An Empirical Analysis on the Operational Efficiency of CRM Call Centers in Korea

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Summary
As CRM has come into the spotlight, call center, which is at the cutting edge of CRM strategy, is newly spotlighted as an important communication channel of relationship between company and customer. Since call center handles more than 70% of all customer contacts, there is no doubt that efficient and effective call center operation is vital for ensuring customer satisfaction remains high. Despite the strategic importance of the call center, however, there has been no empirical research completed on the efficiency of call center operation. The purpose of this study was therefore to assess the operational efficiency of call centers in Korea, to indentify the current status and issues of call center operations, and to suggest ways to improve operational efficiency. For this purpose, non-parametric efficiency measurement method, Data Envelopment Analysis (DEA), was applied to cross-sectional data for 43 domestic call centers to compare their relative efficiency. According to the empirical results of applying the input-oriented BCC model of DEA, 19 call centers were identified as efficient call centers while the rest were identified as relatively inefficient call centers. In conclusion, it is anticipated that the methodology suggested herein may be applied to various contexts including call center certification, call center outsourcing management, and call center agents productivity diagnosis.

Key words:
Call Center, Operational Efficiency, Key Performance Indicators, Caller Satisfaction, DEA, CRM, Business Process Outsourcing.

1. Introduction

As more and more companies focus on CRM (Customer Relationship Management), a call center which is a contact point between customer and company, is being illuminated in a whole new light as the core CRM channel. A call center can be understand as either strategic customer marketing center which provides solutions for customer needs and answers questions about the products and services or customer communication center that plays key roles of executing CRM strategy. Recently in accordance with the development of information and communication technology, the traditional call center is transforming into a contact center which utilize multiple communication channels, including fax, email and the Web in addition to the voice medium. Many industries, including finance/banking, communication, manufacturing, logistics and distribution, wholesale and retail, and e-commerce to name a few, have embraced the call center, which can now be found in corporations and government offices of all sizes.

A call center handles over 70% of all customer-company interactions (Feinberg et al., 2002); ergo, it would not be too farfetched to claim that customer satisfaction with call center experiences determines the success or failure of a company. Actually according to a recent survey (Genesys Global Consumer Survey, 2007), it is revealed that 75 % of consumers surveyed worldwide expressed that they would do business with a company based on a great call center experience, and 50 % say the last time they stopped doing business with a company was partly or wholly due to poor customer service.

Having recognized this critical importance of the call center, most companies have been working with key performance indicators (KPI) for their call center, to raise the quality of service, increase customer satisfaction, and enhance the efficiency of their call center operations.

Despite the strategic importance of the call center, however, there has been no empirical research completed on the efficiency of call center operation. Efficient and effective call center operation must first and foremost be preceded by an accurate evaluation of the call center's current operation status. Such an evaluation will allow for the identification of operational trouble spots and bottlenecks and ultimately lead to practical solutions for reducing or eliminating operational inefficiencies.

Therefore, the purpose of this study is to assess the operational efficiency of call centers in Korea, to indentify the current status and issues of call center operations, and to suggest ways to improve operational efficiency. In detail, this paper first examines the level of operational efficiency of domestic call centers; identifies the causes and magnitudes of inefficiency for each input and output; and then provides benchmarking information about how inefficient call centers can become more efficient.

In order to accomplish described above, this study applies Data Envelopment Analysis (DEA) model in measuring and analyzing the operational efficiency of the subject call centers. Unlike many classical methods, DEA is able to

* This study was carried out with the support of the Korea Callcenter Industry Research Center.

handle multiple inputs and outputs simultaneously, even with different measurement units, and does not require a priori weights nor a functional form for input/output relationships.

2. Call Center Overview

2.1 Basic Concepts of Call Center

Call center refers to the on/off line communication channel between company and customer for handling customers' complaints and solving their problems. It can be found in various forms such as customer service center, telemarketing center, help desk and CRM center and is expanded into the areas of entire industry including public sector organizations (Cheong et al., 2004). The most recent trend has been to convert call centers into multiple channel contact centers.

Call center can be divided into the inhouse call center that the company or organization sets up and operates directly or the outsourced call center that the company or organization contracts out the job to an outside agent and uses the services. Also according to the execution function, this can be classified into the inbound call center that customer places a call directly and inquires for the difficulties or problems or the outbound call center that places call directly to customer and performs marketing and sales activities.

It could be stated that call center has evolved through three phases according to the development of technology. First, the PBX (Private Branch Exchange) based call center that has performed the function of inbound customer services while basing on the simple telephone responses can be referred to as the first phase and the introduction of the call center function based on the highly functional integration technology (CTI: Computer Telephony Integration) between computer technology and telephony system can be said as the second phase. Lastly, the third phase would be the integrated IP (Internet Protocol) Contact Center that has based on the network along with the development of internet.

Figure 1, as the diagram of call center that has applied a 3rd party CTI, shows the method that phones are connected to the PBX through a CTI server. In the early days, CTI was at the elementary level that has added the automatic call distribution (ACD) function which connects an empty circuit by regulating incoming calls, but recently it has been expanded into the Internet Telephony Integration (ITI) which integrates multiple channels such as telephone, voice response system, facsimile, Web and e-mail.

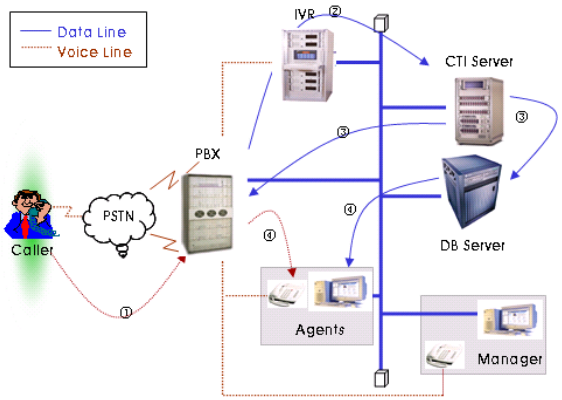

Fig. 1 Architecture of CTI-Based Call Center

2.2 Call Center Market Analysis

In case of USA, there were no less than 50,600 call centers as of 2004 and the number of call center agents had come to 2.8 million people. However, the number of call centers by 2008 is expected to come down to 47,500 sites with 2.7 million agents due to the introduction of self-service technology, increase of offshore call center outsourcing and do-not-call list of federal government. In case of England that constitutes the largest call center market in the European region, agents corresponding to 2.2% of the entire working population have appeared working in the field of call center. This is the number nearly twice as high as the ratio (1.2%) of call center agents throughout the Europe.

In case of the Asia-Pacific region, the number of call center seats in China and Taiwan was found to be 184,000 and 65,000 seats respectively as of 2005 and the call center and telemarketing industry of Japan have employed 140,000 people with 6,500 companies showing a steady growth rate of 50% each year with the market size of 1.8 trillion yen as of 1995. Especially, the number of call center agents in India that is the place spotlighted recently as the target offshore call center outsourcing area of multi-national corporations has come to 120,000 people as of 2004 and the market size of call center has shown a fast increasing tendency of 107% as compared to that of 1 year ago.

The market of South Korean call center industry is expected to show a steady growth from the point of about 10 trillion won in 2007 while recording a very high growth rate for 3~5 years in the future from 5.2 trillion won in 2002 and 6.7 billion won in 2003. Since the call center outsourcing market tends to use specialized agents rather than making direct investments in order to avoid the risks involved in running and building call centers internally by organizations, it is expected that the

outsourcing market will show a rapid growth together with the existing competitors and new entries into the market by large-sized corporations. The call center solution (H/W, S/W) market has shown reduction in the market size since 2001 due to the weakness of international economy and completion of building existing call centers after showing their expansion from the time starting to build call centers for the finance industry in 1998. However, the overseas expansion and continuous growth of solution companies are expected as more diversified and advanced solutions emerge in the market starting in 2002. Previously, companies recognized call center as a simple customer service unit or sales unit, but recently this recognition was shifted into a profit center rather than a cost center together with the recent emergence of customer-oriented paradigm. Hence, this industry is expected to grow at a high rate every year by using the multi-contact center based on CRM (Korean Telemarketing Survey, 2002).

The size of call center outsourcing market throughout the world is expected to grow to a level of 12.2 billion dollars in 2007 from the level of 8.7 billion dollars in 2004. Especially, the number of call center agent seats that has been outsourced to India was 9,900 seats in 2002 and 109,300 seats in 2003 and this figure will come to a level of 241,100 seats in 2007, showing an average growth rate of 12% every year. This is a very high ratio that takes up 5% of the entire market that is expected to grow to 4.78 million seats in 2007. One primary reason that accelerates the offshore outsourcing of call center functions in this way may be the effect of saving labor costs. In other words, while the yearly labor costs per seat of call center in USA is 57,600 dollars, the annual labor costs per seat of call center in the identical size is no more than 8,640 dollars in India. The market of South Korean call center outsourcing is expected to grow to 3.5 trillion won in 2007 and currently, there are about 100 companies that are involved in the call center outsourcing business (Korean Call Center Industry Statistics Report, 2006).

2.3 Key Performance Indicators

Call center is the organization that performs the most important role in determining the level of customer satisfaction of a company (Anton, 2000). Generally, recognition to the company by customer is greatly influenced from the interactions with employee when customers present a complaint to the company (Tax et al., 1998). Accordingly, call center agents that have directly in contact with customer play an essential role in determining impression over a specific company by customers. If call center agents are haughty or does not understand well about customer complaints, the company may experience a great loss from losing customers; on the other hand, if customers are satisfied with the company by responding properly to them, the profits of the company will increase by influencing on the repurchase behavior of customer (Feinberg et al., 2000).

Due to this reason, call center managers emphasizes the quality improvement of customer service that is provided to raise the customer satisfaction. In order to accomplish this, call center manages use various key performance indicators (KPI), but KPIs are not well defined and managed.

As for the KPIs of call center, the metrics presented by the Center for Customer Driven Quality (CCDQ) are commonly used. Jon Anton (1997) has suggested the KPIs of call center by classifying into the operation related indicators, income related indicators, cost related indicators and service quality related indicators and especially as for the key indicators of influencing on customer satisfaction in the inbound call center, he has emphasized the percentage of calls closed on first contact, adherence to schedule, average time in queue, average abandonment rate and average response speed.

Also, Feinberg et al. (2002) have studied the KPIs of call center related to caller satisfaction. They have suggested the 13 KPIs such as average speed of answer, percent of calls closed on first contact, average abandonment rate, average talk time, adherence to schedule, average work time after call, percentage of calls blocked, average time before abandonment, average calls per agent shift, call center calls per year, agent turnover rate, average time in queue, and service level.

The Customer Operation Performance Center (COPC), which is an international call center related certificate authority, evaluates the operation level of call center through a total of 32 measurement indicators for the 4 domains of Leadership/Planning, Process, People and Performance.

The Korea Agency for Technology and Standards (KATS) has established the service specification (KS-A 0976-1) of call center in order to enhance the service competitiveness of call center and here, KATS has stipulated the operation level of customer-oriented call center by 80% or more of response rates within 20 seconds, less than 5% of service abandonment rate and 70% or more of the settlement rate at the first call.

This study has drawn the key performance indicators that call centers commonly use to measure and analyze their call center operations as shown in Table 1.

Table 1: Key performance indicators of call center

KPI	Definition
Service Level	▪ Percentage of calls connected with call center agent within the target time from the total calls entered ▪ Formula: ((number of call responses within X seconds + number of calls abandoned within X seconds) / (total number of call responses + number of abandoned calls)) × 100
Average Speed of Answer	▪ Average time from the connection request of the customer to a response by call center agent
Average Time in Queue	▪ Time in queue for all customers having in connection with the switchboard (calculated by the switchboard) ▪ Formula: accumulated time in queue for the total number of calls in queue / (number of successful call connections with call center agent + number of abandoned calls in queue)
Percentage of Response	▪ Percentage of calls having had in connection with call center agent among the calls requested for the connection with call center agent ▪ Formula: (number of calls having had connection with call center agent / number of calls having requested for call center agent connection) × 100
Average Abandonment Rate	▪ The concept of abandonment in queue is '1-response rate' ▪ The cases that either customer gave up the call or the call was forcefully disconnected by the system due to a timeout prior to a call center agent connection after requesting for a call center agent connection
Percentage of Calls Closed on First Contact	▪ Percentage of calls processed on the first contact ▪ Formula: (calls closed on the first contact) / (total number of calls closed by all call center agents)
Adherence to Schedule	▪ Percentage that the time scheduled to be used for the work time is actually used
Average Talk Time	▪ Time taken in talking with customer
Average After Call Work Time	▪ Upon completion of call, the time taken in closing the job related to the customer service
Agent Turnover Rate	▪ Percentage of agents that have quitted the job as compared to the entire number of call center agents during a fixed period of time ▪ Formula: monthly turnover rate = (number of agents having quitted the job during the month) / (number of agents at the beginning of the month + number of agents at the end of the month) / 2 × 100
Percentage of Calls Blocked	▪ Percentage of calls that have not entered the system in the center because of busy signals
Customer Satisfaction	▪ Score of service satisfaction that was evaluated by the customers of having used the call center by having connection with call center agent

3. Data Envelopment Analysis

Generally, an organization's achievements or performance is subjected to evaluation as a means of determining whether or not that organization is efficient and/or productive. The term *efficiency* can be defined as minimization of inputs under given outputs or maximization of outputs under given inputs and the term *productivity* can be defined as the ratio of inputs versus outputs.[*)]

DEA, a mathematical programming model, and SFA, an econometric model, are two models currently under the spotlight as possible solutions to overcoming the limitations of traditional efficiency measurement techniques. This study, however, opted for the DEA model to measure the relative efficiency of call center management and analyze the causal factors behind call center inefficiency.

DEA is a non-parametric approach that bases itself on linear programming to measure the relative efficiency of multiple decision-making units (DMU) with multiple inputs and multiple outputs. CCR, which assumes constant returns to scale (CRS), and BCC, which deals in variable returns to scale (VRS), are two representative DEA models (Charnes et al., 1978; Banker et al., 1984). They can each be measured from the input perspective (input minimization against output) or the output perspective (output maximization against input), but the input-oriented BCC model was chosen in this study to measure the operational efficiency of domestic call centers.

First, let's take the following assumptions: there are n number of call centers (DMU $k = 1,2,\cdots,n$) using m number of x_{ik} ($i = 1,2,\cdots,m$) inputs to produce s number of y_{rk} ($r = 1,2,\cdots,s$) outputs. In this case, the efficiency of the subject call center k^0 ($k^0 \in \{1,2,\cdots,n\}$) can be expressed as the ratio of weighted sum of outputs over weighted sum of inputs as shown in Equation (1). Here, v_i and u_r are weights for inputs and outputs, respectively, and their values are determined in the DEA model. In addition, the first constraint prevents the calculated solution to exceed 1 and ε included in the second constraint is a constant of a very small value that ensures the calculated solution is a positive number. Therefore, the solution calculated from Equation (1) comes to carry a value between 0 and 1.

Fractional programming models (Equation (1)), however, feature calculative difficulties due to issues of non-linearity and non-convexity and can therefore be converted into linear programming models (Equation (2)). Converting these linear programming models again into a

[*)] Productivity and efficiency are commonly mistaken to mean the same thing and are used inappropriately.

dual program then enables expression as envelopment models (Equation (3)).

$$\max \theta_{k^0} = \frac{\sum_{r=1}^{s} u_r\, y_{rk^0}}{\sum_{i=1}^{m} v_i\, x_{ik^0}} \quad \cdots\cdots (1)$$

$$s.t. \quad \frac{\sum_{r=1}^{s} u_r\, y_{rk}}{\sum_{i=1}^{m} v_i\, x_{ik}} \le 1, \quad u_r, v_i \ge \varepsilon > 0$$

$$\max \theta_{k^0} = \sum_{r=1}^{s} u_r\, y_{rk^0} \quad \cdots\cdots (2)$$

$$s.t. \quad \sum_{i=1}^{m} v_i\, x_{ik^0} = 1,$$

$$\sum_{r=1}^{s} u_r\, y_{rk} - \sum_{i=1}^{m} v_i\, x_{ik} \le 0, \quad u_r, v_i \ge \varepsilon, \quad \forall\, r, i$$

$$\min \theta_{k^0} - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right) \quad \cdots\cdots (3)$$

$$s.t. \quad \sum_{k=1}^{n} \lambda_k\, x_{ik} + s_i^- = \theta_{k^0}\, x_{ik^0},$$

$$\sum_{k=1}^{n} \lambda_k\, y_{rk} - s_r^+ \ge y_{rk^0}, \quad s_i^-,\ s_r^+,\ \lambda_k \ge 0, \quad \forall\, i, r, k$$

Optimal solution $\theta_{k^0}^*$ calculated from Equation (3) expresses the subject call center k^0's efficiency index. When $\theta_{k^0}^* = 1$ and input and output slack variables $s_i^{-*},\ s_r^{+*} = 0$, call center k^0 is relatively efficient and falls in the reference set that serves as the benchmarking target for other call centers. Conversely, inefficient call centers with $\theta_{k^0}^* < 1$ can be made efficient by reducing the scale of inputs or expanding the output volume.

As such, CCR assumes constant returns to scale. In many cases, however, the business scale can influence efficiency evaluation, making simple comparison of call centers of varying scales an unfair approach. Adding $\sum \lambda_k = 1$ to the CCR model's constraints to facilitate comparison of call centers of comparable scales yields the BCC model, which eliminates the impact of scale.

In the end, efficiency derived from the CCR model becomes divided into the BCC model's pure technical efficiency and scale efficiency (total efficiency = pure technical efficiency × scale efficiency. From here, causes of inefficiency can be analyzed to determine whether they are caused by inefficient operation or due to disadvantageous of scale, or both.

Meanwhile, if scale efficiency ($SE = \theta_{CCR} / \theta_{BCC}$) is a value other than 1 (CCR efficiency not equal to BCC efficiency), $\sum \lambda_k^* < 1$ indicates increasing returns to scale (IRS) and $\sum \lambda_k^* > 1$ indicates decreasing of returns to scale (DRS).

4. Empirical Results and Implications

4.1 Inputs and Outputs

The DEA model was used to perform comparative analysis of the operational efficiency of domestic call centers. Here, the 241 call centers registered in Korea Call Center Research Center's (www.callcenter.or.kr) Call Center Operation Level Diagnosis System was referenced and 43 call centers having all the necessary data were chosen as evaluation subjects (DMUs) of the study. Table 2 shows descriptive statistics of the selected call centers.

Application of the DEA model requires selection of common inputs and outputs that are most suitable for the situations of the chosen call centers. This is an issue with direct association with the model's validity and thus requires close attention. It's important to opt for minimal inputs and outputs so that a high discriminating power can be achieved for the model.

In order to take metric measurements of labor and capital, which are inputs that traditionally define general efficiency analysis, number of agents and number of agent seats were used as proxies for labor and agent training hours and average agent wage were used for capital. Meanwhile, first call resolution and service level were chosen as outputs under the assumption that the ultimate goal of call center operation is customer satisfaction, for these two indicators exhibited the most significant correlations to customer satisfaction from all call center KPIs.

Although no agreed method for optimal selection of the number of inputs and outputs has been presented, it's a general understanding that the number of DMUs (call centers) should be greater than three times the sum of the number of inputs and outputs (Boussofiane et al., 1991; Nyhan and Martin, 1999). Since the study was conducted on 43 call centers, call center efficiency analysis based on four inputs and two outputs deemed appropriate.

The call center can be conclusively defined as a business unit into which number of agents, number of agent seats, agent training hours, and agent wages are inputted to

produce first call resolution, service level, and other operational performances for the overall goal of customer satisfaction. And, when a particular call center produces the same results as other call centers using a combination of less inputs in the process of converting multiple inputs into outputs, that call center can be said to be operating at a relatively more efficient state.

Table 2: Descriptive statistics of input and output variables

Category	No. of Samples	No. of Agents	No. of Agent Seats	Agents Training Hours	Agent Wage	FCR (%)	SL (%)
Finance/Banking	13	179	216	175	1,460	83	84
Communications	13	184	223	171	1,468	89	78
Manufacturing and Distribution	13	60	80	131	1,472	86	91
Public Sector	4	37	48	104	1,700	88	91

Note 1: FCR: First Call Resolution, SL: Service Level
Note 2: Wage unit: KRW million

4.2 Efficiency Analysis

Results from efficiency analysis of the 43 call centers by applying input-oriented BCC model of DEA to the selected input and output variables from above are summarized in Table 3. Here, DEA Excel Solver was used as the analysis tool (Cooper et al., 2000).

The efficiency measurements revealed that Korean call centers are operating at an average efficiency of 77.3%. In comparing by industry, call centers in the manufacturing and distribution sector and the public sector showed highest operating efficiencies at 88.1% and 93.7%, respectively, whereas the finance/banking sector and communications sector revealed below-average efficiencies at 73% and 65.8%, respectively. Specifically, 19 call centers with efficiency index of 1 (100%) were found to be operating efficiently and 12 of these 19 call centers, with pure technical efficiency of 1 and scale efficiency of 1, were found to be operating at the most productive scale size. On the other hand, inefficient call centers with efficiency index of less than 1 were deemed to be in need of benchmarking the efficient call centers to improve their input-output structures.

Applying the pure technical efficiency and scale efficiency concepts from Table 3 makes it possible to determine whether the cause of inefficiency is purely from the operating side or due to the effects of the input-output scale.

Table 3: Estimated results of call center efficiency

	Call Center (DMU)	DEA-BCC Model		SE	RTS
		PTE	Benchmarking Target (λ)		
Ce/Ba	call center 01	0.219	15(0.071) 34(0.876) 39(0.053)	0.936	CRS
	call center02	0.600	28(0.765) 34(0.118) 38(0.118)	0.215	DRS
	call center03	0.515	12(0.016) 15(0.304) 34(0.260) 35(0.419)	0.999	CRS
	call center04	0.670	12(0.405) 15(0.322) 34(0.156) 35(0.117)	0.978	CRS
	call center05	**1.000**	-	0.545	DRS
	call center06	**1.000**	-	0.862	IRS
	call center07	0.600	28(1.000)	0.534	DRS
	call center08	**1.000**	-	0.705	IRS
	call center09	0.911	28(0.390) 34(0.118) 38(0.493)	0.756	DRS
	call center10	0.735	15(0.283) 28(0.065) 31(0.080) 34(0.106) 35(0.143) 38(0.323)	0.942	DRS
	call center11	0.932	15(0.203) 33(0.554) 38(0.243)	0.974	CRS
	call center12	**1.000**	-	**1.000**	CRS
	call center13	0.307	12(0.129) 15(0.146) 34(0.725)	0.849	CRS
Communication	call center14	0.200	12(0.178) 34(0.822)	0.923	CRS
	call center15	**1.000**	-	**1.000**	CRS
	call center16	**1.000**	-	0.405	DRS
	call center17	0.408	06(0.002) 15(0.707) 34(0.291)	0.999	IRS
	call center18	**1.000**	-	**1.000**	CRS
	call center19	0.850	28(0.390) 34(0.118) 38(0.493)	0.497	DRS
	call center20	0.232	12(0.117) 34(0.883)	**1.000**	CRS
	call center21	0.289	12(0.131) 18(0.044) 34(0.629) 35(0.195)	0.989	CRS
	call center22	0.775	12(0.009) 15(0.137) 34(0.476) 39(0.378)	0.923	CRS
	call center23	0.691	15(0.538) 34(0.191) 35(0.271)	0.986	CRS
	call center24	0.686	28(1.000)	0.501	DRS
	call center25	**1.000**	-	**1.000**	CRS
	call center26	0.421	12(0.118) 15(0.098) 28(0.490) 34(0.294)	0.765	DRS
Manufacturing & Distribution	**call center27**	**1.000**	-	**1.000**	CRS
	call center28	**1.000**	-	0.954	DRS
	call center29	0.231	12(0.070) 15(0.160) 34(0.764) 35(0.006)	0.998	CRS
	call center30	0.703	12(0.293) 15(0.379) 27(0.085) 34(0.206) 42(0.037)	0.998	CRS
	call center31	**1.000**	-	0.941	DRS
	call center32	**1.000**	-	**1.000**	CRS
	call center33	**1.000**	-	**1.000**	CRS
	call center34	**1.000**	-	**1.000**	CRS
	call center35	**1.000**	-	**1.000**	CRS
	call center36	0.776	15(0.724) 28(0.087) 31(0.081) 34(0.005) 38(0.103)	0.918	DRS
	call center37	0.743	12(0.007) 15(0.203) 27(0.152) 34(0.135) 35(0.247) 38(0.257)	0.952	CRS
	call center38	**1.000**	-	**1.000**	CRS
	call center39	**1.000**	-	**1.000**	CRS
Public Sector	call center40	0.985	12(0.017) 34(0.232) 38(0.294) 42(0.456)	0.711	CRS
	call center41	**1.000**	-	0.548	DRS
	call center42	**1.000**	-	**1.000**	CRS
	call center43	0.763	12(0.044) 15(0.191) 27(0.126) 34(0.113) 35(0.470) 38(0.056)	0.982	CRS

Note: PTE (Pure Technical Efficiency); SE (Scale Efficiency); RTS (Returns to Scale); CRS (Constant Returns to Scale); DRS (Decreasing Returns to Scale); IRS (Increasing Returns to Scale).

Hence, it can be said that the 6 call centers whose BCC model pure technical efficiency is 1 but scale efficiency is less than 1 are operating efficiently with the exception for the effects of scale, identifying the cause of inefficiency in these cases to be entirely associated with scale. Here,

careful consideration has to be given to adjustment to the concerned call center's scale, i.e. whether inputs in the concerned call center should be increased or decreased. While it is possible to increase the efficiency of call centers operating at increasing returns to scale (IRS) by expanding the scale of inputs, call centers operating at decreasing of returns to scale (DRS) are currently operating with inputs beyond their most productive scale size and streamlining the operating process can be considered rather than investment into input resources. Lastly, call centers whose pure technical efficiency and scale efficiency are both less than 1 can be interpreted as having inefficient causes on both operating and scale sides, where the side with the relatively lower value contains the main hindrance to overall efficiency.

Table 4: Slacks for the inefficient call center

Call Center22 (0.775)		Actual	Target	Improvement (%)	Benchmarking Target(λ)
Input	No. of Agents	100	77	-23 (-22.5%)	call center12(0.009) call center15(0.137) call center34(0.476) call center39(0.378)
	No. of Agent Seats	160	95	-65 (-40.7%)	call center12(0.009) call center15(0.137) call center34(0.476) call center39(0.378)
	Agent Training Hours	33	25.6	-7.4 (-22.5%)	call center12(0.009) call center15(0.137) call center34(0.476) call center39(0.378)
	Agent Wage (10,000)	1,500	1,162	-338 (-22.5%)	call center12(0.009) call center15(0.137) call center34(0.476) call center39(0.378)
Output	First call resolution (%)	78	81	3 (3.8%)	call center12(0.009) call center15(0.137) call center34(0.476) call center39(0.378)
	Service Level (%)	88	88	0 (0%)	call center12(0.009) call center15(0.137) call center34(0.476) call center39(0.378)

Table 4 contains results from in-depth analysis of causes of inefficiencies and ways of their improvement for call center 22, which the DEA model found to be running inefficiently. Call center 22's efficiency index was 0.775, and its cause of inefficiency is believed to be stemming from the operating side rather than the scale side (refer to Table 3). Ergo, benchmarking the reference set (call centers 12, 15, 34, and 39) is needed to enhance the operating efficiency of call center 22. In particular and of the reference call centers, call center 34 features the highest weight (λ) and is therefore the most similar to call center 22 in terms of their input-output structures and should therefore be the most appropriate benchmarking target. Comparison of call center 22 with the reference set revealed how the call center's input-output should be restructured, and results from analysis of the difference between call center 22's actual figures and improvement target figures projected on the efficient frontier are presented in Table 4. In other words, call center 22 is experiencing excessive investment throughout all of its inputs and excessive output of first call resolution. To reach efficient operation, call center 22 needs to close the gap between the actual value and the target value.

5. Conclusions and Recommendations

The sudden inflation of the call center market recently brought on by labor shortage in metropolitan areas and aggravating operating costs has made rural relocation of call centers a serious matter of consideration for corporations running these call centers. In response, many of the regional municipalities are aggressively engaging in enticing metropolitan call centers to their respective areas. Their proactive luring campaigns that offer tax exemptions, subsidies, office lease support, and other incentives are in fact resulting in rural relocations of many major call centers. As such, the number of rural call centers are continuing to rise thanks to the favorable policies of these municipalities (relocation & construction and expansion), but support for enhancement of operational efficiency of these call centers still remain insufficient.

To this end, this paper presents a methodology for assessing the operational efficiency of call centers and, based on the empirical findings from call centers operating in Korea, analyzes the causes of input-output structure inefficiencies and their scales. This analysis will be able to assist in identifying the detailed status of operational efficiency in the Korean call center industry, and the causes of inefficiency and their scales identified in this study will be able to contribute to the solidification of plans to cultivate the call center industry.

The outlook for the call center market is continued expansion, and demand for efficient and effective call center operation will also make its presence, which will in turn call for objective and scientific measurement and evaluation of the call center operation. To this end, this study will be able to serve as a means of providing suitable answers to the aforementioned demands.

In conclude, it is anticipated that the methodology suggested herein may be applied to various contexts including call center certification, call center outsourcing management, and call center agents productivity diagnosis. In particular, this study carries a meaning in that it offers the groundwork for development of a realistic support program aimed at increasing the efficiency of the call center operation.

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