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APPLICATION OF TOTAL QUALITY MANAGEMENT AND REWARD (TQMR) ON INDUSTRIAL PROJECT

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ABSTRACT

Abstract: - More than two decades of liberalization and globalization has resulted in free flow of foreign goods to India and opened up trade of domestic products elsewhere in the world. As the world has become one big commerce platform, the Indian consumers are getting accustomed to the International quality standard for products and services. So when it comes to the products or services of the India construction industries like Infrastructure, Buildings and other projects, the expectation remains the same of getting international quality standard. Indian Construction Industry has no choice but to elevate themselves to produce the best in class quality products and services or get replaced by the hands of foreign competition. The India construction companies can adopt the tools and techniques of Total Quality Management by improving each activity by everyone associated with the project to produce world class quality. The paper brings out a new model of Total Quality Management & Reward (TQMR) which shall provide a way out to adapt Total Quality Management with a combination of Reward mechanism to motivate the employees for the best results.

KEYWORDS: Critical To Quality, Total Quality Management, Total Quality Management and Reward, World Trade Organisation.

I. INTRODUCTION

India is one of the fastest growing economy with 17.86 % of the world population living in India. This has made India as the demand center for whole of the world. The buzz word in the world economic forum is if a company does not sell in India it can no longer exist. The free trade policy of India by signing of the WTO agreement has opened the door for the world manufacturers to set up shops in India. The wide spread usage of Internet on mobile has exposed the Indian consumers to the world of information and the E-commerce has brought the world class products to their doorsteps just by a click on "Add To Cart" on Amazon or Flipcart. The quality expectation cannot be limited to only few consumer products but would apply to the products and services from construction Industry as well. The informed consumers of the Indian construction industry as well wants best roads, high speed trains, metros, urban developed cities like smart cities, adequate infrastructure, clean water, sufficient power and Internet enabled user friendly neighborhood.

But in realty the Indian construction industry is one of the most disorganized sector though being the second largest employment generation after agriculture. There are a very few organized players who can be counted on figure tips**.** The organized companies in Contracting, Real estate and Consultancy is less than 30 to 35 % of the total Indian market size of INR. 250,000 Crores. More challenges comes from the fact that the construction workers mostly remains unskilled due to non- availability of proper training facilities/ schools for the workmanship. Also the labour force constantly shifts from construction industry to agriculture industry between the harvesting seasons.

These factors leads to poor quality being produced by the unorganized sectors and final product with defects. All such projects on stage of completion take enormous time and efforts to rectify the snags due to poor quality of work. The few organized sector engages quality control department to carry out the quality control which is a

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corrective action rather than the preventive action of quality assurance. All such effort and the cost associated makes them a little more expensive than unorganized sector and hence not a level playing ground.

A major threat to the Indian construction Industry due to Low quality of work is from the International companies which in huge numbers are establishing themselves in the Local market. With a more liberal foreign direct investment in India, many such organizations from Middle East, Europe, China, Korea, US, Australia and Singapore have already established offices in India and are aggressively bidding in their respective sectors. Another reason for them to come to a high growth developing nations like India is due to the fact that back home in their own countries they have over developed Infrastructure requirements for next few decades and cannot provide any business to them. Moreover all the major works are now called through Global tenders which allows the works carried out by these Multinationals in other countries to qualify the technical criteria. Also for few of the works which are implemented for the first time in India, the participation of these Multinationals becomes inevitable due to their International exposure, say as in case of bullet trains.

The objectives of this paper is to establish importance of adoption of Total Quality Management approach by Indian construction industries to sustain the global competition. Our construction sector follows the age old traditional systems which has to go through enormous changes to match the global standards. It is the least mechanized industry compared to others sectors due to the availability of cheap labour force. It is quite challenging to implement the tools and techniques of TQM to a Factory set up which is mostly mechanized, carried out by repetitive process at one location. However it becomes multiple fold difficult in case of projects which are unique every time and implemented at different geographical locations by involvement of local work force under unpredictable complicated situations.

Total quality Management is a holistic approach of ensuring the high quality of work at each and every stage of work, by each and every individual working within or outside the Organization to give complete satisfaction to the final consumer who pays or avails the benefits of the products or services of the organization. The concept of TQM is to attain quality in every activity by everyone connected with that activity. From a project perspective it is applicable to the entire project cycle involving the activities by each stakeholders from Client, Architects, Consultants, Contractors, Subcontractors, Vendors, Suppliers, Engineers to the workforce.

TQM aims at improving the work culture, employee empowerment, customer satisfaction, maximization of return on investment and overall performance excellence by adopting the Standard Operating Procedures and Statistical Quality Control technique. It is not limited to material testing or quality assurance of end product only but it aims at the process of quality planning, quality improvement and quality control as per Juron's trilogy at each and every phase. Once an organization chooses to implement the TQM philosophy, the success or the failure truly depends on the real essence of implementation to the core. The biggest road block or resistance may be due to the additional efforts which the employees or work force need to put to achieve the desired results. The best way to overcome this challenge is to motivate the employees by a proper reward and recognition. This paper suggests a new model of combining the Implementation of TQM with a reward mechanism which is based on the quantity of work performed by the employees as per their Key Result Areas (KRA's) provided that the quality parameter which are Critical to Quality (CTQ) are met by them.

II. LITERATURE REVIEW:

.Humans have always been on the path of continuous improvement which is evident from our journey from Apes to Humans. From early centuries till present era, only human species have continuously improved to rule over the world. The definition of TQM in work is no different. The goal of the review is to understand the research work done on similar topics available in the public domain and take their insight into consideration of this study.

Review of Technical papers:

2.1. Elghamrawy, T. and Shibayama, T. (2008)

A study was conducted to compare the best TQM philosophies adopted by the Japanese companies working in Egypt with an Egyptian company. The study recognized TQM as a successful philosophy which can be implemented in construction Industries in Egypt. The Paper presented:

- ✓ Characteristics of Egyptian Construction Companies.
- ✓ Concerns in Application of TQM in Construction.
- ✓ Best practices of Japanese Construction Company which could be adopted by Egyptian companies.
- ✓ Proposed a new model for TQM implementation which is suitable to Egyptian construction industries.

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Following were the steps to implement the new model:

1. Commitment by Top Management
2. Orientation
3. Planning of the Program
4. Training on the TQM
5. Conducting the Quality Projects
6. Improving Job site quality
7. Measuring Results.

2.2. Kenneth T. Sullivan (2011)

i. The study identifies the three classical quality management programme of TQM, six sigma and lean production which has been widely implemented in manufacturing industry. However their application was very limited to construction industry due to the following reasons:
   - ✓ The Lowest bidder wins the bid which make the application of TQM unviable due to low margins.
   - ✓ The lean production utilizes the least resources to produce the same result, practiced by the Toyota Production System. The Non repetitive and unique nature of the project make it unviable to implement lean production system.
   - ✓ Six sigma was found to be more user friendly for implementation by controlling the process to produce less than 3.4 defects per Million.

ii. An Owner driven "The best value system" which was compared with the classical programme. The best value system eliminates the waste by reducing client decision by aligning the best contractor to the client and delegate the decision making power of the client to a third party.

2.3. Chokor, A., El Asmar, M., and S. Paladugu, B. (2016).

The research paper brings out the Incentive mechanism to control the cost and time over run, which is practiced more and more in US construction Industry. The incentive is categorized based on four types namely cost, Time quality and safety. Study collected the data from 30 companies and analyzed that the incentive mechanism can reduce the cost and schedule overruns by 5.3% and 8.4%, respectively.

2.4. T. W, Qiang. M, Duffield, C., Young, D., and Lu, Y. (2009).

The study was made on the increasing trend of the TQM principle in construction sector. Various barriers to the implementation of TQM can be overcome by giving incentive to the various stakeholders. The study suggested partnering as a solution for the successful implementation of the TQM principles which brings a team effort in unified direction. The saving due to the addition effort is shared between the participants. The study was carried out on Chinese companies which resulted in establishing a positive correlation b/w TQM and use of incentive scheme like partnering.

2.5. Khadour, L and Darkwa, J (2008)

The study has coined a new term to integrate the total quality management with the environmental aspects as "TQEM" - Total Quality Environmental Management which is extension of TQM with focus to address the Environmental aspects. TQEM has been implemented successfully in factory setups and need to be implemented to the construction industry to raise the quality, productivity and environmental standard. Data were collected through a survey conducted in UK from 50 companies practicing TQEM. The data concluded that the benefits derived were in terms of reduction in quality costs, higher job satisfaction and a better working relationship with vendors.

2.6. Abdulaziz Ali Banawi (2013)

He has worked on the implementation of TQM tool Six-Sigma on the Design Built Projects to improve the efficiency and the construction processes during the pre-construction, construction and the post construction periods. Poor management of the projects leads to high wastages in resources and the additional time in rectifying those defects. Such high wastages increases the cost of the construction. The study concluded that the dedication of the top management was the most important factor to successful implementation of any TQM tools to the construction projects. All such efforts of implementation of Six-Sigma programme consumes addition time and efforts to be effective.

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III. UNDERSTANDING TQM

The best way to understand TQM is to trace works of various Quality Gurus and understand their perspective.

- ✓ **Walter Shewart**
  The founder of Plan –Do-Check-Act (PDCA) to apply to the repetitive process where in every next cycle is carried out with the improvement learnt in the previous cycle.

- ✓ **W. E. Deming**
  Deming was the follower of Walter and worked in the same lab. He popularized the P-D-C-D cycle and defined Quality as a key Competitive advantage. Deming led the quality revolution in japan after the world war –II. The Japanese companies were trying to get foot hold of the western market but were failing to do so due to the quality issues. Deming summarized all the reasons for the downfall of the organization into seven point of disease. The most prestigious quality award has been named after Deming. As per him the increase in the quality leads to decrease in rejection work, benefitting the entire value chain. Deming believed in three philosophies of

  i) Organizational commitment to continuous improvement and innovation
  ii) Total Employee involvement and
  iii) Scientific knowledge of product, process, tools and techniques.

- ✓ **Joseph M Juran**
  Juran gave a holistic approach for all round business excellence known as Juran's trilogy of quality planning, quality control and quality improvement. His approach was based on deciding the mission, vision and the quality objectives in planning stage to achieve the same in least cost. He introduced the concept of cost of poor quality and to focus on elimination of wastage. He led the Quality revolution of the Japanese industries after world war-II. He defined "Quality as fitness for use by the customer". He published the first hank on Quality. Juran founded Juran Institute in Connecticut. He encouraged a concept known as Managing Business Process Quality, which is a method for executive cross-functional quality improvement.

- ✓ **Kaoru Ishikawa**
  A legendary Japanese quality guru Ishikawa turned around Japan's declining production industry by tailoring the work of Deming and Juran to make their philosophies of quality work specifically for the Japanese. He found the problem solving technique known as Fish Bone diagram or Cause and effect diagram. In this method the problem is written in a central box and a line is drawn from the center of the Box. Various causes are listed on the either side of the central line. A line radiates out from the central line for each cause. For each cause further sub causes are listed on the either side on the cause. This continues till the root cause is identified and resolved. Ishikawa developed the concepts of Quality Circles, which were the group of people working in the same department and who are trained to identify and solve their work related problems. They present their final solutions to top management in an effort to improve the performance of an organization. This technique can also be used to motivate employees.

- ✓ **Philip B Crosby**
  He was Quality guru from US who wrote books "Quality is Free", Quality without Tears", etc. He defined "Quality as conformance to requirements". He gave the concept that the quality is the sole responsibility of management and a small fraction of earning if spent on training the employee, can substantially improve the quality of output. He publicized the concept of do it right the first time and the concept of zero defect. In 1979, he founded Philip Crosby Associates, Inc. (PCA), teaching management how to establish a preventive culture to get things done right the first time. He gave the 14 steps for an organization to follow in building an effective quality program.

- ✓ **A V Feigenbaum**
  The American quality expert who introduced the concept of Total Quality Control later to be called as Total Quality Management.

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- ✓ **Taiichi Ohno**
  Lean Production was introduced by this Japanese Engineer, which gives emphasis on less of everything in Production, Time, Tool, Space and Human Efforts to produce same result, also called as Toyota Production System. It eliminates the waste efforts which do not add value to the process. The concept of JIT9 just In Time) and Kanban system of Manufacturing was introduced by him.

- ✓ **Sheigo Shingo**
  Single minute exchange of dies was founded by Sheigo Shingo to reduce the set up time of changing the die below 10 minutes which reduced wastage from few days to few minutes.

IV. RESEARCH WORK

The study of literature review reveals that TQM was found to be a better tool for achieving quality than any other available tool. The biggest road block in achieving the TQM in project is due to the low level of participation and low motivation of the employees. Also incentive scheme in construction like partnering and incentive sharing seems to be workable to enhance the participation of the employees. A new model to successfully implement the tools of TQM is to blend with a reward mechanism named as TQMR i.e. Total Quality Management and Reward. TQMR is the application of TQM principle in an organization by developing the standard operating procedures for every activity of the organization and continuously improving the process till it reaches the zero defects and to reward the employees on the Measurable quantity parameter on attainment of quality of work. This keeps the people involved in enhancing the efficiency of work but not at the cost of quality which is one of the major drawback in implementing the reward mechanism based on the performance of work alone.
TQMR model need to be implemented across the organization for each and every activity and for each and every individual working in the organization, however this paper has restricted it analysis to a construction site which can be replicated to other functional area of the organization.

V. METHODOLOGY

TQMR model is developed based on the data collection of an industrial project. Following are the steps to develop the model:

1. Bill of quantities (BOQ): Collect the details of the project site like project information, the final Bill of Quantities and the work specifications.

2. Standard Operating Procedures (SOP): Based on the specification of work from BOQ, prepare the Standard Operating Procedure for all the major civil works. The SOP acts as a standard document to carry out the work at project site.

3. Quality Assurance Plan for Activities (QAP-Activity): This document specifies the various quality assurance methods and tests to be carried out on various project activity with their frequencies. The QAP for Activities is prepared as per the BOQ and SOP for the major items of works.

4. Quality Assurance Plan for Material (QAP-Material): QAP for Material specifies the various quality assurance methods and tests to be carried out on the project items of work with their frequencies.

5. Check List for the Quality Assurance and Control: The check list is developed for all major civil works which act as check point before the commencement of work. The check list, lists all the control points to be inspected and approved before starting of the task so as to give assurance of quality of work.

6. Roles and Responsibility Matrix (R&R Matrix): This Matrix is prepared for each and every individual members of the project team. The matrix clearly lists the various responsibilities of project members towards the projects and each other. The matrix distinguishes the roles and responsibility of each members and avoids the conflicting roles.

7. Measurable Quantity Parameter (MQP): MQP is the quantity parameter of the works executed in the project, which is used as the performance parameter to reward the employees. MQP is derived from the BOQ by clubbing few items of related work. This can be used as a KRA (Key Result Area) for the employee's performance.

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8. Questionnaire Survey: Here a questionnaire was prepared to take the industry feedback on the percentage of the project cost (Items of work) which can be shared with the project team. The questionnaire was mailed to the industry experts and feedback is taken to arrive at the reward money.

9. Critical to Quality (CTQ): The check list is prepared for the identified MQP to measure the Quality of work. CTQ is prepared based on the SOP, QAP and the Checklist.

10. Total Quality Management and Reward (TQRM model): TQMR model is developed to reward the project team on monthly basis based on the quantity of work (as per MQP) only if the quality (CTQ) is met.

VI. DATA COLLECTION AND ANALYSIS

The Bill of Quantities is collected from the Industrial project site**. The Major Civil works as per the table below:

Tables

Table 1. Major items of civil works

SR. NO	ITEM DESCRIPTION	AMOUNT (INR)
1	Excavation	11089170
2	Compound wall	12558740
3	External Drainage System	7572610
4	Roads	27199870
5	Main Plant	169896099
	Total	22831689

** The Project Time line is 10 Months for the Civil Works.

TQM is implemented in the project site as per the following steps:

6.1 The Standard Operating Procedure (SOP) for Works.
6.2 Quality Assurance Plan for Activities.
6.3 Quality Assurance Plan for Material.
6.4. Checklist for item of Work.
6.5. Clear Roles and Responsibility Matrix of Team Members

6.1 STANDARD OPERATING PROCEDURE OF WORKS.

Standard Operating Procedure is drawn to standardize the process and act as a guiding document for the project team to refer as and when required. An approved copy of SOP is referred to assure the quality of work during various stages of construction. SOP is developed for all the activities of project work as per the BOQ, which step by step elaborate the right methods of carrying out the work.

6.2 QUALITY ASSURANCE PLAN FOR ACTIVITIES

The purpose of quality assurance plan is to:

A. Verify, vet, correct and impose the Quality Control function for its program.
B. Ensure that the result of each completed task complies with the project specifications and design requirements.
C. All the activities in the project site is carried as per QAP.

A sample QAP for activity is given below for excavation:

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Tables:

Table 2. QAP for Activity (Excavation)

SR. NO	ITEM	TESTS TO BE PERFORMED	METHOD OF TEST	REFERENCE DOC	PERMISSIBLE LIMIT	FREQUENCY	REMARK
1	Soil strata	Bearing Capacity	Lab	As per approved tender doc. / Drg. And IS 456	As required as per approved drg. & as per remark	100%	Review of Classification of strata. Type of strata to be verified.
2	Excavation	Pit dimension check	Field	Same as above	Same as above	Random	Under mentioned notes are to be adhered to.
The bed of the foundation trenches shall be cleaned of all loose material & well-watered, if dry to prevent absorption of water from the green concrete. If the area on which concrete is to be placed is under water, water shall be completely removed. The contractor shall plan, construct, and maintain satisfactorily, safe and pool-proof arrangement for dewatering to ensure safe foundation excavation & laying concrete & masonry in the dry.							

6.3 QUALITY ASSURANCE PLAN FOR MATERIAL

The purpose of preparing the quality assurance plan for material is to List down various tests to be performed, the acceptance criteria of the result and the test frequency.
A sample QAP for activity is given below for excavation:

Tables:

Table 3. QAP for Material (Stone)

ITEM	TESTS TO BE PERFORMED	METHOD OF TEST	REFERENCE DOCUMENT	PERMISSIBLE LIMIT	FREQUENCY
Stone for Masonry / Soling	1) Visual	Field	As per Specf.	As per remark	Random
Stone for Masonry / Soling	Water absorption	Lab	As per Specf.	Shall not absorb water more than 5% of its dry weight	1 test per lot
The stones to be used in the face shall be tough, hard, dense, sound & durable, resistant to weathering action, reasonably fine-grained, uniform in color and texture & free from seams cracks or other defects which would adversely affect their strength, durability or appearance. They shall also be free from weathered portion & skin. The expose surface shall be entirely free from any type of discoloration. Stones shall generally be freshly quarried with clean faces and sharp edges all round and shall be of such a character that it can be wrought to such lines and surfaces, whether curved or plane as may be required.					

6.4 CHECK LIST FOR CIVIL WORKS

The check list is prepared for all the civil works. The check list is distributed to all the respective contractor and asked to fill before starting of any work. The check list is then forwarded to the client for the pre-inspection of work. The client representative comes to the site and checks the work before the commencement to ensure that the works are carried out as per the specification of work. No work is allowed to be commenced unless the same has been signed by the client representative.

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Tables:

Table 4. Check list for Masonry

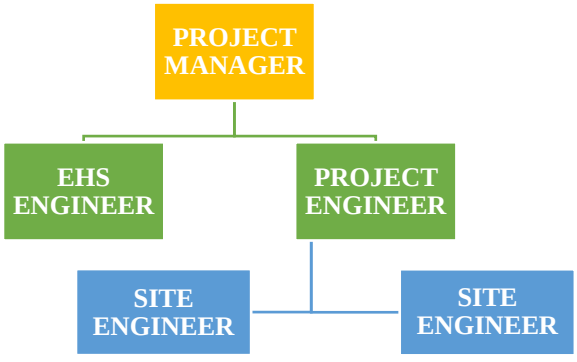
Structure: Date:
Location : Approx. Qty:

SR.NO	ITEM	CONTRACTOR	CONSULTANT
	PRE-MASONRY WORK		
1	Availability of material as per daily requirement		
2	Cleaning work area off loose material / Concrete		
3	Proper stacking of bricks / Blocks		
4	Quality of bricks / sand / Cement		
5	Wetting of bricks		
6	Door/ window frames if any to be erected in position		
7	Line out rechecked		
8	Provision of Platform		
9	Hacking		
	DURING MASONRY		
1	Check line / level / Right Angle		
2	Check Mix proportion		
3	Check provision of patli beam		
4	Proper raking of joints		
	AFTER MASONRY		
1	Check cleaning of dead mortar and broken bricks / blocks etc.		
2	Check curing		

6.5 ORGANOGRAM OF THE PROJECT MANAGEMENT TEAM AND R&R MATRIX

The project management team for this project consist of five members who are full time deployed at the project site. The project team is as shown below.

Figure:



The Project Management Team

Roles and Responsibility Matrix is prepared for each and every member of the team and explained to each of them. A sample of R&R Matrix is shown below for site engineer:

Site Engineer: The Site Engineer reports to the Project Manager. His duties and responsibilities shall include:

- Understand & implement the overall Construction Management strategy;
- Assist in co-ordination with Architects/ Vendors /Consultants on behalf of Company during the site execution;

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- Involve in execution of the project and attend co-ordination meeting regularly with Consultants /contractors and subcontractors;
- Coordination between vendors, suppliers, various labour contractors and subcontractors on necessary resources, material, machinery, equipment, to ensure that the works are carried out in strict accordance with the planned schedule;
- Ensure that the construction work is carried out according to drawings, method statements, specifications and relevant standard;
- Ensure that the requirements stated in the project QAP are implemented effectively;
- Conduct Periodical and Preventive Quality Checks using Standard Operating Procedures, and checklists. Resolve all quality issues to improve the overall product and monitor quality of the site operations;
- Any other duties as assigned by the Project Manager.

6.6 IDENTIFICATION OF MEASURABLE QUANTITY PARAMETER (MQP)

6.6.1 Definition: MQP is the Quantity of work planned and executed at project site which can measured on a monthly basis and can be used to develop a reward mechanism to reward the employees. The Reward keep employee motivated to perform the work and increase the productivity and the efficiency.

6.6.2 Steps followed in identification of MQP, say for Excavation.

✓ The Items in BOQ which are related works are clubbed together to identify the MQP as follows:

SR. NO	ITEM DESCRIPTION	UNIT	QTY	AMOUNT
1	Mass excavation in Black Cotton soil	C UM	22760	3869200
2	Mass excavation in Rock	CUM	3200	2528000
3	Mass Filling with available material	CUM	18654	2611560
4	Carting away surplus excavated earth	CUM	13422	2080410
	TOTAL COST			11089170

✓ Here the quantity of Excavated Soil and Rock is taken as the MQP for excavation work. Adding both the qualities 22760+ 3200= 25960

SR.NO	ITEM DESCRIPTION	UNIT	MQP	AMOUNT
I	Excavation	CUM	25960	11089170

6.6.3 So the MQP for the Entire Project Shall be as follows:

Tables:

Table 5. Measurable Quantity Parameter for the Project

SR.NO	ITEM DESCRIPTION	UNIT	MQP	AMOUNT
1	Excavation	CUM	25960	11089170
2	Finished Compound Wall	RMT	996	12558740
3	RCC Hume Pipe	RMT	1162	7572610
4	Road	SQM	12500	27199870
5	P.C.C	CUM	1100	9980000
6	Cement Concrete	CUM	1385	26392095
7	Block Masonry	CUM	630	8553500
8	Structural Steel	MT	850	87631000
9	Vacuum Dewatered Flooring	SQM	5900	8990000
10	Double Skin Roofing System	SQM	7500	28349504
	TOTAL PROJECT COST			228316489

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6.7 ALLOCATION OF REWARD AS PER SURVEY METHOD

6.7.1 Survey by Questionnaire method

The reward based on the % of work completed should be worked out so as to motivate the team and at the same time should be affordable to the organization. To establish the % reward, a survey by Questionnaire method was carried out by sending the E-mails to the senior management personals in the construction industry. The questionnaire comprised of detail of the new model along with choosing an option from the below shown table. They were asked to select any one alphabets from A to F to register their opinion.

Tables:

Table 6. Incentive table for survey

SR. NO	PROJECT COST (CRS)	INCENTIVE ON PROJECT COST	TOTAL INCENTIVE	AVG. MONTHLY INCENTIVE FOR TEAM*	SELECT THE % INTENSIVE
1	22.3	0.1%	2,23,000	22,300	A
2	22.3	0.2%	4,46,000	44,600	B
3	22.3	0.3%	6,69,000	66,900	C
4	22.3	0.4%	8,92,000	89,200	D
5	22.3	0.5%	11,15,000	1,11,500	E
6	22.3	0.6% or More	13,38,000	1,33,800	F

* Project period -10 Months

6.7.2 Analysis of the response received from Questionnaire survey

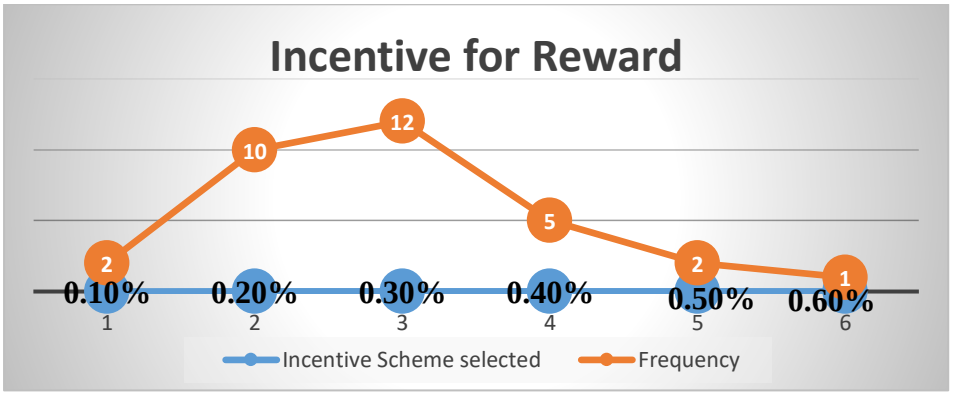
Questionnaire was sent to 44 companies from construction industry and feedback were obtained from 32 companies as given below.

Tables:

Table 6. Frequency table for response of survey

SR. NO	INCENTIVE SCHEME SELECTED	FREQUENCY
1	0.1%	2
2	0.2%	10
3	0.3%	12
4	0.4%	5
5	0.5%	2
6	0.6% and more	1
	Total	32

Figure:



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Thus the industry survey recommends the incentive as 0.3% of the Project Cost.

6.7.3 Calculation of the Reward based on the survey method.

The reward is calculated based on % of the cost of completed work and measured in terms of reward per unit of work as calculated below:

Tables:

Table 7. Reward calculation for per unit MQP

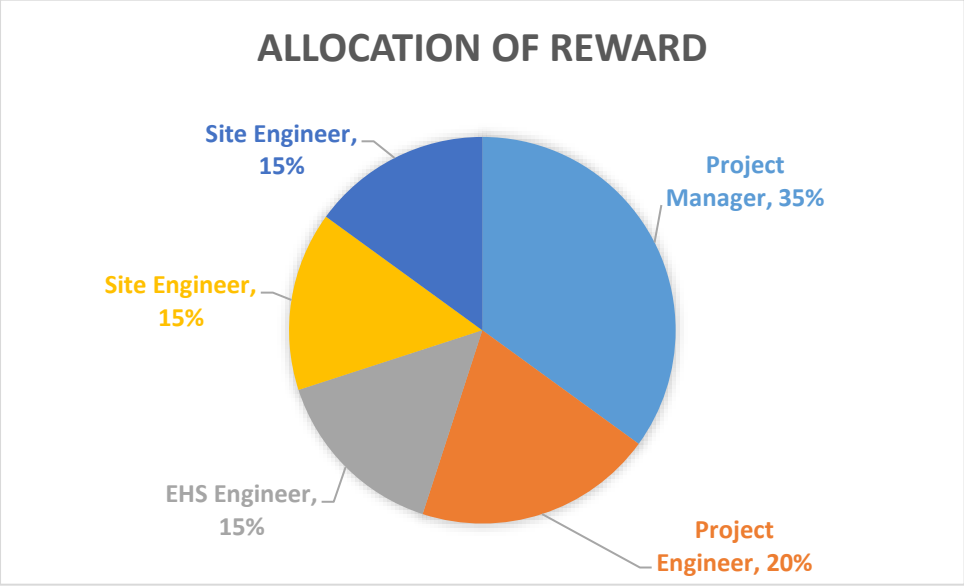
SR. No	ITEM DESCRIPTION	UNIT	REWARD	REWARD PER UNIT
1	Excavation	CUM	33268	1.28
2	Finished Compound Wall	RMT	37676	37.83
3	RCC Hume Pipe	RMT	22718	19.55
4	Road	SQM	81600	6.53
5	P.C.C	CUM	29940	27.22
6	Cement Concrete	CUM	79176	57.17
7	Block Masonry	CUM	25661	40.73
8	Structural Steel	MT	262893	309.29
9	Vacuum Dewatered Flooring	SQM	26970	4.57
10	Double Skin Roofing System	SQM	85049	11.34
	Total		684949	

Total Reward distributed to Project Team is INR. 684949/- over the project duration of 10 Months.

6.7.4 Allocation of Reward Money within the Team:

Reward Money should be distributed among the team based on rational basis. In this case based on the team size and the experience level of the team member the ratio proposed is as follows:

Figure:



% distribution of Reward among the team member

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Tables:

Table 8. Incentive table for the Project Team

SR. NO	PROJECT MEMBER	% ALLOCATION	TOTAL
1	Project Manager (PM)	35	239732
2	Project Engineer (PE)	20	136990
3	EHS Engineer (EHS)	15	102742
4	Site Engineer 1 (SE 1)	15	102742
5	Site Engineer 2 (SE 2)	15	102742
	Total Incentive for a Project (10 Months)		**684949**

6.8 IDENTIFICATION OF CRITICAL TO QUALITY (CTQ):

The Proposed Model of Total Quality Management and Reward recommends rewarding the Employees based on Quantity of work done by them as per the established Measurable Quantity Parameter (MQP) shown in table7. As there is a natural tendency of Employees to speed up the work on the cost of Quality, the TQM cannot be implemented unless the reward is linked to the Quality of Work as per the set parameters.
Definition of Critical To Quality (as per Six Sigma) "Critical To Quality is the key measurable characteristics of a product or process whose performance standards or specification limits must be met in order to satisfy the customer.
Here, CTQ means the quality of work performed in construction site in terms of the established MQP. CTQ is measured using a checklist by a designated representative from the reporting office to quantify the quality and recommend for reward. CTQ checklist is prepared based on the QAP for activities and material, SOP's, Checklists for work and the R&R Matrix. A sample of the CTQ checklist as shown below:

Tables:

Table 9. Checklist for measuring Critical To Quality (CTQ)

SR. NO	CTQ CRETERIA	Y/N/NA	REMARK
1	Cross checked the actual soil strata with bore log and action taken in case of deviation.		
2	Marked, Recoded and preserving all bench marks, center lines, tangent points, demarcation and other field stones as established.		
3	Protection of the excavated sides from collapse and using appropriate methods.		
4	No damage to existing underground municipal service line along the excavation,		
5	No rework required to excavate more to reach the Reduced levels or filling required due to extra excavation.		
6	Anti Termite done and verified the Consumption of chemicals.		
7	Proper filling of soil in layers and achieving of compaction.		
8	Record keeping of quantity of excavated material, Rock cutting, blasting and filling of soil.		
9	Excess Excavated earth stored in the Notified dumping Area.		
10	Zero accidents and no more than 2 incidence.		
	Total points complied (Min 8/10) or 80 %		

The reward is paid every month by calculating the quantity of MQP as per table 5 and multiplying by the reward per unit as per table 7. The reward becomes payable only if the minimum points as per the checklist in table 9 is met, say for example if 80% CTQ is met in the activity excavation then only the reward becomes payable.

VII. CONCLUSION

The objective of the research was to understand the need of adoption of global standard in the construction industry. The informed consumers of the today's world require international best products and services from the construction industry. More and more works are carried out by calling the global tenders, which are being participated by global players from the developed nations.

Total quality management can be solution to these problems which need to be implemented across the various functions of the organization. As the quality is the function of the entire organization, each and every individual working in the organization should be covered.

TQM in project sites can be implemented by adopting five procedures which are

Developing the Standard Operating Procedure (SOP) for Works.

- ✓ Quality Assurance Plan (QAP) for Activities
- ✓ Quality Assurance Plan (QAP) for Material
- ✓ Checklist for item of Work
- ✓ Clear Roles and Responsibility Matrix of Team Members

Successful implementation of any such programme require an enormous efforts by the people of the organization, which also creates a hostile approach to such initiatives. This research has made an effort to propose a new approach of implementing the TQM by combining with an incentive mechanism named as Total Quality Management and Reward (TQMR).

TQMR model proposes to reward the employees based on the MQP (quantity of work) completed per month. The reward is calculated based on the % of project cost payable during the project period to the project team provided that the CTQ (quality of work) is within the acceptable parameter. A check list for CTQ is developed for all the MQP items and is filled by technical person other than the project team. The reward money should be paid along with the salary of the subsequent month.

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