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Research Article

ENGINEERING VALUATION PERSPECTIVES ON SUSTAINABLE ENGINEERING INFRASTRUCTURE FOR ACCELERATED RURAL DEVELOPMENT

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ABSTRACT

Rural development is the process of improving the quality of life and economic well-being of people living in rural areas while infrastructure is the basic physical and organizational structures and facilities like buildings, roads, power supplies and the like needed for the operation of a society like rural communities. It is therefore necessary to ensure that the structures and facilities operate efficiently at optimum capacities for accelerated rural development. Engineering valuation places value on the facilities for possible replacement, maintenance and resale to avoid waste due to obsolescence. Thus engineering valuation of sustainable engineering infrastructure ensures accelerated rural development.

INTRODUCTION

It is relevant to define some terms to make for easy alignment to the theme of this presentation. The terms include infrastructure, infrastructural development, sustainable development, rural development and engineering valuation.

Infrastructure

Infrastructure is the term for the basic physical systems of a business or nation. Examples include transportation, communication, sewage, water and electric systems. These systems tend to be high-cost investments and are vital to a country's economic development and prosperity [1]. *Infrastructure* is also defined as the fundamental facilities and systems serving a country, city, or other area, including the services and facilities necessary for its economy to function efficiently [2]. Clearly, infrastructure is the basic physical and organizational structures and facilities like buildings, roads, power supplies and the like needed for the operation of a society or enterprise.

Common types of economic infrastructure include the following [2]

1. Transportation. Transportation services such as roads, bridges, cycle highways, rail, airports and ports.
2. Energy. Production and delivery of energy including electric grids.
3. Water.
4. Safety and Resilience.
5. Financial.
6. Health and Education.
7. Standards and Rules.
8. Public Space.

Infrastructural Development

Infrastructural development involves fundamental structures that are required for the functioning of a community and society. As stated earlier, such structures include roads, water supply, sewers, electrical grids, telecommunications, renewable energy and the like. Infrastructural engineering on the other hand ensures that the information technology (IT) infrastructure is sufficiently robust, scalable and efficient to deliver the integrated services underlying the physical environment that supports the processes.

Sustainable Development

Sustainable development is *development* that meets the needs of the present without compromising the ability of future generations to meet their own needs [3]. Sustainable

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development is also defined as the economic development that is conducted without depletion of natural resources.

In September 2015, the United Nations General Assembly adopted the 2030 Agenda for Sustainable Development that includes 17 Sustainable Development Goals (SDGs). Building on the principle of "leaving no one behind", the new Agenda emphasizes a holistic approach to achieving sustainable development for all. The 17 sustainable development goals (SDGs) to transform our world include the following [3]:

GOAL 1: No Poverty
GOAL 2: Zero Hunger
GOAL 3: Good Health and Well-being
GOAL 4: Quality Education
GOAL 5: Gender Equality
GOAL 6: Clean Water and Sanitation
GOAL 7: Affordable and Clean Energy
GOAL 8: Decent Work and Economic Growth
GOAL 9: Industry, Innovation and Infrastructure
GOAL 10: Reduced Inequality
GOAL 11: Sustainable Cities and Communities
GOAL 12: Responsible Consumption and Production
GOAL 13: Climate Action
GOAL 14: Life below Water
GOAL 15: Life on Land
GOAL 16: Peace and Justice Strong Institutions
GOAL 17: Partnerships to achieve the Goal

Rural Development

Rural development is the process of improving the quality of life and economic well-being of people living in rural areas, often relatively isolated and sparsely populated areas Rural development has traditionally centered on the exploitation of land-intensive natural resources such as agriculture and forestry [4]. However, *rural* development is not just about agricultural *growth* and, whilst agricultural *growth* is a very important dimension of *rural* development, it is not enough on its own to ensure economic *growth* in *rural* areas. It includes agriculture and natural resources like crops, livestock, fishing and forestry [4]. Fortunately, Goals 1, 3, 6, 7, 11 and 15 of the SDG tend to address rural development.

Engineering Valuation

Valuation (appraisal) gives an unbiased opinion of value or other physical attributes of identified property. Value, on the other hand, is the monetary worth of property, goods or services [5]. A value in exchange is a hypothetical price and the hypothesis on which the value is estimated is determined by the purpose of the valuation. A value to the owner is an estimate of the benefits that would accrue to a particular party from ownership. Price is the amount asked, offered or paid for an asset. Because of the financial capabilities, motivations or special interests of a given buyer or sell, the price paid may be different from the value which might be ascribed to the asset by others. Cost is the amount required to acquire or create the asset. When that asset has been acquired or created, its cost is a fact. Price is related to cost because the price paid for an asset becomes its cost to the buyer. Thus value is not a fact but an opinion of either the most probable price to be paid for an asset in an exchange or the economic benefits of owning an asset.

The Machinery and Technical Specialties (MTS) Committee [5] of the American Society of Appraisers (ASA) established methods for valuation of property including machinery and equipment. These methods conform to the Uniform Standards of Professional Appraisal Practice (USPAP). Valuation of property and indeed machinery and equipment is necessary for various purposes including ownership change, partnerships, mergers and acquisitions, accounting, financing, insurance, leasing, liquidation and bankruptcy, management planning and tax issues [6].The premise of value includes the fair market value in continued use, fair market value installed; fair market value – removal, orderly liquidation value in place, orderly liquidation value, forced liquidation or auction value, salvage value, scrap value, insurance replacement cost and insurance value depreciated The Industrial Inspectorate Department (IID) of the Federal Ministry of Industry, Trade and Investment (FITI) in conformity with the Institute of Appraisers and cost Engineers (IACE) of the Nigerian Society of Engineers (NSE) internalized the valuation process in carrying out the mandate of determining the investment valuation of capital undertakings with the view to issuing acceptance certificate for capital allowance purposes and certificate of value for equity contribution [7].

The valuation (effective) date is important because it sets the exact date at which the value is determined and establishes the context for the opinion of value. The next step in the valuation process is the application of the appropriate value concepts/techniques. The value concepts/approaches include the cost approach, sales comparison approach and the income approach [6].

The cost approach is based on the proposition that an informed purchaser would pay no more for an asset than the cost of producing a substitute with the same utility as the subject asset. This concept is known as the principle of substitution. The cost approach assumes that the maximum value of an asset to a knowledgeable buyer is the amount currently required to purchase or construct a new asset of equal utility. When the asset is not new, the current cost is adjusted for all forms of depreciation attributable to the asset as of the date of valuation. In its simplest form, the cost approach is represented as follows:

Cost New – Depreciation = Value.
The starting point of the cost approach is reproduction cost new, replacement cost new or a combination of both.

The sales comparison approach considers market data in determining the value of the subject assets. The purpose is to determine the desirability of the subject assets through an analysis of recent sales or offering of similar assets to arrive at an indication of the most probable price for the subject assets. If the comparable from the market is superior to the subject asset regarding specific characteristics, the comparable is adjusted downward or upward if otherwise. In its simplest form, the sales comparison approach can be represented as follows:

Comparable Sale + or – Adjustment = Value range.
The income approach considers values to be represented by the present worth of future benefits derived from ownership typically measured by the capitalization of a specific level of income. The basic premise of the income approach is that a

purchaser expects to receive a certain rate of return on the income stream attributable to the subject assets. It can be stated as follows:

Value x Rate = Income or Income = Rate x Value (IRV) or Income ÷ Capitalization Rate = Value.

The income approach may possibly be used to value machinery and equipment that typically produce income such as rail cars, airplanes and heavy construction equipment. The final step in the valuation process is the preparation of an appraisal report highlighting salient issues leading to the determination of value for the subject assets.

Application

The application of the value concepts/techniques in the valuation process is demonstrated with two examples [7].
Example 1:

You are to appraise an X company model Y front-end loader built in 1995 at a cost of $50,000 freight on board (FOB) manufacturer. The current replacement cost new is $60,000. You have estimated all forms of depreciation to be 25% and capitalization rate of 40%. The Brown guide (hypothetical) indicates that similar 1995 machines, similarly equipped are readily available in the used market with significant number of sales, selling for $35000 to $40000. The ABC market survey report (hypothetical) indicates very few model Y machines are available for rent but when they are available, the gross rent is $20000 per year less 10% for less or expenses. What is the fair market value (FMV) using the cost, sales comparison and income approaches. What conclusion can be made as the FMV for the subject asset?

[Source: Institute of Appraisers and Cost Engineers (IACE), 2005] [8].
Solution [7]
Name of Company : X
Name of Machine : Front-End Loader Type : Model Y
Year of Manufacture : 1995
Cost of Machine : $50000 (FOB)
Replacement cost new : $60000
Resale value (resale market): $35000 - $40000
Depreciation rate : 25% Capitalization rate : 40%
Annual gross rent : $20000
Lessor expenses : 10%

1. Cost approach

Value = Cost new minus Depreciation = 60000 – [0.25 x 50000]
= 60000 – 12500
= 47500

2. SALES Comparison Approach

Value = Comparable sale + Adjustment = 35000 (40000) + [0.25 x 50000]
= 350000 (40000) + 12500
= 47500 (52500)

The comparable is adjusted upwards due to depreciation in age. It is built in 1995 similar to the subject machine. It is likely to be inferior to the subject machine.

c. Income approach Value = Income ÷ Rate
= [20000 – 0.10 x 20000] ÷ 0.40
= 18000 ÷ 0.40
= 45000

The Fair market value (FMV) of the front-end loader is about $47500.

Example 2

A plant has numerous machines but the backbone of the production is made up of four Numerically Controlled (NC) machines. These consist of two identical ABC Manufacturing company Model 40 machining centres and two identical XYZ manufacturing company Model ZZ20 turning centres. All these machines were purchased 15 years ago in April. The effective appraisal date is April 1 of the current year. It has been determined that the normal life for the equipment is 20 years and that straight line depreciation is to be used. To determine cost, the appraiser called the ABC manufacturing company and spoke with a salesperson who has been there for more than 20 years. The salesperson stated that the Model 40 machining centre was no longer made and has been replaced by a Model 50 five years ago. This person was familiar with both models and said that, by comparing specifications for both machines, the Model 50 had 20% more productive capacity, reflected by a coinciding 20% increase in cost which is represented by the $240000 replacement cost new of a Model 50. The appraiser called the XYZ Manufacturing Company and was told that the Model ZZ20 turning centre was still in production but that the sales price had dropped to $65000 from $80000. The sales price dropped because the controls for this machine were now less costly due to an improved design that made it cheaper to manufacturer but did not affect its output. Also, the Model ZZ20 is going to be replaced by a Model ZZ25 within the next six months with the same production capacity as the ZZ20. Three different used machinery dealers were contacted. All had one or more identical ABC Model 40 machines in stock and in good condition. They were offering these machines at a reasonably consistent price of $26500 but were having trouble selling them due to the older type configuration. Two dealers each had one XYZ machine Model ZZ20 for sale. One was offered at $22000 and the other at $18000. Both dealers felt that if they could not sell the machine before the new Model ZZ25 was introduced, they would have to drop the price drastically. The assessor and taxing guidelines instruct an assessor to apply a trend factor to the historical cost of the item and then depreciate that amount on a straight line basis to arrive at a fair market value in continued use. The trend factor is determined to be 1.45. The historical cost includes all of the direct and indirect installation costs. The current cost of installation is $25000 for the ABC Model 40 and $15000 for the XYZ Model ZZ20. What is the fair market value (FMV) in continued use, using the cost, sales comparison and income approaches? Reconcile the value using the most applicable approach or combination of approaches. What is the reproduction cost new?

[Source: Institute of Appraisers and Cost Engineers (IACE), 2005] [8]

Solution [7]

1. Name of Company : ABC

Name and type of Machine : Model 40 Machining Centre
Age of Machine : 15 Years
Normal life of Machine : 20 years
Historical Cost of Machine : $200000 (Installation included)
Resale value of Machine : $26500

Depreciation rate (secondhand): 6% (Generated – Appendix 2) [9]
Current Installation Cost : $25000
Depreciation rate : 75% (straight line)
Lessor expenses : 10%

2. Name of Company : ABC
Name and type of Machine: Model 50 Machining Centre
Current Replacement Cost New: $240000
Age of Machine : 5 years
Normal life of Machine : 20 years
Depreciation Rate : 25% (straight line)
Depreciation Rate (Secondhand): 5% (Generated – Appendix 2) [9]

3. Name of Company : XYZ
Name and type of Machine : ZZ20 Turning Centre (Lathe)
Age of Machine : 15 years
Normal life of Machine : 20 years
Historical Cost : $80000(installation included)
Depreciation Rate : 75% (straight line)
Current Replacement Cost New : $65000
Resale Value : $18000 and $22000
Depreciation Rate (Secondhand): 6% (Generated – Appendix 2) [9]
Current Installation Cost : $15000
Trend Factor for the Machines: 1.45

1. ABC Model 40

a. Cost approach

Value = 240000 – (0.75 x 200000)
= 240000 – 150000
= 90000
FMV in continued use = 90000 (0.1) + 25000
= 34000

b. Sales comparison approach

Value = 26500 – (0.06 x 200000)
= 26500 – 12000
= 14500
FMV in continued use = 14500 + 25000
= 39500

2. XYZ Model ZZ20

a. Cost approach

Value = 65000 – (0.75 x 80000)
= 65000 – 60000
= 5000
FMV in continued use = 5000 + 15000
= 20000

b. Sales comparison approach

Value = 18000 – (0.06 x 80000)
= 18000 – 4800
= 13200
FMV in continued use = 13200 + 15000
= 28200

3. ABC Model 50

a. Cost approach

Value = 240000 – (0.25 x 200000)
= 240000 – 50000
= 190000
FMV in continued use = 190000 + 25000
= 215000

b. Sales comparison approach

Value = 240000 – (0.05 x 200000)
= 240000 – 10000
= 230000
FMV in continued use = 230000 + 25000
= 255000

4. Reproduction Cost New (Model 40)

= 200000 x 1.45
= 290000

5. Reproduction Cost New (Model ZZ20)

= 80000 x 1.45
= 116000

The income approach is not applicable because there is no income stream associated with the machines.

Interpretation

The cost, sales comparison and income approaches are applicable in the first example. The income approach is not feasible in the second example because there is no income stream generated by the machines. In the two examples, the derived values are highest with the sales comparison approach and least with the income approach. This may be attributed to the uncertainties in the resale market. The sales comparison approach is most reliable when there is an active resale market providing sufficient number of sales of comparable property that can be verified independently through reliable sources. The cost approach is reliable when all forms of depreciation can be determined accurately. The use of the income approach, on the other hand, depends on accurate determination of the expected income stream and the rate of return (capitalization rate) of a property. The results of the examples show that fair market value (FMV) is within acceptable limits. The replacement cost new is provided in the examples. Otherwise the first cost (historical cost) which is the starting point of the cost approach, would have been determined by an appropriate IID technique [7].

DISCUSSION

Rural development is not limited to agricultural growth but includes exploitation of natural resources like crops, livestock, fishing and forestry [4]. This fact must have informed the United Nations General Assembly to provide for rural development in the adopted sustainable development goals (SDG) at its meeting of September 2015. Infrastructure is needed for the operation of society which includes rural areas. There is therefore the need for infrastructural development to address the peculiarities of rural development. Infrastructure is largely machine-driven. It is therefore necessary to acquire and maintain such machinery and equipment at reasonable cost to ensure sustainability. Engineering valuation provides good guide to the value placed on machinery and equipment for efficient operation of infrastructure for sustainable development especially in rural communities.

Valuation is multi-disciplinary according to Ashaolu [10]. However, valuation of machinery and equipment can better be handled by engineers, specifically engineers of the Institute of Appraisers and Cost Engineers (IACE). The two examples demonstrate the application of the value concept/technique to derive value for machinery/equipment that can be deployed for infrastructural development in rural communities. The application of the value concept/technique brings to the fore the engineering valuation perspective on sustainable infrastructural development for accelerated rural development and indeed societal development.

CONCLUSION

Rural development includes agricultural growth and natural resources like crops, livestock, fishing and forestry that require infrastructural facilities for sustainability. Economic development of rural areas should be conducted without the depletion of natural resources for it to be sustainable. Sustainability can thus be achieved if the value of the infrastructural facilities can be determined for optimal acquisition and operational efficiency. Fortunately, engineering valuation provides one of the methods of determining the value of infrastructural facilities for rural development as demonstrated by the worked examples. Engineering valuation is therefore relevant in the appraisal of sustainable engineering infrastructure for accelerated rural development.

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