International Journal of Engineering Research And Advanced Technology (IJERAT)
ISSN: 2454-6135 [Special Volume. 02 Issue.01, May-2016]

Project Management for Monitoring of raw materials Conveying and storage Setup for a multi commodity product in a Food processing unit

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Abstract *– The paper titled "Project Management for monitoring of raw materials conveying and storage setup for a multi commodity product in a Food Processing Unit" is based on providing a best suitable set up for Conveying, Storage and dosing of multi- commodity raw material as per customer requirement for a food processing industry. The setup mainly consists of conveying the raw material from intake hopper to storage, then storage to the batch hopper using conveyors.*

As per the customer requirement, Engineering Drawing and Specification document were prepared using Solid Edge V.19. Project management tools like Checklists, scheduling, status tracker, organigram, time sheet, were used in tracking of the entire project.

Based on the above said documents request for quote were prepared and sent to different Vendors. After receiving the quotes, detailed study is done, analyzed and comparative matrix of potential vendors were developed and submitted to Customer. Vendor fact sheet for potential vendors were prepared and submitted to customer for final decision making process along with other documents.

Key words: Project Management, Food processing Unit, Engineering Requirement Document, Engineering Drawing, Request for quote, Vendor Fact sheet.

I. INTRODUCTION

Any industry or business firm involves large-scale planning that affects every department or aspect of a production or business. Implementing the project means dealing with human recourses, budgetary time and supply constraints. Project managers create plans to manage interdependence and address resource conflicts. Organizations that use project management to monitor and control processes and schedules can more effectively complete their projects on time and on budget, with minimal disruption to the rest of the production.

A food processing industry needed a setup of a processing unit comprising of raw materials dozing, storing and conveying section which would convey the raw materials from the intake hopper to batch hopper with minimum cost and time constraint.

The requirements of the food processing industry customer were understood and accordingly planning was done. Project management tools like project plan, milestone checklist, scheduling, status tracker, organigram and time sheet to calculate the number of man hours used in the process of the project was used in tracking the whole project processes. It helps to estimate project cost and schedules, meet time constraints, focus on customer needs, link project goals and objectives to stakeholders, calculate risks and establish dependable project control and monitoring system.

II. PROBLEM DEFINITION

- Food processing industry consists of various processing section depending upon the process/technology and end product.
- Raw material conveying is one of the major sections in this industry where single (or) multiple raw materials need to be conveyed and stored accordingly.
- Handling of raw materials plays a major role and care should be taken in order avoid any contamination to raw materials.
- Different systems are available in the market for conveying of raw materials from one place to another (storage section).
- In snack processing industry, Different raw materials are used for process and all the material needs to be

weighed before feeding into further processing (i.e. mixing).

- For our Project study and understanding, we have consider the raw material conveying (Multiple product) section for snack processing industry.
- Different types of models are available in the market for doing the same task.
- Choosing the right model which suits the exact requirement of the end user makes an important role during the selection process.
- Through Project Management, we can help the customer/industry in order to choose the right model. And we can support them for the complete project.

III. OBJECTIVE

To develop a comparative matrix of suppliers to setup a process by considering the raw materials with bulk density of 500kg/m^3 for 250kg/hr conveying capacity

SUBOBJECTIVE

To achieve the tasks with respect to the above set objective the sub objectives were set as follows

1. Functional analysis
2. Engineering requirement document (ERD)
3. Request for quotes (RFQ)
4. Techno- commercial review
5. Comparative matrix
6. Vendor fact sheet

IV. METHODOLOGY

The project methodology is as follows:

Step 1:

Initially the requirements are identified and problem is defined for easy and clear understanding.

Step2:

Objectives are defined as the goals that need to be realized in order to fulfill customer requirements. Appropriate methodology for the problem is formulated.

Step3:

In this stage the objectives and sub objectives are set, Planning and scheduling are done

Step 4:

Drawing of the process flow of material from the intake hopper to batch hopper is prepared (to convey graphically the idea and information necessary for the construction or analysis of the machine/structures or systems)

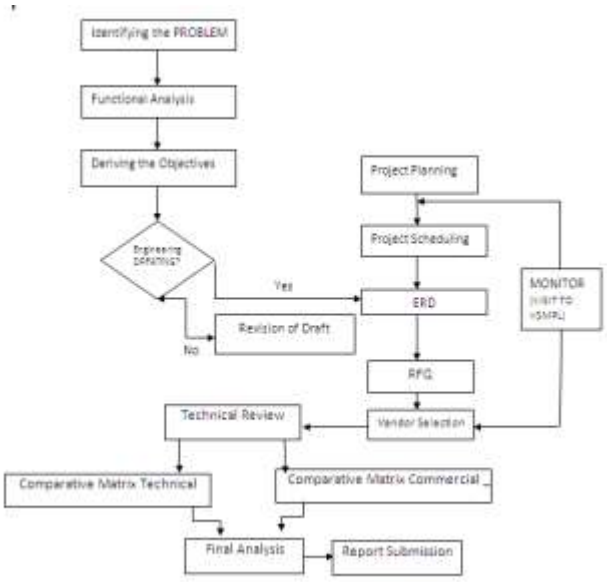


Fig.1- Flowchart of the Project Methodology

Step5:

An Engineering Requirement Document ERD is to be prepared which refers to the defining, documenting and maintaining requirements of the process.

A Request for Quotation RFQ is prepared and is sent to one or more potential suppliers eliciting quotations for a screw conveyor.

Step6:

Here the suppliers with the quotations are analyzed by considering some of the factors like past experience with suppliers, telephonic conversation with salesmen, technical and descriptive catalogues.

Step7:

In this stage the technical specifications and commercial factors of the screw conveyor mentioned by various vendors in their quotations are reviewed (techno commercial review).

Step 8:

A vendor fact sheet and comparative matrix of the suppliers and quotations received are prepared and a report is then prepared to be furnished industrial customer in order to decide on choosing the most suitable vendor.

V. DATA COLLECTION AND ANALYSIS

Functional analysis: Understanding the needs of the Customer/Industry and mapping the requirements against the reality.

The task of choosing the best alternative from the four alternatives of conveying the raw materials was the initial criterion. The four options are as follows:

	Option 1	Option2	Option3	Option4
1. Floor space	Required more as a hopper is added.	Acquired by using batch hopper is completely eliminated. Hence, requires lesser area.	Acquired by using batch hopper is completely eliminated. Hence, requires lesser area.	Acquired by using batch hopper is completely eliminated. Hence, requires lesser area.
2. Extra material	Required to manufacture the hopper.	Required quality and using the same to manufacture the hopper is saved.	Required quality and using the same to manufacture the hopper is saved.	Required quality and using the same to manufacture the hopper is saved.
3. Cycle time	Reduced as there is pre-batching and continuous mixing.	Production time increases as the system must wait until each raw material is added to the mixer	Less compared to that of load cell connected directly to the load mixer.	Less compared to that of load cell connected directly to the load mixer.
4. Conveying speed of raw material	Raw materials in required quantity can be supplied continuously.	Production time increases as the system must wait until each raw material is added to the mixer.	Production time increases as the system must wait until each raw material is added to the mixer	Production time increases as the system must wait until each raw material is added to the mixer
5. Additional load cells	No additional load cells are required if future bins are added.	Addition of future bins does not require extra load cells.	More load cells are required as the number of conveyors increase.	More load cells are required as the number of conveyors increase.
6. Conveying distance	As the conveyor is not directly connects the bin to the mixer, distance between then cannot be reduced.	As the conveyor directly connects the bin to the mixer, distance between then can be reduced (land area).	As the conveyor directly connects the bin to the mixer, distance between then can be reduced (land area reduced).	As the conveyor directly connects the bin to the mixer, distance between then can be reduced (land area reduced).

Table - Comparison of the 4 Options

1. *Bins on Load cell*
2. *Screw Conveyor on Load cell*
3. *Batch Hopper on Load cell*
4. *Mixer on Load cell.*

Using functional analysis comparison of the four alternatives were carried out and the option 3 *Batch Hopper on Load cell* was chosen since,

i. Usage of Minimal number of Load Cell
ii. Reduce cycle/batch time
iii. Easy Maintenance
iv. Cost Effective

SCHEDULING

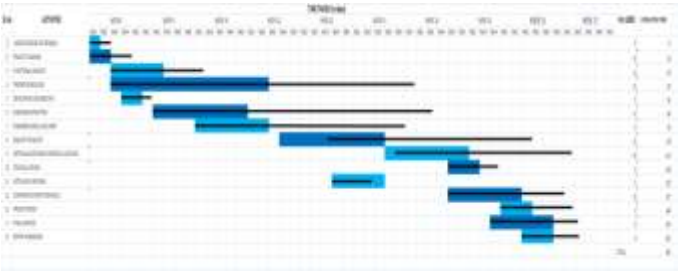


Fig.2 - Scheduling Chart

The scheduling chart shown in **Fig.2** is prepared using Microsoft Excel and includes start date and end date of particular activity. When the project is assigned execution of the project is planned. Individual activities related to the project were being planned and listed.There are some activities that start at the same time called parallel activities. Some activities are interrelated i.e. until one activity is completed the next task does not begin. This scheduling chart helps to ensure that the tasks get completed in an effective manner before the next task in the process begins. Many of the times the plan must be improvised if things are not according to plan or have to work over-time to deliver the project on time. Based on the activities listed in this chart, individual tasks are assigned to the team members so that, each and every one working on the project would know their tasks.

The time for completing the activities are estimated and represented as planned hours, this helps to organize and complete the project in a timely quantity and financially responsible manner. While carrying out the project activities the time taken for each activity to be completed is entered in the chart periodically which is represented as actual hours. In the chart, planned time is represented by the blue blocks and actual time is represented by black line. The black line extended refers to the extra time taken to complete the task. Extension of the time is due to revising of activities. The planned time and actual time required to complete the activities, help to meet project deadlines. The estimate of the time to be taken to complete each activity is noted and cumulative of the entire time taken to complete the project is calculated and found to be 153 hours. Thus it helps to record, keep projects on track, set realistic time frames, assign resources appropriately and report progress towards project completion.

ORGANIGRAM

Organigram is also called as organization chart. It helps establish the channel of communication in an organization. The resources/tasks in this project are being distributed within the team to the team members. Each of the tasks assigned were being corrected by the internal and external guide periodically. Organigram records all the assigned work to a team member in a project. This is represented as a flow diagram showing graphical representation of information flow or delegation of duties. It shows the roles of a team member in a project. The level of responsibility assigned to us. The tasks assigned were to be completed within the time constraint. There are some activities which were assigned to be done individually whereas some were to be done in a team together. If there is any information related to a particular process is to be required, can be obtained from the person handling the same as stated in the Organigram. Revising of tasks and follow ups and information flow among the team members value smart team and the guide is documented using Organigram

The draft of equipments for the flow of raw material from intake hopper to batch hopper is as shown in **Fig. 4** and a brief description of the equipments are as follows,

1. Intake hopper which is a material holding container which stores the raw material
2. Pneumatic conveyor of blowing type is provided at the start of the conveyor which is used to blow the raw materials into bins.
3. Bins are containers which are used to feed the batch hopper with the required raw materials in predefined quantity
4. Screw conveyor is a type of conveyor which rotates on a shaft having groves (like a screw) to convey the material.
5. Batch hopper is a container where the raw materials are fed into the mixer, here a pre-batch of the required raw materials of specified quantity is prepared and fed into mixer without any discontinuity.

4.4.1 The process of flow of raw materials from Intake Hopper to Batch Hopper

Initially the raw materials in powdered form having a bulk density of 500kg/cubic meter are fed to the intake hopper manually. A safety gauge is provided at the intake hoper to avoid any contaminations that may occur due to workers negligence. Now from the intake hopper through the pneumatic conveyor of blowing type the raw material is conveyed into the each of the bins (capacity of 2 Tonnes) diverting the flow using a plug diverter of automatic type. A filter along with a fan is provided to suck any moisture content that exits in the bins to maintain the moisture level of the material. From the bins through screw conveyors the raw materials of specified quantity is fed into the batch hopper for obtaining a premix before feeding it into the mixer. A flexible connection is provided at the batch hopper section because if the screw conveyor is connected directly to the batch hopper, vibrations from the batch hopper may lead to variability in performance of the screw conveyor. A Load Cell is provided on the batch hopper to keep in check of the raw material conveyed by weighing the batch hopper for the required weight of the mix. The weight of the batch hopper is displayed in the control panel of the load cell. This is the brief process of material flow in the section considered.

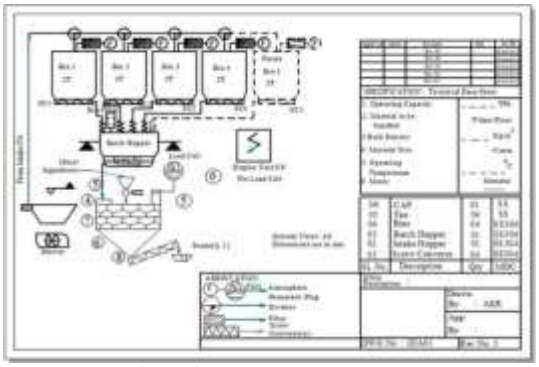


Fig.3 - Process flow of raw material at various stages

Engineering Requirement Document (ERD)

Engineering Requirement Document **ERD** is a technical document which consists of the specifications of all the components in the process which is later submitted to potential vendors in the form of Requirement for quotation **RFQ**.

The ERD as shown is as shown below which represents the key specifications derived from the customer requirement.

SPECIFICATION OF INTAKE AND CONVEYING SECTION:

Raw material to be conveyed from the station at ground level to the storage bins.

1) Intake Hopper (Station):

The above ERD altogether comprises of in-detail specifications of

1. Intake and conveying section
2. Storage section
3. Conveying and dosing section.

These specifications are discussed in detail in this report.

Doc No:ERD_210415_03	Engineering Requirement Document	Date:21-04-2015 Location: Bangalore

Sl. No	Description	Specifications
1	Intake Hopper Capacity	300kg.
2	Supporting structure for hopper	Mild Steel
3	Feed to hopper	Manual.
4	Quantity	1 No.
5	Conveying Capacity	250kg/hr
6	Bulk Density Of Conveying Material	500kg/m^3
7	Material Conveyed	Wheat flour, Rice flour, Corn flour
8	Material Of Construction	SS304

1. Intake and conveying section:

The intake section consists of the intake hopper (station), pneumatic conveyor and a diverter.

- Intake hopper :

As explained in the draft, the intake hopper is a container in which material is poured and is later conveyed. The material input is determined based on the output required. Raw materials of bulk density 500kg/m^3 are required at 250kg/hr conveying capacity. This is carried out in 2 shifts (1 shift =8

hours). As the conveying capacity is 250kg/hr, the intake hopper capacity can be safely derived to be 300kg. The supporting structure for hopper is Mild Steel and the material of construction of intake hopper is stainless steel of grade SS304 based on its appropriate composition and cost effectiveness.SS304 is suitable to store the multi product raw-materials (Wheat flour, Rice flour, Corn flour) being conveyed due to its low reactive capacity with the materials based moisture content in air, relative humidity and location of plant.

- Pneumatic conveyor:

Raw materials are conveyed from tipping station at ground level to storage bins. Conveying distance of Horizontal Length of 15m, Vertical Length of 30m is determined based on the line capacity of the plant on which diameter of the pipe of conveyor is decided by the vendor. Bulk density of wheat flour is 480kg/m^3, corn flour is 560kg/m^3 [5]and rice flour is 700kg/m^3Among them, the least bulk density of the material is considered for conveying purpose as lower density increases the speed of conveying. Therefore, bulk density of 500kg/m^3 is considered. Pneumatic conveyor blowing type (positive pressure) or suction type (negative pressure) -best suitable for conveying the material is determined by the vendor.

- Diverter : :

Diverter can be of plug type or any diverter based on the availability and suitability to the conveying pipe to control the flow of flowing material. 3 diverters are required for the present setup and additional diverter can be considered when requirement of additional bins arise.

- **2. Storage section:** :

The storage section in this setup consists of bins.

- Bins :

Bins are used to store the raw materials before being sent to the dosing section in appropriate quantity.
The material holding capacity of the bins in 2Tons. As the bulk density of the raw materials is 500kg/m^3 the volume of the bin is appox. =4m^3i.e, 2Tons. The space available in the plant for installation of bins is
Height 3m, Width 20m. The material of construction of bins is SS304 for the same reasons as stated in the intake hopper.

2. Conveying and Dosing section:

This section consists of screw conveyor and batch hopper.

- Screw conveyor:

- The screw conveyor is a screw type conveyor from which the raw materials are transferred from storage bins to the batch hopper. It uses a rotating helical screw to move the powdered materials. 4horizontal screw conveyors of lengths 6m, 6m and4m, 4m for 1st bin, 2nd bin, 3rd bin and 4th bin respectively are provided for transferring the material. They are provided with flexible connections (e.g. cloth) between the conveyor and batch hopper in order to avoid contamination. the screw conveyor is not directly attached to the batch hopper as variations may occur due to the vibrations caused by the screw conveyor.

- Batch hopper:

Several different types of batch hoppers like a) batch hoppers with rotary bin discharge, b) bin vibrators, c) batch hoppers with chain conveyors (closed) etc are available in the market. The batch hopper used in this set up is a bin vibrator. As the raw materials of different percentage is conveyed to the batch hopper, the holding capacity of the batch hopper is determined based on the bulk density and amount of material conveyed. The supporting structure of batch hopper is made of mild steel and the material of construction is SS304 same as intake hopper and bins. The batch hopper is provided with load cells to weigh one ton of raw materials. Hence, load cell capacity of 2tons is required (batch hopper + material weight).

Each and every section of the setup is provided with safety devices (mesh etc) and accessories (blowers, fans etc) based on ATEX and IP standards.

REQUEST FOR QUOTATION

A **request for quotation** (**RFQ**) is a standard business process whose purpose is to invite suppliers into a bidding process to bid on specific products or services. **RFQ** generally means the same as IFB (Invitation for Bid).
A sample RFQ sent to the suppliers for screw conveyor is as shown below

Dear Sir/Madam,

We have a requirement of screw conveyor. Kindly go through the below specifications and provide us your best quote. We have also attached the process flow diagram along with this document

Screw conveyor:

Doc No:RFQ_210415_00	**Request for Quote**	**Date:16-03-2015 Location: Bangalore**

SI No	*Description*	*Specifications*
1	*conveying lengths*	*6m,6m,4m*
2	*Flexible connections*	*4 No. + Future*
3	*No. of screw conveyors*	*4No. + Future*
4	*Bulk Density Of Conveying Material*	*500kg/m^3*
5	*Material Conveyed*	*Wheat flour, Rice flour, Corn flour*
6	*Material Of Construction*	*SS304*
7	*Safety devices and accessories.*	*-*
8	*ATEX and IP Standards.*	*-*

If you have any queries feel free to contact us

Best Regards

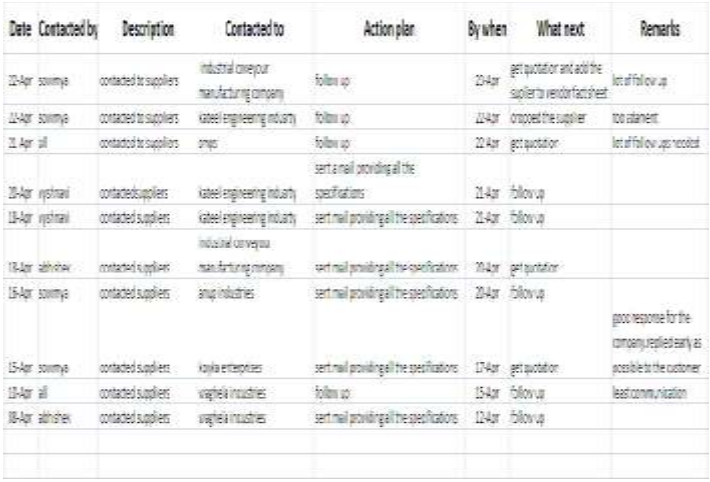
Once the required specifications are listed in the form of Engineering Requirement Document, a cover letter inviting various suppliers to bid is attached to it and sends out to potential vendors. Here, the cover letter is attached to the requirements for a screw conveyor and later submitted to several qualified vendors, preferred vendors and approved vendors requesting for quotations. It seeks an itemized list of prices for one or more components of the setup and in this case –screw conveyor. These various suppliers go through the specifications and respond to the request for quote and quote the prices on the component.

TIME SHEET

An employee in a company is paid for the time spent by him working on a project. The time sheet is used to keep track on the man hours utilized by a company.
After preparing the list of activities it is assigned individually to the team members. The time taken by each member in a day for doing any work related to the project is noted. Time spent in a week by all members is shown and total overall time taken is calculated. The time spent is VSMSPL is indicated by blue color. The task assigned previously before were discussed and were corrected in VSMSPL. The time sheet acts as a written proof for the amount of time the team has worked for the project completion.

STATUS TRACKER

Status tracking is an important tool of project management. This tool is helpful in tracking the status of each activity in a project. It tells the status tracking of the vendors who were contacted for the quotation of screw conveyor. It keeps an account of the description of the vendors contacted, their name, contacted date, follow ups, action plan, and estimate as to date by when to receive quotation.



Date	Contacted by	Description	Contacted to	Action plan	By when	What next	Remarks
22-Apr	soumya	contacted to suppliers	industrial conveyour manufacturing company	follow up	23-Apr	get quotation and add the supliers to vendor fact sheet	list of follow up
21-Apr	soumya	contacted to suppliers	kateel engineering industry	follow up	22-Apr	dropped the supplier	too elament
21 Apr	ajit	contacted to suppliers	anup	follow up	22-Apr	get quotation	list of follow ups received
20-Apr	vyshnavi	contacted suppliers	kateel engineering industry	sent a mail providing all the specifications	21-Apr	follow up	
19-Apr	vyshnavi	contacted suppliers	kateel engineering industry	sent mail providing all the specifications	21-Apr	follow up	
19-Apr	abhishek	contacted suppliers	industrial conveyour manufacturing company	sent mail providing all the specifications	20-Apr	get quotation	
15-Apr	soumya	contacted suppliers	anup industries	sent mail providing all the specifications	20-Apr	follow up	
15-Apr	soumya	contacted suppliers	Koyoka enterprises	sent mail providing all the specifications	17-Apr	get quotation	good response for the company replied early as possible to the customer
13-Apr	ajit	contacted suppliers	vaghela industries	follow up	15-Apr	follow up	least communication
18-Apr	abhishek	contacted suppliers	vaghela industries	sent mail providing all the specifications	12-Apr	follow up	

Fig.6 - Status tracker for vendors

Information about the suppliers of screw conveyors were obtained from many sources. Around 9 vendors through email and telephone were contacted among them only 6 are listed here. The remarks on their communication are written in the status tracker. An industry named Koyoka enterprise, in Haryana is the one who communicated well. The response to our requirement was fast. The quotations for the requirement were sent to us with less number of follow ups as seen in the status tracker.

COMPARATIVE MATRIX

Comparative matrix is a matrix which describe and compares attributes and characteristics of the quotes submitted by the suppliers.

Table – Comparative matrix for the 2 vendors

The comparative matrix is an assessment, on both quantitative and qualitative aspects. This allows our customers or stakeholders to:

- Specify and prioritizing their needs
- Evaluating, rating, and comparing the different alternatives among the quotes received and
- Selecting the most feasible quote.

- It involves the evaluation of technical documents and commercial aspects with respect to the requirements.

In the matrix a techno-commercial review on two quotations for screw conveyors that were provided by two suppliers has been performed as shown in table.8. Although both the suppliers were able to meet our requirements, there is a clear difference in their prices, motor speed, power consumption and service taxes.

To ensure that a supplier can perform they must be successfully evaluated against their ability to meet the requirements in RFQ. The matrix above lists on two options or suppliers for the decision, and each alternative is evaluated. Choice whether to accept the quotation can be taken based on the option that appears to be the most technically and commercially suitable

VENDOR FACTSHEET

A vendor **fact sheet** is a presentation of data in a format which emphasizes key points of the vendors concisely.

Table – Vendor fact Sheet for Harish Fabrication

This document given to the customer has the details about the vendor providing the quotations and his enterprise. Vendor factsheets is prepared for two suppliers in table.10. This includes information about the company like name of the company, year of establishment, locality, employee strength, strength, weakness and opportunities. Customer makes decision based on the company reputation, years of experience, transportation, capacity and expertise in other fields of the vendor can be analyzed by the customer and help in making the right decision, Information provided by the company is utilized to prepare the vendor factsheet and if required, the customer can refer the same for future requirements or requirement of the company's expertise in other lines of the plant or different projects carried out by the customers.

Thus, the detailed analysis of the entire process is provided to the customer in a simple format in a single page through which the customer selects the suitable supplier.

VII RESULTS AND CONCLUSION

Through application of project management, the outcomes obtained are as follows:

1. We understood the exact requirement of Customer and planned the other activities accordingly. Refer Table.1
2. We prepared the specification sheet and Engineering Drawing to get better quality on the technical requirements which will help the Vendors to quote accordingly. Refer Fig.4, Table 2, 3, 4, 5 6 and 7.
3. Using Project management tools like scheduling, status tracker, timesheet and Organigram helped to carry out overall monitoring of the project and determine the number of hours spent on the project which in turn help the customer to plan his other activities accordingly. Refer Fig.2, 3, 5 & 6.
4. Through efficient project management approach engineering drawing, engineering requirement document, Request for quote was developed. Refer Annexure 1
5. Based on the quotations received, Comparative matrix was prepared accordingly. Refer Table.8
6. The vendor fact sheet and comparative matrix were submitted to the customer. This helped the customer to take decision accordingly. Refer Table.9 & 10

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