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VALUE ADDITION IN WALL PLASTER

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Abstract

The aim of value engineering is to design a product that will represent the optimum value to the manufacturer and customer. Value Engineering is a systematic step by step methodology for continuous improvement of products, process, service and system. Value Engineering is often done by systematically multi stage job plan. This project introduces how to apply theories and methods of Value Engineering in the Wall Plastering. Value Engineering is a proven management technique that can make valuable contributions to value enhancement and cost reduction of the wall plastering. The basic fundamental of Value Engineering with its different phases which can be implemented in any product to optimize is its value. A case study of Wall Plastering is discussed in which the ingredients of plaster are changed according to the value engineering methodology. The material is chosen such that the cost is reduced without affecting the value of the product and its design. We have used the material which is more adhesive than traditional one. We have also think about the chemical reaction of the materials. To find the best possible alternative from the choices we have used the tools such as Function analysis, Functional Evaluation and Decision Matrix which gives the most appropriate results. Hence as a result of the analysis the cost is reduced.

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1. INRODUCTION

Lawrence D. Miles established the Value Engineering in the monograph of "Techniques of Value Analysis and Engineering" in 1947. In the monograph he pointed out that success of a free enterprise in the overall long-term competition lay in continuously selling the best value to customers and evoking expected price, and the best value is function and cost. Using Value Engineering can help all the departments of a enterprise to determine the best scheme that meets all the needs of the customers with the lowest cost.

In general, 15% to 20% or more of the unnecessary costs can be reduced within reducing the value of consumers. Since 1978, the theory of Value Engineering was introduced into China; it has been widely adopted by many companies and made great economic benefits. With 35 years' practice, the theory and methodology of Value Engineering has been recognized by the academic community, especially the business circles, which has been one of the significant methods to improve product quality, reduce product cost.

However, in India, VE is mostly associated to any alternative design with the intention of cost cutting exercise for a project, which is merely one of the initial intentions of the VE. This project outlines the basic frameworks of Value Engineering and presents a case study showing the cost reduction of Value Engineering in a Furniture Manufacturing Industry.

1.1. Roadblocks to Cost Effectiveness

The practice of VE doesn't imply that there may be intentional "gold plating," conscious neglect of responsibility, or unjustifiable error or oversight by the design team. VE simply recognizes that social, psychological, and economic conditions exist that may inhibit good value.

The following are some of the more common reasons for poor value:

- **A.** Lack of information, usually caused by a shortage of time. Too many decisions are based on feelings rather than facts.
- **B.** Wrong beliefs, insensitivity to public needs or unfortunate experience with products or processes used in unrelated prior applications.
- **C.** Habitual thinking, rigid application of standards, customs, and tradition without consideration of changing function, technology, and value.
- **D.** Risk of personal loss, the ease and safety experienced in adherence to established procedures and policy.
- **E.** Reluctance to seek advice, failure to admit ignorance of certain specialized aspects of project development.
- **F.** Negative attitudes, failure to recognize creativity or innovativeness.
- **G.** Over specifying, costs increase as close tolerances and finer finishes are specified. Many of these are unnecessary.
- **H.** Poor human relations, lack of good communication, misunderstanding, jealousy, and normal friction between people are usually a source of unnecessary cost. In complex projects, requiring the talents of many people, costs may sometimes be duplicated and redundant functions may be provided.

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2. PHASES OF VALUE ENGINEERING PROCESS

2.1. Information Phase –

During this phase, the VE team gathers as much information as possible about the program requirements, project design, background, constraints, and estimated/projected costs. The team performs functional analysis of systems and subsystems to identify high cost areas.

2.2. Speculative/Creative Phase –

The team uses a group interaction process to identify alternative ideas for accomplishing the function of a system or subsystem.

2.3. Evaluation/Analytical Phase –

The ideas generated during the speculative/creative phase are screened and evaluated by the team. The ideas showing the greatest potential for cost savings and project improvement are selected for further study.

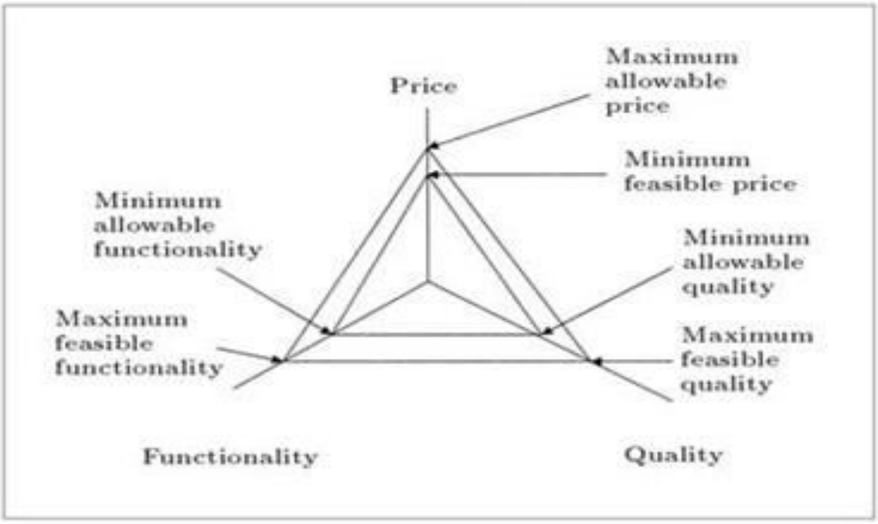

Figure 1 - The survival zone for a product source

2.4. Development/Recommendation Phase –

The team researches the selected ideas and prepares descriptions, sketches, and life cycle cost estimates to support the VE proposal (VEP) recommendations.

2.5. Report Phase –

The team presents the VEP's to the Government during an oral presentation at the conclusion of the workshop. Shortly after the completion of the VE workshop, a preliminary VE report encompassing the entire VE effort is prepared by the VE team leader and submitted to the Industry Management.

3. INFORMATION PHASE

This phase has been recommended by all experts. The information about the Value engineering project is the backbone of the whole exercise. Objective of the information phase is about the whole information about that particular project also we can check the accuracy of information and check, recheck, test, update and process all data.

3.1. Plaster –

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Plaster is a building material used for coating walls and ceilings.
It is manufactured as a dry powder and is mixed with water to form a paste.
The reaction with water liberates heat through crystallization and then the hydrated plaster hardens a mixture of lime or gypsum, sand and water.

3.1.1. Components of Plaster –

A. Binder – The substance which basically holds together the layer or the coat.

eg. – Lime, cement, gypsum.

B. Sand – This comprises of the actual bulk of material in the layer or the coat.

eg. – Various sizes as per requirement and availability.

C. Water.

3.1.2. Methods of application of plaster –

A. External Plastering –

In this method, cement and fine aggregate mix ratio should be 1:4. Thickness should be in between 15 to 20 mm. on a brick wall.

B. Internal Plastering –

In this method, cement and fine aggregate mix ratio should be 1:6. Thickness should be in between 10 to 15 mm. on a brick wall.

i. Chemical composition of cement plaster

Table 1: Chemical composition of cement plaster

Constituents	Proportion (%)	Uses of constituents
Silica and insoluble residue	18.69	Increase compressive & bond strength
Iron and aluminum oxides	1.21	Rapid strength achieved
Calcium oxide	26.11	Absorbing water
Magnesium oxide	0.43	Proper mixing
Sulfuric anhydride	33.27	Regulating setting time
Carbon dioxide	3.15	Setting and hardening
Water	15.29	-
Total	98.75	-

3.1.4. Types of Plaster based on mortar used –

A. Gypsum plaster (plaster of Paris) –

Produced by heating gypsum to about 300 ºF i.e. 150 ºC.

$CaSO_4 . 2H_2O + heat \longrightarrow CaSO_4 . 0.5H_2O + 1.5H_2O$ (released as steam).

B. Lime plaster –

Mixture of calcium hydroxide and sand. CO_2 causes the plaster to set by transforming the calcium hydroxide into calcium carbonate (limestone).

C. Cement plaster –

Mixture of suitable plaster, sand, Portland cement and water. This plaster was first introduced in America around 1909.

D. Heat resistant plaster –

Used for coating walls and chimney. It should be used in cases where the wall is likely to exceed the temperatures of 50 ºC.

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E. Ready mix plaster –

It is a polymer modified premixed cement base plaster. It offers high quality ready mix plaster at the most competitive market rates.

4. FUNCTION PHASE

This particular phase holds an important place in the VE job plan. It is the heart of the concept. Functional analysis is concerned with improving the profits by attempting to reduce the costs and/or by improving products by adding new features in a cost effective way so that they are attractive to customers and also the profits actually increase. During this phase, the team members should define the function of their product, process or system very clearly and effectively.

4.1. Basic or Primary functions –

A. Prevent actual structure of building, i.e. brick masonry or R.C.C. units.
B. Used as weather-proofing, i.e. to protect against wind, rain and sun.
C. Surface coating to fill gaps in the wall so as to keep vermin and insects out of the structure.

4.2. Secondary functions –

A. Aesthetic purpose.
B. Levelling coat.
C. Smooth surface for application of paints and polishes.
D. Fire protection.

4.3. Function Analysis System Technique –

Function Analysis System Technique or FAST is a valuable technique that can be added to the System engineering tool box.

In addition to being an effective methodology for functional decomposition, it can be used to enhance the Integrated Product. Team's understanding of the system through its synergistic effect.

Additional improvements will be seen if Value Engineering is applied as a way to identify design improvements, develop and evaluate trade-off studies, and build team and management consensus on the design concept. Also, FAST and VE can be used throughout the design process to identify cost trade-offs and opportunities for improvement.

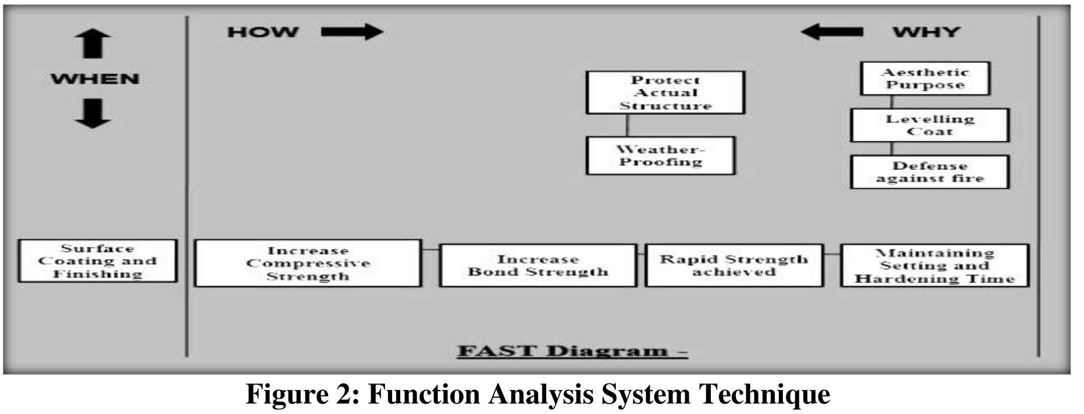

Figure 2: Function Analysis System Technique

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5. CREATIVE PHASE

In this phase the main objective function is to generate the alternatives for providing function and item through the creative thinking, brainstorming and even speculation. The creative phase consists of divergent and convergent thinking. While creative approaches are required during the divergent stage, analytical approaches are necessary at the convergent stage.

In this phase we generates the number of ideas about the use of various alternative materials that can be used for plastering. In this phase we generate the ideas like –

We can add various materials so as to reduce its cost such as –

A. Crushed stone.
B. Fly ash.
C. Polymer.
D. Saw dust.
E. Wood fibre.
F. Clay.

5.1. Crushed stone –

Crushed stone or angular rock is a form of construction aggregate, typically produced by mining a suitable rock deposit and breaking the removed rock down to the desired size using crushers. It is distinct from gravel which is produced by natural processes of weathering and erosion, and typically has a more rounded shape.

Angular crushed stone is the key material for macadam road construction which depends on the interlocking of the individual stones' angular faces for its strength. Crushed natural stone is also used similarly without a binder for riprap, railroad track ballast, and filter stone. It may also be used with a binder in a composite material such as concrete, tarmac, or asphalt concrete.

5.2. Fly ash –

Fly ash, also known as flue-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. Ash that does not rise is called bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants, and together with bottom ash removed from the bottom of the furnace is in this case jointly known as coal ash. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide (SiO_2) (both amorphous and crystalline) and calcium oxide (CaO), both being endemic ingredients in many coal-bearing rock strata.

5.3. Polymer –

A polymer (Greek; poly = "many" + mer = "parts") is a large molecule, or macromolecule, composed of many repeated subunits. Because of their broad range of properties, both synthetic and natural polymers play an essential and ubiquitous role in everyday life. Polymers range from familiar synthetic plastics such as polystyrene to natural biopolymers

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such as DNA and proteins that are fundamental to biological structure and function. Polymers, both natural and synthetic, are created via polymerization of many small molecules, known as monomers. Their consequently large molecular mass relative to small molecule compounds produces unique physical properties, including toughness, viscoelasticity, and a tendency to form glasses and semi crystalline structures rather than crystals. Appearance of real linear polymer chains as recorded using an atomic force microscope on a surface, under liquid medium.

5.4. Saw Dust –

Sawdust or wood dust is the by-product of cutting, grinding, drilling, sanding, or otherwise pulverizing wood with a saw or other tool; it is composed of fine particles of wood. It is also the by-product of certain animals, birds and insects which live in wood, such as the woodpecker and carpenter ant. It can present a hazard in manufacturing industries, especially in terms of its flammability. Sawdust is the main component of particleboard. Sawdust made with hand saw Ogatan, Japanese charcoal briquettes made from sawdust.Major use of sawdust is for particleboard; coarse sawdust may be used for wood pulp. Sawdust has a variety of other practical uses, including serving as a mulch, as an alternative to clay cat litter, or as a fuel. Until the advent of refrigeration, it was often used in icehouses to keep ice frozen during the summer. It has been used in artistic displays, and as scatter. It is also sometimes used to soak up liquid spills, allowing the spill to be easily collected or swept aside. As such, it was formerly common on barroom floors. It is used to make Cutler's resin.

5.5. Wood Fibre -

Wood fibres are usually cellulosic elements that are extracted from trees and used to make materials including paper. The end paper product (paper, paperboard, tissue, cardboard, etc.) dictates the species, or species blend that is best suited to provide the desirable sheet characteristics, and also dictates the required fibre processing (chemical treatment, heat treatment, mechanical "brushing" or refining, etc.). In North America, virgin (non-recycled) wood fibre is primarily extracted from hardwood (deciduous) trees and softwood (coniferous) trees. Wood fibres can also be recycled from used paper materials. Wood fibres are treated by combining them with other additives. They are then processed into a network of wood fibres, which constitutes the sheet of paper

5.6. Clay -

Clay is a fine-grained natural rock or soil material that combines one or more clay minerals with traces of metal oxides and organic matter. Clays are plastic due to their water content and become hard, brittle and non–plastic upon drying or firing. Geologic clay deposits are mostly composed of phyllosilicate minerals containing variable amounts of water trapped in the mineral structure. Depending on the content of the soil, clay can appear in various colours, from white to dull grey or brown to a deep orange-red.

A. We can add colors pigments to reduce additional cost for coloring.
B. We can increase porosity of plaster. So minimum water will require.
C. We can add lime so as to increase its adhesive property.

6. EVALUATION PHASE

During the creative phase, the VE team comes up with alternatives. It is always advisable that alternative should be more than one. And the creation of the alternatives does not mean that they would be better than the existing ones.

Table 2: Comparison of various Plasters

PARAMETERS	CEMENT PLASTER	READY MIX PLASTER	POLYMER PLASTER
Area (sq.m)	100	100	100
Thickness (mm.)	12	12	12
Proportion	1:4	-	1:4
cost (rs.)	7440/-	12845/-	10935/-
Ingredients	Cement, sand	Gypsum, silica, sand	Polymer, sand
Availability	Easy	Rare	Very rare
Effectiveness	Not more	Effective	More effective
Drawbacks	More curing is required	Less curing is required	Less curing is required

6.1. Cost required for Cement Plaster –

A. For 100 Sq. Meter Area, and thickness = 12 mm.

Total Area = 1.2 Cu.m.

Proportion = 1:4

B. Add 20% extra mortar for filling joints and depressions and wastages –

Volume of Mortar = 1.2 + (30/100) * 1.2 = 1.56 Cu.m.

C. Increase 30% of volume to get dry volume =1.56+(30/100) * 1.56 = 2.028 Cu.m.

D. Cement Required= (1/5) * 2.028 = 0.4056 Cu. M.

E. Weight of Cement= 0.4056*1440= 584 kg.

F. No. of Bags= 11.68 = 12 nos.

G. Sand Required = (4/5) * 2.028 = 1.622 Cu.m.

H. Cost required :–

1. Cement = Rs. 4440/-
2. Sand = Rs. 3000/-
3. Total Cost = Rs. 7440/-

6.2. Ready Mix Plaster-Alternative for Cement Plaster –

One bag contains 40kg of material.

Cost for 1 bag is Rs.260/-

It requires less time as compared to usual one.

It covers less amount of work as compared to traditional.

A. Evaluation Analysis –

Following are the alternatives for Wall Plaster –

- Cement Plaster.
- Ready Mix Plaster.

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- Polymer Plaster.

B. Criteria for evaluating value of above alternatives –

Adhesiveness, Cost, Curing Period, Availability.

Table 3: Alternative & cost

Alternative → Cost ↓	A	B	C
1	Less	Medium	More
2	Rs.8000/-	Rs.12840/-	Rs.10945
3	High	Low	Very Low
4	Easy	Rare	Very Rare

7. DEVELOPMENT PHASE

The functionally developed alternatives from the Evaluation Phase, which are workable solutions to the problems are in this Phase and are refined from the semi-finished state to the finished state.

7.1. Polymer Plaster –

Sand is altered by crushed aggregates. It will reduce CO_2 Emission which is released from cement.Fly ash along with alkaline activator which is combination of NaOH and Na_2SiO_3 forms a gel which binds fine and coarse aggregate. It will consume waste product fly ash which will otherwise utilize as land filling material. Geo-polymer is selected from various types of polymers. Proportion is changed to 1:2:4 i.e. polymer: fly-ash: crushed aggregates.

Table 5: Development Phase

	A	B	C	Total
A	--	2A	3A	5A
B	--	--	2B	2B
C	--	--	2D	2D
D	--	--	--	--

8. IMPLEMENTATION PHASE

The acceptance of recommendation will not have any meaning unless it is implemented. Sometimes, the decision maker may impose some conditions before an implementation. Successful implementation depends on integrating the necessary actions to be taken into the normal routine of the organization. Reviewing progress periodically and monitoring at set points would expedite completion. The final and most critical part of project work is the audit of the benefits and savings realized and verification that the anticipated results have been achieved.

The conditions may be –

A. Testing the component/assembly in test rigs.

B. Testing the component/assembly in a live environment.

8.1. Following tests are conducted on Polymer plaster –

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A. Tap Test –

Figure 3: Showing Tap all surface

Tap all wall surfaces after installation of final coat to identify any hollow areas.
All hollow areas should be remedied accordingly.

B. <u>Water Pressure Test –</u>

Water is forcely applied in Polymer Plaster and the adhesiveness of Plaster should be checked.
If the upper part is roved then the adhesiveness has been reduced, if not then it is ok.

Figure 4. – Water Pressure Test

9. CONCLUSION

Adhesive property of polymer plaster is more as compared to the traditional plaster. Cost is approximately same to the cement plaster. By the use of value addition, this plaster can be applied to brickwork, masonry work, R.C.C. wall, etc.
VE is recognized as an effective way to improve the performance of a product with reduction in cost. It is more effective and influential on the performance, quality, and cost of a product when done relatively early in the production schedule.
In the Case Study discussed above we have seen how the VE is used for the cost reduction without the change in the product design & its value. A proper decision matrix is prepared for choosing the appropriate alternative from the feasible choices available.

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