An Optimal Profit Linear Programming Model for Business Call Centre's Operators in Nigeria

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Abstract: This study examined the different combinations of the three major mobile telecommunication provider's lines used for call centres business in Nigeria with a view to maximizing the call business operator's profit subject to identified operational resource constraints. Thus, we evolve a model for the operational plans (in terms of choice of combinations of providers' lines to be used by call centre operators) under the operators' profit maximization objective. Data were collected from 120 business call centres which were randomly selected from different parts of Ondo State in Nigeria through structured questionnaire and direct observations. The statistical analysis of the data showed that the call centre's profit and patronage, depends on the number of different providers' lines used by the operators while the quality of service in the various call centres does not. However, results from the linear programming models showed that majority of the call centres are operating at sub-optimal profit level, though optimality can be attained by constantly monitoring the providers' tariffs together with the call market situations and changing the combination of provider's lines used for the call business as appropriate.

Key words: Mobile telecommunication service providers, call centre operators, resource constraints, statistical analysis, linear programming, profit maximization

INTRODUCTION

Telecommunication services are essential to all and sundry, though the importance individuals attached to it varies depending on status in the society, level of literacy and the need for usage. However, in most developing countries, the accessibility to these services is still very low. For example, in Nigeria, the teledensity is low despite the improvement brought about by the introduction of global system of digital mobile telecommunications (GSM) in the country. That as it may be, the accessibility to mobile telecommunication in Nigeria is relatively partial, this is because majority of the subscribers only use their telecommunication lines as mere receivers, making just occasionally short calls for urgent and important transactions or purposes while they make most of their calls from business call centres. The reason for this is not unconnected with the seemingly high difference between the tariffs for call centres and private callers as charged by mobile telecommunications service providers. This has resulted into the emergence of a huge market for the business call centres. Consequently, the proliferation of business call centres in the country is no surprise to many.

Particularly, when we considered the unemployment situation in the country (graduates inclusive) coupled with the fact that business call centres operations requires relatively low capital to start with; then, investing in a call centre business may be an escape route from the unemployed class. Now, call centre business is well patronized; even government at different levels and related agencies are giving soft loans to unemployed people to go into this business for temporary empowerment pending the time they will be gainfully employed. The problem now is to ensure that this people (call centre operators) get optimal profit on their little investment to forestall operators' return to unemployment.

As a result, this operations research study aims to examine the different combinations of the three major mobile telecommunication provider's lines used for call centre's business with a view to maximizing the operator's profit subject to identified operational resource constraints. In this regards, we will formulate a model for the call business operational plans indicating the choices of combinations of providers' lines to be used by call centre operators under the operators' profit maximization objective.

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It is expected that the results from this study will serve as guide to call business operators in deciding the choice of combination of provider's lines to use for their call business in other to maximize their profit. It will also serve as an indicator to the customers on how to get optimal value for charges on call from the call centres and telecommunication service providers. Also, we hope that findings from this study would indicate to the mobile telecommunication service providers aspects of their services that should be improved upon and government the possible areas of assistance needed by different stakeholders in the telecommunication sector in order to benefit optimally from the sector.

MATERIALS AND METHODS

The data: Data were collected on operators' profit, operational cost, operational hours, call market situation and call connecting time in relation to different combinations of provider's service lines used for the call business.

Actually, the data were obtained from the call centre operators through questionnaires and observations at their respective business call centres. The observations are done as follow up to the questionnaire responses to cross validate some of the responses. This was accomplished by pretending as customers to some of the call centres to get some other information or validate some of the information earlier collected.

Moreover, occasional short interviews were conducted at some of the centres for clarification and cross validation of some of their responses too. However, the researcher got the data for call connecting time from direct experimentation by calling using each of the lines to call the three respective lines at different times of the day while noting the connecting time in each case.

Also, some of the responses given by the operators that relates to the service providers were confirmed from the different providers' web sites[1-3].

Data analysis: The analysis techniques adopted involves both descriptive and inferential statistics. We used the mean of the sample of data collected to represent the entire sample information as appropriate; we set up relevant null hypotheses of interest and carried out x^2 test[4] on each of the hypotheses at 0.05% level significance. Each of the null hypotheses were rejected or accepted based on the outcome of the test while appropriate inferences are then drawn. In this regard, we found out that patronage to call centre and call centre operator's profit depends on the number of different provider's service lines used at the call centre, while the quality of service at a call centre is independent of the number of different provider's service lines used at the centre.

The linear programming model: We can now formulate our linear programming model[5] under the assumption that the operator wants to maximize his gross profit through the optimum choice of different service provider's lines used for business within the sustainability of its available resources.

The model is as below:

Maximize $P = \sum_{i=1}^{n} \lambda_i x_i$

Subject to:

Operational hour constraint

$$\sum_{i=1}^{n} \alpha_{1i} x_i \leq \beta_1$$

Market constraint

$$\sum_{i=1}^{n} \alpha_{2i} x_i \leq \beta_2$$

Running capital constraint

$$\sum_{i=1}^{n} \alpha_{3i} x_i \leq \beta_3$$

and $\forall \quad x_i \geq 0$

where:
i =1, 2, 3,
P- the objective function to be maximized, which in this case, it is the call centre operator's profit,
x_i- the decision variables which represents the number of calls to the ith service provider's network line,
λ_i- the profit per unit of the ith provider's line destination call,
α_{ji}- the amount 'α' of the jth resources used in the delivery of one unit of the ith provider's line destination call,
$\beta_1, \beta_2, \beta_3$- quantities or levels of resources available.

It is worthy to note that we considered just three different GSM providers' lines in our model because the three dominates mobile telecommunication sector, though, this was also confirmed from the data analysis of our questionnaire responses which showed that 100% of the our business call centre operators uses one or more of these three lines for call business.

Table 1: The three major mobile telecommunication lines used by business call centres and their associated operational charges

Call centre line(s)	Customer's call destination line	Service provider's tariff/min (₦)	Customer's charge/min (₦)	Profit margin/min (₦)	Booster charge/month (₦)
A	A	18.00	20.00	2.00	12000/month
	B	24.00	30.00	6.00	
	C	24.00	30.00	6.00	
B	A	24.00	30.00	6.00	10000/month
	B	17.00	20.00	6.00	
	C	24.00	30.00	6.00	
C	A	30.00	35.00	5.00	9000/month
	B	30.00	35.00	5.00	
	C	18.00	20.00	2.00	
A and B	A	18.00	20.00	2.00	(A)12000/month
	B	17.00	20.00	3.00	+
	C	24.00	30.00	6.00	(B)10,000/month
A and C	A	18.00	20.00	2.00	(A)12000/month
	B	24.00	30.00	6.00	+
	C	18.00	20.00	2.00	(C) 9000/month
B and C	A	24.00	30.00	6.00	(B) 10000/month
	B	17.00	20.00	3.00	+
	C	18.00	20.00	2.00	(C) 9000/month
A, B, and C	A	18.00	20.00	2.00	(A)12000/month
	B	17.00	20.00	2.00	(B) 10000/month
	C	18.00	20.00	2.00	(C) 9000/month

Source: Data analysis

In the same vain, the constraints considered were limited to the ones enumerated above because we found out that they were the most relevant to the operator's profit maximization target as confirmed from the responses from the interviews and questionnaire.

Below is a Table 1 containing information relating to call business operations as obtained from sampled operators and service provider web site[1-3] .

It is important to explain that the call centre line(s) is the telecommunication service provider's line(s) that is used by the call centre for the call business operation, the customer's destination call line is the line that is called using the call centre line, the service provider's tariff per minute is the charge the operator pay to the provider per minute call on its network, the customer's charge per minute is the amount paid by customers to the operator per minute call at the centre, the profit margin per minute is the difference between customer's charge per minute and provider's tariff per minute and booster charge per month is the amount each operator's pay in advance to appropriate provider's to enjoy the stated low tariffs.

As can be seen from the table above, there are seven alternative choices of lines or combination of lines that can be used for the call centre business. However, business call centres using more than one line usually call to other network (line) with the line with the lowest patronage and cheapest booster charge.

Moreover, information from the data analysis of the questionnaire responses showed that 70% of the call centres uses one line, 11.7% of the call centres uses two lines and 18.3% of the call centres uses the three lines for their call business operations.

RESOURCE AVAILABILITY AND USE IN THE STUDY

Operational hour constraint: Time is an essential factor in almost everything that man does. At any point in time, time may mean different things to different people depending on individual's interest or target. However, the most important issue is to manage the time as much as one can to get the best as regards one's interest or target. In our case, we are interested in allocating the call business operational hours in relation to the different destinations calls made constrained by the business maximum operational hours. Based on our observations, we got that none of the business call centres operate more than fifteen hours a day. Also, we got, through experimentation, the average connecting time for each of the calls within and outside the business line provider's network and assumed equal delays (time) in transfer of phone from one customer to the other for successive calls. Consequently, data from stated steps above were used in the construction of the operational hour constraint.

Market constraint: This actually relates to the frequency with which customers use the call centres to call different destination lines. Data required for this were gotten from our data analysis results with respect to the various choices of lines combination used at business call centres. Though, this is restricted to a maximum based on our experience with call business operations. We need to know that the market structure for each line or lines combination varies depending on the location of the call

centre and the patronage/loyalty enjoyed by each of the telecommunication service providers. The ratio of the average market for each of the line or line combinations constrained by a calculated maximum is then used to arrive at market constraint.

Running capital constraint: This deals with cost incurred by the operator in relation to the various destination calls made from his/her centre as charged by the provider's which is limited by the amount of money he used as running capital for the call business. Here, the different destination call tariffs are used as appropriate to formulate the running capital constraints subject to the available running capital. In general, we assumed that each call takes exactly one minute, where, a longer duration call is to be made, the call is terminated after a minute and another call is made, though the new call may still be to same destination line.

RESULTS AND DISCUSSION

The statistical analysis of our data showed that patronage to business call centres and the profitability of the centres depends on the number of different provider's lines used at each of the various call centres. However, we also found out that the quality of services in business call centres is independent of the number of different provider's lines that is used at the centres. These inferences were arrived out based on the outcome of the $\div^2$-test from our data analysis. The implication of this result is that as the number of different provider's lines used at the various call centres increase; the respective centre's patronage as well as its profit increases while the quality of service is unaffected.

This conveys that business call centre's operators should utilize series of different provider's lines for their call business to get more profit on their investment. Also, the result showed the customers that the quality of service at any call centre is relatively the same irrespective of the number of different provider's lines used at the centre.

Obviously, the acquisition of more different provider's line for call centre business will require additional running capital from the operator aside the amount of money that will be spent on procurement of durable mobile phones plus provider's booster charge of the call centres. Consequently, the operator needs to be convinced that this additional investment into the call business would yield a marginal profit greater than the hitherto one. In order to establish this fact, we formulated the linear programming model to depict the problem as described in the methodology with all the constant parameters emanating from our data analysis. Then, the resulting linear programming model was solved using Simplex method. The summary of the optimal solution for the linear programming models formulated is as shown in the Table 2.

As can be seen from the Table 2, assuming the turnover for each of number of line choices category is same, then, it is more profitable to use line choice B for one line call centre operators; it is more profitable to use line choice B and C, followed by line choice A and B and A and C respectively; for two provider's lines operators. The choice of the three lines for call centre, though gives the largest profit but percentage profit is not the highest. Moreover, the results will imply that the three provider's line call centres should only be preferred whenever there is the assurance that the turnover will be at least one and a half times that of a two line call centre.

Considering the marginal profit in Table 2, we will observe that for an operator using line A, it is more profitable to add line B than C while for operators using line C only, it is more profitable to add line B than A, but for an operator using B, it is not too profitable to add more line, though it is better to add line A than line C. Nevertheless, increasing a call centre's line from one to two will only be justifiable if this will result in at least double the initial turnover; otherwise it will not be worth additional investment.

It is important to explain that the call type indicates the provider's of operator's line and customer's call destination line respectively while percentage profit is the ratio of the optimum profit to the running cost expressed as a percentage. Based on the fact that price is the most effective marketing strategy, most importantly in Africa; we need to see what happens to the operator's profit due to reduction in customer's charges per unit call. As we know, reduction in customer's charges per unit call is tantamount to reduction in the operator's profit margin per unit call; the effect of this was established by carrying out some sensitivity analysis on our LP models. The sensitivity analysis of our optimal solution showed that an operator can only reduce his/her profit margin per unit call and retain the optimal profit whenever there is the guarantee that this will lead to a proportionate increase in patronage. Clearly, this will bring about a proportionate increase in the turnover; thus resulting in the attainment of the initial optimal profit. Also, we observed that slight changes in the values of the resource constraints do not have significant effect on our optimal results.

It is important to note that the validity of the results from this research holds as long as the status quo in relation to operator's, providers, customers and market situation remain same. Otherwise, the model will have been modified appropriately to obtain valid results.

Table 2: Summary of optimal solutions for the linear programming models

No. of line(s)	Choice of line(s)	Running capital	Call Type	Optimum no. of calls	Optimum profit	Marginal profit	% Profit
1	A	1500	A-A	83	583.31	-	38.89
			A-B	0			
			A-C	0			
	B	1500	B-A	0	705.92	-	47.6
			B-B	88			
	C	1500	C-A	0	583.31	-	38.89
			C-B	0			
			C-C	83			
2	A and B	3000	A-A	142	1202.63	619.32 (B)	40.09
			B-B	26		496.08 (A)	
			B-C	0			
	A and C	3000	A-A	167	1166.67	583.36 (C)	38.89
			C-B	0		583.36 (A)	
			C-C	0			
	B and C	3000	B-A	0	1400.00	694.08 (C)	46.67
			B-B	175		816.69(B)	
			C-C	0			
3	A, B and C	4500	A-A	245	1756.76	554.13 (C)	39.03
			B-B	5		590.09 (B)	
			C-C	0		356.76 (A)	

Source: Data analysis

The result brings to the fore how customers can get maximum value for their money per unit call they make at the call centres. It showed the customer's that if they make calls as much as the optimum number for any of single line choice centres, then it cheaper for them or a group (say a family) to have business call line (virtual call centres) to be used for their calls. As for the operator's, the results showed how they can maximize their profit depending on their choice of lines or combination of lines and whenever there is the need to add another provider's line , it provides a guide on how to go about it. As regards the mobile telecommunication service providers, findings from this work could indirectly help come up with operational plans and market strategies that will enable them to dominate their rivals and enjoy optimal subscribers' patronage. Finally, our finding from this work can indirectly indicate to government how to assist each of the stakeholders in the mobile telecommunication sector such that all could benefit maximally from sector.

CONCLUSION

In this study, we evolved a model for the operational plans for call centre's business in terms of choice of combinations of providers' lines to be used at the centre under the operator's profit maximization objective. In this regards, we collected relevant data and statistically analyzed as appropriate. We established that call centre's profit and patronage depends on the number of different provider's lines used at the centre while the quality of service at various call centres does not depend on this.

We used facts from our data analysis to formulate linear programming models. Solutions from the LP models showed that majority of our operators are operating at suboptimal profit level. Results from the LP models when juxtaposed with findings from the data analysis showed there is no fixed way to profit optimality in call centre business, rather it is determined by the prevailing situation depending on the market, provider's charges, customer's patronage and operator's choice of line or lines combination.

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