because customer satisfaction is the goal of all successful organization. All policies should be based on customer need and workshop should adopt a clear policy about customer satisfaction as the main objective in order to be a productive organization.

4.3.12.2Irregular Conferences with User Units

Since customer satisfaction is the most important aspect of TQM philosophy so in all workshops regular interaction through MTO conferences should be held in order to obtain exact customer feedback. Survey suggests that regular conferences should be held with user units to have an up to date feedback about quality of product being delivered. Revised EMER should contain some regulation regarding holding regular conferences at least once in a month to obtain current feedback.

4.3.12.3Poor Relationship among Workers, Users and Suppliers

TQM philosophy advocates good relation among workers, users and suppliers in order to achieve best results. Unfortunately this aspect is ignored in EME Base Workshops. In order to make workshops more productive an environment of healthy relationship among workers, users and suppliers need to be established.

4.3.12.4No means of Reviewing Customer Satisfaction

Customer satisfaction should be reviewed regularly in order to streamline procedures and SOPs of Workshop. Workshop Management should concentrate on regular reviewing customer satisfaction which in turn will make workshop productive.

4.3.12.5Supplier Selection Criteria need to be revised

Results show that all workshops are selecting supplier totally on the basis of low price which is contrary to TQM practices. TQM suggest a model of selecting suppliers on the basis of different aspect including good quality supplies, timely delivery with reasonable price.

4.3.12.6Vague Procedure of Handling with Defaulter Contractors

Survey results show that there is no procedure of handling with those contractors who are violating rules, providing sub standard quality materials / items and are not in time. Revised EMER should suggest proper guideline for black listing such type of contractors. This will make other contractors conscious for providing quality products within time.

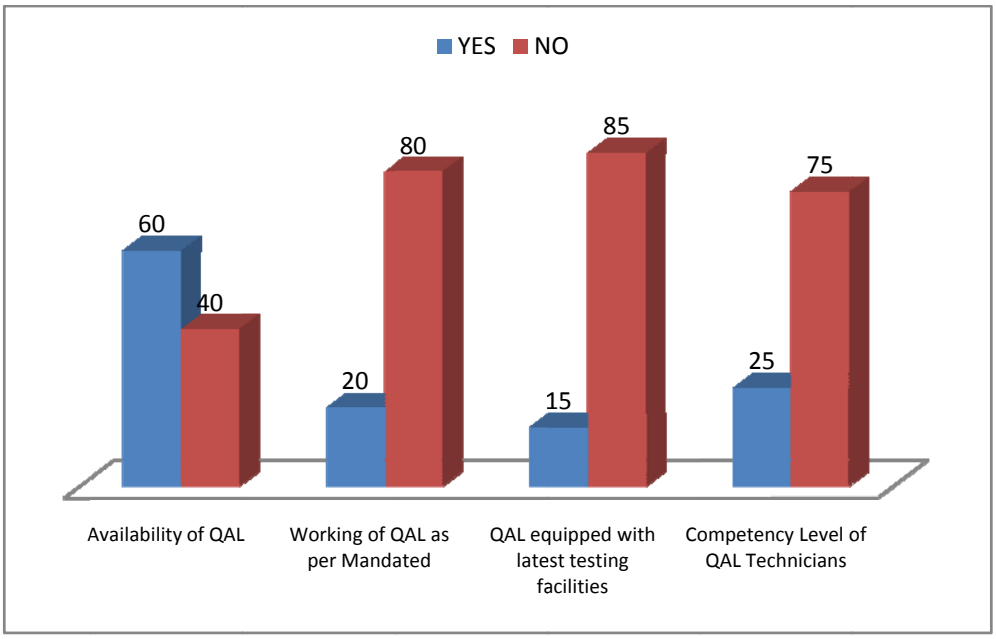

Fig 4.11. Result Regarding Functioning of QAL as per Existing EMER

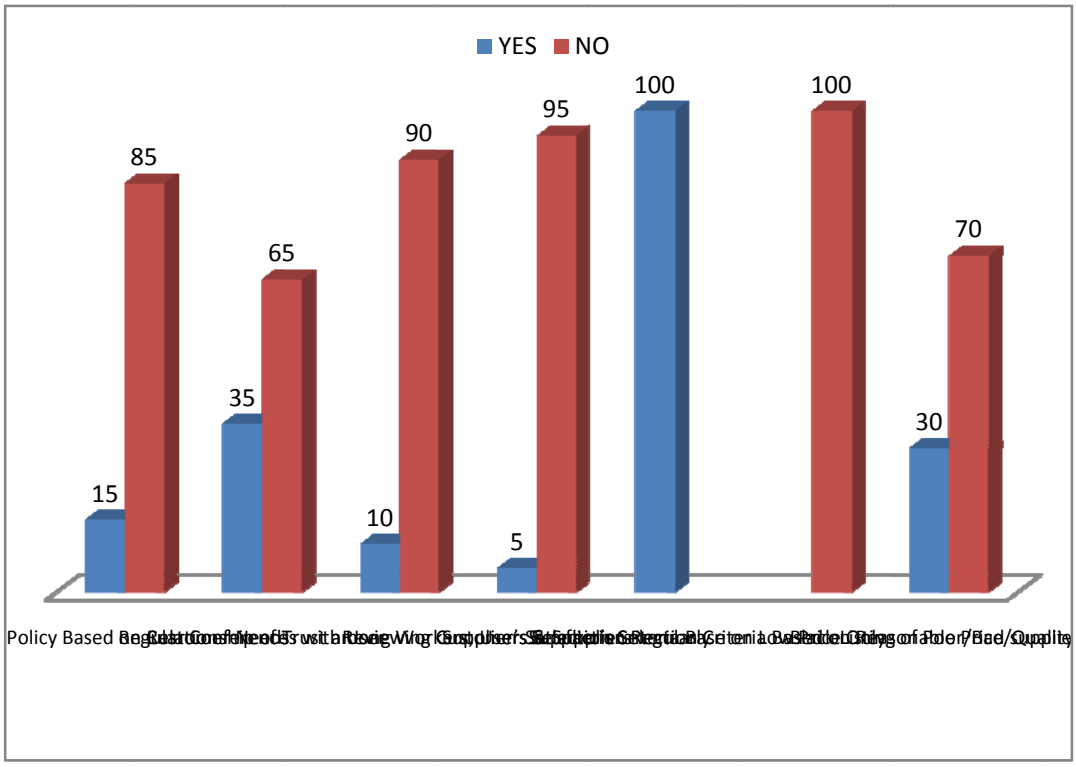

Fig 4.12. Result Regarding Users & Suppliers Interactive Management.

Source: Constructed from the data received through circulation of Questionnaire to all EME Base / Regional Workshops about EMER H-409 and Workshop practices.

4.3.13 Users Training and Feedback System in Workshops

Figure 4.13 show results regarding Users Training and Feedback System in workshops as per existing EMER H-409. These results are explained as follows.

4.3.13.1No System for Training of Users on Maintenance of Equipment

Results show that most of the workshops are not aware about imparting training on maintenance of vehicles and equipment to users which results in reducing life of vehicles and equipment. Revised EMER must point out some way of imparting training to the user on maintenance of all types of equipment and vehicles regularly.

4.3.13.2No System of Educating Suppliers on Quality Aspects

Supplier need to be educated on importance of Quality so that they should delivered quality products resulting in enhanced workshop productivity. Only those suppliers can deliver good quality items and material who are being regularly educated on this aspect. Revised EMER should incorporate means for supplier's education.

4.3.13.3Improper System for Obtaining Feedback from Users

It is observed through survey results that obtaining feedback from customer about product delivered is very weak thus desired results are not achieved. Revised EMER should recommend a comprehensive system of obtaining feedback and how to interpret and incorporate this feed.

4.3.13.4No System of Timely Follow up on User Feedback

Results revealed that system available to follow up user feedback is vague and each workshop is practicing it in its own way. Revised EMER should suggest different procedures and SOPs with workshop management to address timely follow up on feedback received in accordance with TQM philosophies.

4.3.14 Leadership / Strategic Planning in Existing EMER H-409

Figure 4.14 shows result regarding Leadership and Strategic Planning practices in the existing EMER H-409.

4.3.14.1No Support of Top Management for Quality Vision and Mission

Results show that there is very little support of Top Management available for Quality Vision and Mission Statement. Top Management must focus on supporting Quality vision and mission to elaborate it to all the workers for strict adherence.

4.3.14.2Ignorence to Continual Quality Improvement Practices

Continual improvement is a process which keeps Workshop striving for excellence in all operations, processes and functions ultimately leading to enhanced production. Revised EMER should suggest following measures in this regard.

- Special Technical Quality Cadres / Quality Circle.
- Lectures / Presentations.
- Training Conferences

4.3.14.3Non Implementation of TQM Concepts

There is no system for the implementation of TQM concepts in the workshop in order to enhance quality of the product delivered. Senior and middle level management should focus on implementing TQM philosophies in the workshop which should be indicated in the revised EMER.

4.3.14.4Insufficient Financial Resources

The job of a Base / Regional Workshop is to keep vehicles and equipment on its maintenance load in a battle worthy condition. This can only be possible if sufficient funds / financial resources are allocated right in time in order to avoid unnecessary delay. Previously all funds were controlled by Corps of Ordnance, which has been revised and financial powers regarding repair, maintenance and overhauling has been given to Corps of EME. Revised EMER should point out clear policy about the utilization of these funds so that efficiently all job should be completed.

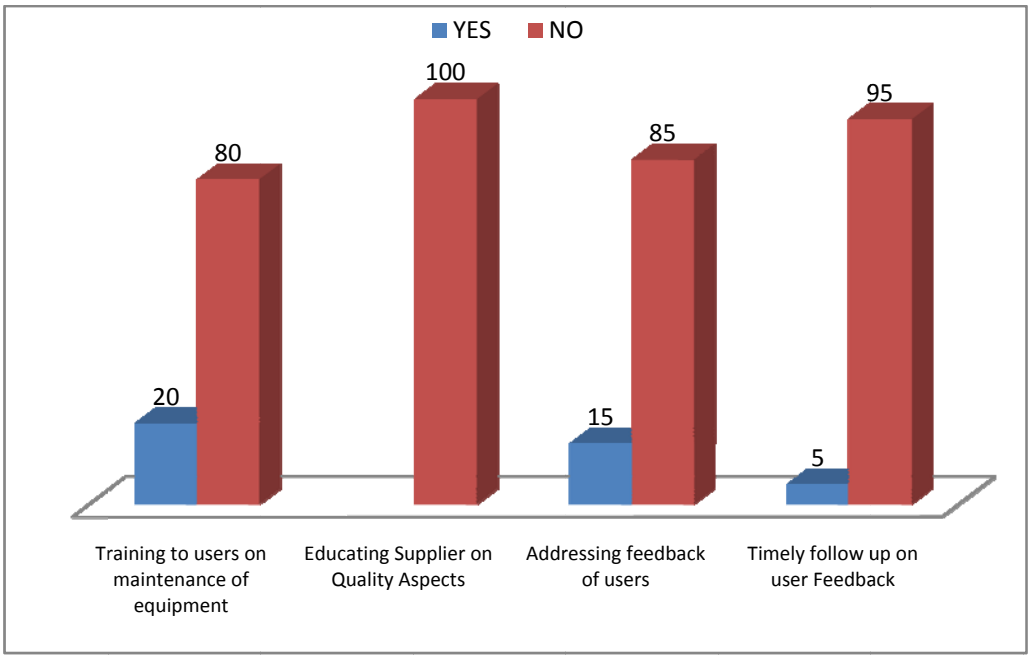

Fig 4.13. Result Regarding Users Training and Feedback System as per EMER H-409

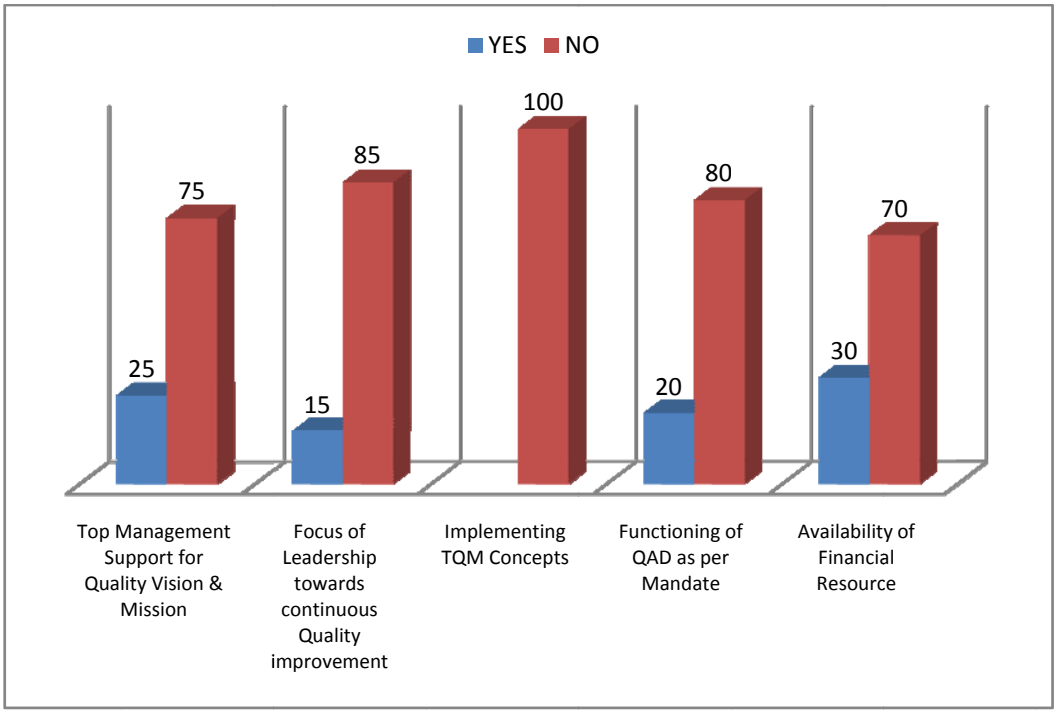

Fig 4.14. Results Regarding Impediments in Current EMER about Strategic Planning

Source: Constructed from the data received through circulation of Questionnaire to all EME Base / Regional Workshops about EMER H-409 and Workshop practices.

4.3.15 Workforce Management in Current EMER H-409 Ignored

Figure 4.15 show results regarding work force management in Current EMER H-409 and are explained as follows.

4.3.15.1Inadequate Workforce

It is revealed through results that although reasonable workforce is available in the workshop but they are not being properly used. Most of the technical trade manpower is being utilized on non technical duties which make technical manpower unavailable. A technician in a workshop performs many non technical duties besides handsome leave.

4.315.2Low Competency Level of Technician

Results pointed out that workers competency level is low due to their employment of other non technical duties. Revised EMER must address this issue and should suggest procedure for not using technician on non technical duties.

4.3.15.3Worker Empowerment towards Decision Making Ignored

Results show that workers and supervisors are not having any power regarding decisions in their respective areas of responsibilities / sections. Revised EMER should suggest empowerment of supervisors and workers in order to enhance their competency and efficiency leading to quality production.

4.3.16 Producer-Customer Interactive Management

Fig 4.16 shows result regarding producer and customer Interactive Management.

4.3.16.1Customer Satisfaction Given Least Priority

Survey results show that no priority is given to customer satisfaction by the senior workshop management which is contrary to TQM philosophies.

4.3.16.2Proper Education to Suppliers on Quality Aspect

It is evident from the results that there is no system available in the workshop for the education of supplier on Quality which is mandatory for workshop activities.

4.3.16.3Suppliers Need to Contribute towards Quality Objectives

Suppliers do not contribute towards Quality objects in Workshop and it is considered as a series impediments towards implementing TQM philosophies.

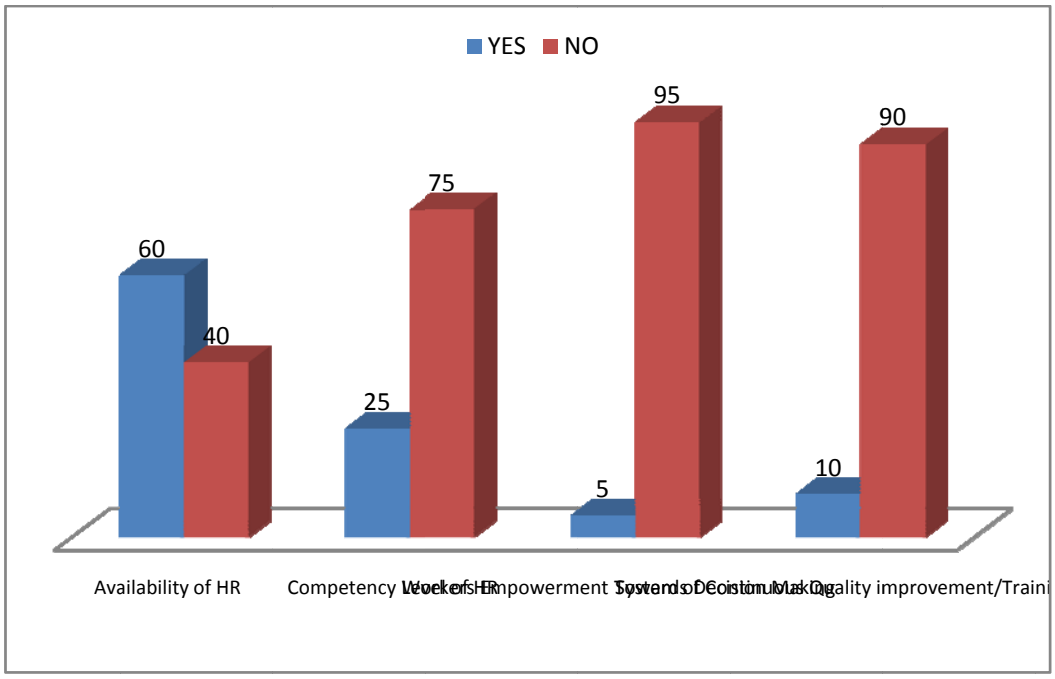

Fig 4.15 Result Regarding HR Management in Workshop Practices

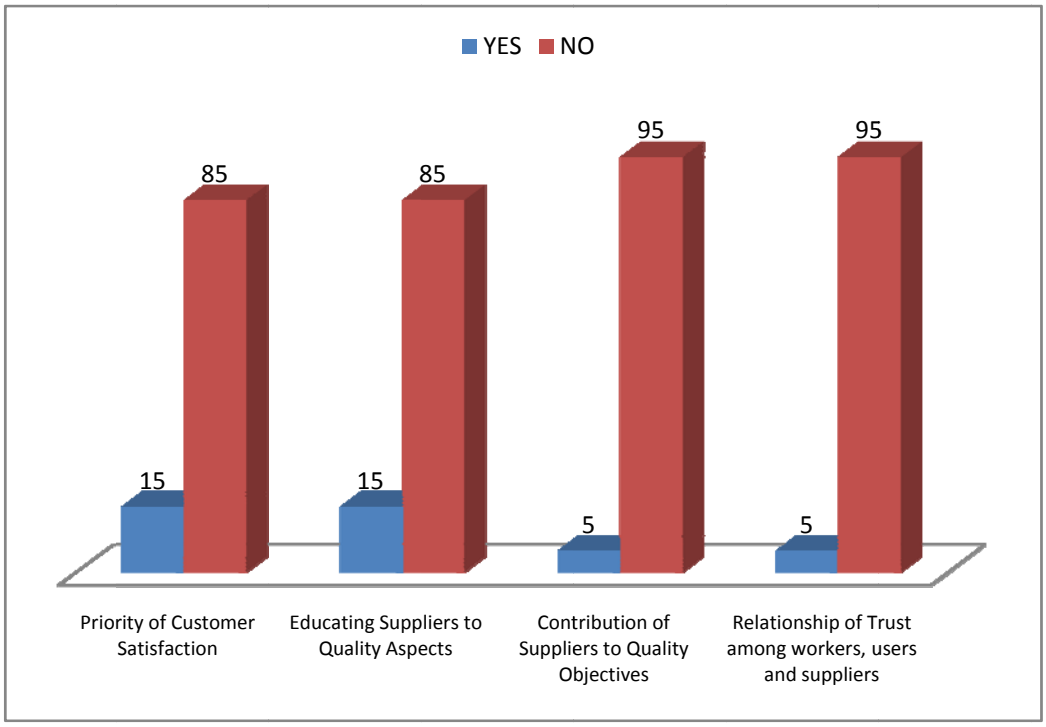

Fig 4.16 Result Regarding Producer and Customer Management in Workshop Practices

Source: Constructed from the data received through circulation of Questionnaire to all EME Base / Regional Workshops about EMER H-409 and Workshop practices.

4.3.17 Provisioning and Maintenance of Test, Measuring and Diagnostic Equipment (TMDE) in the Workshop

Figure 4.17 show results about provisioning and maintenance of TMDE and are explained as follows.

4.3.17.1 No Procedure for Provisioning and Maintenance of TMDE

It is unfortunate that most of the workshops are not having exact quantity of TMDEs thus compromising workshop efficiency. Revised EMER should suggest proper procedure for provisioning of TMDE to all workshops for better production. Similarly maintenance procedure for TMDE should be streamline in order to maintain them regularly enhancing their life.

4.3.17.2 Improper Calibration of TMDE

Results show that there is no proper procedures for calibration of all held TMDE in the workshop. Revised EMER should suggest a comprehensive plan for regular calibration of these TMDE in order to enhance efficiency and accuracy.

4.3.17.3 Requirement of Regular Training Cadre to Enhance Workers Skill about TMDE

Results show that there is no class / cadre plan to enhance workers skill about usage of TMDE. All workshops must plan regular classes which enhance workers skill about usage of available TMDE.

4.3.18 Non Availability of Safety Equipment and Other Gauges

Figure 4.18 show results about availability of safety equipment / gauges in the workshops and are explained as follows.

4.3.18.1 Improper and Ineffective Safety Equipment

Unfortunately proper safety equipment is not held with maximum workshops which is a series lapse on the part of the management.

4.3.18.2 Insufficient Number of Gauges and Specialist Tools

Result shows that Gauges and specialist tools are not available as per the requirements. Top Management must make arrangements for the provisioning of these gauges and specialist tools.

4.3.18.3Deficiency of Technical Tool Kits

Tool kits are not available to every worker working on the shop floor which stops workers performing their jobs efficiently. These tool kits should be available in the workshop for efficient working of technicians and workers.

4.3.18.4Technicians Lacking Qualification of Using Test Equipment

Results revealed that technician lack requisite qualification about using test equipment and tools which is due to less training cadres for efficient using of these tools.

4.3.18.5Workers Lacking Knowledge about Safety Regulations

It is revealed through the survey that workers lack knowledge about the safety regulations due to no training imparted to them.

4.4 Miscellaneous Observations / Suggestions

Different observations / suggestion were received through circulation of questionnaire and conduct of visit / interviews with different appointment in the workshop. Some of the important observations / suggestions are discussed below (also attached as Annexure ‘C’).

4.4.1 Improper Employment of Quality Assurance Inspectors

Quality Assurance Inspectors are not being properly employed in each section of the Base / Regional Workshop as per the existing EMER H-409. 501 Base Workshop suggest the appointment of Quality Assurance Inspectors for each section which will act as facilitator to Quality Assurance Officer in discharging of his duties. This will bring a rapid cultural change leading to improved Quality Standards.

4.4.2 Improper Procedure for Maintenance of Records

It is observed during visit to different workshops that there is no proper system available for maintenance of records, which make retrieval of record difficult at the time of need. It is suggested that records should be maintained in such a way that it is easily retrievable at the time of need without wasting time and effort. It is suggested that revised EMER should focus on providing easy and effective methods of maintaining record.

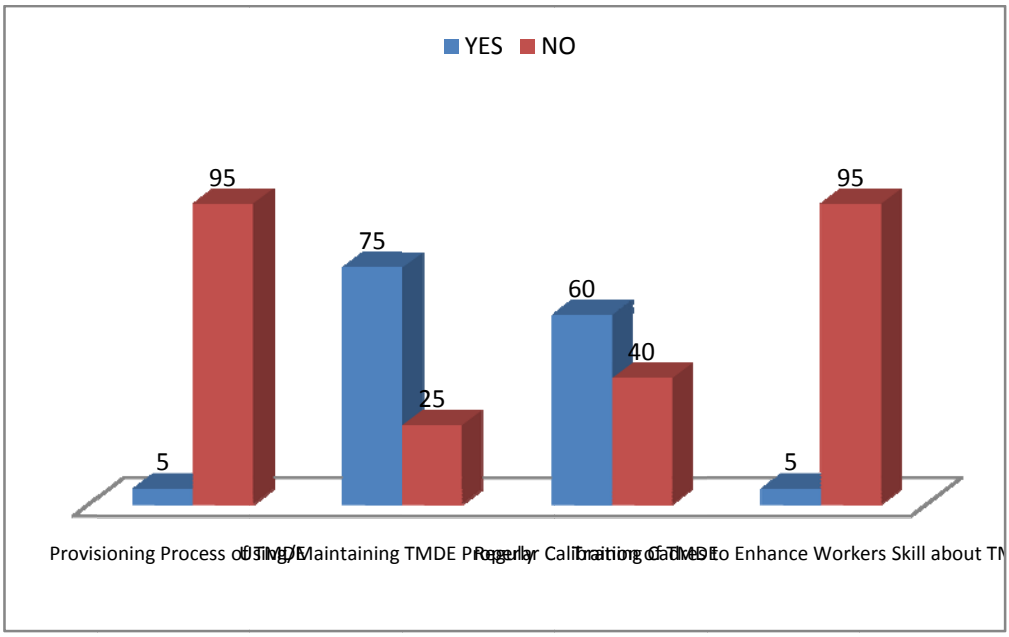

Fig 4.17. Result about TMDE Availability within the Workshops

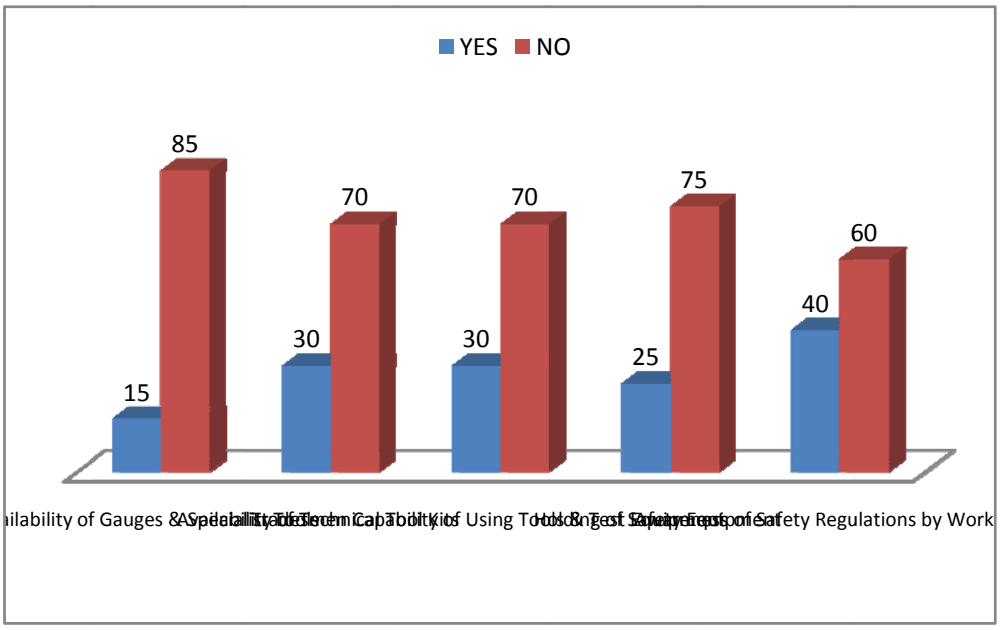

Fig 4.18 Result Regarding Availability of Safety Equipment and Gauges/Tool Kits

Source: Constructed from the data received through circulation of Questionnaire to all EME Base / Regional Workshops about EMER H-409 and Workshop practices.

4.4.3 Poor Performance of QAD Regarding Failure Analysis

Proper analysis of every failure/rejection is essential to avoid recurrence and waste of precious resources. Detailed and thorough analysis on scientific lines of every failure / rejected component, sub assembly and main equipment help in finding main cause enabling production branch to take necessary corrective measures to obviate recurrence. It is suggested that revised EMER should recommend establishment of failure analysis section with following;

- A proper system of feedback of premature failure to QAD.
- Proper recording and investigating of failure as a result of extended trials.
- Thorough analysis of all incoming material, parts and assembly at any stage.
- Preparation of periodic failure trend reports. Copies to be sent to EME Directorate and other workshops engaged in similar overhauling activities.

4.4.4 Improper Procedure of Inspection of Stores

During visit to different workshop it was observed that inspection procedure adopted is not proper. Revised EMER should suggest following procedure in this regard;

- QAD should have qualified / competent technicians for inspection of stores.
- Stores for inspection should be sent on some prescribed form to QAD.
- Job Number should be assigned for easy reference.
- Inspection be done critically to avoid acceptance of substandard parts.
- Accepted / Rejected stores should be suitably stamped for easy segregation.
- Regular training classes should be arranged to enhance level of competency.

4.4.5 Improper Main Equipment Assembly Inspection Procedure

During the visit it is observed that main equipment assembly line inspection is done irregularly without any set procedure. It is suggested that following should be incorporated in the revision phase of EMER H-409.

- All items should be inspected in accordance with some standards.
- Relevant specifications for each stage and line items should be available.
- In case of line production, inspections should be organized in various stages.
- Final inspection of assembly should be done on test bench.
- Recording of inspections and rejections on proper proformae.

4.4.6 Improper Minor Assembly Inspection Procedure

During the conduct of visit it is also observed that inspection procedure for minor assembly inspection is improper and need to be revised. It is suggested that following should be incorporated in the revision phase of EMER H-409;

- Each assembly should be given shop serial number, entered in a register.
- Workshop symbol with serial number should be stamped on assembly.
- Each minor assembly should be tested on a test bench.
- Random checks should be made as per checklist with specifications.
- Rejected assemblies should be tagged with rejection slip and kept separate.
- Accepted assemblies be sent immediately to next stage with a pass slip.

4.4.7 Impracticable Quality Implementation Checklists

Visits to different workshops revealed that there is checklists available with the workshops are impracticable and never consulted during the work. Moreover no guideline is provided in existing EMER H-409 for Quality implementation checklist. Revised EMER should incorporate this point and suggest a standardized checklist for the implementation of Quality.

4.4.8 Quality Audits

It is observed during the conduct of interviews to different appointments in the workshop that there is no system of regular Quality Audits available in the workshop. A comprehensive system of regular Quality Audit should be adopted in the workshops which guarantee user's satisfaction and enhanced productivity.

4.4.9 Raising Workshop Standards as per ISO 9001:2008 Standards

Visits to different workshop revealed that there is no procedure adopted by Base / Regional Workshop for preparing workshop and its different departments for ISO Certification. ISO certification is very important and valuable for any productive organization. An ISO certified organization will have standard procedures which lead to quality production, so revised EMER should suggest some procedure for workshop for ISO certification to enhance workshop efficiency.

CHAPTER 5

REVISED EMER H-409 (2009) ON QUALITY ASSURANCE IN BASE / REGIONAL WORKSHOP

5.1 General

Current EMER H-409 on quality assurance was published back in February, 1989 (copy attached as annexure 'A') without considering TQM philosophies essential for any organization for quality production and user satisfaction. The job of revising existing EMER H-409 on the basis of TQM principles to assist all Base / Regional workshops require complete information about current procedures and SOPs along with level of competency and knowledge of workers, technicians and senior management. This job was done through circulation of comprehensive questionnaire along with visits and interviews to the workers of different workshops.

The response from all Base / Regional Workshops was encouraging and a comprehensive data was gathered which provided a guideline of revising existing EMER H-409. Basing on this comprehensive feedback received in the form of results of questionnaire and suggestions revised EMER prepared under the guidance of Professor Brig Dr. Nawar Khan.

5.2 Salient Features of revised EMER

Revised EMER is based on TQM and it has following features in it.

5.2.1 Defining Quality Standards

Quality Standards are defined clearly in revised EMER along with Quality Control, Quality Assurance and Quality Management System.

5.2.2 Defining Conditions for Implementation of TQM Philosophies

Revised EMER cover all aspects which are necessary for the implementation of TQM Philosophies. These are enumerated as follows;

- Commitment of management towards Quality production
- Quality Leadership
- Customer focus approach in Workshop
- Aim and purpose of the workshop should be known to each worker
- Conducive working Environment

- Maintaining Quality consciousness and improvement culture
- Develop pride of workmanship in repair work
- Proper education and training on Quality
- Improve user's satisfaction
- Vendor selection criteria and periodic evaluation
- Removing organizational barriers
- Employees empowerment
- Employees motivation through rewards and recognition
- Continuous Quality improvement
- Involvement of every worker in quality activities
- Functioning of Quality Improvement / Assurance Teams
- Record keeping, its analysis and presentation

5.2.3 Defining Quality Policy

Since revised EMER focus on quality so defining quality policy in the revised EMER is mandatory. It should elaborate Quality policy about functioning of different departments basing on customer satisfaction through delivery of reliable products.

5.2.4 Establishing Quality Assurance Department

Revised EMER will recommend establishing of QAD with following steps

- Ensure high standard of quality products.
- Preparation of different SOPs regarding functioning of various departments.
- Reporting to Commandant on all matters related to quality.
- Provisioning of manpower
- Establishing of different teams for quality control and quality assurance.

5.2.5 Defining Mission of Quality Assurance Department

Existing EMER H-409 do not define any statement about mission of QAD, which is necessary for any workshop to run effectively.

5.2.6 Organization of Quality Assurance Department

Existing EMER H-409 do not define organization for QAD, which is require for the establishment of QAD in Base / Regional Workshops. Revised EMER highlight proper establishment of QAD according to its organization.

5.2.7 Defining Job Description for Different Appointment

Existing EMER do not define any job description of different appointment like commandant, deputy commandant, OIC QAD etc, creating difficulty in execution of orders in true letter and spirit. Revised EMER will highlight job description for all these appointments in order to make functioning of workshop easier.

5.2.8 Defining Tasks for Quality Assurance Team (QAT)

Revised EMER will define complete tasks for quality assurance team so that every worker of this team should know his job exactly.

5.2.9 Appointing Quality Assurance Inspectors (QAI)

Existing EMER do not provide any appointment of Quality Assurance Inspectors. In Base / Regional workshops Quality Assurance Inspectors are necessary for achieving quality products. Revised EMER will facilitate appointment of these inspectors along with their job description.

5.2.10 Different Stamps / Bands to be used by QAI

Revised EMER suggest different stamps / bands to be used by QAI according to the decisions made by QAI, which are never used in existing EMER. These stamps will show particular decision made by QAI for easy segregation of items inspected.

5.2.11 Tools kits for QC / QA Inspectors

Revised EMER will also suggest different special tool kits for QC / QA Inspectors. These tools kit are imperative to perform the duties in a proper manner.

5.2.12 Maintaining of Record and its Presentation

Revised EMER will suggest complete procedure for maintenance of record and its presentation at all levels so that its analysis and retrieval at the time of need is easy. It will also suggest different ways to present the available data as per the requirement.

5.2.13 Proper Functioning of QAL

Revised EMER will suggest proper procedure for functioning of QAL and suggest different equipment to be available for proper testing of material and items.

5.2.14 Analyses of Data

Revised EMER will also suggest different procedures for the analysis of data received in order to make management able to take appropriate decisions.

5.2.15 Store Inspection Procedure

Revised EMER will also provide detail procedure for the inspection of incoming stores to the Base / Regional Workshop.

5.2.16 Minor / Main Equipment Assembly Line Inspection Procedure

Minor and Main equipment assembly line inspection is important in Base / Regional workshops, so revised EMER will suggest proper procedure for the inspection of minor and main equipment assembly line.

5.2.17 Measurement and Analysis by using TQM Tools

Revised EMER will also suggest different TQM tools which can be utilized by workshop management for measurement and analysis. These tools are completely discussed in the chapter of revised EMER.

5.2.18 Quality Audits

Revised EMER will suggest a comprehensive method for carrying out quality audit regularly in order to determine whether quality measures are adequate and applied properly. It also suggest internal audit of cross departments to assure quality production.

5.2.19 Quality Monitoring Cell

Revised EMER suggest establishment of quality monitoring cell under OIC QAD for the monitoring of all efforts in order to ensure quality production.

5.2.20 Suppliers Selection and Evaluation Record

Revised EMER suggest a comprehensive criterion for the selection of suppliers and then keeping its record in order to evaluate their performance and contribution.

5.2.21 System of Rewards and Recognition

Revised EMER suggest a system of reward and recognition in order to encourage workers and supervisors participation in all workshop activities.

5.2.22 Quality Conferences and Seminars

Revised EMER suggest holding of regular conferences on quality in order to evaluate quality activities in the workshop.

5.3 Revised EMER

Revised EMER on Quality Assurance in Base / Regional Workshops to be published through EME Directorate in the same pattern is attached in Annexure ‘D’.

CHAPTER 6

RECOMMENDATION AND CONCLUSIONS

6.1 Recommendations

After having gone through existing EMER H-409 February, 1989, following are recommended.

6.1.1 Adopting Data Analysis oriented Approach

A data analysis-oriented approach to problem solving should be adopted where data is collected to ascertain results. The results then suggest what remedial actions should be taken. Experience and intuition are not of value to management unless they can be interpreted and explained in the context of a theory.

6.1.2 Involvement of Top Management in Workers' Motivation

People are motivated by a combination of intrinsic and extrinsic factors. The motivation to excel is intrinsic. Reward and recognition are extrinsic. Management needs to create the right mix of these factors to motivate.

6.1.3 Removing Barriers to Quality Improvement

Remove barriers that rob people of pride of workmanship. A direct effect of pride in workmanship is increased motivation and a greater ability for employees to see themselves as part of the same team the team that makes good things happen.

6.1.4 Inculcate Quality Culture

In order to achieve Quality Culture in our Base / Regional Workshops, all tiers of management must first understand TQM philosophies and only then they can work on changing the workshop culture to quality culture.

6.1.5 Education and Training towards Quality Improvement

Employees, from top to bottom of an organization, should be provided with the right level and standard of education and training to ensure that their general awareness and understanding of quality management concepts, skills, competencies, and attitudes are appropriate and suited to the continuous improvement philosophy; it also provides a common language throughout the organization. A formal programme of education and training needs to be planned and provided on a timely and regular basis to enable people to cope with increasingly complex problems.

6.1.6 Preparation of Quality Control / Assurance Process Sheet

Preparation of 'Quality Control Process Sheets', identification of Quality Check Markers/critical steps on repair manual/process sheets and monitoring of repair work according to check markers by Quality Control Inspectors to be ensured.

6.1.7 Maintaining all Test and Safety Equipment

Monthly Maintenance along with inspection of all TMDEs (test, measuring and diagnostic equipment by a team of experts in the supervision of Officer Commanding should be done to ensure excellent working of these equipment.

6.1.8 Educating Users and Suppliers about Quality Aspects

Educating users (customers) with regards to general maintenance procedures and preservative techniques required to be followed at their end.

6.1.9 Translating Technical Manuals into Urdu

Translating technical manuals/inspection forms into Urdu for further disseminating it to all technicians for easy assimilation/ understanding.

6.1.10 Obtaining Regular Feedback

Units must be encouraged to comment freely on the aspect of improving workshop's performance. Weekly/fortnightly feedback (user satisfaction survey) may be resorted to for vehicle repaired by the workshop till the time quality of repair improves.

6.1.11 Issuance of Warranty Cards

Warranty cards may be issued with engines / equipment overhauled by the workshop in order to achieve user's satisfaction.

6.2 Total Quality Management System for Army

Pakistan Army can maintain its dominance across the entire spectrum of operations by properly anticipating future requirements and transforming to meet those needs. Remaining an Army that is persuasive in peace, invincible in war requires that it should stay ready for the future. Since Army does not react to change, rather it leads change so Army Performance Improvement Criteria (APIC) is a valuable resource for leading the change. It supports "The Army Vision" by providing a framework for in-depth organizational assessment and measurement of the continuous improvement efforts that are the hallmark of Total Quality Management (TQM) for Army. Based on the

Malcolm Baldrige Criteria for Performance Excellence, the APIC guides Army leaders through seven categories, which examine all aspects of their organization and determine how well it is meeting its goals. This system is shown in Figure 6.1.

6.2.1 Support of APIC to Pakistan Army

The APIC supports TQM for Army in three specific ways.

- First, it serves as a working tool for strategic planning, organizational assessment, and training.
- Second, it raises the organization's performance expectations and standards.
- Finally, it establishes common performance criteria to facilitate communication and sharing of best business practices among Army organizations, business, and industry.

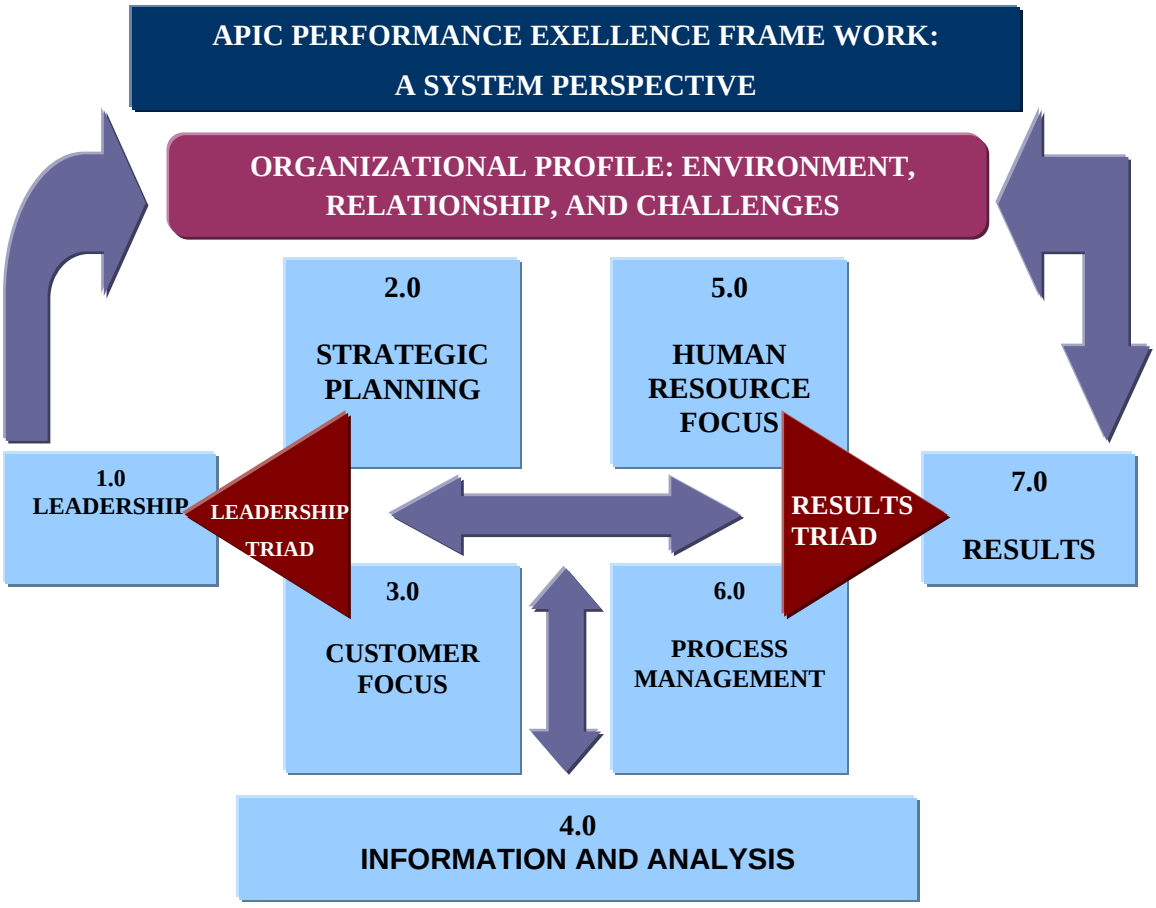

Figure 6.1. Army Performance Improvement Criteria (APIC)

Source: Adapted from the Website of Army Performance Improvement Criteria available at "http://www.apic.com".

6.3 Conclusion

A successful approach to quality improvement requires a long term commitment and recognition because effort is an unending journey. Some early successes can be achieved but a cultural transformation to full use of TQM Principles and approaches will occur only gradually. Modern armies of world are conscious of the need of QC and QA in peace and war times. Quality, battle worthiness and reliability of the equipment are the most important factors for the armies around the world and hence, a rigorous campaign in EME Base / Regional Workshops is necessary to produce vehicles and equipment of best possible quality within the existing resources. It is not enough for management to desire good QC/QA, exhort people towards quality performance or to set up quality systems, but TQM principles and techniques will work for Workshops when installed carefully, knowledgeably and competently (general information, desires and wishes will not do anything). Those engaged in quality activities, from top management to a craftsman on shop floor must become aware that quality starts with conception of the product, as represented by design and development, and ends with customer's long term satisfaction.

The swift pace of induction of high technology warrants continuous revision and updating of different procedures and processes available in the form of EMER. With this, the requirement of matching inputs in the form of expertise and material resources is also of inescapable nature. To improve productivity attention to a fast changing world and improve the organization's capacity to adjust to change has t pay. This research conducted has lead to the conclusion that Workshop which does not realize this important aspect will not only be left behind in the race of today but will also be vanished like all those in the past unable to coup up with the changing world of TQM. The low productivity parameters put barriers against quality of work and productivity as highlighted in this research are not only the problem of Pakistan Army Base / Regional Workshops, rather these are common in nearly all the production units of Pakistan Armed Forces. The suggested model and implementation methodology is equally good to be implemented in any repair / production outfit of Pakistan Armed Forces.

Annexure 'A'

Existing EMER H-409 in its original form (February, 1989) for Quality Assurance in the Base Workshops of EME undertaking Base overhaul rebuild

Existing EMER H-409 on Quality Assurance in its original forms is attached for reference purpose only.

Annexure 'B'

Questionnaire (Is current EMER H-409 used by Base Workshops effective to Assure Quality Standards as per latest TQM Philosophy) and results received

Table below shows accumulative result obtained through circulation of this Questionnaire which helps in revising EMER H-409 with latest TQM Techniques. It will also help to improve different areas of workshops to assure excellent Quality of product overhauled and offered to the end users with better production. Suggestion received through this questionnaire and through visit and conduct of interview to different appointments of Base / Regional Workshops is placed in annexure "B".

PART –I (Strength / Weaknesses of Existing EMER H-409)			
S. No	**Questions**	**Yes (%)**	**No (%)**
1.	Is SOP on QA available based on TQM Philosophies?	**10**	**90**
2.	Is language of EMER H-409 easy to understand by skilled workers? If no, which area requires improvements / modification? (Suggestions regarding area of improvement are in annexure 'C').	**35**	**65**
3.	Is language of EMER H-409 easy to understand by officers? If no, which area requires improvements / modification? (Suggestions regarding area of improvement are in annexure 'C').	**75**	**35**
4.	Is organizational structure suitable QAD? If no, offer suggestion. (Suggestions received are placed in annexure 'C').		**100**
5.	Is Top Management involved in QA activities?	**10**	**90**
6.	Does leadership driving force and involvement incorporated?	**20**	**80**
7.	Has Quality Vision and Mission statement been expressed clearly?	**30**	**70**
8.	Has Quality objectives to be achieved been clearly defined?	**20**	**80**
9.	Is workshop emphasizing on continuous quality improvement? (Suggestions received have been included in revised EMER).	**15**	**85**

10.	Has mandate of QAD been defined clearly? If no, offer your suggestion. (Suggestions have been incorporated).	**15**	**85**
11.	Are TQM concepts mentioned in EMER H-409 sufficient to apply to Workshop? If no, which tools should be included / deleted? (Number of TQM tools is required to be included and all these tools have been included in the revision of EMER).	**10**	**90**
12.	Has Process Flow Chart been available? If no, then what modification you like to make? (Suggestions received regarding modification have been incorporated in revised EMER).	**25**	**75**
13.	Has QC and QA measures been defined clearly?	**15**	**85**
14.	Has importance of flow process sheets incorporated in EMER?	**15**	**85**
15.	Has JD for each worker been clearly written?	**30**	**70**
16.	Has worker empowerment and teamwork concept been incorporated? If no, then what changes would you suggest? (Suggestions regarding improvement are in annexure 'C').		**100**
17.	Does a system of Rewards and Recognition exist in the Base Workshop? If no, what changes do you suggest? (Suggestions received have been incorporated in the revision of EMER).	**20**	**80**
18.	Has customer involvement and satisfaction been incorporated?	**15**	**85**
19.	Has role and importance of suppliers / vendors been defined?	**10**	**90**

Part II (Functioning of Workshop as per existing EMER H-409)

1.	Is existing EMER H-409 practicable?	**10**	**90**
2.	Are sufficient numbers of copies available and easy to retrieve?	**10**	**90**
3.	Is EMER H-409 being consulted during work on shop floor?	**15**	**85**
4.	Does existing EMER H-409, contribute towards preparation of Biennial Technical / Annual Technical Inspection?	**10**	**90**
5.	Are IEME observations on functioning of QAD addressed?	**10**	**90**
6.	Is syllabus for quality training available and updated regularly?	**15**	**85**
7.	If syllabus is in line with current TQM principles?		**100**

8.	Is top management focused towards achievement of defined Quality objectives? If no, what are the reasons?	**10**	**90**
9.	Is QAD working effectively as per its mandate? If no, what improvements would you suggest? (Suggestions received regarding working of QAD, have been incorporated).	**10**	**90**
10.	Is Organizational structure centralized and authoritative?	**5**	**95**
11.	Is Organizational structure decentralized and supportive?	**95**	**5**
12.	Do officers know TQM Techniques and SPC Tools?	**15**	**85**
13.	Are JCOs / NCOs trained on TQM principles and SPC Tools?	**10**	**90**
14.	Are JCOs/NCOs and civilian workers (acting as supervisors), empowered enough in their areas of responsibilities?	**5**	**95**
15.	Is effective HR available for carrying out different activities?	**60**	**40**
16.	Are workers performing efficiently according to their JD?	**30**	**70**
17.	Is Quality Assurance Supervisor available in each section?	**35**	**65**
18.	Does system of “Continuous Quality Training” for different tiers of workers and management being followed effectively?	**15**	**85**
19.	Does system of Rewards and Recognition being practiced?	**30**	**70**
20.	Is conducive working environment being provided to workers for Quality objectives? Is there any suggestion. (Suggestions received have been incorporated in the revision of EMER)	**25**	**75**
21.	Are Process Quality Control Charts being used?	**40**	**60**
22.	Are decisions been taken on the bases of tangible / factual data?	**30**	**70**
23.	Whether sufficient checklists and forms developed by QAD?	**10**	**90**
24.	Is complete record regarding different Quality activities of workshop being maintained and retrievable?	**15**	**85**
25.	Does existing work flow facilitate speedy overhauling resulting in reducing “Down Time”?	**10**	**90**
26.	Are technical manuals/flow process sheets used on shop floor?	**40**	**60**
27.	Does fault trend analysis lead to effective training of workers and education of dependent units to avoid waste?	**15**	**85**

28.	Is Quality Assurance Laboratory (QAL) available in Workshop?	**70**	**30**
29.	Is QAL working as per its objective and mandated?	**35**	**65**
30.	Is QAL equipped with latest testing facilities?	**25**	**75**
31.	Are technicians of QAL competent to carry out different tests?	**20**	**80**
32.	Is quality policy derived from customer needs and expectation?	**15**	**85**
33.	Is regular conferences held with user units to get their feedback?	**25**	**75**
34.	Does feedback provided by users being addressed effectively and incorporated in future overhauling plan?	**15**	**85**
35.	Are timely follow up actions being taken on user's feedback?	**15**	**85**
36.	Are users being trained on maintenance of equipment?	**20**	**80**
37.	Does relationship of interdependency, trust and mutual loyalty exist among workers, users and suppliers?	**10**	**90**
38.	Does customer satisfaction being reviewed on regular basis?	**5**	**95**
39.	Is supplier's selection criteria based on low price only?	**95**	**5**
40.	Is supplier's selection based on reasonable price and Quality?	**10**	**90**
41.	Are suppliers being educated on quality of supplies? If no, then how quality is being assured? (Suggestions received are placed in annexure 'C' and been incorporated in revision of EMER).	**5**	**95**
42.	Is supplies acceptance / rejection record being maintained?	**35**	**65**
43.	Is there any system exist for black listing of poor / bad suppliers and awarding and recognition of best suppliers?	**10**	**90**
	Part III (Impediments in Implementation of Existing EMER H-409)		
1.	Is Top Management support sufficient to implement Quality Vision and Mission in its true spirit?	**10**	**90**
2.	Is leadership focused towards continuous Quality improvement?	**15**	**85**
3.	Are TQM concepts being implemented in effective manner?	**10**	**90**
4.	Is quality given highest priority in workshop activities?	**20**	**80**
5.	Is QAD functioning as per its mandate?	**35**	**65**
6.	Is sufficient HR available for carrying out different workshop	**60**	**40**

	activities? If no, offer your suggestions? (Suggestions received have been incorporated in the revision phase of EMER.)		
7.	Is available HR competent to implement Quality Policy?	**25**	**75**
8.	Are workers empowered to take independent decisions in their area of responsibility? If no, offer suggestions. (Suggestions received are placed in Annexure 'C').	**15**	**85**
9.	Does system of Continuous Quality improvement exist?	**10**	**90**
10.	Does customer satisfaction given highest priority? If no, how customer based quality goals are determined? (Suggestions received have been incorporated in the revision of EMER).	**15**	**85**
11.	Are suppliers being educated about quality aspects of supplies?	**15**	**85**
12.	Are suppliers contributing to Quality objectives achievement?	**5**	**95**
13.	Does relationship of interdependency, trust and mutual loyalty exist among workers, users and suppliers?	**5**	**95**
14.	Are sufficient resources, including finances, available?		**100**
15.	Can the EMER be truly implemented in its existing form?	**15**	**85**
Part IV (Availability of Testing, Measuring and Diagnostic Equipment (TMDE))			
1.	Is provisioning process of TMDE in workshop satisfactory?	**5**	**95**
2.	Are Quality controls charts, tools and techniques being used?	**15**	**95**
3.	Are sufficient numbers of tool kits held with workshop?	**20**	**80**
4.	Are these tools properly used and maintained?	**75**	**25**
5.	Are sufficient number of test equipment, gauges and specialist tools available in the workshop?	**15**	**85**
6.	Are tradesmen capable of using these tools and test equipment?	**25**	**75**
7.	Is there any special training / cadre held to enhance workers and supervisors skill about Test Measuring Diagnostic Equipment?	**10**	**90**
8.	Have these TMDE in workshop been calibrated regularly?	**60**	**40**
9.	Are sufficient safety equipment held and are used properly?	**25**	**75**
10.	Are tradesmen aware of safety regulations?	**40**	**60**

Annexure 'C'

Valuable suggestions received through survey questionnaire, visit to different Base / Regional Workshops and conducting interviews of different workers / supervisors

1. Maximum workers, supervisors and even officers do not know about TQM. Workshop to run special classes to educate its officers and supervisors about TQM.
2. These classes should also be made part of different courses run at EME College and EME Centre for every individual.
3. EMER should be translated in Urdu for easy understanding and should be easily available to common technician at the shop floor.
4. Existing EMER should be practicable.
5. Sufficient copies of EMER should be available on shop floor for easy and regular consultation during overhauling by supervisors.
6. Maximum workers are using their experience during overhauling, instead of different tools and techniques which should be stopped immediately.
7. In maximum workshops SOPs on QA are not available. It should be prepare immediately in line with TQM concepts.
8. Structure of QAD is not practicable as per new Management Philosophies. It should be made decentralized and revised in accordance with latest TQM philosophies.
9. Special presentations and Lectures should be arranged for Top and Senior Management of Workshops to enhance their knowledge about TQM. It will also enhance their awareness of involvement in QA activities of Workshop.
10. Top / Senior Management should be educated about the need of interacting with workers and supervisors at lower levels to enhance their confidence.
11. Continuous quality training should be made part of all training program in order to achieve quality production.
12. Mission and objective of QAD should not be narrow and it should be in accordance with latest TQM concepts (It should cover all Quality Management aspects).
13. Knowledge of TQM tools and techniques should be provided to senior workshop management, which in turn will make lower tiers aware of these.

14. Old and out dated flow process charts are available which need to be revised. Moreover, workers should be educated about the procedure of using these charts.

15. QC and QA measures should be defined properly in the revised EMER.

16. Existing EMER do not include importance of TMs and flow process sheets. These items are very important in the working of Base / Regional workshops, so revised EMER should incorporate using of relevant TMs and flow process sheets.

17. Worker Job Description (JD) was written a long time back. Due to latest development in Management System it should be written again in accordance with TQM techniques in order to get promising results.

18. Due to centralized system, worker empowerment in their respective areas is not possible. With the emergence of TQM Philosophies, revised EMER should suggest Top Management to empower supervisors in their respective areas of responsibilities leading to enhance quality productivity.

19. There is no concept of Team work in workshops as Management is not aware of this factor and so running the workshop in a conventional way. Revised EMER should suggest the importance of this concept.

20. The system of reward / recognition which encourage workers do not exists in most of the workshops. This will make workers to take pride in workmanship. Revised EMER should suggest proper system of reward and recognition in the workshop in order to motivate workers.

21. EMER should suggest some steps for users' involvement in Quality activities, which can be done through critically analyzing user's feedback. This will allow workshop management to take proper and prompt actions in time.

22. It is suggested that revise EMER should be designed in such a way that it should help in preparing workshops for ISO Certification. This step will make workshop procedure streamline and enhance productivity. Moreover it will help workshop management to prepare the workshop for different types of necessary inspections.

23. Observations of IEME are very important to prepare workshop for battle worthy condition. It is suggested by most of the workshop that these observations should be rectified on priority and proper funds should be allocated to workshop management for this purpose.

24. There is no regular syllabus available for Quality training of workers and supervisors. It is suggested that revised EMER should focus on preparing such syllabus for quality training incorporating TQM philosophies.

25. Most of the workshops suggest that proper training of JCOs, supervisors and workers should be planned at EME centre and EME college level in order to enhance their competency level. When these people will be competent in their field, they will be empowered in their areas of responsibility for qualitative results.

26. Visit to different Base / Regional workshops revealed that although sufficient technical manpower is available in the workshop, but they are not being properly used as per their competency need managerial skill. Most of the time these technicians are employed on non technical duties thus reducing qualitative work. It was suggested that revised EMER should not only provide proper guideline to enhance competency level but it should also provide some regulations regarding using of these technician on technical duties.

27. Job Description (JD) of most of the workers are old and these are not being consulted during the work. It is suggested by many workshop that these JDs should be revised as per new requirements as a part of EMER.

28. During visit to different workshop it was observed that although appointment of QA Inspector exist in many workshops but they are not effective. It is suggested that through education and training excellent supervisors can be produced who can act as QA Inspectors in different department and after performing duty as QA Inspectors, once these inspectors fall back to their original department, they will be more productive thus enhancing Quality.

29. It was strongly suggested that conducive working environment should be provided in the workshop leading to Quality objectives achievement. This working environment can be provided through proper availability of tools, equipment viz. a – viz workers and supervisor empowerment.

30. During the conduct of interview to lower tier of management it was learned that leave policy is not been properly practice which is a key factor for worker's encouragement. So, proper leave policy should be prepared by top management within the workshop so that every worker can plan his leave according to his requirements.

31. QC charts are not being used in most of the workshops. These charts are necessary to be used for Quality production. EMER should suggest use of these charts in accordance with TQM principles and techniques.

32. Proper feedback should be recorded and available in the form of data. Data should be based on facts and further line of action should be drawn from this obtained feedback.

33. QAD in most of the Workshops is not effective. Revised EMER should suggest decentralized organization with latest equipment. It should also suggest different checklists and forms to be used by this department for its effectiveness.

34. System of maintaining proper records and its timely retrieval is not practice in most workshops. Revised EMER should suggest different methods for record keeping and its presentation by QAD and other departments so as to facilitate speedy retrieval of the record.

35. Visit revealed that existing procedure of overhauling is lengthy due to old and unjustified work flow. It does not reduce down time of overhauling. Revised EMER should suggest easy and manageable workflow charts in commensuration with TQM philosophies.

36. Survey and visit pointed out that fault trend analysis charts currently used in most workshops are difficult to understand. Revised EMER should suggest comprehensive and latest fault trend analysis techniques for quick reference / action.

37. Survey of different workshop revealed that although QAL exist in every workshop but it is not working properly due to shortage of equipment and competent technicians. Revised EMER should suggest a comprehensive policy regarding QAL functioning. It should also suggest reasonable funds for up gradation of QAL.

38. It was suggested that the objective and mission of QAL need to be updated and should be revised to make it in line with the latest TQM techniques.

39. It was suggested that QAL should be functional properly in order to carry out all required tests by the Base/Regional workshops. Base / Regional Workshops are carrying out different required tests by other civilian agencies on payment.

40. Currently no training for QAL technicians is being carried out. EMER should suggest training of these technicians through other reputed agencies so that these technicians may be able to handle equipment of QAL efficiently.

41. It was observed through visits to different workshops that there is no focus on customer requirement which is contradictory to TQM philosophies. It was suggested that revised EMER may focus on customer satisfaction as a policy matter.

42. It was observed through conduct of visit to different workshop that top Management is unaware of conducting regular conferences with user units. It should be adopted as a regular policy matter in revised EMER. This will provide management current feedback about user.

43. There should be a proper system of recording feedback which is provided by user units in a proper way in order to get required information in time without any delay. It should be suggested in the revised EMER that a system of record keeping used by some leading organization should be studied and implemented in the workshop.

44. Record office is not working effectively although it is under direct control of OIC QAD. It is suggested that in revised EMER this record office should be upgraded and aim / objective should be elaborated more in order to achieve desired results.

45. It was observed that harmonious relationship among different stake holders like workers, middle and top management, users and suppliers do not exist. Revised EMER should suggest maintaining of good working relationship among all these stakeholders in the workshop.

46. It was observed during survey and visit to different workshops that awarding contracts only on the basis of low price should be discontinue immediately. Revised EMER should suggest a comprehensive system of supplier selection which should be based on many aspects like quality, timely response and cooperation in addition to low price.

47. It is observed that all workshops are currently dependent on inspection for Quality. Revised EMER should suggest a system of self inspection and enhancing competency level of common worker to assure Quality of the product.

48. Visit to different workshop revealed that although record of supplier acceptance and rejection is maintained, but it is not consulted during inspection of stores. Revised EMER should suggest proper method as a policy decision for the maintenance of record.

49. A system of black listing poor / bad supplier should be revised and it should be done as a regular practice. More over revised EMER should suggest keeping of proper record of black listed supplier and providing this information to other workshops also.

50. Supplier contribution towards achievement of Quality Objectives is not observed during the visit to different workshops. Revised EMER should suggest regular interaction between management and supplier through coordination conferences.

51. During the visit to different workshops it was observed that Test, Measuring and Diagnostic Equipment (TMDE) are not available as per the requirements in many workshops. Revised EMER should suggest regular provisioning of these TMDE in workshop thus enhancing production with quality product.

52. It was observed during visit to different workshops that TMDE are not calibrated regularly which is very important for proper functioning of these equipment. It is suggested that calibration of different TMDEs should be arranged regularly in accordance with the set SOPs.

53. It was suggested that ISO certification should be plan as per COAS directives by all Base / Regional workshops, which enhance quality production.

54. It was observed that tool kits available with workers are old and not as per proper specification. Revised EMER should suggest proper provisioning process for different tool kits to all technicians.

55. It was revealed during the visit to different workshops that latest firefighting equipment is not held with most of the workshops. Revised EMER should suggest some scale for the provisioning of these firefighting equipment at different places in the workshop to avoid any mishap.

56. It was observed during visit to different Base /Regional workshops that Safety equipment is not held with different department which can lead to any individual mishap during the work. Revise EMER should suggest proper provisioning of these safety equipment along with scale.

Annexure 'D'

Revised EMER, October, 2009 on Quality Assurance in EME Base / Regional Workshops Undertaking Base Overhaul / Rebuild

Revised EMER, October, 2009 based on TQM Tools and Techniques on Quality Assurance in EME Base / Regional Workshops is attached as follows.

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