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Paradigm for Total Quality Management in Building Maintenance Operation

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Abstract
The study is about developing benchmark/ paradigm for total Quality Management in Building Maintenance Operations. Building defects is usually outcome of failure or shortcomings recorded at early stage of project which could be design oriented and sometimes wrong approach, this need to be corrected and as well maintained, the study thus present paradigm/benchmark through which quality of maintenance operations being carried out on construction projects and buildings could be improved.
The methodology involved primarily opinion survey, measured against benchmarked Total quality management principles, the data were collected with the aid of a structured questionnaire, designed in Likert scale 1 to 5. The secondary data were collected through review of pastworks, Journal articles and Textbooks. Random sampling method was used for population sampling, the result generated were analysed using mean item score, frequency count and Ranking
The study concluded with recommending eighteen benchmarked quality points which when observed could lead to productivity enhancement, accident reduction, waste elimination, quality job output and host of other positive outcomes.
Keywords: Quality, Maintenance, Benchmark ,Management, Paradigm,Operation

Introduction

By the nature of creation there is virtually nothing man-made that is indestructible, but the usefulness of many such items can be extended by carrying out repair at regular intervals through an activity known as maintenance. White (1979) defined maintenance as the "work undertaken to restore every facility to an acceptable standard at an acceptable cost. The use and exposure to environmental conditions subjects machines, buildings and other service facilities to deterioration. The process of deterioration if unchecked, culminate in rendering these facilities unserviceable and brings them to a standstill. Firms and organization, therefore have no choice but to attend to them from time to time, to repair and recondition them so as to prolong their usefulness to the extent that they are economically and physically priviledged.
Maintenance is made responsible, for provision of a condition, of machines, buildings, and services that will permit uninterrupted implementation of plans requiring their use. Theoretically, maintenance should aim at keeping the machines and other facilities in a condition that allows them to be used without any interruption and at their maximum profit making capacity. (Adegoke, 2003).However, as adequate care is being taken to ensure the reconditioning of the machine and building facilities back to their original state, a level at which it will be able to perform the intended use, however cognizance should be taken of the fact that, if it has to be done; it should be at minimum cost, with improved output, emphasis placed on employee involvement and empowerment, continuous improvement, cutting across the entire organisation, and with every responsibility for quality of work output. (Iyagba, 2005 and Wahab, 1987).

Quality, as a measure of excellence is subjective, that is, it depends on the perspective at which individual views it. It could be explained as the totality of features and characteristics of a product or service that bears on its stated ability or implied needs and to be generally acceptable. (Lam 2000).

The acceptability of a product or a service will depend on its ability to function satisfactorily over a period of time, and it is this aspect of performance which is given the name ***reliability or quality assurance***.Quality assurance has the aim of getting things right first time, and to provide platform upon which consistent improvement could be based. It is broadly termed as the prevention of problems undermining quality through planned and systematic activities. These include the establishment of a good quality management system and the assessment of its adequacy, the auditing of the operation of the system, and the review of the system itself.Therefore, from the standpoint of quality assurance, every step taken in the reconditioning of a system back to its best state is important, ensuring that the right thing is being done promptly and at a reasonable cost, without unnecessary waste of effort and resources.
According to Olawunmi (1992), consequence of neglecting the aspect of management of quality in the maintenance of facilities, machines, and buildings, has resulted in the following: i. Increase in maintenance cost and low building performance. ii. Wasted energy and effort iii. Inadequate client's management of maintenance. e.g. - Lack of communication regarding maintenance issue - Inadequate resources allowed

for adequate maintenance. - Capital cost overriding life-cycle-cost. iv. Very complex service system with low reliability. v. Lack of sufficient instrumentation for easy monitoring

However the above stated facts could be corrected by applying the tools/principles of Total Quality Management. Since the principle of Total Quality Management profers solution out of the such problems since it forms the nucleus of what the principle address.

Statement of the Problem

A careful look at Nigerian environment would reveal erratic building maintenance pattern among buildings owners/occupiers, especially, most of the public buildings are left unattended to the major preoccupation then seemed to be, construction of big edifice without considering subsequent maintenance of such a property. Thus maintenance of building in Nigeria tends to be a sort of onerous task, and it is also saddle with a lot of problems which tends to hampers it and makes it a sort of herculean task. Some of such problems being encountered in building maintenance in Nigeria and which needs to be attended to are as follows:

i. Inappropriate maintenance policy ii. Non-compliance with statutory requirements iii. Inability of management of organization to carry employee along in decision-making and policy formulation. iv. Insufficient training and skilled manpower in maintenance operations v. Lack of standards performance monitoring system.

The above listed problem could be countered by considering certain virtues in total quality management, which tend to provide way out of the problems. It is believed that if the principle could be applied in building maintenance most or nearly all the problem arising therein would be solved. To this end therefore, this research work is about studying an approach through which TQM principles could be adopted for an effective maintenance operation.

Review of Related Literature

Maintenance could be defined as the work undertaken to restore facility to an acceptable standard and with minimum cost and also getting personnel involve in the process and as well ensure their empowerment for quality work output. (Iyagba, 2005 and Wahab, 1987). Quality could be explained according to Lam (2000) and Ashworth (1994) as totality of features and characteristics of a product or service that bears on its stated ability or implied needs and its acceptability. The acceptability of a product however is dependent upon its satisfactory performance over a period of time, which is referred to as Quality assurance or reliability.

Quality assurance aims at getting things right first time and to provide platform upon which consistent improvement could be based.

It is regarded as the prevention of problems undermining quality through planned systematic activities. These involve establishing good quality management system, and the assessment of its adequacy. The planned systematic activity to be used in preventing problems undermining quality is through applying the Total Quality Management system principles. (Rao 1998 and Ashworth 1994). Total quality management is a system that seeks to realign the mission, culture and working practices of an organization by means of pursuing continued quality improvement. (Ashworth, 1994 and Ashford, 1989).

This recognizes the fact the nature of something can be improved, and therefore grades of excellence can be aimed for. Continuous quality improvement which form the basis of total quality management (TQM), refers to the notion of “never been satisfied” with the current degree of quality and success in meeting customers identified needs, requirements, interest and expectation. This is why total quality management involves the searching for an improvement rather than maintaining current performance. (Langford, 1990 and Rao 1998). Total quality management does set to meet a pre-defined quality, on continuous basis, by a process of research, evaluation and feedback. This will help in identifying area of improvement, and resources could be channeled in that particular direction. (Ashford, 1989 and Oakland, 1989).

Total quality management philosophy and practice originated through the ideas of Dr W. Edwards Denning, an American who provided the intellectual drive behind Japan’s post war construction. He persuaded Japanese companies to involve consult with customers in their effort to improve products continually. The focus is people centered and towards creating an appropriate, supportive and well disciplined climate for promoting a positive and effective commitment to improving quality (Ashworth, 1994). By and large, others have developed these ideas believing that the present performance is any function and should be improved. Several other management scientists embraced this Edward Denning’s idea and further develop on this, like: Juran, who proposed quality Trilogy, an action that later created quality revolution in Japan. According to him, managing quality involves three basic processes (Juran, 1986).

Total quality management will always require sufficient appropriate investment to ensure all planned activities occur. Total quality management acknowledge that the nature of something can be improved, and therefore

grades of excellence can be aimed at, total quality management refers to the notion of "never being satisfied" with the Current degree of quality and success in meeting customers' identified needs, requirements, interests and expectations, thus Total quality managements searches for opportunities for improvement. (Ashworth, 1994 Ashford, 1994 and Oakland, 1989)

PERSPECTIVE TO THE DEFINITION OF QUALITY

Quality as measure of excellence means different things to different people, and as such it is totally subjective. There are four (4) approaches to quality according to (Rao, 1998).

The product based perspective,the manufacturing-Based perspective, the customer-use Based perspective an value-based perspective

The product-Based perspective**:** This provides specific features with which quality can be measured in the product. The manufacturing-Based perspective is centred on the conformity of manufacturer to the specification of Engineering system that design the product; the more the conformity the more the product.

Also, in customer-use-based perspective, the more useful a product is to customer the more they rate the quality of such product. However, value-based perspective believes that Quality is seen as getting the value for money spent in purchase of an item.

The system upon which the whole universe is based is controlled by system that manipulate inputs and add value together to yield outputs; likewise for effective functioning and performance of an organization, numerous linked activities has to be identified and managed, in order to enable the transformation of inputs into outputs, this mechanism can be considered as process.

Thus, a process needs to be established in order to manage quality and the associated problems understanding its achievement. Total quality management is the right approach to use if the problems affecting quality are to be tackled. So also, other researchers have worked on quality improvement apart from Juran, such as Lam (2000), Crosby (1980), Ashworth (1994), Rao (1998), Panasurama (1989), Oakland (1989) and Ashford (1989) they have all worked in this direction.

Total Quality is not an accidental occurrence it is often planned, execute and maintained. Thus if quality is desirable in building maintenance, it has to be planned, and also provide basis for its future improvement. The plan need to start right from inception (design-stage),to construction stage and commissioning stage up to redevelopment stage. Policy that would ensure continuity is to be put in place, and a fact that, if neglected, would lead to inadequate maintenance of such a development which leads to sick building syndrome. According to Iyagba (2005), Adenuga (1999), Wahab (1987) and Bamisile (2004), the problem that leads to poor state of building originates from time of construction, ranging from inability to maintain procurement of quality materials, qualified construction workers/specialist, which lead to poor workmanship and poor production system.

The Principles Of Total Quality Management

The key principles of total quality management that should present the "working life" of any organization a spring to operate total Quality management are as follows (Ashworth, 1994, Rao, 1988 and Langford, 1990).

A. An organization wide commitment to quality**:** This entails organization making Total Quality overtly the highest priority, defining Aim, and how to achieve good health and safety condition.

B. creating appropriate climate**:** Creating conducive environment to the parties involved. i.e. implicit mutual respect of all stakeholders involved in total quality organization with assurance that all are going to benefit from the projects.

C. Focus on satisfying customer's need: This involves defining customers' need and strives to ensure its satisfaction.

D. Communication**:** Good managerial sense for both technical and managerial issues by all parties. A total quality organization communicates openly and clearly its principles, benefits, values, mission statement, and policy for quality.

E. Precision: Getting it right the first time to achieve near perfection or near zero defects stage, and during maintenance operations.

F. Adequate resources allocation and building**:** Total quality management would always require sufficient appropriate investment to ensure that planned activities occur.

G. Efficient Performance Monitoring System**:** Good, established conventional method of monitoring equipment performance is highly essential.

H. Continuous Improvement In Manpower Skill And Development: For an organization to imbibe the total quality management culture successfully, all its managers and leaders must be subjected to periodic skill development appraisal, to acquire coaching skills and interpersonal discipline.

Techniques of Total Quality Management

There are six time-tested Techniques of total quality management TQM as proposed by (Rao, 1998). They are as follows:

1) Empowerment: This is the transfer or delegation of responsibility and authority. Without this, empowerment fails. This works best if these four forces are operating simultaneously. i.The delegator (manager) has established a clear vision, what the goals are and has communicated to the subordinates, ii. The delegator has established high personal and business standards and has consistently demonstrated those standards through his actions, iii) The delegator has established close relationship with subordinate and has trusted them to make decision. The delegator is willing to let subordinates make mistakes, and only intervenes to prevent disaster, iv) Employee Participation and Involvement**:** In decision-making and problem solving processes.

3) Creativity and innovation**:** Valuing and respecting contrary ideas, and encourage employee with good initiative.

4) Management By Score Keeping**:** This borders around performance appraisal and feedback interview. When performance is measured and reported back, the rate of improvement accelerates.

5) Team Building**:** When several people work together to achieve a well-defined goal, the result of many far exceeds the result of a few. This is referred to as synergy, the most important benefit of team performance.

6) Managers Skill Development or Appraisal**:** For effective implementation of TQM, periodic skill development is essential for all Cadres of managers. With reference to the above facts, effective maintenance management of building can be approached through the implementation of total quality management techniques, the overall aim of which is, enhanced output / efficiency and quality improvement.

Discussion of Result/Findings.

The data collected through the questionnaire is presented as follows:

Characteristic of Respondent

Table1: Company/organization Category

Category
Maintenance Workers
Maintenance Work Supervisors

There are two category of respondents from table labour(1) the worker of maintenance units of various firms junior workers and (ii) the maintenance work supervisors.

Table 2: Respondents Number of Working year

Period (year)	Total	Percentage(%)
5-10years	30	93.75
10-15years	2	6.25
15-20years	0	0.0
Over 20years	0	0.0

From table 2, ninety-four percent (94%) of respondents have been with their companies for 5 to 10years, while six percent(6%) have worked for period of 10 -0 15years with their companies. This shows tendency to obtain qualitative information from such individuals.

Table 3: Company/Organization Category.

Period (year)	Total	Percentage(%)
Indigenous Firms	17	47.22
Indigenised Firms	19	52.78

From table 3;fifty-three percent (53%) out of all the thirty-six companies whose their response was available belong to Indigenised company category while forty seven percent(47%) belongs to indigenous companies

Table 4: Total Quality Management Parameters.

S/N	T.Q.M PRINCIPLES	S. A	A	D	S. D	M. D
A	QUALITY POLICY.					
	1 Policy on Maintenance Method to be used should be clearly defined 2	32	20	0	0	0
	Employee should be involved in decision making.	30	28	4	5	0
	3 Standard of works and operational quality should be clearly communicated	30	25	0	0	0
	4 Quality assurance team should be formulated.	32	22	0	0	0
	5 Period retrospective check on successful implementation essential.	30	27	0	0	0
B	COMMUNICATION, AUTHORITY&PESPONSIBILITY.					
	1There should be effective Communication of information on work quality standard to the maintenance personnel.	30	28	0	2	1
	2 Management should convey meeting on quality in maintenance issue periodically.	32	25	0	0	0
	3 Policy implementation committee need to be established.	15	10	10	20	4
	4 Delegation of responsibility is essential for over or overall operation success.	32	20	2	3	0
	5 Establishing line of command is essential.	28	24	0	1	1
C	WORK ENVIRONMENT					
	1 Work environment should conform to international standard.	28	15	2	0	0
	2 Adequate ventilation, first aid and Personal Protective items should be available.	30	25	0	0	0
	3 Work schedule should be flexible to minimize error and accident.	32	8	1	1	1
	4 Man-machine convenience should be give consideration.	23	15	4	3	0
	5 Provision of incentive to enhance productivity.	30	25	0	0	0
D	MANPOWER TRAINING AND DEVELOPMENT					
	1 Skill worker should be sufficient in companies anies/organizations maintenance operations.	25	10	5	4	0
	2 Workshop, Conference should be organized for workers.	30	10	2	0	1
	3 Refreshers courses is essential for on-job development.	28	15	0	0	0
	4 Rotational of job-bits for workers job-experience University.	25	15	1	1	1
	5 Mechanization of production processes operation.	28	25	0	0	1
E	MEASUREMENT AND PRECISION					
	1 Emphasis is usually on getting work done correctly once and always.	20	10	1	2	1
	2 Periodic measurement of maintenance quality management.	25	15	4	1	1
	3 item repaired last long before development faults.					
	4 Fault developing period on maintenance items are as follows:					
	Below 5 months.	1	3	14	22	2
	5-10 months.	5	4	13	23	2
	10months and above	25	16	3	3	1
F	PERORMANCE MONITORING.					
	1 Conventional method of detecting faults should be in place	30	25	2	1	1
	2 Human-based inspection method should give way to conventional method	25	23	10	5	2
	3 Personnel should be taught fault recognition techniques	30	25	0	0	0
	4 Personnel should be taught ways of assessing maintenance works done	30	25	1	0	0
	5 Frequency of corrective operation (rework) should be noted as performance index	15	10	20	22	2
G	RESOURCE ALLOCATION AND BUDGETING					
	1 Resource should be allocated for works in every fiscal years.	25	20	1	3	1
	2 Financial allocation should exist for emergencies.	24	25	0	0	0
	3 There should be budget for routine maintenance.	25	23	0	0	0
	4 Progressive auditioning of operations.	22	25	1	3	0
H	QUALITY COST OBJECTIVE					
	1 Minimizing Expenditure to maximize profit.	10	1	10	24	0
	2 Having maintenance expenditure base on machine/equipment age/utilization	30	10	5	5	0
	3Allowing contingencies for tools and incidentals: internal and external failure cost/appraisal	25	25	0	0	0

S.A --------- Strongly Agree D --------- Disagree M.D --------- Moderately Disagree
A --------- Agree S. D ---------- Strongly Disagree

From Table 4; Mean item score (M.I.S) is derived from following formula:

$$M.\ I.\ S = \frac{5N_3 + 4N_4 + 3N_3 + 2N_2 + 1N_1}{5(N_5 + N_4 + N_3 + N_2 + N_1}$$

Where M.I.S = Mean item score
N_5 = S.A = Strongly Agree
N_4 = A = Agree
N_3 = D = Disagree
N_2 = S.D = Strongly Disagree
N_1 = M.D = Moderately Disagree
R.K = Ranking

DISCUSSION OF RESULTS/FINDING

The cumulative figure of respondents' opinion as regards issues on application of Total Quality Management principle in maintenance operation is presented in Table 5, the Mean item score is also calculated of the Data generated therefrom. However it was discovered from table 5 that: Sensitization of personnel,this refers to communication on the issue of quality as regards various maintenance operations top the list, with mean item score 1.00 that Management of organization should convey periodic meeting of the employee, which will provide a forum of discussion on quality issues; this will enable issues of bottlenecks in operation to be discussed and solved.

Manpower base of the organization needs be consolidated, through driving qualitative personnel development programme, this was ranked second (2^{nd}) with mean item score 0.96, that qualitative knowledge and skill could be acquired through workshop, seminar, vocational skill acquisition programme and organization of refresher courses was ranked third (3^{rd}) with mean item score).93, this is essential to keep personnel abreast current technological development in their area of discipline since organization at all facet in life has been the order of the day since the inception of concept of globalization .So also communication of main tenancy policy to all and sundry, mechanization of production processes operation and formulation of quality assurance team, were ranked fourth (4^{th}) with mean item sore 0.92. Hand/manual work tends to be monotonous and tedious, is slow and retards efficiency. Certain operation could be carried out more rapidly and efficiently if machine were used in carrying them out. The nature of maintenance policy in place should be well defined and communicated to personnel, this will enable them to share the vision burden, clear communication of the policy gives an organization focus and direction and results in a well structure that favours productivity.

As well important is the formulation of quality assurance team, this teams major preoccupation is check and control of the quality in production system. This culminates in a concept of self-driven team, they generate/originate ideas, formulates quality policy and set up framework for its implementation.

So also, an organization that desires enhance output will hold in high esteem the upholding of standard work among its workers, thus from table 5, clear communication of standard of work and operational quality, periodic retrospective check on adherence to quality in maintenance operations, provision of incentives to enhance productivity and teaching of personnel the art and skill of fault recognition in maintenance operations, were ranked seventh (7^{th}), with mean item score value 0.91.

The personnel needs taught skill and techniques useful in recognizing fault during maintenance works; this lessens the burden on supervisors, and would held forestall delay and unnecessary re-work.
Incentive provision is also essential in encouraging workers on to higher productivity, the incentive induces higher productivity, when well managed and administered. The incentives could be Financial incentive, Non-financial incentive or combination of both. The incentive nullifies dissatisfaction among workers and enables them to put in their best. An incentived maintenance workers will be effective at work, efficiency is high, waste is reduce and productivity per head is enormous. However, the incentive mentioned above alongside with provision of first aid and personal protective items are all means of eliciting higher productivity from workers. Periodic retrospective evaluation of result achieved as regards policy implementation is necessary; this should be observed, in order to determine the extent of success attained, in order to call for policy reformation or re-programming.

Table 5: Analysis of Response.

Total	Quality Management Principles Maintenance Operation			
S/N	T.Q.M Principle	Total	M.I.S Val	RK
A	Quality Policy			
	1.Policy of maintenance method to be used should be clearly defined	52	0.92	4
	2. Employee should be involved in decision making.	62	0.85	28
	3. Standard of works and operational quality should be clearly communicated.	55	0.91	7
	4. Quality assurance team should be formulated.	55	0.92	4
	5. Period retrospective check on successful implementation essential.	57	0.91	7
B	Communication, Authority and Responsibility.			
	1. There should be effective communication of information on work quality standard to the maintenance personnel.	61	0.88	16
	2. Management should convey meeting on quality in maintenance issue periodically.	57	1.00	1
	3. Policy implementation committee need to be established	59	0.54	32
	4. Delegation of responsibility is essential for over operation success	57	0.88	16
	5. Establishing line of command is essential.	54	0.89	14
C	Work Environment			
	1. Work environment should conform to international standard.	45	0.92	3
	2. Adequate ventilation, first aid and personal protective items should be available	55	0.91	7
	3. Work schedule should be flexible to minimize error and accident.	43	0.88	16
	4. Man-machine convenience should be given consideration	45	0.86	23
	5. Provision of incentive to enhance productivity.	55	0.91	7
D	Manpower Training and Development			
	1. Skill workers should be sufficient in companies/ organizations maintenance operations.	44	0.86	23
	2. Workshop, Conference should be organized for workers.	43	0.96	2
	3. Refreshers courses is essential for on-job development.	43	0.93	3
	4. Rotational of job-bits for workers job-experience universality	43	0.89	14
	5. Mechanization of production processes operation	48	0.92	4
E	Measurement and Precision			
	1. Emphasis is usually on getting the work done correctly once and always	34		21
	2. Periodic measurement of maintenance quality management.	46		21
	3. Item repaired last long before developing faults.			
	4. Fault developing period on maintained items are as follows:			
	Below 5 months.	42	0.50	35
	5-10 months.	47	0.55	34
	10 months and above	48	0.85	28
F	Performance Monitoring			
	1. Conventional method of detecting faults should be in place.	59	0.88	16
	2. Human-based inspection method should give way to conventional method	65	0.80	30
	3. Personnel should be taught fault recognition techniques.	55	0.91	7
	4. Personnel should be taught ways of assessing maintenance works done.	56	0.90	12
	5. Frequency of corrective operation (rework) should be noted as performance index	71	0.88	16
G	RESOURCE ALLOCATION BUDGETING			
	1 Resource should be allocated for works in every fiscal years.	50	0.86	23
	2 Financial allocation should exist for emergencies.	40	0.74	31
	3 There should be budget for routine maintenances.	48	0.90	12
	4 Progressive auditioning of operations.	51	0.86	23
H	QUALITY COST OBJECTIVE.			
	1 Minimizing Expenditure to maximize profit.	45	0.59	33
	2 Having maintenance expenditure base on machine/equipment age/utilization	50	0.85	23
	3 Allowing contingencies for tools and incidental: internals and external failure	50	0.90	12

From the Table (5), Establishing line of command, Job-bits rotation, were ranked fourteen (14th) with mean item score 0.89; Establishing line of command is necessary for effective instruction and information dissemination as well as job-bits rotation, this prevent exhaustion, job burnt-out, and work monotony, it also allows for experience universality.

In line with the above is establishing flexible work schedule, delegation of responsibility, effective communication work/operations quality, and using conventional methods in fault detection for purpose of maintenance work, were ranked sixteen 916th) with mean item score 0.88. Work schedule should be flexible, this prevents overwork, work fatigue and dissatisfaction that could lead to work accident or exhaustion, which is counter-productive, authority, needs be delegated for effective administration, and overall success. So also conventional method should give way to primitive fault detection method that are ancient and outdated, computerized fault detecting gadget should be employed e.g. calibrated electronic fault detecting devices.

Minimizing Expenditure to maximize profit is ranked thirty-third (33rd) with mean item score 0.59, maintenance operation incures expenditure by its nature, thus it is not profit oriented, thus adequate expenditure programme should be in place. Emphasis here should be getting the operation carried out correctly once and always, with periodic measurement of maintenance quality management to ensure consistency, this will enable items maintained to last before developing fault, to this end however, the suggested window fault detection period that could be abstracted is benchmarked at period of 10 month and above, this will tend to lesson expenditure.

Conclusion/Recommendation

With reference to the discussion above Total quality could be managed in various maintenance operation against the following benchmarked position:

(a) Conveying of meeting on quality as regards maintenance issues periodically.
(b) Empowering workers through knowledge base consolidation approaches such as: Seminars Workshop, Vocational acquisition course, and Refresher course
(c) Clear communication of maintenance policy to all stakeholders.
(d) Formulation of quality assurance team to oversee various maintenance operations.
(e) Mechanization of production processes where necessary.
(f) Periodic retrospective check on process/success achieved at various policy and operations.
(g) Provision of good environment, well ventilated workspace, first aid and protective items.
(h) Site work environment
(i) Provision of incentives (financial and Non-financial).
(j) Teaching of maintenance personnel/crew the art and technique of fault recognition for purpose of maintenance.
(k) Provision of contingencies for tools and incidentals: internal and external failures.
(l) Provision of budget for routine maintenance.
(m) Teaching personnel ways/method of assessing quality of work married out.
(n) There should be effective communication of information on work quality-standard to personnel
(o) Delegation of responsibility
(p) Work schedule should be flexible to minimize error and accident.
(q) Using conventional method in fault detection during maintenance operation.
(r) Financial allocation should be put in place for emergency.
(s) Maintenance allocation should be ranged based on frequency of equipment utilization, and period of purchase.

If the above could be observed, productivity will increase among maintenance workers, accident will be reduced, incidence of rework and waste will be eliminated and there will be quality job output.

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