TECHNICAL EFFICIENCY OF CUSTOMERS SERVICE CENTRES IN THE NIGERIAN TELECOMMUNICATION INDUSTRY USING DATA ENVELOPMENT ANALYSIS

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ABSTRACT

Cost leadership strategy thrives on operational efficiency and convey strategic advantage on firms in price-sensitive markets. It emphasizes efficient utilization of resources. This study based on data obtained on customer service centres of four telecommunication firms used data envelopment analysis to determine operational efficiency of these facilities and compare differences in efficiencies between these firms. Results of data analysis indicate that substantial degree of inefficiency exist in these facilities with 64.9% of the facilities obtaining less than 0.7(CRS) efficiency scores while 59.5% of the facilities have less than 0.8 efficiency ratings under the variable returns to scale assumptions (VRS). In addition, comparisons of service centres efficiencies on the strength of locations indicate that significant difference exists in the efficiency of these facilities; however, only minimal changes in efficiency scores seem to exist between service providers. It seems advantageous to explore the effect of size on efficiencies of these facilities. In addition, performance benchmarking, resource re-allocation and managerial creative actions that raised output profile and deepen use of available resources may be required to make these customers service centres positive contributors to competitive edge, reputation and image of these firms.

Keywords: Customer service, data envelopment analysis, technical efficiency, variable returns to scale

INTRODUCTION

Telecommunication companies have remained relevant for building, maintaining and sustaining social relations among people. The capacity of telecommunication services to sustain business and social interactions have been magnified with the covid-19 disruption of social interactions and events across nations. Social and community lives have been restricted with the strategic approach that advocate social, physical distancing and self-isolation in addressing global and community's health concerns in the pandemic era. Increased technological advances which have extended the industry beyond voice calls is widening the industry connectedness with different facets of social, economic and communication activities. Societies and individuals are compelled to explore the assortment of options for advancing lives and business opportunities by telecommunications industry.

The present and future outlook of the telecommunication industry is excitingly attractive in the light of increasing evidences of remote virtual work space and de-construction of traditional organization. Emerging organization structures emphasize mode of communications that require intense use of telecommunications or ICT driven products. Gerpott *et al*. (2001) had observed the increasing importance of telecommunication companies with their influence traversing cultures and industry. Besides, the telecommunication industry has become globally recognized as a major contributor to national economies (Oghojafor, Ladipo, Ighomerebo, & Odunewu, 2014; Sedziuviene & Vveinhardt, 2010).

The espoused attractive future of the telecommunication industry will demand assortment of competitive behaviours focused at securing leadership in the industry and creativity from competing firms. Telecommunication companies have also been more creative in the design of responsive competitive tactics to the rivalry in the industry. Competitive behaviours, strategies and tactics of telecommunications companies seem more oriented towards retention of existing subscribers. Building a loyal subscriber base that will not be eroded in the prevailing intense competition has become an attractive focus; as acquisition of new subscribers slows down with industry maturity and intense competitive rivalry. There are advantages in such competitive focus and approach: loss of a single subscriber has implications in terms of present and future earnings and investment to attract a replacement. Therefore, customer service is a veritable tool for customer retention with implications on corporate reputations and image (Metz, Ilies, & Nistor, 2020).

Customer service centres have become main tactical approach in the competitive dynamics in the industry because of its importance in securing competitive advantage (Metz *et al*., 2020). Customer service is an evident response of telecommunication firms to poor service quality, high rate of porting activities, call jamming and dropping, delay in or delivery of text messages after charges deductions, among others, in the industry (Ibidunni, Abiodun, Ibidunni, & Olokodun, 2019; Alabar, Egena, & Gbande, 2014). It is expected that customer

service effectiveness and efficiency will affect organizational effectiveness and efficiency (Goodman, 2009). Securing customers' satisfaction is an attractive and desirable goal, however, service centres must be operationally efficient to hedge against resource wastage and achieve competitive edge in the industry. Management need to minimize operations cost while deploying and utilizing input resources to generate proportionate outputs (Kuo, Haung, &Wu, 2011; Simpson, 2012).

The focus of this research is to evaluate the efficiency of telecommunication firms' customer service centres and the effect of location on their efficiency. Inefficient use of resources in the service centres withdraw resources from other productive activities and restrict the ability of the firm to compete and extend services to larger percentage of customers. Customer service centers have a strong tendency to determine customer satisfaction through quality of services received and are strong determinants of the firm's ability to maintain and attract customers (Tsoukas & Vladimirou, 2001, Ibidunni, 2017, Abiodun, Ibidunni, Salami & Ojeaga, 2017). It is an important part of firms' cost and revenue outlets; therefore, determining their operational efficiency is strategic to company's overall performance.

LITERATURE REVIEW

Customer service centres, by design, are equipped as part of the company that handle interactions with customers. Functionally, it provides service to customers before, during and after purchase, with the focus of making customers' interactions with the company a delightful experience; and building trust, image and reputations for the firm. Customer service build strategic partnership with customers in the service production and delivery process; and direct focus on the needs and expectations of customer (Metz, *et al*., 2020). It is a veritable instrument for improving customers' satisfaction and weapon for driving competitors out of the market as it identifies customers' needs, complaints and informs management for customer driven decisions (Anning-Dorson, Christian, & Nyamekye, 2020). Therefore, company's human, material and financial investment in customer service centres is often substantial and carefully planned.

Christopher (2005) opined that customer service centers add value to service rendered; especially in the telecommunications industry where customers often have complaints. Operational efficiency is a rational objective to secure maximum contributions of the service centres. Management of the centre aim at utilizing input resources to produce proportionate outputs to contribute to the firm's competitive advantage (Simpson, 2012; Kuo, Huang, & Wu, 2011). The firm must attempt to optimize operations based on cost, quality, labour and other related input and output measures. According to Arvind, Sanjay and Omar (2005), a firm is operationally efficient if it is capable of responding to the day to day requirements of members of its chain in an efficient manner using fewer resources to generate more or maximum output or generating increased resource from existing inputs.

Efficiency, therefore, reveal the extent to which the firm's resources are utilized (Fugate, Mentzer, & Stank, 2010). This demand that internal processes, strategy, structure and culture are designed and implemented with a focus on maximally achieving objective. Efficiency emphasizes cost saving, waste reduction and elimination, and avoidance of redundancy in business processes (Bartuševiciene & Šakalyte, 2013). In the prevailing

difficult economic conditions in most transition economies and changing competitive landscape, operational efficiency is a major concern of management whose focus is to ensure customer satisfaction (Chung, Ahn, Jeon, & Thai, 2015).

Data Envelopment Analysis (DEA) has been used in efficiency studies in service industries such as bank branches (Sherman, 1984), restaurants (Reynolds & Thompson, 2007), hotels (Hwang & Chang, 2003) and hospitals (Rosko, 1990). It has also been applied is the evaluation of performance of participants in business simulation games (Koltai, *et al.*, 2017), dredging (Lai, Chang, & Lai, 2019), fishing operations (Sowunmi, *et al.*, 2016), ecoefficiency of industrial parks (Bai, Qiao, Kang, Zang, &Guo, 2017) military units, local government, airports, among others (Bowlin, 1998). Thus, the methodology has been widely applied in both profit and non-profit organisations. The methodology measures relative efficiency of organisations, units or decision-making units producing multiple outputs with multiple inputs in its operation and performing similar tasks (Yun *et al.*, 2004).

Decision making units in DEA term describe an organization, unit, department which constitute the element of the study (El-Mashaleh, Rababeh & Hyari, 2010). DEA is a non-parametric technique used to identify efficiency of production processes (Kuo *et al.*, 2011; Xiuqing & Xiaoli, 2009). The increased use and application of DEA is rooted in the strength and its reliability to handle multi inputs and outputs situation without complication and it does not require explicit specifications of any functional form relating inputs to outputs (Ayricay & Ozcalici, 2014; Ray, 2004). Indeed, DEA has proved a reliable instrument for estimating multi-product technology functions and assessment of managerial performance of DMU that utilizes multiple resources in producing multiple outputs (Mecit & Alp, 2014; Charnes, Cooper& Rhodes, 1978). Typically, a customer service center utilizes multiple inputs for multiple outputs.

As a non-parametric technique for measuring efficiency, DEA utilizes Linear programming model formulation rather than regression (Ray, 2004). DEA constructs a piece-wise linear production frontier based on observed best practice. DEA approach is foundation on radial measure of efficiency developed by Farrel (1957) on the strength of the coefficient of resource utilization defined by Debreu (1951). The DEA model was introduced to operations research literature by Charnes *et al*. (1978) under the constant returns to scale assumptions; and was extended by Banker *et al*. (1984) with variable returns to scale assumptions to estimate production frontiers and efficiency measurement using linear programming methodological approach. DEA has however, been improved to handle scale efficiency or indicate variations in input use. We have increase returns to scale when increase in input results in more than proportionate rise in output, and decreasing returns to scale when output falls in response to increase use of input resources. A constant return to scale is suggestive of an optimal plant size such that input increase result exact output increase. Technical or economic efficiency are derived using the basic model of Charnes *et al*. (1978) while the output of Banker *et al's*. (1984) models output shows pure technical efficiency. DEA methodology establishes a best practice group and quantifies the amount of potential improvement possible for each inefficient unit. DEA model are of two variants: an input minimizing model (input orientation) or output maximizing model (output

orientation). Structurally, DEA align with linear programming structure: objective function to be minimized or maximized subject to a set of constraints and the non-negativity condition

Objective function Minimize $\theta_0 \lambda_o$

Subject to:

$$\sum_{n=1}^{N} y_{nj}\lambda_n \geq y_{oj} \quad \text{(Output Constraint)} \quad (j=1,2,...m.)$$

$$\theta_0 X_{oj} \geq \sum_{n-1}^{N} X_{ni}\lambda_n \quad \text{(Input Consttraint)} \quad (i=1,2,...N)$$

$$\sum_{n=1}^{n} \lambda_n \leq 1 \quad \text{(Scale Constraint)}$$

$$\lambda_n \geq 0 \quad (\text{Non}-\text{negativity Constraint}) \quad (n=1,2...N)$$

The Scale Constraint is adjusted according to the assumption required for the study. A variable return to scale frontier (Banker, et al, 1984; the BCC Model) is obtained by substituting the Scale Constraint of the linear programme $\sum_{j=1}^{n} \lambda_j = 1$

MATERIALS AND METHODS

This study utilized customers service centres of four active telecommunication firms in Nigeria with active presence in Lagos and Abuja. The choice of the study location is premised on the fact that Lagos may be described as the economic capital and Abuja as the political capital of Nigeria with fairly heterogeneous population made up of foreigners and diverse representations from most states in the country. These locations are, perhaps, the most competitive and most lucrative geographic market segment in the country with headquarters of most firms located in either of the cities. Responsiveness to customers' needs and good services in these locations may, potentially, have snowball effect on telecommunications firms marketing efforts and reputations in other parts of the country due to active local and foreign media presence, and diverse population in these cities. Besides, these locations offer an interesting competitive field because customer service centres of all the telecommunication firms are represented and effective deployment of tactics is expected to produce credible results. Potentially, customer service centres represents and project the overall interest of corporate headquarters

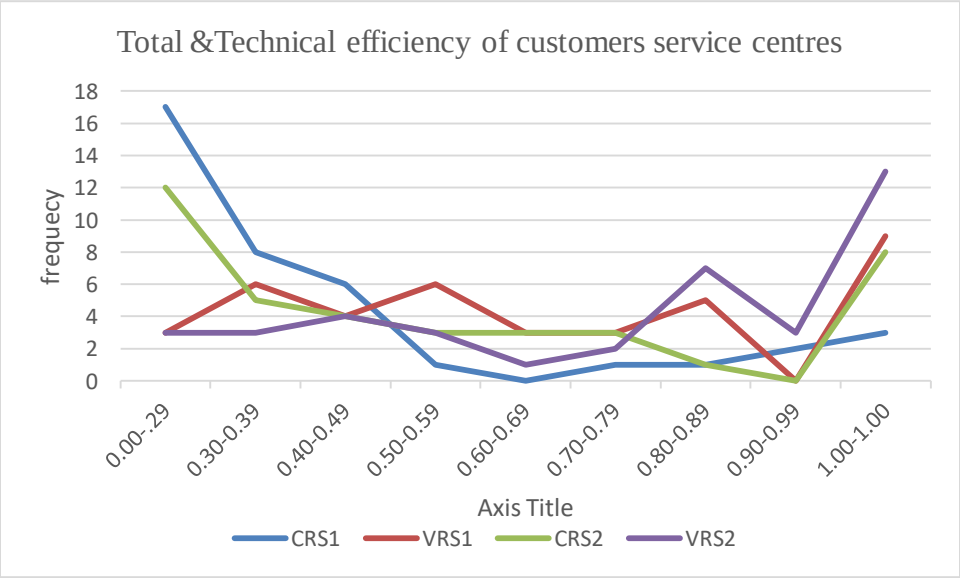
Data for the study was obtained on thirty-nine customer service centres of the telecommunications operators and to maintain homogeneity of data set as required in DEA studies, three inputs and output for which complete data were obtained were utilized in the study (Andreas & Yiannos, 1997). The study utilized customer service personnel (numbers of personnel in each centre), training (estimated investment in training of personnel) and investment in equipment (including estimated investment in technology) in each centre as inputs and customers served, (average personnel-customers' business interactions in each centre), cases resolved (complaints and personnel-interactions that were successfully handled) and innovations of service personnel (including new products, adaptable method

due to covid-19 restrictions) as output. The dataset is consistent with prior research (Ibidunni, 2017, Abiodun, Ibidunni, Salami, & Ojeaga, 2017). The data were analyzed under the assumptions that the centres are operating at optimal scale: constant returns to scale, and the assumptions that their performance is affected by the scale of operations: variable returns to scale. The variable returns to scale assumption seems more realistic because achieving effective competitive behaviours demand that size of the customer centres will be influenced by commercial viability and costs considerations. Thus, the basic CRS DEA model was utilized in the first stage of analysis while the VRS model was used in the second stage of analysis

Further, non-parametric analysis of DEA output was undertaken to shed light on efficiency measures across the cities, a non-parametric Mann-Whitney test was undertaken. Mann-Whitney test was chosen because no parametric error structure was included in the original model and, therefore, no assumption was made as to normal distribution. The result of the Mann-Whitney test is to provide insight on whether location has effect on efficiency on similar facilities in these cities. In order to gain insight into whether efficiency performance for customer service centres under different ownership and management changed significantly, the non-parametric Kruskal Wallis test was used.

RESULTS AND DISCUSSIONS

Rational competitive behaviour suggests that operations managers should aim at generating maximum output from a given set of inputs otherwise company's survival and response to competition will be weakened. Efficiency in operations is a strategic advantage in competition as it affects ease of interactions with customers, delivery and after sales support (Rrushton, Croucher, &Baker, 2014). The total and technical efficiency of the operations of the customers service centres are indicated in figure 1 below. (details in appendix b).



Source: Output of data analysis on technical efficiency of customer service centres in the Nigerian telecommunication industry (2021).

Technical Efficiency (TE) of Customer Service Centres

Theoretically, constant returns to scale assumptions, which is the main feature of the basic DEA by Charnes *et al*. (1978), assumes a production process in which optimal mix of inputs and outputs are independent of the scale of operations. It provides a comprehensive evaluation of resource utilization efficiency of each service centre. Fig. 1 showed that only 8.1% of the sample is technically efficient in their operations with 39.8% or 14 service centres having an efficiency scores in the range of 0.00-0.29 (CRS1: two inputs and two outputs were utilized in this model). In competitive environment these inefficiencies in operations of the customer service centres should exact penalty on the telecommunication firms, however, the weak regulatory environment offers little protection to subscribers. Therefore, the penalty may rather have been borne or passed over to subscribers. Call jamming, dropping, delayed or non-delivery of text messages after charges deductions are common experiences of subscribers (Ibidunni *et al*., 2019, Alabar *et al*., 2014).

However, with the inclusion of innovations in each centre as output and investments in equipment for each centre included as input variable indicating increased resources and more intense use of available resources (CRS2) total efficiency indicators for the service centres, in line of expectations, showed improvement with 21.6% of service centres being efficient, however, significant numbers of service centres (64.9%) are below technical efficiency ratings of 0.7. The implication of this is that 30% of resources utilized by this segment could have been saved while maintaining current output or service level. The result is somewhat in alignment with findings from Abiodun *et al*. (2017). Extant literature suggested that inefficiency is "immoral and unethical," evidence of lost opportunities for improvement without additional expenditure of resource or compromise of public good. Operational inefficiency questions the stewardship role of managers entrusted with oversight of those facilities.

Pure Technical Efficiency (PTE) of Customer Service Centres

Total technical efficiency can be decomposed into pure and scale efficiency. Improvement on the basic DEA model made this possible (Banker *et al*., 1984). Pure technical efficiency or variable returns to scale assumptions is less restrictive and realistic because it considers that management and techniques influence efficiency. Fig. 1 above showed the VRS 1 and VRS2 with better picture of the performances of these customer service centres. 37.8% or 14 of the customer service centres distributed among the telecommunication providers are efficient when investment in technology and innovations at each centre were included as variables in the model; though inefficiency persists in the operations management of these service centres with 40.5% of the centres having efficiency scores below 0.7. The inefficiency is slightly higher if those variables are not included as inputs. 59.5% of the facilities have less than .80 efficiency in VRS1 model.

High variability in observed performance across the sample provides evidence that the customer service centre, which, in design, should project image and reputations of telecommunication firms, suffer significant losses in resources (Abiodun *et al*., 2015). In essence these are not operating or using available resources efficiently, competitively and their positive impact in competition is reduced which place questions on the stewardship

roles of the supervising units of these customer service centres to the headquarters. It seems, their potential contributions and customer satisfactions roles are in question on account of evident inefficiency and resource wastage. A basic objective of customer service is to satisfy customers in terms of trust, communication, and convenience (Murphy & Knemeyer, 2018). Operational inefficiency in organisational processes jeopardizes management ability to achieve this goal. It also affects customer satisfaction and, potentially, harms ability to compete. The long-term consequences will be on company's reputation, image and customers' patronage (Abiodun *et al*., 2015).

Comparison of customer service centre efficiency scores within and across states

The study seek basis for inference on the effect of location and organizational variables (management and ownership) on the efficiency performance of customer service centres of telecommunication firms in Abuja and Lagos. The natural thought is to assume that the efficiency scores of these facilities are the same, however, differences in terms of ownership, management and location are evident. Table 1 below show the result of Mann-Whitney test of the comparison. The test was preferred because the original model exclude parametric error structure, consequently no assumption was made on normal distribution

Table 1: Mann- Whitney Test of DEA Efficiency by Cities

States	Mean Rank	Sum of Ranks of VRS	Mean Rank	Sum of Ranks of CRS
Lagos	19.18	633.00	19.52	644.00
Abuja	30.00	270.00	28.78	259.00
Mann-Whitney U		72.00		83.00
Wilcox W		633.00		644.00
Z		-2.389		-2.0150
Prob(2-taied)		.017		.04

Source: Output of data analysis on technical efficiency of customer service centres in the Nigerian telecommunication industry (2021).

Mann-Whitney test shows that Lagos with the lowest mean rank has a larger number of customer service centres with low efficiency scores. Similarly, Abuja with higher mean rank indicates that it has greater number of facilities with higher efficiency scores. Test evidence above support the view that efficiency measures of facilities in these cities are not similarly distributed. The Z values for the efficiency measures with the significance level of p=0.01 (vrs), 0.04 (crs), is less than 0.05 in any of the cases under consideration which suggests that the result is significant. A significant difference in the efficiency of service centres in Lagos and Abuja exist. We have basis to suggest that ownership, location and management have significant effect on efficiency performance of these facilities. At 90% level of confidence, this result is consistent with extant literature in health care Valdmanis (1990) and Masiye (2007).

As a corollary to the foregoing analysis, the study attempts to evaluate the result of policy and managerial measures of each of the telecommunication providers in respect of their service centres. It is assumed at onset that no significant difference exists in the efficiency scores of the customer service centre across the telecommunication industry. The result of Kruskal Wallis test is as shown in Table 2 below:

Table2: Kruskal-Wallis Test of DEA Efficiency by ownership

Ownership	Mean Rank of VRS	Mean Rank of CRS
ML	23.17	24.33
GL	22.00	23.56
AL	19.00	24.68
NL	22.12	15.42
Chi-square	.696	4.695
Prob	.87	.196

Source: Output of data analysis on technical efficiency of customer service centres in the Nigerian telecommunication industry (2021).

The chi-square result for the mean rank of pure technical efficiency (vrs), and total efficiency (crs) are 0.696, 4.695 and 2.70 respectively. However, the p -values of 0.87, 0.196, fall outside the acceptable region of p=0.05 or 0.10, and provide a reasonable ground to suggest that differences exist in the efficiency measures for service centres, though statistically not significant. This is line with expectations that these facilities are under different oversight management organ. Change in efficiency between these facilities is minimal as observed from the mean ranks. Could it be inferred that the regulatory framework inclined the customer service centres to wastage rather than being a virile competitive arm for the company? Or could it be that possible managerial measures merely duplicate existing efforts than being creative in approaches and seeking innovative projections of the company reputations?

CONCLUSION AND DIRECTION FOR FUTURE STUDIES

This study explored the applicability of DEA model in the assessment of operational efficiencies of customer service centres in the telecommunication industry, and compare efficiencies of these facilities on the basis of location in two cities. Findings of the study revealed substantial operational inefficiencies in these facilities across service providers which provide basis to suggest that subscribers may have been penalized for these inefficiencies. This raise a question: could it be inferred that the regulatory framework inclined the centres in telecommunication sector to wastage rather than being a potent competitive unit for the telecommunication company? It is evident that efficiency of organizational processes for creating value will significantly affect service effectiveness, customers experience and relations with service providers.

Changes in efficiency of facilities between the service providers are minimal as observed from the Kruskal wallis test. Again, we may ask: could it be that possible managerial measures merely duplicate existing efforts than being creative in approaches and seeking innovative projections of the company reputations? Minimal changes in efficiency across telecommunication firms suggest that it may be of advantage to explore the effect of size on

the operations of these facilities. Decomposition of efficiencies for each service centre to unearth the scale efficiencies is profitable to identify the magnitude of efficiencies due to scale of operations. This will guide managerial intervention efforts which might take the form of reallocation of input resources or boosting the output profiles of customer service centres to improve resource utilization.

The study is explorative; however, it is useful to note some limitations of the study and provide guide to future studies. Narrow range of inputs and outputs were used in the study because of difficulty in securing data. Further studies may need to include broader range of inputs utilized at the service centres and examine contextual factors that interact with operational efficiencies of these facilities. A more in-depth analysis will be required to determine the role of size of service centres on their efficiencies. A larger production entity should normally handle more inputs to produce more output than smaller facilities.

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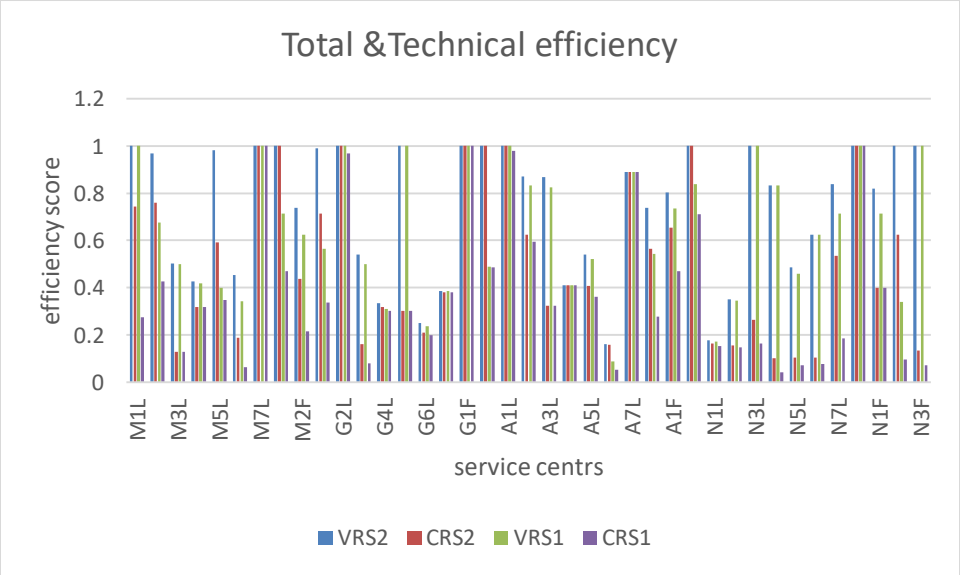
Appendix A



Appendix B: Total and Pure Technical Efficiency of the customers service centres

DMU	VRS2	CRS2	VRS1	CRS1	DMU	VRS2	CRS2	VRS1	CRS1
M1L	1.0000	0.74207	1.0000	0.27516	A3L	0.8675	0.32409	0.824	0.32409
M2L	0.96702	0.75848	0.67669	0.42614	A4L	0.41111	0.41023	0.41111	0.41023
M3L	0.50204	0.12841	0.5000	0.12841	A5L	0.53877	0.40844	0.52031	0.3600
M4L	0.42598	0.31667	0.41667	0.31667	A6L	0.15969	0.15827	0.0885	0.05104
M5L	0.98153	0.59063	0.39897	0.34667	A7L	0.88889	0.88889	0.88889	0.88889
M6L	0.45333	0.18646	0.34146	0.06189	A8L	0.73792	0.56546	0.5417	0.27727
M7L	1.00000	1.00000	1.0000	1.0000	A1F	0.80417	0.65462	0.73582	0.46857
M1F	1.00000	1.0000	0.71429	0.46857	A2F	1.0000	1.0000	0.83856	0.70974
M2F	0.7389	0.43818	0.625	0.21491	N1L	0.17723	0.16228	0.17187	0.15123
G1L	0.99094	0.71236	0.56433	0.33635	N2L	0.3503	0.15419	0.34484	0.1456
G2L	1.0000	1.0000	1.0000	0.96818	N3L	1.0000	0.26405	1.0000	0.16202
G3L	0.53913	0.16000	0.5000	0.0800	N4L	0.83333	0.10019	0.83333	0.04034
G4L	0.3328	0.31641	0.30833	0.3000	N5L	0.48698	0.10304	0.45833	0.06956
G5L	1.0000	0.3000	1.0000	0.3000	N6L	0.625	0.10478	0.6250	0.0750
G6L	0.24869	0.21053	0.23542	0.19773	N7L	0.8375	0.53339	0.71429	0.18344
G7L	0.38500	0.38000	0.38500	0.3800	N8L	1.0000	1.0000	1.00000	1.0000
G1F	1.0000	1.0000	1.0000	1.0000	N1F	0.81853	0.40000	0.71429	0.4000
G2F	1.0000	1.0000	0.48797	0.4869	N2F	1.00000	0.6250	0.33846	0.09524
A1L	1.0000	1.0000	1.0000	0.97939	N3F	1.00000	0.13333	1.0000	0.07201
A2L	0.87141	0.62406	0.83308	0.59448					

*** The DMU used alphabeth and numbers to mask the identity of the service providers*