

Assessing Cost Engineering Technique for Budget Estimating of Vegetable Oil Refinery Project Development in Nigeria

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Abstract

Cost engineering, an adjunct of traditional engineering seeks to integrate judgement and experience, utilizing and applying adjusted cost information as supplied by specialists that handled previous similar projects to either designing to cost or costing to a design to obtain the likely cost of a proposed project. It further relies on scientific principles and techniques in handling emerging problems of estimation, cost control, business planning and management sciences, profitability analysis, project management, planning and scheduling during execution till delivery. Estimating in cost engineering for the procurement of vegetable oil refinery, a process engineering project captures cost of construction, risks, overheads, profit and makeup. This work assessed budget estimating for vegetable oil refinery project development procured through cost engineering technique relying on the basic cost of the process estimate derived from material and equipments suppliers, plant vendors, specialist contractors and subcontractors. It was found to be labour intensive requiring costing on among others man hour estimating technique. It was further found that the accuracy revolved on the degree of familiarity of the experts to the project, project cost information data, the time for the preparation of technical designs, guaranteed delivery dates and installation schedules as confirmed with all suppliers and subcontractors. Recommendations such as obtaining cost analyses from experienced line managers, specialist contractors and/or suppliers, fabricators, use of experienced cost engineers to ensure effective planning, scheduling, control and coordination were proffered.

Keywords: *Project, Cost engineering, Vegetable oil refinery, Budget estimating.*

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Background to the Study

The actualization of any product of the construction industry is a function of quality, quantity (COST) and time tripod. The traditional –procurement of a given construction project contractually bestows and separates functions and responsibilities to the extent of the Engineers and Architects oversee quality while the Quantity Surveyors oversee COST. Time management is shared by Architects, Engineers and Quantity Surveyors. Perhaps, this workability is celebrated especially when the project is less complex sophisticated specialized and easily affordable cost in nature.

In this regard the costs estimating of this type of project seeks to produce model for forecasting construction costs for clients and to estimating resource costs for contractors. On the other hand, a project may be dimensioned to comprise physical infrastructure, plant/equipment for manufacture and industrial processes. The resultant involved activities are executed by specialists in varying but related disciplines. In this regard, the issue of separating the function and/or responsibilities of time, Quality and costs seems virtually difficult.

A coordinator, endowed with sound and experienced knowledge in engineering, costing and management of similar project emerges who collapses the tripod of Quality, costs and time management of a project into Cost Engineering. According to <http://www.acoste.org.uk>, Cost engineering seeks to integrate judgment and experience in the utilization and application of scientific principles and techniques to problems of estimation, cost control, business planning and management sciences, profitability analyses, project management and planning and scheduling.

Ordinarily, engineering addresses technical such as the physical design of a structure or system, building or bridge for instance. However, when considerations such as money, time and other resources are incorporated in the creation of the project product(s) and coordinated by a professional, cost engineering emerges.

Numerous projects appear to be favored by the techniques of cost engineering. The projects include environmental engineering projects, process engineering projects, etcetera. Process engineering focuses on physical, chemical and biological manufacturing processes. In the chemical manufacturing industry, process engineering concerns itself with chemical and mechanical manufacturing of which vegetable oil refinery is one of them.

Vegetable oil refinery as a project is unique specialized complex sophisticated and attracting huge funds thereby making its budget estimating not to be conventional. This work provides an insight into how the techniques of cost engineering exist in producing a budget for vegetable oil refinery project.

Objective of the Study

The objective of the study is to estimate less complex infrastructural project which are usually procured through traditional method/ technique, parading less difficulty. This is explained as the involved cost centers, conventionally explicit and devoid of ambiguity.

However, when a proposed project showcases cost centers encompassing activities revolving on chemical, mechanical, electrical, warehousing, roads and other related, the production of a cost plan budget through the process of estimating becomes relatively difficult, novel and requiring specialized technique.

In the circumstance, this work attempts to evolve a synergy of collaborative techniques. Hence, the work considered collapsed technique of cost engineering, whose efficacy revolves on application of scientific principles to estimation, cost control, business, planning and management, investment analysis, project management and scheduling towards achieving a result oriented budget estimate for a complex project of vegetable oil refinery.

Project

The term project, has been variously defined. As a submission, Akpan and Chizea (2010) stated that a project refers to structures which are erected in accordance with the idea or design of the structures already stated either in sketches, drawings, directives or in mathematical instructions to satisfy its purpose functionally, structurally and aesthetically exhibit a high degree of complexity in nature, bring together many skills and conditions which are already variable.

According to Smith (2008), A project can be any new structure, plant, process system or software, large or small or the replacement, refurbishing, renewal or removal of an existing one. It is a one- off investment. He further stated that in recent times projects have had to meet the demands of increasing complexity in terms of technical challenge, product sophistication and organizational change. It follows that every design of car, aircraft, ship, refrigerator, computer, crane, steel mill, refinery production line, sewer, road, bridge dock dam, power station, control system, building or software package is a project.

Cost Engineering

Cost Engineering <http://www.acoste.org.uk> is the engineering practical devoted to the management of project cost involving such activities as cost -and- control- estimating, which is cost forecasting, investment appraisal, and risk analysis. Cost Engineers budget, plan and monitor investment projects. They seek the optimum balance between cost, quality and time requirements.

Furthermore Cost Engineers utilize acquired experience and judgment in the application of scientific principles and techniques to problems of estimation, cost control, business planning and management science profitability analysis, project management, planning and scheduling (<http://www.dace.nl>).

The relevance of Cost Engineering must be glaring so as to justify the sole articulation and management of time, Quality and Quantity (Cost). In other words, the relevant resources must have been optimally combined and synthesized so as produce a result- oriented cost/ technical trade-offs.

This is explained as in the traditional procurement, the design consultants achieve the project cost limit, either Designing- to-a Cost or Costing- to-a Design which often yield timely delivery. The efficacy of Cost Engineering appears to revolve on the functions of reliability utilization and application of adjusted cost information as supplied by specialists that handled previous similar projects to either Designing- to- cost or costing- to- a Design to obtain the likely cost of the proposed project. This technique thus goes a long way in ensuring effective cost/benefit trade- offs.

As a contribution, Hollmann (2010) posits that the objective of cost engineering is to arrive at accurate cost estimates and schedules and to avoid cost avenues and schedule slips. Thus, cost engineering goes beyond preparing cost estimates and schedules by helping to manage resources and supporting assessment and decision making. Hence, cost engineering besides encompassing a wide range of cost related aspect of engineering and programme management is particularly involved in cost estimating, Cost analysis/ cost assessment, design to cost, schedule analysis/ planning and risk assessment.

Vegetable Oil Refinery

Vegetable oil refinery typifies process engineering. According to <http://www.princeton.edu> process engineering is the branch of chemical engineering that addresses the design, synthesis and operation of chemical or manufacturing processes in which raw materials are converted into products. It encompasses a vast range of industries such as chemical, petrochemical mineral processing, advanced materials, food, pharmaceutical software development and biotechnological industries.

As a submission, Rudoff (2012) stated that process engineering focuses on the design operation control and optimization of chemical, physical and biological process. Vegetable oil refinery is synonymous with chemical manufacturing plants and involves filtration, distillation, dissolution crystallization, and extraction. As a mechanized process, vegetable oil refinery seeks to achieve increased efficiency, consistency, speed and affordability of processes (<http://www.wisegeek.com>).

According to www.oilmillequipment.com, vegetable oil refining is a step by step process involving the removal of phospholipids, pigments, off flavours, free fatty acids and other impurities from the crude oil extracted from seeds such as palm oil, nuts, cotton seeds. This is a chemical operation which seeks to achieve degumming/ neutralization, bleaching, deodorization and winterization. Vegetable oil refining could also be achieved through physical process of distillation of deodorization.

Budget Estimating

Ordinarily estimating is the technical process of predicting costs of construction. In cost engineering, estimating involves more than just cost of construction to include such ingredients as risk, overheads, profit and markup. Generally, certain factors are involved in budget estimating of cost engineering processes. Gerves and Jourvier (2003) articulated these factors to include;

The nature of the activity to be assessed, the degree of familiarity of the organization with the term or activity to be assessed; the extent to which reference can be made to previous exercise; the availability of reliable design information and the time available to prepare the estimate. Estimating in process engineering, project actualized through cost engineering technique is that the basic cost of the process estimate is derived from material and equipment suppliers, plant vendors, specialist contractors and subcontractors. According to Smith (2008), these components commonly account for about 80% of the total cost of the project. It follows that to ensure accuracy, firm quotations together with guaranteed delivery dates and installation, schedules are confirmed with all suppliers and subcontractors.

Furthermore, the main process plant contractor, the engineering contractor usually carries on the design, procurement and management functions which account for most of the remaining cost of about 20%. Basically, the engineering contractor estimates his own costs as accurately as possible. The work items include detailed design, procurement project management and site supervision charges.

Process engineering projects are typically labour intensive requiring man- hour estimating technique. In this regard, the estimations now based on confirmed principal quantities of the proposed work, the items to be subcontracted, the materials and plant needed for the job, critical dates for actions by subcontractors and suppliers and whether any design alternatives would be involved. In the establishment of the net cost of used data, allowances for possible fluctuation or any shortfall on each item of work are made. Also provided is the general contingency sum which takes care of any eventual costs to be incurred in the totality of the project cost estimate. Also to be included is the consultancy fee as appropriate.

A Case Study

This work is a case study of a vegetable oil refinery including associated infrastructure whose budget estimate was synthesized and procured through cost engineering technique in the South East of Nigeria.

The cost centers comprised installation of refinery and fractionation plant storage tanks, fractionation utility panel, Direct on line utility panel, factory building, Broiler room, lagging and installation works, warehouse packaging building, plant house, security house, external works/Drainage electrical installation, power generated, Labour costs, risks, professional fee and contingency sum.

Cost Syntheses

The data used in the syntheses of costs were obtained through primary and secondary sources. Cost information relating to warehouse factory gate houses etcetera are of primary sources while those relating to quotations obtained for electrical works, lagging of pipelines and vessels installations etcetera were of secondary sources and all the data provided by the practice of Network Projects Nigeria (NPN).

According to NPN (2014), each of the received and/or generated amounts per cost Centre further was added with a makeup so as to at least accommodate projected effects of macroeconomic forces, fiscal policy and general inflation.

A twelve percent of eventual total estimate representing approved scale of fee for professional by the federal Government of Nigeria was also allowed.

A ten percent of the eventual total was allowed to capture the general contingency for unforeseen circumstance.

The sum thereafter represented the grand total and budget estimate for the project.

The graphical general summary is thus:

Budget cost of vegetable oil refinery and associated infrastructural development in South East Nigeria, March, 2016.

General Summary

a. Electrical Installations	40,502,100.00
b. Storage Tanks	20,893,000.00
c. Power Generators	9,935,000.00
d. Fractionation Utility Panels	12,513,500.00
e. Labour Costs	5,550,000.00
f. Direct Online Utility Panel	25,572,000.00
g. Lagging and Insulation Works	31,817,200.00
h. Refinery and Fractionation Plant	129,275,695.00
i. Factory Building	80,939,600.00
j. Warehouse/Packaging Building	84,013,750.00
k. Boiler Room	33,805,610.00
l. Security House/81 Long Security Wire Gauze	12,927,390.00
m. Plant House	9,775,170.00
n. External Works/Roads/Drainage	52,344,052.00

Contingencies

Allow the provisional sum of 53,000,000 (fifty three million naira only) for general contingencies.

Sub Total

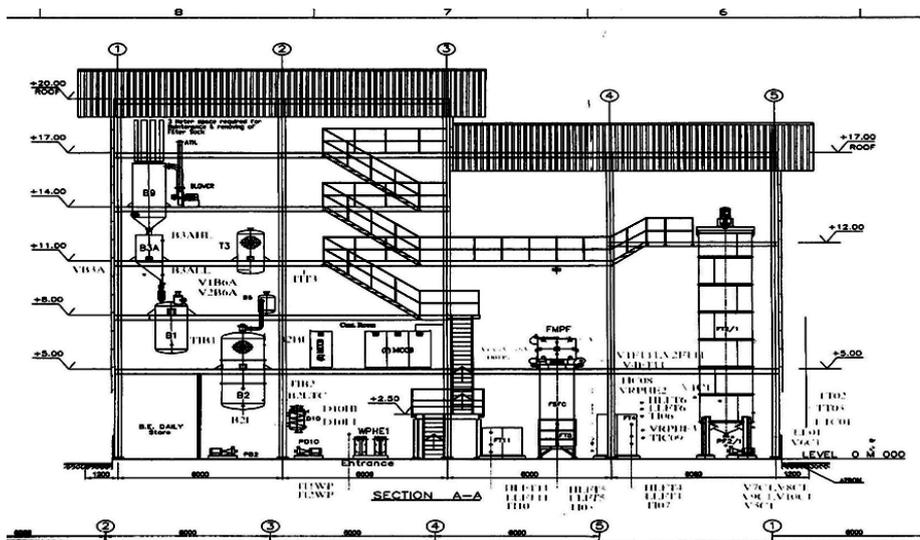
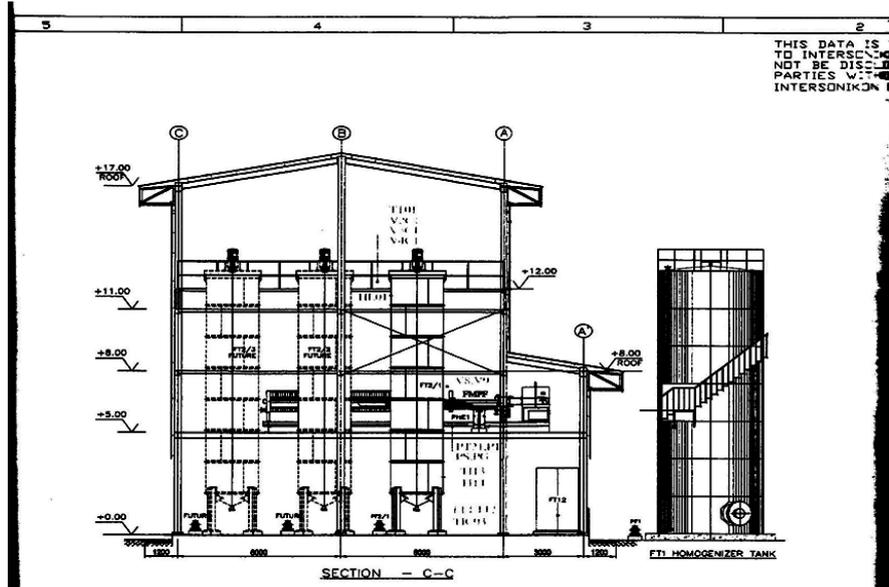
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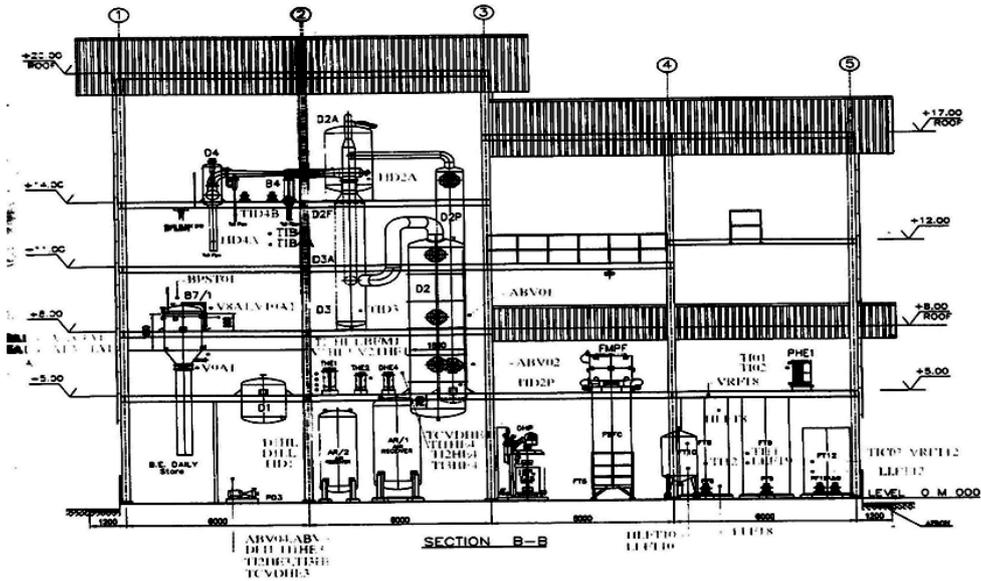
Add

- A. Professional fee for consultants (12%) 68,972,888.04
- B. Reimbursable: Sum to cover site visits, meetings, documentations, logistics, transportation, and sundries 10,000,000.00

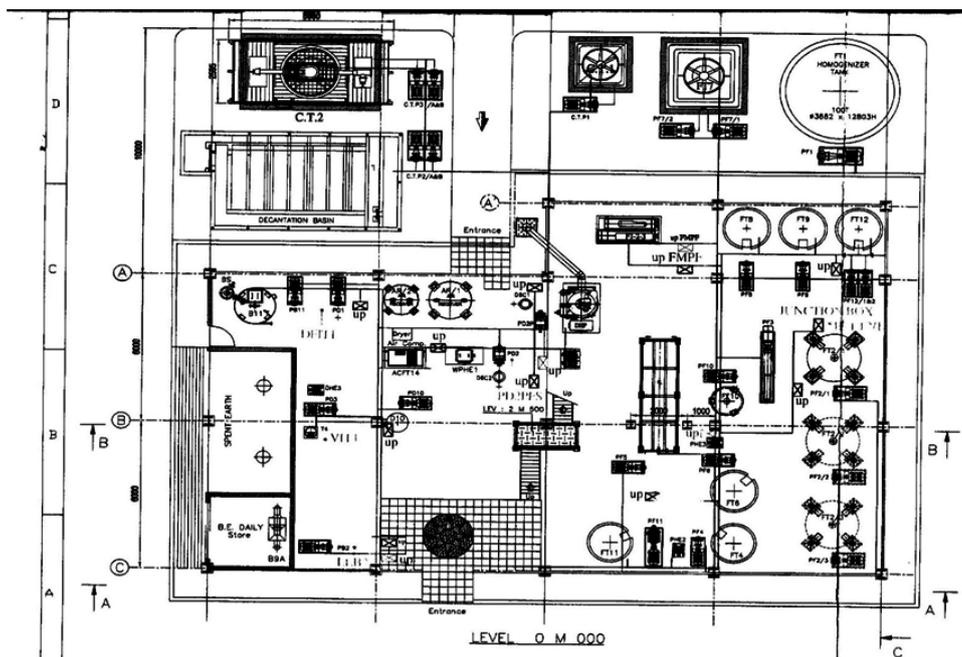
Budget Estimate

653,446,955.04





Section of Refinery and Fractionation Plant



Plan of Vegetable Oil Refinery Plant

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