# ENGINEERING VALUATION, COST ENGINEERING AND ENGINEERING ECONOMY AS STRATEGIC TOOLS FOR NATIONAL DEVELOPMENT

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## ABSTRACT:

This presentation explores Engineering Valuation, Cost Engineering, and Engineering Economy as strategic instruments for national development, particularly in emerging economies such as Nigeria. It argues that sustainable industrialization, infrastructure resilience, fiscal discipline, and investor confidence depend not merely on engineering design and construction, but on the rigorous quantification of value, cost, and economic viability throughout the asset life cycle.

It concludes that engineering valuation, cost engineering, and engineering economy are not peripheral technical specialties, but strategic levers for productivity, transparency, infrastructure optimization, and sovereign wealth protection.

## Preview

There is this contentious issue about the suitability of Engineers in valuation practice and cost management activities in Nigeria.

There are subsisting Federal legislations which allow Engineers to carry out valuation activities.

These laws are:

i) The Industrial Inspectorate Act Cap 18 LFN 2004
ii) Companies and Allied Matters Act (Amendment) Act Cap 20 LFN 2004
iii) Engineers (Registration etc.) Act Cap E11 LFN 2004 amended 2018
iv) Federal Republic of Nigeria Official Gazette No 98 Vol 105 dated 31st July 2018 on COREN Regulations for Engineering Valuation
v) Federal Republic of Nigeria Official Gazette No 93 Vol 105 dated 6th August 2018 on COREN Regulations for Cost Engineering
vi) Federal Republic of Nigeria Official Gazette No 92 Vol 105 dated 1st August 2018 on COREN Regulations for Engineering Economy
vii) The Financial Reporting Council which statutorily has the mandate to promote valuation standards in Nigeria recently mobilized Engineers,

Accountants and Estate Surveyors to produce the current Valuation Guide for Financial Reporting.

Furthermore, the two prominent professional associations dedicated to cost engineering and total cost management are Association for the Advancement of Cost Engineering (AACE) (1956) and International Cost Engineering Council (ICEC) (1975).

The Nigerian Institute of Appraisers and Cost Engineers is a member of International Cost Engineering Council.

With these references, Engineers can practice and indeed be involved in Valuation and Cost Management activities.

Engineering Valuation involves applying professional engineering knowledge and judgement to determine the value of technical asset such as plants, machinery, factories, infrastructure, etc., cost engineering focuses on managing cost throughout the lifecycle of any enterprise while engineering economy provides the qualitative methods of evaluating projects and compares alternatives to determine the best return on investment for scarce public funds.

The application of these interdisciplinary engineering activities on any engineering project provide the veritable platform and strategic tools for informed corporate decision which invariably impact sustainable national development.

## 1.0 Background

The following laws mandate Engineers to practice valuation in Nigeria:

- The Industrial Inspectorate Act CAP 18 LFN 2004

> *"It shall be the duty of the division to generally carryout investigations into any proposed, new and existing undertaking involving any proposed capital expenditure and in particular for the purposes of determining the investment **valuation** of the undertaking that is:*

*The actual capital (whether foreign or local) employed*

*The actual **valuation** of buildings, plant and other machinery employed or proposed to be employed in the undertaking and any addition thereto."*

The Scheme of Service expressly states that Engineers and allied courses shall carryout this responsibility.

- Companies and Allied Matters (Amendment) ACT CAP C20 LFN 2004 *Section 137(6) states* ***"Valuer means an auditor, a Valuer, a surveyor, an engineer or an accountant …"***

- Engineers (Registration etc.) ACT CAP E11 LFN 2004 amended 2018

  *Practice of engineering includes any professional service or creative work requiring the application of special knowledge of mathematics, physics and engineering in form of consultation, invention, discovery,* ***valuation****, research and teaching in recognized engineering institutions, planning, operation, maintenance supervision of construction and installation involving investigating, advising, operating, evaluating, measuring, planning, designing, specifying, laying and directing, constructing, commissioning, inspecting or testing in connection with any public or private utilities, structures, buildings machines, equipment, processes, works or projects;*

- Federal Republic of Nigeria official Gazette No. 98 Vol 105 dated 31st July, 2018 on COREN regulation for engineering valuation.

## *2.0 Introduction*

*Valuation is a systematic process of determining the worth of an asset, business, property, or investment.*

It is the art or process of estimating value or an estimate of value. It can be further summarized as an unbiased expression of opinion of value of an identified property(asset). Overall, valuation is an analytical process of determining the current or projected worth of an asset.

The terms *valuation* and *appraisal* are synonymous.

Individuals universally exercise the art of valuation without realizing the fact. Each exchange of a property, involves an estimate of the relative worth of the item

being exchanged. In ordinary trade, value is estimated by instinctive decision that the price quoted is fair or unfair. In all these everyday affairs, the exercise of the art of valuation is informal.

Carefully ordered practices of the industrial world recognize the need for a systematic procedure in estimating the value of industrial and infrastructural properties. In consequence, a formal process in the art of valuation has been developed.

## 2.1 Types of Valuation

**i) Ordinary valuation**. — In ordinary exchanges of property, the value is determined by the judgment of the seller and the buyer, each taking into account his knowledge of the property, of the prevailing exchange conditions for such property, and of his own exigencies and those of the other party. The seller and buyer finally agree upon the actual sales value. In majority of such cases, only few and simple, if any, mathematical computations are needed. Such valuations are made authoritative and binding only through acceptance by both the owner and the prospective purchaser of the property.

### ii) Formal Valuation

Value is determined by the judgement of qualified valuators (real estate). Real property is usually the realm where formal valuation is applied and values are mostly fixed by expert judgement.

### iii) Engineering Valuation

Is the art of estimating the value of specific properties where professional engineering knowledge and judgement are essential. It is a specialized field that combines technical engineering knowledge with financial analysis to determine the value of physical assets. Such properties include mines, factories, building, machinery, industrial plants, engineering constructions of all kinds, infrastructure, etc. It is distinguished from formal valuation by its focus on industrial and infrastructural properties where professional engineering knowledge and judgement are required. Engineering valuation entails knowledge of fundamental principles of

valuation, costs, service lives, and operating characteristics of the components that make up industrial and infrastructural properties.

## 2.2 Valuation Methods & Their Applications

a) Market Approach (Comparable Sales Method)
The appraiser uses the sales comparison approach to indicate value by analyzing recent sales (or offering prices) of properties that are similar (i.e., comparable) to the subject property.
The process involves identifying comparable properties that are similar to the subject property in terms of location, size, age, condition and other relevant factors. Adjustments are then made to the sale prices of the comparable properties to account for differences between them and the subject property. The sales comparison approach is most reliable when there is an active market providing sufficient number of sales of comparable property that can be independently verified through reliable sources. It is also not feasible when the subject property is unique.

- Best for: Real estate, vehicles, machinery, publicly traded companies, etc.

Advantages:

- Simple and based on actual market data.
- Reflects current market conditions.

Disadvantages:

- May not work for unique or rare assets.
- Requires access to comparable sales data. (active market)

b) Cost Approach (Depreciated Replacement Cost – DRC Method)
The appraiser starts with the current replacement cost of the property being appraised and then deducts for loss in value caused by physical deterioration, functional obsolescence and economic obsolescence.
In its simplest form, the cost approach is the current cost (new) less all depreciation.

- Best for: Machinery, industrial plants, infrastructure, special-purpose buildings, etc.

Advantages:

- Useful for unique, non-market-traded assets.
- Ensures assets are valued based on actual cost.

Disadvantages:

- May not reflect market demand.
- Depreciation estimation can be subjective.

c) Income Approach (Discounted Cash Flow – DCF Method)

The income approach estimates the value of a property based on its income generating potential.

It considers the present worth of future benefits (income) as a measure of value.

- Best for: Investment properties, businesses, rental assets, intellectual property.

Advantages:

- Accounts for future earning potential.
- Ideal for business and investment valuations.

Disadvantages:

- Requires accurate future cash flow projections.
- Sensitive to interest rates and discount factors.

Generally, Appraisers use the market approach of valuation to determine the market value of the assets by analyzing historical market transactions. On the other hand, the depreciated replacement cost method or cost approach to valuation calculates the current value of assets by estimating the cost of replacing the plant and machinery with a similar asset in the same condition while the income approach considers the present worth of future benefits(income) as a measure of value.

## 2.3 Best Practices for Accurate Valuation

◆ Use standardized valuation frameworks and guidelines (IFRS, IVSC, COREN regulations, FRCN).
◆ Conduct regular asset inspections to ensure accurate reporting.
◆ Utilize technology (AI, IoT, drones, big data analytics) for enhanced valuation

accuracy.
◆ Engage certified valuation professionals for unbiased assessments.

In summary, when used as part of a comprehensive business development strategy, valuation provides businesses with accurate data that can be used to make informed decisions about investments and assets. Accurate valuation reports can also improve business credibility with investors, lenders, and other stakeholders.

## 3.0 Cost Engineering

Many people have limited view of what engineering encompasses. The general perception is that engineering addresses only technical issues such as the physical design of a structure or system. However, beyond the physical manifestation of the design of a structure or system, there are other dimensions to consider such as the money, time and other resources that would be deployed in the development of the structure or system.

"Cost" is the collective term for resources such as: money and time. These resources are limited and should be utilized efficiently. That is where the practice of cost engineering focuses on; "managing cost throughout the life cycle of any enterprise.

With this background, cost engineering is the application of scientific principles and techniques to problems of estimation, cost control, business planning and management science, profitability analysis, project management and planning and scheduling. In order words, it is an engineering practice devoted to the management of project cost involving such activities as estimating, cost control, forecasting, investment appraisal and risk management. Cost engineers budget, plan and monitor investment of projects. They seek optimum balance between cost, quality and time requirements.

In summary, cost engineering is an engineering practice devoted to the management of project cost throughout the project lifecycle. It combines engineering principles with financial management to optimize project performance, manage risks and mitigate cost overruns and schedule slips. Overall, cost engineering enhances profitability, minimize delays, optimize resources and enables informed corporate decision making.

### 3.1 Key aspects and methodology

- Cost estimation.

Developing detailed budgets based on the scope.

- Cost control and forecasting.
  Monitoring expenditure, tracking project progress, and predicting final outcomes to take corrective actions. It involves monitoring expenses against budget, identifying variances (cost and schedule variances) and implementing corrective actions.
- Risk Management.
  Analyzing and quantifying financial risk and their impact on the budget.
- Value engineering.
  Optimizing project performance while minimizing costs without compromising quality
- Planning and scheduling
  Planning define project goals, scope and resources while scheduling maps these onto a timeline
- Profitability; provides accurate capital and operating costs assessment
- Optimization; balances time, cost and quality requirement
- Project lifecycle management
  Managing costs from initial conceptual design through engineering, construction and final operation

It is important to highlight the relationship between the concepts of Total Cost Management and Cost Engineering. Cost engineering provides the technical data driven methods (estimation, control analysis) to manage project costs while total cost management (TCM) is the broader holistic framework that applies these methods throughout the entire lifecycle of an asset. Essentially, cost engineering is the technical application within the comprehensive framework. Cost engineering provides the data tools and technical expertise required to execute the strategic goals of TCM.

## 3.2 Strategic tools

- Budget and Risk Management
  Through techniques like earned value management, cost engineers monitor cost overruns and schedules, preventing projects from becoming abandoned.
- Value engineering
  A systematic approach to achieving required project functions at the lowest lifecycle cost without compromising quality or performance
- Optimizing resource allocation
  It helps organizations allocate labour, materials and equipment efficiently

At this point, it is important to introduce cost discipline concept in project cost management structure.

Cost discipline is the strategic, ongoing process of managing, monitoring, and reducing business expenses to increase profitability without sacrificing long-term performance or quality. It involves fostering a cost-conscious culture, leveraging automation, and optimizing vendor contracts to ensure efficient resource deployment, rather than just indiscriminate spending cuts. It goes beyond simple cost cutting to build a sustainable cost-conscious culture that increases efficiency through technology, vendor management and strict data driven spending controls. It involves maintaining control over expenditure from conception to completion.

**Key Strategies for Cost Discipline**

- Budgetary Control: Establishing, monitoring, and adhering to strict budgets, with regular reviews to compare actual spending against projections.
- Process Optimization: Implementing lean manufacturing, reducing waste, and utilizing automation/AI to streamline operations and enhance efficiency.
- Visibility and control: Implementing strict, transparent tracking of expenses and adjusting budgets.
- Supplier Management: Renegotiating vendor contracts, seeking competitive bids, and consolidating vendors to reduce procurement costs.
- Operational Efficiency: Identifying and cutting non-essential, low-value initiatives or underperforming product lines.
- Cultivating Accountability: Empowering Engineers to make, and be accountable for, data-driven spending decisions. Engineering accountability requires engineers and teams to own their decisions, actions, and outcomes, prioritizing safety and ethics to foster trust with the public and stakeholders. It moves beyond blame to create a culture of transparency, clear ownership, and continuous learning from mistakes. Engineering accountability ensures that engineers are responsible for the outcomes of their decision.

## 4.0 Engineering Economy

Establishes the economic justification in the selection of competing alternatives with regards to projects, investments, manufacturing processes, etc. It is essentially the

science of formulating, estimating and evaluating the economic outcome of alternatives.

Generally, engineering economy is a subset of microeconomics that integrates economic analysis with engineering decision making, focusing on evaluating the feasibility of projects, managing resources and optimizing outcomes. It applies quantitative financial and microeconomic techniques to evaluate the viability of engineering projects. The key concepts include time value of money, interest rates, cash flow estimation/analysis, minimum attractive rate of return (MARR), economic equivalence.

## 4.1 Methodologies

- Present worth: converting all future cash flows to a single value at time, zero
- Future worth: determining the worth of a project at a specific future date
- Annual worth: calculating the equivalent uniform annual cash flow
- Rate of return: finding the interest rate at which costs equal revenue
- Benefit cost analysis: comparing the present value of benefits to the present value of costs

## 4.2 Strategic tools

- Alternative analysis: ensures that scarce national resources are invested in the most profitable or beneficial options
- Economic viability: it bridges technical engineering with economic reality, prioritizing investments that drive economic growth and industrialization

## 5.0 Conclusion

Integration of these proactive engineering activities create a comprehensive and veritable platform and strategic tools for national development. This technical expertise optimizes resource allocation, maximize value, manage project cost, promote transparency and accountability, ensure financial and infrastructure sustainability and consequently, reduce the high rate of abandoned projects and corruption in project management and administration. It also helps in overcoming the challenges of project failure, cost overruns and economic inefficiency.

By merging cost estimation and control (Cost Engineering) with financial analysis (Engineering Economy) and monetary value assessment (Engineering Valuation), businesses optimize project cost management, maximize return on investment and

promote operational efficiency and accountability. Together, engineering valuation, cost engineering and engineering economy provide businesses with accurate data that can be used to make informed corporate decisions.

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