Industrial Engineering Letters
ISSN 2224-6096 (Paper) ISSN 2225-0581 (online)
Vol.5, No.1, 2015

Prediction of Profit Lost to Underutilization during Useful Life of Manufacturing Systems

Nwankwojike Bethrand Nduka (Corresponding author)
Department of Mechanical Engineering, Micheal Okpara University of Agriculture, Umudike
P. M. B. 7267, Umuahia
E-mail: *jikeobodo*@gmail.com

Okorie Innocent Iheukwumre
Department of Mechanical Engineering, Micheal Okpara University of Agriculture, Umudike
P. M. B. 7267, Umuahia
E-mail: sumadaz2222@gmail.com

Abstract
Rapluc-Comparator used for predicting and comparing future worth of profit that will be lost to underutilization during the useful life of production equipment and their replacement costs was developed in this study and used to evaluate the equipment replacement potentials of some manufacturing industries in Nigerian. Results obtained showed that 21.52% of the industries investigated (mainly small and medium scale firms) will lose profit worth more than their equipment replacement cost to underutilization at the end of their systems while 35.14% of them will lose profit worth over 50% of their equipment replacement cost. This revealed that capacity planning which amply accounts for both input availability and product demand before design and procurement of production facilities is inadequate in the small and medium scale manufacturing sector of this nation. Hence, the significant effect of unused capacity charges on selling price of products of small firms relative to those of the large ones in Nigeria and incessant liquidation of Nigerian small and medium manufacturing industries due to the inability of the firms to replace their production facilities as at when due because of huge profit lost to underutilization. Rapluc-Comparator is therefore recommended to owner/managers of industries for self-assessment of their potentials for continuous existence and robustness in stiff market competition.
Keywords: Capacity, manufacturing system, profit lost, replacement cost, underutilization

1.0 Introduction

Capacity utilization of manufacturing sector has been a crucial economic issue in developing countries over the years due to the leading position of this sector in promoting productivity, investment, import substitution, export expansion, employment and per capita income of any nation at a faster rate than any other sector (Ogwuma, 1995; Shebeb, 2002). In addition, manufacturing sector provides wider and more efficient linkage among different sectors (Ogwuma, 1995). Capacity utilization is a measure of the extent to which an enterprise or a nation uses its installed productive capacity (Hosen et al, 2011). Technically, capacity utilization is the average ratio of the actual output of a firm to the maximum that could be produced with her existing plant and equipment (Johansson, 1988) while for an economist, it measures the ratio of actual output to the level of output, beyond which the average cost of production begins to rise (Berndt and Morrison, 1981). However, Hosen et al (2011), revealed that even though the typical engineering idea of capacity differs from the economist's definition because what is technically possible may not be economically desirable, time series analysis showed that both views stress the same fact (output versus input) over time. This view of Hosen et al (2011), is correct because with adequate capacity planning which account for optimal production level with respect to input availability and product demand before design and procurement of facilities in a firm, the differences between the available economic and engineering capacities is insignificant. Thus, irrespective of the perspective one is viewing it, capacity utilization remained the ratio of used capacity to the available one. The difference between the used and available capacities is referred as excess or underutilized capacity.

All entrepreneurs/companies desire hundred percent capacity utilization but records showed that none operates at this rate because of downtime due to equipment malfunctions and various other causes (James, 2002; Anwar and Moudud, 2004; Susan and Roger, 2004; Chijioke, 2010). A consistent rate of about 85 percent utilization of installed productive capacity is considered optimal in most industries. Records revealed average capacity utilization rate of United States firms as 79.5%, Japan 83–86%, European Union 82%, Australia 80%, Brazil 60–80%, India 70%, China perhaps 60%, Turkey 79.8%, Canada 87% while that of Nigeria is very low (30 - 40%) despite high demand of manufactured goods in this nation (Anwar and Moudud, 2004; Dauda, 2006; Akindele, 2014). Hence, a lot of wastes of meager production capacities available in this country. This ugly phenomenon is more pronounced in many indigenous owned/managed production firms in Nigeria. Thus, the ever increasing rate of liquidation of small and medium scale industries as well as many indigenous large scale production firms in this country despite several policy initiatives and resources government is injecting in this

sector to facilitate the process of industrialization in the country. Many attributed this national menace to lack of technological know-how, shortfall in utility and inadequate government policies (Ukoha, 2000; Olorunsola, 2002; Dauda, 2006; Akindele, 2014). However, Chijioke (2010), revealed the inability of the liquidated firms to replace their production equipment/machineries after their useful life as the major cause of the high rate of their liquidation. This work stressed that Nigerian entrepreneurs are not sensitive to the adverse effect of huge profit they sacrifice daily to underutilized capacities on the stability and continuous existence of their firms in a stiff market competitive condition. Chijioke (2010), then recommended that this attitude must be controlled before other measures toward sustainable manufacturing sector will yield the desired result in this country. Therefore, it is economically necessary to develop a model that will be used in predicting and comparing the total profit that will be lost to unused capacity of any manufacturing system after its salvage period with its replacement cost at any given time and production rate. Comparison of these two parameters is necessary to enable operators of manufacturing systems know the ratio of the money required for their system replacement which will be lost due to excess or unused capacity. In other words the prediction and comparison of the two parameters is a measurement of the monetary worth of unused systems capacities relative to their replacement costs and will be a tool for forecasting equipment replacement potentials of industries at any given production rate and time. Although, many model and approaches for capacity utilization measurement have being developed and used over the years by Rasche and Tatom (1977), Berndt and Morrison (1981), Corrado and Mattey (1997), Omer (1998), Kim (1999), Anwar and Moudud (2004), Ray and Kankana (2005) and Hosen et al (2011) and many others, none of the tools developed/used in previous works quantified the losses associated with underutilized capacity of a system relative to its replacement cost. This is why atimes it is difficult to relate the losses to a tangible quantity which the investors in this sector will understand. Thus, the objective of this study is to develop a prediction tool that will used in evaluating the total profit that will be lost to underutilization during the useful life of manufacturing systems.

2.0 Model Development and Evaluation Procedure

The model of the profit lost to underutilization of a production system during its salvage period was derived from basic economic/mathematical concept which expresses profit, P_f as the difference between total sales, SP and production cost, CP (Equation 1).

$$P_f = SP - CP \quad (1)$$

Production cost is the total cost of materials, wages, depreciation and other production disbursements such as transportation cost, selling cost, maintenance cost etc. Therefore, profit per unit product, P_u constitutes the difference between the selling price per unit, S and production cost per unit (Equation 2);

$$P_u = S - \left(\frac{M+W+D+O}{A}\right) \quad (2)$$

Where M, W, D and O constitutes annual cost of raw materials, wages, depreciation and other disbursements respectively while A is the actual production rate of the system in any given year. Annual depreciation which measures the cost of deterioration in the value of a production system or the cost of having the system during any year under review was determined using straight depreciation method given by Onwualu et al (2002) as;

$$D = \frac{(Z-F)}{N} \quad (3)$$

Where Z, F and N are the initial cost, salvage value and salvage period of the system respectively. Initial cost constitutes total amount spent in the procurement, installation and commissioning of the production equipment/system. The total profit lost due to unused capacity of a manufacturing system in any year, P_L is the product of the profit per unit item sold and number of items that should have been produced but are not because the system is not fully utilized (underutilized capacity). Recall underutilized capacity of any system is the difference between its installed and actual production rate. Thus, the total profit lost to unused capacity of a manufacturing system in any given year is expressed mathematically as follows;

$$P_L = P_u(C - A) \quad (4)$$

Where C is the installed capacity of the systems per year, which is the number of products the system was installed to produce in a year. Hence, the future worth of the total profit lost, P to unused capacity at the end of the salvage period of any production equipment was determined from Equation (4) using compound interest approach;

$$P = P_L(1+i)^{\mathrm{N}} \quad (5)$$

Where i is the interest rate prevailing in the economy. Substituting Equations (2), (3) and (4) into Equation (5) gives the future worth of the profit lost to underutilization during the salvage period of any production system as;

$$P = \left(S - \frac{N[M+W+O]+[F-Z]}{AN}\right)(C-A)(1+i)^{\mathrm{N}} \quad (6)$$

Equation (6) is suitable for prediction when the annual production rate, selling price, cost of raw materials, wages, depreciation and other production disbursements remained constant over the salvage period of the manufacturing system. However, this is rarely possible in practice, in order to reduce the effect of variations in

the values of these parameters over the productive life span of the system, their mean values for a given test period (k > 1year) should be used for the prediction instead of production data of one year. Hence, accounting for the fluctuation in these production parameters from year to year gives the future worth of the profit that will be lost to underutilization of any production system as;

$$P = \frac{1}{k}\sum_{k=1}^{k}\left(S - \frac{N[M+W+O]+[F-Z]}{AN}\right)(C-A)(1+i)^{\mathrm{N}} \quad (7)$$

The future worth of the replacement cost, R of a production system at the end of it salvage period was deduced from capital recovery model of Onwualu et al (2002) as;

$$R = Z(1+i)^{\mathrm{N}} - F \quad (8)$$

Therefore, the percentage ratio, T of the profit lost to underutilization of a manufacturing system to its replacement cost was determined as;

$$\mathrm{T} = \frac{100[1+i]^{N}}{kZ[1+i]^{N} - kF}\sum_{k=1}^{k}\left[\left(S - \frac{N[M+W+O]+[F-Z]}{AN}\right)(C-A)\right] \quad (9)$$

In order to sidestep lengthy and error-prone manual computations in the use of these models (Equation 7, 8 and 9) and to make their application user friendly, an easy to comprehend object oriented C# dot net. program, *Rapluc Comparator* was also developed for their implementation. This software was designed with an embedded installation set up that installs all its pre-requisite files including the .chm help files offline as a single install pack. System configuration required for this software includes Windows 2000 or higher; 512MB of RAM; 800MB of free disk space; 1024x768 screen resolution or higher and Microsoft.NET framework version 4.0 (64or 32 bits). Its installation involves double clicking on the CD/DVD drive icon on "My Computer" to open the software CD named "*Rapluc Comparator*" before a double click on the folder named "*Rapluc Comparator setup"* to run the setup file inside the folder following the prompts to install the software.

Launching of Rapluc Comparator after its installation requires a double click on its HelpNDoc 3 shortcut icon on the desktop (Fig. 1) or click the same on the window start menu to feature the command window of the software (Fig. 2). The command window serves as the main program interface by which operations are performed using its main menu and tool bar. The main menu (Fig. 3) has three major options- "FILE", "VIEW" and "HELP". A click on the "FILE" menu displays five different sub-options, "New", "Existing", "Export to Excel", "Print" and "Exit". A click on "New" opens a window (Fig. 2) for creating a new test record; type in your data in the appropriate text boxes as per each test period or year before a click on "save" to save the inputs and thereafter click on "calculate" to generate the predicted values of P, R and T which will be displayed under the "Result" section of the window (Fig. 4).The "Existing" option is used to display the tests sidebar if it is not visible. The side bar shows the list of all the previous tests saved in this program. The "Export to Excel" option allows for exportation of table of data (inputs and predictions) from this application to Microsoft Excel while "Print" is used for printing of works performed directly. "Exit" closes the application. The "VIEW" menu is used to display and hide the Toolbar, Parameter definition and Tests sidebar. The "Toolbar" gives quick access to useful functions like New, Existing, Save, Export, Print, Show all data, Data Summary and Help. "Show all data" button shows the parameters values during all experimental periods for all tests recorded with the predicted values of P, R and T while "Data Summary" button shows a table of data for all saved tests (Fig. 5). The "HELP" menu shows two options; "About" and "Help". The "Help" shows the help file while "About" displays information about the software.

The production data used in the assessment of profit lost to underutilization with this software were obtained using questionnaire approach complemented with physical verification of the data through field visits to thirty-seven manufacturing firms in Nigeria between May and December, 2013. The questionnaire was structured so as to assess all the parameters of the models while the interest rate used in this study is the prevailing mean interest rate of 14.9% in Nigeria during this period.

Fig. 1: Rapluc Comparators HelpNDoc 3 shortcut on the desktop

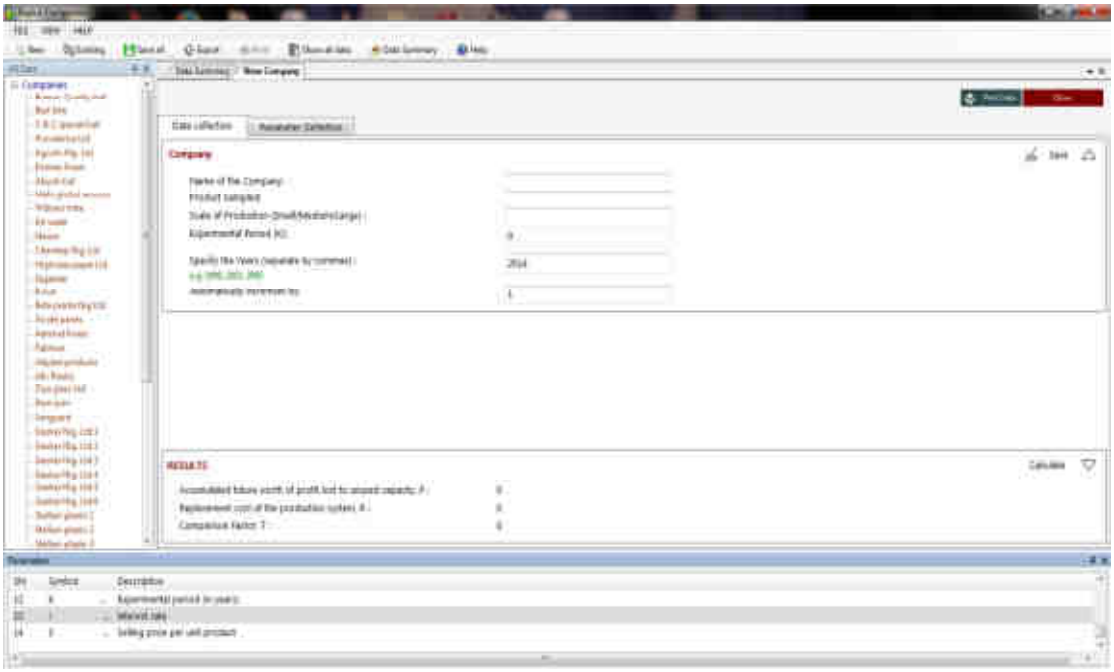

Fig. 2: Command window of Rapluc Comparator

Fig. 3: Main menu and Toolbar options of the Rapluc Comparator

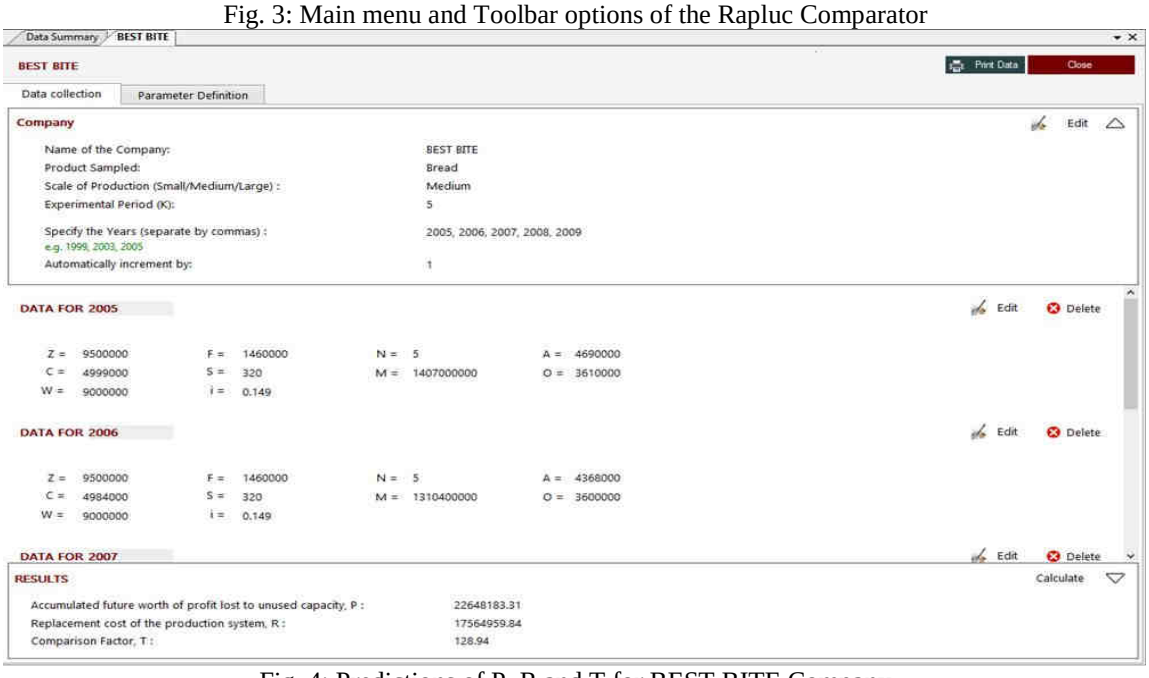

Fig. 4: Predictions of P, R and T for BEST BITE Company

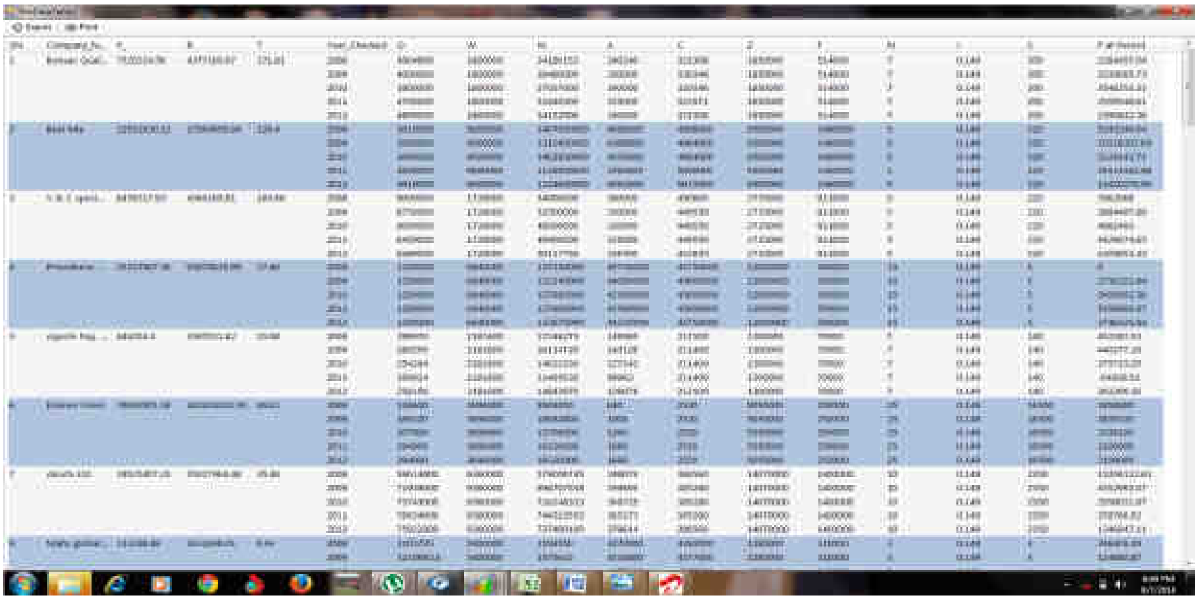

Fig. 5: Summary of inputs and predictions generated by the Rapluc Comparator

3.0 Result and Discussion

The Rapluc-Comparator predictions of the profit lost to underutilization, replacement cost and the comparative ratio of these two parameters made from the production data of the thirty-seven Nigerian manufacturing companies investigated are shown in Table 1. This table shows that 21.52% of the industries will lose profit worth more than their equipment replacement cost to underutilization at the end of their systems' useful life while 35. 14% of them will lose profit worth over 50% of their equipment replacement cost. This revealed that capacity planning which amply accounts for both input availability and product demand before design/procurement of production equipment is lacking in the small and medium scale manufacturing sector of this nation. Hence, the high cost of goods from these sectors relative to large scale sector resulting from shifting the cost of unused capacity to consumers, thereby placing the firms in a tight corner in a prevailing competitive economy. The results also revealed high rate of liquidation of manufacturing industries in this nation as a result of the inability of the firms to replace their production facilities as and when due because of huge profit lost to underutilization during the useful life of their facilities.

Table 1: Comparative Analysis of the Profit Lost to Underutilization and Replacement Costs of Production Systems

1	Company_Name	P_(₦)	R(₦)	I(%)	Year (k=5)	O(₦)	W(₦)	M(₦)	A(units)	C(units)	Z(₦)	L(₦)	N(years)	i(%)	S(₦)	P/year(₦)
2	Bonsac Quality Loaf	7581024.56	4377160.67	173.18	2008	4805000	1800000	34186152	240240	321.106	1850000	514000	7	0.145	300	3365455.08
3	326 Obohia Road Aba				2009	4000000	1800000	29950000	210000	321.105	1850000	514000	7	0.145	300	3179065.71
4					2010	3800000	1800000	27013000	190000	321.105	1850000	514000	7	0.145	300	3540251.01
5					2011	4700000	1800000	33440500	235000	322.571	1850000	514000	7	0.145	300	3595046.61
6					2012	4800000	1800000	34152000	240000	321.106	1850000	514000	7	0.145	300	3350692.36
7	Best Bite Foods Ltd	22552930.12	17556795.84	128.4	2008	3610000	9000000	1402000000	4650000	4972000	7500000	1050000	5	0.145	320	5240270.04
8	Port-harcourt, Rivers				2009	3600000	9000000	1310400000	4360000	4960000	7500000	1050000	5	0.145	320	10115307.89
9	State				2010	3600000	9000000	1402800000	4670000	4990000	7500000	1050000	5	0.145	320	5290111.71
10					2011	3600000	9000000	1120000000	3750000	5000000	7500000	1050000	5	0.145	320	30114302.58
11					2012	3610000	9000000	1224500000	4082000	5015000	7500000	1050000	5	0.145	320	15410230.75
12	V & C Special Loaf	6140137.48	4566105.01	165.66	2008	5800000	1728000	54000000	360000	451500	7735000	511000	5	0.145	220	3562058
13	God's Favor Avenue				2009	5250000	1728000	52500000	350000	449550	7735000	511000	5	0.145	220	3869413.02
14	Old Umuahia				2010	4800000	1728000	48000000	320000	449550	7735000	511000	5	0.145	220	4582493
15					2011	4950000	1728000	49500000	325000	449550	7735000	511000	5	0.145	220	4424024.65
16					2012	4950000	1728000	50117250	325500	452725	7735000	511000	5	0.145	220	4329651.42
17	Providence Ventures	26172580.35	95048035.09	27.45	2008	1200000	6900000	1372500000	45750000	45750000	1300000	300000	15	0.145	5	0
18	Nig. Limited				2009	1200000	6900000	1372400000	44080000	45580000	1300000	300000	15	0.145	5	7746121.08
19	18 Oyama street,				2010	1200000	6900000	1276800000	42560000	45580000	1300000	300000	15	0.145	5	5450762.36
20	Calabar				2011	1200000	6900000	1276800000	42560000	45580000	1300000	300000	15	0.145	5	5456666.67
21					2012	1200000	6900000	1326750000	44225000	45750000	1300000	300000	15	0.145	5	7746121.08
22	Agachi Nig. Ltd	844154.3	3367001.02	25.08	2008	272570	2181600	17980725	147265	212100	1300000	20000	7	0.145	140	452083.51
23	Aba Bye-pass, Mile 1				2009	280255	2181600	18114720	140138	211400	1300000	20000	7	0.145	140	340277.18
24	Port-harcourt				2010	254384	2181600	14621330	127142	211400	1300000	20000	7	0.145	140	375721.35
25					2011	179724	2181600	11495830	97962	211400	1300000	20000	7	0.145	140	640850.51
26					2012	250155	2181600	14083770	125078	212100	1300000	20000	7	0.145	140	370275.16
27	Lumes Foam	7990501.56	16241424.5	48.61	2008	138800	3698000	8384000	690	7520	3050000	750000	25	0.145	16500	1650000
28	Umuagwu Village,				2009	156120	3698000	10694800	1018	7520	3050000	750000	25	0.145	16500	2625000
29	Osisioma LGA Aba				2010	202500	3698000	13366000	1260	7520	3050000	750000	25	0.145	16500	3136000
30					2011	225000	3698000	15120000	1800	7520	3050000	750000	25	0.145	16500	2105000
31					2012	225000	3698000	15120000	1800	7520	3050000	750000	25	0.145	16500	2105000

32	Akuchi FoodMill	19525407.33	55027964.48	35.48	2008	59614800	9360000	579008745	298074	386360	14070000	1400000	10	0.149	2350	15206122.61
33	Company				2009	71939000	9360000	698707538	359695	385280	14070000	1400000	10	0.149	2350	4532992.07
34	Rumuokoro, Port				2010	73745000	9360000	716248313	368725	385280	14070000	1400000	10	0.149	2350	2958031.87
35	Harcourt				2011	76634600	9360000	744313353	383173	385280	14070000	1400000	10	0.149	2350	378766.52
36					2012	75922800	9360000	737400195	379614	386360	14070000	1400000	10	0.149	2350	1246847.11
37	Moto Global Services	113188.88	1631646.01	6.94	2008	1103795	5400000	1558530	4270000	4392000	1280000	310000	3	0.149	4	248409.19
38	Limited				2009	1115892.8	5400000	1575632	4316800	4377600	1280000	310000	3	0.149	4	124680.87
39	Km 2 Umuahia				2010	1131609.6	5400000	1597824	4377600	4377600	1280000	310000	3	0.149	4	0
40	Okigwe Expressway				2011	1131609.6	5400000	1597824	4377600	4377600	1280000	310000	3	0.149	4	0
41					2012	1135832	5400000	1603680	4392000	4392000	1280000	310000	3	0.149	4	0
42	WidowsMite Bakeries	621514.84	3742384.83	16.61	2008	1636800	9120000	52371200	327320	367400	1850000	514000	6	0.149	210	659600
43	20 Timber market				2009	1665000	9120000	53280000	333000	366300	1850000	514000	6	0.149	210	564233.33
44	Road Abak, Awka Ibom				2010	1831500	9120000	58608000	366300	366300	1850000	514000	6	0.149	210	0
45					2011	1798200	9120000	57542400	359640	366300	1850000	514000	6	0.149	210	126687.63
46					2012	1837000	9120000	58784000	367400	367400	1850000	514000	6	0.149	210	0
47	AV Table water	2664381.27	461257.05	577.63	2008	1683600	6000000	6002400	7320000	9607500	370000	100000	3	0.149	4	4845000
48	Company Limited				2009	2055648	6000000	7328832	8937600	9576000	370000	100000	3	0.149	4	1448280
49	6 Oboro street				2010	2055648	6000000	7328832	8937600	9576000	370000	100000	3	0.149	4	1448280
50	Umuahia				2011	2097600	6000000	7478400	9120000	9576000	370000	100000	3	0.149	4	1040700
51					2012	2104500	6000000	7503000	9150000	9150000	370000	100000	3	0.149	4	0
52	Nason Bottle Water	3100990.12	18336899.86	16.91	2008	1932480	5400000	37068480	2196000	2928000	14600000	3810000	3	0.149	25	2300791.11
53	Km 6 Aba Umuahia				2009	2054553.6	5400000	39410073.6	2334720	2918400	14600000	3810000	3	0.149	25	1976076.53
54	Expressway				2010	2054553.6	5400000	39410073.6	2334720	2918400	14600000	3810000	3	0.149	25	1976076.53
55					2011	2054553.6	5400000	39410073.6	2334720	2918400	14600000	3810000	3	0.149	25	1976076.53
56					2012	2061312	5400000	39539712	2342400	2928000	14600000	3810000	3	0.149	25	1990577.33
57	Chemlap Nig. Ltd	9726410849	12896222232	75.42	2008	6513576	120000000	3236788000	10835960	15399918	200000000	5000000	30	0.149	350	179072149.9
58	Osisioma LGA Aba				2009	7537629	120000000	3768814500	12562715	15338501	200000000	5000000	30	0.149	350	117039198.3
59					2010	6487932	120000000	3243966000	10813220	15338501	200000000	5000000	30	0.149	350	178149506.1
60					2011	6487932	120000000	3243966000	10813220	15338501	200000000	5000000	30	0.149	350	178149506.1
61					2012	75671172	120000000	3783558600	12611862	15399918	200000000	5000000	30	0.149	350	101503545.8
62	Highclass paper	4259463.97	6046300.28	70.45	2008	1801800	2760000	131040000	1092000	1122000	1550000	170000	10	0.149	150	770884.62
63	Conversion Industries				2009	1785960	2760000	129888000	1082400	1118000	1550000	170000	10	0.149	150	913945.14
64	faulks road,Aba				2010	1742400	2760000	126720000	1056000	1118000	1550000	170000	10	0.149	150	1587552.27
65					2011	1782990	2760000	129672000	1080000	1118000	1550000	170000	10	0.149	150	939989.06
66					2012	1782000	2760000	129600000	1080000	1122000	1550000	170000	10	0.149	150	1078000
67	Eaglestar Plastic Ltd	3009851.39	23938706.32	12.57	2008	2844800	22500000	33608000	406400	406400	10000000	2500000	7	0.149	200	0
68	Osisioma LGA Aba				2009	2479400	22500000	33649000	354200	404800	10000000	2500000	7	0.149	200	1591453.06
69					2010	2479400	22500000	33649000	354200	404800	10000000	2500000	7	0.149	200	1591453.06
70					2011	2479400	22500000	33649000	354200	404800	10000000	2500000	7	0.149	200	1591453.06
71					2012	2667000	22500000	36195000	381000	406400	10000000	2500000	7	0.149	200	917771.43
72	B-Lux Integrated	1296085.05	1652364.62	78.47	2008	676000	1800000	6760000	6760	8528	900000	150000	5	0.149	2000	1081200
73	Ind. Nig. Limited				2009	780000	1800000	7800000	7800	8528	900000	150000	5	0.149	2000	473200
74	Umuahia Aba Express				2010	790400	1800000	7904000	7904	8528	900000	150000	5	0.149	2000	407652.63
75	Road, Abia State				2011	696800	1800000	6968000	6968	8528	900000	150000	5	0.149	2000	967432.84
76					2012	806000	1800000	8060000	8060	8528	900000	150000	5	0.149	2000	307974.19
77	Beta Paint Nig Ltd	324571.16	2841324.48	11.42	2008	2857500	7260000	11620500	38100	38100	1300000	150000	6	0.149	650	0
78	Ubakala, Umuahia				2009	2656500	7260000	10803100	35420	37950	1300000	150000	6	0.149	650	130838.1
79	Abia State				2010	2561625	7260000	10417275	34155	37950	1300000	150000	6	0.149	650	196087.04
80					2011	2561625	7260000	10417275	34155	37950	1300000	150000	6	0.149	650	196087.04
81					2012	2561625	7260000	10845800	35500	38100	1300000	150000	6	0.149	650	161064.88
82	Vicote Chemical Ind.	1606296.27	1952627.35	82.26	2008	1064000	2400000	25840000	15200	30400	1000000	50000	5	0.149	2000	906000
83	Limited				2009	1696800	2400000	41208000	24240	30300	1000000	50000	5	0.149	2000	740300
84	23 Old Aba Road,off				2010	1908900	2400000	40839000	27270	30300	1000000	50000	5	0.149	2000	409122.22
85	Woji, Port Harcourt				2011	1590750	2400000	38632500	22725	30300	1000000	50000	5	0.149	2000	878916.67
86					2012	1276800	2400000	31008000	18240	30400	1000000	50000	5	0.149	2000	1070133.33
87	Admiral Paints Ltd	271144.41	1080509.41	25.09	2008	0	3000000	5398160	19304	20320	500000	70000	6	0.149	600	121714.39
88	Bridge Plank, First				2009	0	3000000	5429380	18722	20240	500000	70000	6	0.149	600	172877.3
89	Bridge Busstop				2010	0	3000000	5429380	18722	20240	500000	70000	6	0.149	600	172877.3
90	Abeokuta way				2011	0	3000000	5869600	20240	20240	500000	70000	6	0.149	600	0
91	Lagos				2012	0	3000000	5398160	19304	20320	500000	70000	6	0.149	600	121714.39
92	Fabman Nig. Ltd	9385249.86	6668403.54	140.74	2008	6100000	3000000	49288000	2440000	2440000	1750000	350000	10	0.149	30	0
93	Aba Owerri Road				2009	5700000	3000000	46056000	2280000	2482000	1750000	350000	10	0.149	30	3900266.67
94	Aba				2010	5700000	3000000	46056000	2280000	2482000	1750000	350000	10	0.149	30	3900266.67
95					2011	5700000	3000000	46056000	2280000	2482000	1750000	350000	10	0.149	30	3900266.67
96					2012	6100000	3000000	49288000	2440000	2440000	1750000	350000	10	0.149	30	0
97	Abplast Products Plc	14261831.43	80215384.36	17.78	2008	11459400	30720000	81810000	654480	634480	2050000	200000	10	0.149	400	0
98	Block 6, Flat 12,ISDPC				2009	11415600	30720000	81540000	652320	632320	2050000	200000	10	0.149	400	0
99	Shopping Centre,12				2010	11415600	30720000	81540000	652320	632320	2050000	200000	10	0.149	400	0
100	Industrial Avenue,				2011	10654500	30720000	76104000	608832	632320	2050000	200000	10	0.149	400	8871731.43
101	Ilupeju, Lagos.				2012	10689840	30720000	76356000	610848	634480	2050000	200000	10	0.149	400	8908811.43
102	Afri Plastics Plc	3939332.02	85731358.82	4.6	2008	4581360	31200000	163620000	327240	327240	2200000	250000	10	0.149	850	0
103	Industrial Avenue,				2009	4481680	31200000	160060000	320120	326160	2200000	250000	10	0.149	850	1403908.3
104	Ilupeju, Lagos.				2010	4481680	31200000	160060000	326160	326160	2200000	250000	10	0.149	850	0
105					2011	4439400	31200000	158556000	317100	326160	2200000	250000	10	0.149	850	2096845.71
106					2012	4496320	31200000	160590000	321180	327240	2200000	250000	10	0.149	850	1410688.3
107	Rem Jom	20510979.96	19952281.53	102.8	2008	29370000	3000000	122375000	97900	124000	500000	100000	10	0.149	1800	3539545.43
108	3/5 Umuaduru				2009	30352500	3000000	120468750	101175	124250	500000	100000	10	0.149	1800	4835942.98
109	Road Osisioma,Aba				2010	30352500	3000000	120468750	101175	124250	500000	100000	10	0.149	1800	4835942.98
110					2011	27690000	3000000	113375000	92300	124250	500000	100000	10	0.149	1800	6571730.77
111					2012	32040000	3000000	133500000	106800	124000	500000	100000	10	0.149	1800	3768333.33
112	Geoker Nig. Ltd	12762334.87	38311534.36	33.31	2008	1175300	21516000	881475	2876500	7665000	4800000	240000	15	0.149	6	3464155.43
113	448/450 Oshodi				2009	1292100	21516000	9690750	6460500	7665000	4800000	240000	15	0.149	6	1111214.41
114	Apapa Expressway				2010	1233700	21516000	9252750	6168500	7665000	4800000	240000	15	0.149	6	1141340.53
115	Lagos				2011	1255600	21516000	9417000	6278000	7665000	4800000	240000	15	0.149	6	1143402.33
116	Factory 1				2012	1189900	21516000	8924250	5948500	7665000	4800000	240000	15	0.149	6	1084593.56

117	Geoker Nig. Ltd	9185239.17	15642065.24	58.72	2008	1200485	28200000	15638500	5219500	6570000	4000000	400000	10	0.149	10	1753234.65
118	Factory 2				2009	1099745	28200000	14344500	4781500	6570000	4000000	400000	10	0.149	10	1425390.91
119					2010	1166905	28200000	15220500	5073500	6570000	4000000	400000	10	0.149	10	1707132.34
120					2011	1141720	28200000	14892000	4964000	6570000	4000000	400000	10	0.149	10	1632620
121					2012	1133325	28200000	4782500	4927500	6570000	4000000	400000	10	0.149	10	4933058.33
122	Geoker Nig. Ltd	0	63389293.58	0	2008	7949760	5460000	67572960	39748800	39748800	18000000	3800000	10	0.149	10	0
123	Factory 3				2009	7927920	5460000	67387320	39639600	39639600	18000000	3800000	10	0.149	10	0
124					2010	7927920	5460000	67387320	39639600	39639600	180000000	3800000	10	0.149	10	0
125					2011	7927920	5460000	67387320	39639600	39639600	18000000	3800000	10	0.149	10	0
126					2012	7949760	5460000	67572960	39748800	39748800	18000000	3800000	10	0.149	10	0
127	Geoker Nig. Ltd	11760340.93	32434784.6	36.26	2008	3203200	3060000	190190000	400400	436800	11500000	2500000	8	0.149	600	3878345.45
128	Factory 4				2009	3194400	3060000	189667500	399300	435600	11500000	2500000	8	0.149	600	3806045.45
129					2010	3194400	3060000	189667500	399300	435600	11500000	2500000	8	0.149	600	3806045.45
130					2011	3194400	3060000	189667500	399300	435600	11500000	2500000	8	0.149	600	3806045.45
131					2012	3203200	3060000	190190000	400400	436800	11500000	2500000	8	0.149	600	3878345.45
132	Stallion plastic Ind.	5153016.51	46565683.79	11.07	2008	7927920	1800000	56996380	1441440	1513512	25000000	3500000	5	0.149	85	2577880
133	Ijeshatedo/Cele				2009	7906140	1800000	56780460	1437480	1509354	25000000	3500000	5	0.149	85	2569900
134	Busstop, Apapa				2010	7906140	1800000	56780460	1437480	1509354	25000000	3500000	5	0.149	85	2569900
135	Oshodi Expressway				2011	7906140	1800000	56780460	1437480	1509354	25000000	3500000	5	0.149	85	2569900
136	Factory 1				2012	7927920	1800000	56996380	1441440	1513512	25000000	3500000	5	0.149	85	2577880
137	Stallion plastic Ind.	5131923.9	46565683.79	11.02	2008	6342336	1836000	48778329.6	1153152	1305304	25000000	3500000	5	0.149	70	2508163.29
138	Ijeshatedo/Cele				2009	6324912	1836000	48644323.2	1149984	1301718	25000000	3500000	5	0.149	70	2538883.69
139	Busstop, Apapa				2010	6324912	1836000	48644323.2	1149984	1301718	25000000	3500000	5	0.149	70	2538883.69
140	Oshodi Expressway				2011	6324912	1836000	48644323.2	1149984	1301718	25000000	3500000	5	0.149	70	2538883.69
141	Factory 2				2012	6342336	1836000	48778329.6	1153152	1305304	25000000	3500000	5	0.149	70	2508163.29
142	Stallion plastic Ind.	2701559.43	46565683.79	5.8	2008	810409.6	1836000	14358344	890896	1921920	25000000	3500000	5	0.149	23.33	484479.91
143	Ijeshatedo/Cele				2009	808183.2	1836000	14318898	1756920	1916640	25000000	3500000	5	0.149	23.33	1793260.22
144	Busstop, Apapa				2010	808183.2	1836000	14318898	1756920	1916640	25000000	3500000	5	0.149	23.33	1793260.22
145	Oshodi Expressway				2011	808183.2	1836000	14318898	1756920	1916640	25000000	3500000	5	0.149	23.33	1793260.22
146	Factory 3				2012	810409.6	1836000	14358344	1761760	1921920	25000000	3500000	5	0.149	23.33	1799737.02
147	Stallion plastic Ind.	4115900.83	46565683.79	8.84	2008	4295491.2	1836000	73993920	960960	1025024	25000000	3500000	5	0.149	120	2059319.25
148	Ijeshatedo/Cele				2009	4283690.4	1836000	73790640	958320	1022208	25000000	3500000	5	0.149	120	2052537.97
149	Busstop, Apapa				2010	4283690.4	1836000	73790640	958320	1022208	25000000	3500000	5	0.149	120	2052537.97
150	Oshodi Expressway				2011	4283690.4	1836000	73790640	958320	1022208	25000000	3500000	5	0.149	120	2052537.97
151	Factory 4				2012	4295491.2	1836000	73993920	960960	1025024	25000000	3500000	5	0.149	120	2059319.25
152	Stallion plastic Ind.	13427897.56	46565683.79	28.84	2008	3523520	1836000	92892800	640640	752752	25000000	3500000	5	0.149	220	6717984
153	Ijeshatedo/Cele				2009	3513840	1836000	92637600	638880	750684	25000000	3500000	5	0.149	220	6690578
154	Busstop, Apapa				2010	3513840	1836000	92637600	638880	750684	25000000	3500000	5	0.149	220	6690578
155	Oshodi Expressway				2011	3513840	1836000	92637600	638880	750684	25000000	3500000	5	0.149	220	6690578
156	Factory 5				2012	3523520	1836000	92892800	640640	752752	25000000	3500000	5	0.149	220	6717984
157	Stallion plastic Ind.	16515146.99	46565683.79	35.47	2008	3127124	1836000	50829979.2	568568	720720	25000000	3500000	5	0.149	160	8263067.03
158	Ijeshatedo/Cele				2009	3118533	1836000	50690336.4	567006	718740	25000000	3500000	5	0.149	160	8235855.23
159	Busstop, Apapa				2010	3118533	1836000	50690336.4	567006	718740	25000000	3500000	5	0.142	160	8235855.23
160	Oshodi Expressway				2011	3118533	1836000	50690336.4	567006	718740	25000000	3500000	5	0.149	160	8235855.23
161	Factory 6				2012	3127124	1836000	50829979.2	568568	720720	25000000	3500000	5	0.149	160	8263067.03
162	Stallion plastic Ind.	15748091.15	49715683.79	31.68	2008	3523520	1836000	25625600	640640	816816	25000000	3500000	5	0.149	100	7914192
163	Ijeshatedo/Cele				2009	3513840	1836000	25555200	638880	814572	25000000	3500000	5	0.149	100	7887814
164	Busstop, Apapa				2010	3513840	1836000	25555200	638880	814572	25000000	3500000	5	0.149	100	7887814
165	Oshodi Expressway				2011	3513840	1836000	25555200	638880	814572	25000000	3500000	5	0.149	100	7887814
166	Factory 7				2012	3523520	1836000	25625600	640640	816816	25000000	350000	5	0.149	100	7740942
167	Stallion plastic Ind.	10799156.78	46565683.79	23.19	2008	5285280	1836000	19219200	960960	1153152	25000000	3500000	5	0.149	60	5403424
168	Ijeshatedo/Cele				2009	5270760	1836000	19166400	958320	1149984	25000000	3500000	5	0.149	60	5383208
169	Busstop, Apapa				2010	5270760	1836000	19166400	958320	1149984	25000000	3500000	5	0.149	60	5383208
170	Oshodi Expressway				2011	5270760	1836000	19166400	958320	1149984	25000000	3500000	5	0.149	60	5383208
171	Factory 8				2012	5285280	1836000	19219200	960960	1153152	25000000	3500000	5	0.149	60	5403424
172	Stallion plastic Ind.	14339001.29	46565683.79	30.79	2008	4932928	1836000	22422400	896896	1005064	25000000	3500000	5	0.149	80	7173816
173	Ijeshatedo/Cele				2009	4919376	1836000	22360800	894432	1002138	25000000	3500000	5	0.149	80	7150947
174	Busstop, Apapa				2010	4919376	1836000	22360800	894432	1002138	25000000	3500000	5	0.149	80	7150947
175	Oshodi Expressway				2011	4919376	1836000	22360800	894432	1002138	25000000	3500000	5	0.149	80	7150947
176	Factory 9				2012	4932928	1836000	22422400	896896	1005064	25000000	3500000	5	0.149	80	7173816
177	Sscoap Industry Ltd	313294958.3	152620632.4	205.28	2008	261371088	5837280	330735040	24808800	27632000	40000000	7800000	10	0.149	52.5	78269843.56
178	Plot C83, Amuwo				2009	260538096	5837280	329701680	24739000	27544000	40000000	7800000	10	0.149	52.5	78017371.56
179	Odofin, Industries				2010	260538096	5837280	329701680	24739000	27544000	40000000	7800000	10	0.149	52.5	78017371.56
180	Estate, Oshodi Apapa				2011	260538096	5837280	329701680	24739000	27544000	40000000	7800000	10	0.149	52.5	78017371.56
181	Factory 1				2012	261371088	5837280	330735040	24808800	27632000	40000000	7800000	10	0.149	52.5	78269843.56
182	Sscoap Industry Ltd	393688880	152620632.4	257.95	2008	232329856	5897280	249351168	22105000	27632000	40000000	7800000	10	0.149	40	98356424
183	Plot C83, Amuwo				2009	231589952	5897280	248557056	22035200	27544000	40000000	7800000	10	0.149	40	98035928
184	Odofin, Industries				2010	231589952	5897280	248557056	22035200	27544000	40000000	7800000	10	0.149	40	98035928
185	Estate, Oshodi Apapa				2011	231589952	5897280	248557056	22035200	27544000	40000000	7800000	10	0.149	40	98035928
186	Factory 2				2012	232329856	5897280	249351168	22105000	27632000	40000000	7800000	10	0.149	40	98356424

4.0 Conclusion and Recommendation

Models and their implementation software, Rapluc-Comparator used for evaluating profit that will be lost to underutilization during the useful life of a production system were developed in this study. Analysis of some Nigerian manufacturing industries using this software revealed low capacity utilization rate as one of the major causes of high cost of products of small and medium scale manufacturing firms as well as incessant liquidation of many indigenously owned/managed industries in this country. This is because entrepreneurs at this level are not sensitive to the negative effect of huge profit they sacrifice daily to underutilized capacities on the stability of their firms in a stiff market competition. Rapluc-Comparator is therefore recommended to operators of industries for self-assessment of their potentials for continuous existence and robustness in stiff market competition.

References

Akindele, C. (2014). Capacity Utilization in the manufacturing sector is still very low. Daily Independent Saturday, April 05, 2014

Anwar, S. and Moudud, J. (2004), *Measuring Capacity Utilization in OECD Countries: A Cointegration Method* (2004), Working Paper No. 415. The Jerome Levy Economics Institute of Bard College.

Berndt E. and Morrison J. (1981). Capacity utilization measures: Underlying Economic Theory and an Alternative Approach", American Economic Review, 71, (2007), pp. 48–52

Chijioke (2010). Evaluation of the Effect of Capacity Utilization on Replacement Potentials of Nigerian Manufacturing Companies Using Future Worth method. Department of mechanical engineering. Michael Okpara University of Agriculture, Umudike

Corrado, C. and Mattey J. (1997), Capacity Utilization, Journal of Economic Perspectives. Vol. 11, No.1. pp 151-167.

Dauda, R. O. (2006): "The Determinants of Manufacturing Sector Growth Performance in Nigeria. "Nigerian Journal of Economic and Social Studies, Vol. 5, pp. 67-70.

Hosen, M. Z., Nabi, M. N. and Fahmida, N. (2011). Efficiency Measurement of Capacity Utilization in Pharmaceutical Industry. The Cost and Management. pp. 25-34.

James, C. (2002) "Why there is chronic excess capacity - The Market Failures Issue", in: *Challenge*, Nov-Dec,

Johanson, I. (1988). Production functions and the concept of capacity, Collection Economie et Mathematique et Econometrie, 2, pp. 46–72

Kim, H. Y. (1999). Economic capacity utilization and its determinants: Theory and Evidence, Review of Industrial Organization. Vol.15, No.4. pp. 321-339.

Ogwuma (1995) "Revitalizing the Manufacturing industry in Nigeria." Bullion publication of the Central Bank of Nigeria, April/June.

Olorunsola, J. A. (2002): "Basic Features of Nigeria's Manufacturing Sub-sector", Bullion Publication of the Central Bank of Nigeria (CBN), Oct/Dec. Vol. 26, No. 4.

Omer Gokcekus (1998). Trade liberalization and capacity utilization: New evidence from the
Turkish rubber industry, Empirical Economics, Vol.23, pp. 561-71.

Onwualu A. P., Oluka, S. I. and Offiong. A. (2002). Principles of Engineering Project Management. SNAAP Press Ltd, Enugu. pp. 133.

Rasche.R.H and J.A.Tatom(1977), The effect of the new energy regime on economic capacity, production and prices, Federal Reserve Bank of St. Louis Review, 59(4), pp 2-12.

Ray, S. C and Kankana M. (2005) Direct and Indirect measures of capacity utilization: A non-parametric approach of US manufacturing, The Manchester School, Vol.74, No.4, pp. 526-48, July 2006.

Shebeb, B. (2002). "Productivity Growth and Capacity Utilization in the Australian Gold Mining Industry": A Short-Run Cost Analysis", *Economic Issues*, Vol.7, Part 2, 2002.

Susan Strange and Roger Tooze (2004), *the International Politics of Surplus Capacity: Competition for Market Shares in the World Recession* (London: Allen & Unwin, 1981).

Ukoha, O. O. (2000). Determinants of Manufacturing Capacity Utilization in Nigeria, 1970 1998". *The Nigeria Journal of Economics and Social Studies*, Vol. 42 (2): 121-130.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar