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A Criteria Model for Budgeting and Assessing Industrial Sites Location in Developing Economy

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Abstract
Industrial sites are selected in many of the developing countries without taking into consideration some pertinent criteria that are directly affecting the sustainability of such industries in the locations after commissioning. Industries are located in some areas based on political influence rather than facility availability that support industry's productivity. In this study a criteria model was developed for assessing the present industrial site locations based on predetermined influencing factors called criteria. In the model provision was made for the sorting out of deficient influencing factors for the purpose of upgrading to acceptable level called benchmark through periodical allocation of appropriate funds. In validating the model, identified industrial sites located in selected States of Nigeria were surveyed. Data were collected on factors such as power supply, marketability and raw material availability which were considered influential to the sustainability of industry's site in the respective areas. Data were analysed for the criteria identified along the line of industrial categories which included large-, medium-, and small -scales. Benchmarks, as well as levels of criteria in the respective region were determined using statistical weighted averages and the results were used as input to the model. The output results of the model showed that none of the industrial sites located in the selected six States of the South-Western Nigeria were productivity supportive. However, a good performance was achieved in a site with a budget of $13 million (US Dollars) for the upgrading of the deficient facilities in the next three years.

Keywords
Industrial sites, Location criteria, Benchmark budgeting, Facilities upgrading, Developing economy

1. Introduction

An industry consists of a number of firms producing broadly similar commodities or services for the satisfaction of targeted customers (Aderoba, 1995, 2004). Industry construction involves an intensive use of land and large amount of upfront capital. After construction, a huge amount of capital is still needed for running the manufacturing and production processes before profit can be expected or thinking of maximising the profit (Aderoba, 1997). Many industries were constructed in developing countries including Nigeria without taking into consideration various factors that can influence their sustainability (Ige, 1987; Idris and Aderoba, 2001). Some industries were located and constructed in the areas based on political and/or tribal influence rather than consideration on availability of relevant facilities and resources that are useful for the industrial sustainability. Traditionally, industry's sites are generally located base on the availability of raw material for manufacturing process in the area. However, the survival of industry in developing economy requires some other factors beside raw material; these are infrastructural facilities and maintenance culture. Proper consideration of these factors at initial level of location and construction of the industry at a particular site will enhance the maintainability and sustainability of the integrity of such industry through generation of high productivity and return on investment (Aderoba, 1997).

The concept of industry's performance is yet to be totally embraced by many stakeholders in developing countries; this has grossly and negatively affected the outputs and the efficiencies of both manufacturing and non-manufacturing sectors in the region. The industry focused on the production of goods and services should be located in the area where necessary facilities that are favourably supportive to its activities are available. This development will not only improve the efficiency of operations of such sectors but will also promote the productivity which are critical parameters on which sustainability of an industry is based. Unfortunately, Nigeria Government paid more attention to the oil and gas sector of economy and other sectors were suffering (Diaku, 1989). The few industries in existence were located and constructed based on political inclination rather than considering other factors (as stated) that are vital to the development and productivity of such industries.

In reality, Nigeria industries are encountering numerous constraints which are hindering their performance in the comity of industries. The constraints that adversely effected the industrial development in Nigeria included land tenure and acquisition system, effective and efficient marketing of various goods and services, the public tastes, competitors, the supplier and marketing intermediaries, the political and legal environment, the socio-cultural background of the people, technological advancement, the economic environment and the demographic environment. This study will solve these problems in a way by providing benchmark database that could be used as a reference in determining the level (high or low) of Nigeria industry's performance as regards location and construction. In the framework, avenue is also created for the development of erring factors through proper allocation of funds.

Nigeria is divided into two regions, namely forest and savannah regions. Forest region is further subdivided into South-South, South-West and South-East, while Savannah region comprises North-North, North-West, and North-East (Harrisonchurch, 1980). The scope of the study is limited to the specific manufacturing industries spread within the length and breath of the six States in the South-West geo-political region of Nigeria which are Ekiti, Ondo, Osun, Lagos Ogun and Oyo States. The factors called criteria considered for determining the level of industry's performance in the respective site locations are proximity to highway, labour supply, market, raw material, transportation facilities, water supply, power supply, space for expansion, impact on community, social responsibility, taxation, suitable land and cost, manpower, equipment and machinery, market behaviour, maintenance, finance and climatic condition. These factors were analysed along the line of industry's category namely large-, medium-, and small-scale. The peculiarities of the industry's category are well explained in the literature (Ige, 1987; Diaku, 1989; Atijosan, 1998). The performance level obtained for the stated criteria were compared with the established benchmark. In summary, the study identified the criteria for industry's sites location and construction in developing countries such as Nigeria. The assessment of the criteria was done, benchmarks were established, and the industry performance level was determined by comparing the attained status of the criteria with the established benchmark. The statistical weighted average technique was the tool used to achieve these lofty objectives. The dynamically motivated control model was a driver that conveyed the erring criteria to the established benchmark.

2. Methodology

A mathematical model was formulated to estimate the benchmark of the influencing factors called criteria for industry's sites location. Present status of these criteria was also estimated within the model. The present value of each criterion was compared with its benchmark counterpart. This was done for all criteria in succession. Those criteria that were not meeting the benchmark value were isolated for upgrading or development using dynamically motivated control system. The driver was funding and its implication on developments was also determined. Testing/validation of the model was done using data collected from different categories of industries located and constructed in selected Southwestern Nigeria cities.

2.1 Model Formulation

The minimum requirements (benchmarks) of factors influencing the productivity of industry location and construction are denoted by $X_1, X_2, X_3, \ldots, X_n$
The optimal industry location and construction (P_c) is achieved when the aforementioned minimum requirements are met, and is expressed as a function of benchmark values as,

$$P_c = f(X_1, X_2, \ldots, X_n) \quad (1)$$

Where, $X_1, X_2, \ldots, X_n$, are the benchmarks for influencing factors of types 1, 2, …, n, respectively. The present industry location and construction status (Q_i) is determined as a function of present status of influencing factors, $Y_1^t, Y_2^t, \ldots, Y_n^t$, and is mathematically expressed as,

$$Q_i = f(Y_1^t, Y_2^t, \ldots, Y_n^t) \quad (2)$$

Where, $Y_1^t, Y_2^t, \ldots, Y_n^t$, are present status of influencing factors of types 1 , 2, …, n, at time t, respectively. The influencing factors considered may satisfy the condition $Y_n^t \geq X_n$ completely or partly; if the condition is satisfied completely, that is all Q_i elements are greater than or equal to P_c's, then the industry in focus is strategically located, otherwise, the industry is either partly or not strategically placed. However, gradual developmental efforts through a well structured funding may perhaps enhance the attainment of benchmark level from the present conditions that are not conducive for the industry's operations. Therefore the control system for the upgrading of misplaced elements is stated thus:

$$X_n = g(Y_n^t) + e_n, \quad (3)$$

Where, X_n, Y_n^t, e_n are the benchmark value, present status and control error, respectively for influencing factor, n at time t, and n, is the counter for influencing factors. The associated funding control system is thus given as,

$$\lambda^{tn} = \Delta(t)\lambda^{to} + e_n \quad (4)$$

Where, λ^{tn}, is the cost of periodic upgrading/development for n at time t, $\Delta(t)$, is the funding change rate/ factor at time t, λ^{to}, is the initial available fund at time t_0, e_n, is the error in funding for n. Control error, e_n will be equal to zero if,

$$g(Y_n^t) = X_n$$

The development of these aforementioned elements, n must be done sequentially based on available fund, by prioritizing them from criticality point of view. The funds were not necessarily available at once, then, periodical argumentation of available funds in each period may be required to determine the period(s) when gain(s), $\Delta(t)$s are to be obtained for the respective elements. If the total cost of attaining benchmark level is X_c, and periodical plough back towards attaining the required status is λ, then the expression for the funding at period, t based on discounted cost estimate is given as,

$$\lambda^{tk} = \lambda^{to}(1+j)^k \quad (5)$$

Where, λ^{tk}, is the fund to be made available at time t_k, k, is the counter for time, j, is the discounted cost factor. By induction Equation 4 becomes,

$$\lambda^{tn} = X_c = \lambda^{tk} + e_k$$

The optimal policy is to find the value of period t_k in which $\lambda^{tk} \geq X_c$, λ^{tn}. At this period, the influencing factor is developed to an acceptable level. The corresponding influencing factor gains are similarly given as follows,

$g(Y_n^{tk}) = g(Y_n^{tk}) = (Y_n^{t0})(1+j)^k$ and, $X_n = g(Y_n^{tk}) + e_k$

The parameters stated are as defined before. Then if $g(Y_n^{tk}) \geq X_n$, then the optimal level is reached, otherwise iteration is repeated. If the first iteration is given the optimal results for the elements considered, then funding is augmented and the proportionate developmental effects on the influencing factors are noticed. Periods to attain a good productivity level in the industry's location and construction site are computed using similar procedures as stated above. Figure 1 shows control system design process for the capacities building.

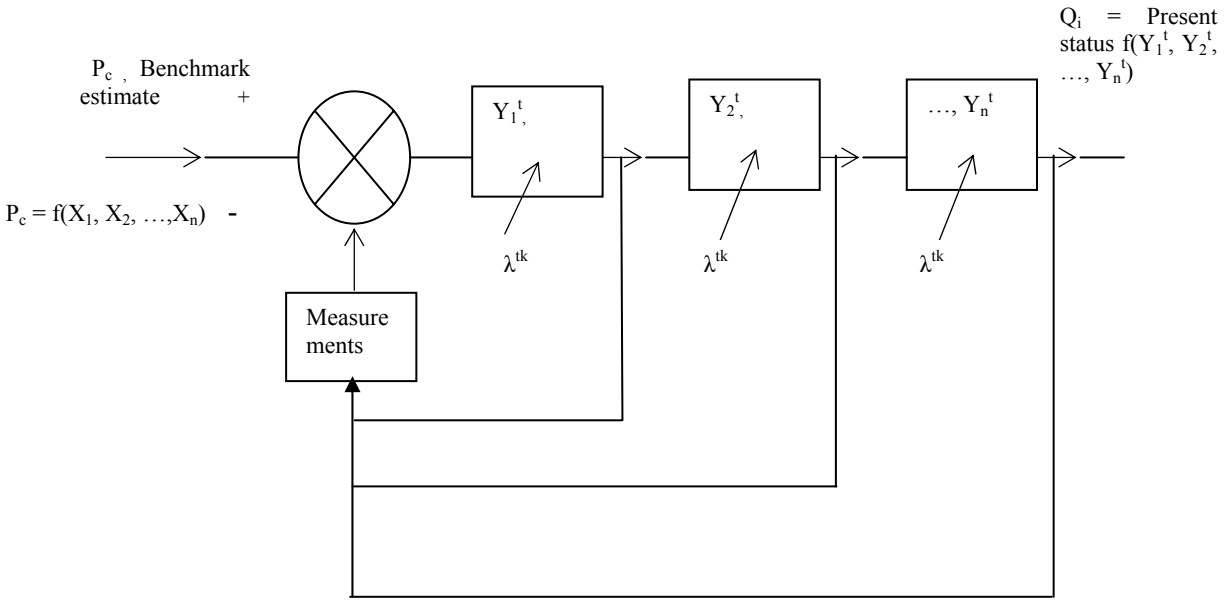

Figure 1: Industry's Site Location and Construction Criteria Status Control System

2.2 Model Testing/Validation

This section takes an inward and critical look into the factors influencing the location and construction of industries in Nigeria as obtained from industrialists and literature (Osibi, 2000; Nwachukwu, 2000; Akintayo, 2006; Kareem, 2007). This has yielded the following criteria: proximity to highway (PH); labour supply (LS); nearness to the market(NM); nearness to the raw material (NR); transportation facilities (TF); water supply (WS); power supply (PS); space for expansion (SE); impact on community (IC); social responsibility (SR); taxation (TX) suitable land and land cost (SL) manpower (MP); equipment and machinery (EM); market behaviour (MB); finance FN); maintenance(MT); government policies and regulations (GP); and climatic conditions (CC). The questionnaires were administered in industries categorised as small-scale, medium-scale and large- scale. Data collected were analysed statistically based on weighted average technique through which benchmark, X_n and present values, Y_n^t for influencing factors were estimated. The values of Y_n^t and X_n were estimated from,

X_n = (cumulative response for nth sub- factor / total expected response) x 100 (in %) (6)

Y_n^t = (cumulative response for nth factor/total expected response) x 100 (in %) (7)

X_n is a measure of criticality (benchmark) of each criterion and n, is the counter for criteria. In this case each of the criteria was weighted based on its importance in term of its influence on productivity performance of the industries. Each criterion was graded as satisfactory, average or unsatisfactory; and the frequencies in the column of satisfactory was given more priority and used as bases for performance evaluation in various states. Y_n^t, is a measure of present status of each of the criteria considered.

2.2.1 Data collection and analysis

Thirty (30) copies of the questionnaire were administered to the industries in the selected six States, namely Lagos, Ogun, Oyo, Osun, Ondo and Ekiti of the South-West geo-political zone of Nigeria, out of which twenty eight (28) were properly filled and returned. The balance were partially filled and therefore rejected. The Table 1 shows the number of industries that were given questionnaires and the responses were analysed based on relations (6) and (7). The companies administered in Lagos State include B. Paints, U. Pharmaceutical, N.D. fabrication, J. wax, O.G. Company, S. Plastic and F. & Co. In Ogun State, D.U. foods, P. Prod., A and Wiborg, E. Pharmaceutical, and S. Breweries were administered. E. Flour Mill, Y. Biscuits, Z. tech. and P. and Gamble were among the companies administered in Oyo State, while in Osun State the companies included Y. O. Foam, O. Distillers and S. co. were conducted. In Ondo State companies included P. industry, B. Sawmill, O. Foams, W. Enterprise, T. Industry, and D. wire and cable were visited, while in Ekiti State, G. S. Water Nig. Ltd. was among the companies administered. The names of the industries are abbreviated to protect their information and integrity.

3. Results and Discussion

Table 1 shows the summary of the responses from the industries in each category to the criteria identified. Table 2 shows the summary of the results of the benchmark and present criteria status obtained using relations 6 and 7. The starred results indicate the criteria that met the minimum (benchmark) requirements. The graphical representations of the performance results are given in Figure 2 for easy comparisons. The graph of benchmark as presented is a plot of minimum percentages each of the criteria must have and the present actual values. The dynamically motivated system results and its associated control errors (obtained based on Equations 1 – 5) are shown in Tables 3 and 4, respectively. From the analysis it can be seen that largest responses came from large-scale industries while the small scale industries were very view in the areas studied (Table 1). This showed that land tenure system in Nigeria is likely to be affecting entrepreneurs who would like to establish small scale industries. The majority of the large-scale and medium scale industries were established by Nigeria Government.

Table 1: Categorisation of Industrial Respondents

Categories	*Frequency*	*Percentage %*
Large scale	14	50.00
Medium scale	9	32.14
Small scale	5	17.84
Total	28	100.00

Generally, performances of the industries in their present locations are not good enough (Table 2). In Osun state, for examples, when comparing the benchmark and the industry performance (IP), it was seen that there was little agreement between the two plots as only five (5) factors (starred) met the minimum requirements (Figure 1). The implication of this result is that it is uneconomically viable and unadvisable to site an industry in such location in its present form. Similar performance were found in identified locations of industries in other States, namely Ondo, Ogun, Oyo, Ekiti and Lagos. However, in Ekiti,

fourteen (14) starred criteria met the minimum requirement which made the state undoubtedly fairly viable for location of industry, though very few industries are located there. This has buttressed the earlier claim that location of many industries in Nigeria was politically motivated rather than based on merit. Oyo state seemly had the next potential for industry location besides Ekiti as it met about sixty percent of the minimum criteria and it was relatively peaceful with availability of space for expansion. Other basic amenities that are supportive to industrialization were also available in the State. Meanwhile, the worse industrial performance in all States came from epileptic nature of electric power supply, which is less than 50% of the benchmark established. Good transportation facilities enjoyed by various industrial sectors enhanced better performance in many States investigated; however, transportation bottleneck was prevalent in Lagos State.

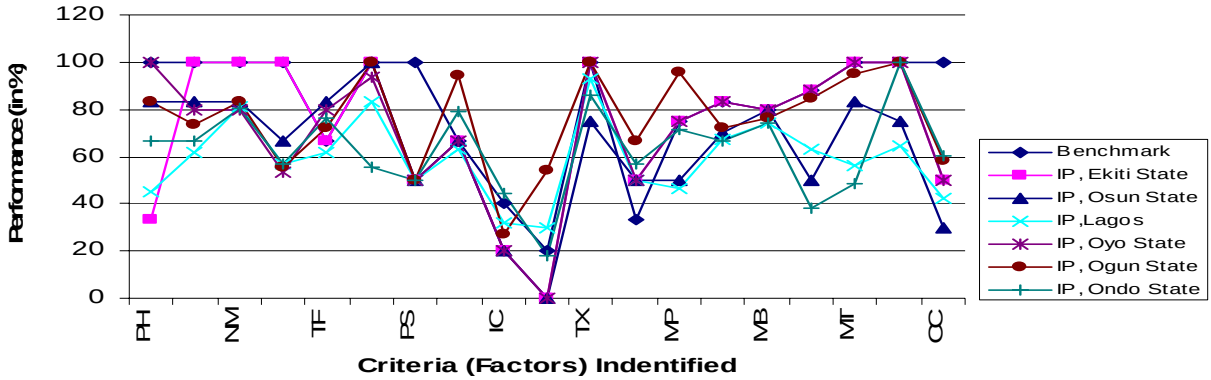

Figure 2: Comparison of Benchmark with Industry Performance (IP) in Selected States of Nigeria

Table 2: Industry Performance and Benchmark Estimate (in %)

Factors, n	*Code*	*Bench mark %, X_n*	*Values obtained from each State (%), Y_n^t*					
			Ekiti	Osun	Lagos	Oyo	Ogun	Ondo
Proximity to highway	PH	100	33.3	83.3	45.4	100*	83.3	66.6
Labour supply	LS	100	100*	83.3	61.9	80	73.6	66.6
Nearness to the market	NM	100	100*	83.3	80.9	80	83.3	80.9
Nearness to raw material	NR	100	100*	66.7	57.1	53.3	55.5	57.1
Transportation facilities	TF	66.7	66.7*	83.3*	61.9	80*	72.2*	76.2*
Water supply	WS	100	100*	100*	83.3	93.3	100*	55.5
Power supply	PS	100	50	50	50	50	50	50
Space for expansion	SE	66.7	66.7*	66.7*	62.9	66.7*	94.4*	78.9*
Impact on community	IC	40	20	20	31.8	20	27.3	44.4*
Social responsibility	SR	20	10	10	30*	10	54.4*	17.8
Taxation	TX	100	100*	75	92.8	100*	100*	85.7
Suitable land and cost	SL	33	50*	50*	50*	50*	66.6*	57.1*
Manpower	MP	75	75*	50	46.4	75*	95.8*	71.4
Equipment and machinery	EM	83.3	83.3*	70	67.5	83.3*	72.2	66.7
Market behaviour	MB	80	80*	80*	74.2	80*	76.6	74.3
Finance	FN	88.3	88.3*	50	62.9	88.3*	84.6	38.4
Maintenance	MT	100	100*	83.3	56	100*	94.7	48.3
Government policies	GP	100	100*	75	64.2	100*	100*	100*
Climatic condition	CC	100	50	30	42.1	50	58	60.5

The budgeting results show that in Ekiti State, upgrading of the present erring facilities can be done in three years from the present status (Table 3). The corresponding three-period moving budget (using a discounted factor of 0.5) for upgrading the defective facilities in Ekiti State to the benchmark has shown that $ 13 million (USD) will be adequate for the purpose without any deficit (Table 4).

Table 3: Dynamically Motivated Control Upgrading for Ekiti State

n	*Code*	*Bench mark %*	*Periodic upgrading, $g(Y_n^{tk})$ of influencing factor at t_k with discount factor j = 0.5*					**Periodic errors, e_k in upgrading, Y_n^{tk} to the benchmark, X_n.**				
		P_c/X_n	Q_i/t_o	t_1	t_2	t_3	t_4	e_o	e_1	e_2	e_3	e_4
1	PH	100	33.3	49.9	74.9	100	-	66.7	50.1	25.1	0	-
2	LS	100	100*	-	-	-	-	-	-	-	-	-
3	NM	100	100*	-	-	-	-	-	-	-	-	-
4	NR	100	100*	-	-	-	-	-	-	-	-	-
5	TF	66.7	66.7*	-	-	-	-	-	-	-	-	-
6	WS	100	100*	-	-	-	-	-	-	-	-	-
7	PS	100	50	75	100	-	-	50	25	0	-	-
8	SE	66.7	66.7*	-	-	-	-	-	-	-	-	-
9	IC	40	20	30	40	-	-	20	10	0	-	-
10	SR	20	10	15	20	-	-	10	5	0	-	-
11	TX	100	100*	-	-	-	-	-	-	-	-	-
12	SL	33	50*	-	-	-	-	-	-	-	-	-
13	MP	75	75*	-	-	-	-	-	-	-	-	-
14	EM	83.3	83.3*	-	-	-	-	-	-	-	-	-
15	MB	80	80*	-	-	-	-	-	-	-	-	-
16	FN	88.3	88.3*	-	-	-	-	-	-	-	-	-
17	MT	100	100*	-	-	-	-	-	-	-	-	-
18	GP	100	100*	-	-	-	-	-	-	-	-	-
19	CC	100	50	75	100	-	-	50	25	0	-	-

Table 4: Dynamically Motivated Control Upgrading Budget for Ekiti State

n	*Code*	*Bench mark (in million dollars), X_c*	*Periodic budget, λ^{tk} for upgrading at t_k of influencing factor with discount factor j = 0.5*					**Periodic errors, e_k in budget for upgrading to the benchmark, X_c**				
		X_c/λ^{tn}	t_o	t_1	t_2	t_3	t_4	e_o	e_1	e_2	e_3	e_4
1	PH	2	1	1.5	2	-	-	1	0.5	0	-	-
2	LS	-	-	-	-	-	-	-	-	-	-	-
3	NM	-	-	-	-	-	-	-	-	-	-	-
4	NR	-	-	-	-	-	-	-	-	-	-	-
5	TF	-	-	-	-	-	-	-	-	-	-	-
6	WS	-	-	-	-	-	-	-	-	-	-	-
7	PS	5	2.3	3.5	5	-	-	2.7	1.5	0	-	-
8	SE	-	-	-	-	-	-	-	-	-	-	-
9	IC	2	0.9	1.35	2	-	-	1.1	0.65	0	-	-
10	SR	1	0.5	0.75	1	-	-	0.5	0.25	0	-	-
11	TX	-	-	-	-	-	-	-	-	-	-	-
12	SL	-	-	-	-	-	-	-	-	-	-	-
13	MP	-	-	-	-	-	-	-	-	-	-	-
14	EM	-	-	-	-	-	-	-	-	-	-	-
15	MB	-	-	-	-	-	-	-	-	-	-	-
16	FN	-	-	-	-	-	-	-	-	-	-	-
17	MT	-	-	-	-	-	-	-	-	-	-	-
18	GP	-	-	-	-	-	-	-	-	-	-	-
19	CC	3	1.4	2.1	3	-	-	1.6	0.9	0	-	-
$\Sigma X_c/\lambda^{tn}$		13	6.1	9.2	13							

4. Conclusion

The study has presented, analyzed and interpreted the constructional locations of Nigeria industries through the administration of questionnaire. A graph of benchmark (minimum standard) was established and used to compare the criteria results of industries located in the selected States. The results obtained, when the data collected from six States of the South-Western Nigeria namely Ekiti, Osun, Lagos, Oyo, Ogun and Ondo were analysed, showed that none of the industries in focus can survive reasonably well in the present state except with proper upgrading of some facilities (in some cases), which include roads, labour, market, raw material, power supply, water supply, equipment and machinery and government policy. Meanwhile, the worse industrial performance in all States came from epileptic nature of electric power supply, which is less than 50% of the established benchmark. Good transportation facilities enjoyed by various industrial sectors enhanced better performance in many States investigated, but Lagos State was having a transportation bottleneck more than 5% of its benchmark. However, upgrading of the present facilities in term of proper funding, for example in Ekiti, has shown that $ 13 million (USD) will be adequate for dynamic development of the erring criteria in three years without any deficit.

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