Flexible Workforce Management System for Call Center: A case study of public sector

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Abstract

Call centers play an essential role in today’s business world. They serve as the ‘public face’ for many firms and their services are directly connected with customers’ perceived quality. Typical inbound call centers are very labor-intensive operations and workforces are the main cause of the cost in call center. And they also affect the customers’ experience in call center. Therefore, many call centers try to manage their workforces more effectively. To this end, WFM (workforce management) systems, computer programs or solutions which can support several tasks required for workforce management, have been used in most call centers. But, in recent, advances of technologies and emerging strategies are applied to call center industry, and these are changing the environment of call center workforce management. To respond to such changes of environment, WFM system should be more flexible. In this paper, we will introduce the current and projected changes for call centers and propose a flexible design of WFM system through a case of a public corporation. Call centers for public sector organizations are in great demand in recent and therefore, our study will be able to provide a good insight into the future directions of call centers and WFM systems. We also have built a web-based WFM system for the public corporation. Because of the flexibility of the system, it is applicable to various conditions of the corporation. Therefore, our system can make call center of the corporation adaptive and agile. As a result, effectiveness of the call center operations can be enhanced and the corporation also will be able to manage their customers’ perceived quality more effectively.

Keywords: Call center; Workforce management system; Public sector organization

1. Introduction

Call centers are an integral part of most industries today. They play an essential role in today’s business world, and are often the primary source of contact for customers. And companies that focus on customer loyalty are increasingly using their centers to differentiate their product or service offering and drive customer satisfaction (Miciak and Desmarais, 2001). Cutting cost and enhancing effectiveness of call center are directly connected with strengthening the competitiveness of the companies.

According to Gans et al. (2002), almost 60 to 70 percent of the total costs for operating a call center involve wage and benefit expenses for personnel. It follows that determining the optimal amount call center workforces and scheduling them based on this are of great interest to call center managers. These tasks are called workforce management (WFM). Regardless of the size or complexity of operations, most call centers have discovered the need for some form of WFM to help them meet a common goal: Maximize efficiency, while controlling costs and increasing revenues (Sterns, 1998). In most call centers there is a planner that is responsible for workforce rosters. Every week or every few weeks, this person begins preparing a forecast for the specified period. Based on this forecast, required numbers of CSR (Customer Service Representative) s are determined and, together with workforces and management input (concerning days off, meetings, etc), rosters and schedules are determined (Gans et al., 2002). This typical process of workforce management is very often supported by WFM systems in call centers. WFM systems are an integral part of modern call centers.

According to Aksin et al. (2007), however, call center industry is growing very fast, and as telecommunications and information technology have advanced over the past several years, new structures and strategies of call centers became possible and the operational challenges faced by call center managers have become more complicated as a result. Therefore, WFM systems should be applicable to various sites which have different strategies, structures and characteristics. Flexible and highly re-usable systems are also required.

In this paper, we will introduce a flexible WFM system development case of a public corporation in Korea. We have developed WFM system for call center, which is under construction, of the corporation. And because of undetermined structure of the call center, our system had

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to be flexible. We will introduce the design issues and propose a flexible design of WFM system in this paper. This was achieved by managing tasks and data related to workforce management process by a unit called ‘management project’. There were similar concept before but we approach from the architectural point of view and outline the structure of it. And design issues in modern call centers are also discussed through the case. Because call centers for public sector are paid much attention in recent, this case can provides a good insight into the future directions of call centers and WFM systems.

The remainder of this paper is organized as follows: In section 2, we present a literature review on call centers and WFM systems. In section 3, we introduce typical workforce management tasks and discuss the design issues in the target call center which can affect WFM system. The concept and structure of management project will be explained in Section 4. And Section 5 describes the WFM system which we built. Finally, concluding remarks and the direction of further research are offered in Section 6.

2. Literature review

2.1 Traditional call center problem areas

Inbound call centers make up a large and growing part of the global economy (Aksin et al., 2007). And there is increasing executive consideration of their vital role in customer acquisition and retention. Hence, call centers have emerged as a fertile area for academic research.

Traditional approach to operations management in call centers was applying mathematical models and techniques to those. The main goals of this area are as follows: (i) to forecast inbound call volumes in future, (ii) to determine the minimum number of CSRs to serve inbound calls of forecasted volumes and (iii) to schedule actual CSRs. To this ends, conventional statistical analyses were used, but among them, queueing theories form an important theoretical basis of such research areas (Brown et al., 2005; Mandelbaum et al., 2005). Queueing theory was conceived by A.K. Erlang at the beginning of the 20th century and has flourished since to become one of the central research themes of Operations Research. In a queueing model of a call center, the customers are callers, the servers are CSRs or telecommunications equipment, and queues are populated by callers that await service (Brown et al., 2005). And queueing theories are widely used to model and evaluate call centers.

Since the call centers’ largest expense generally lies in its agent staff, it is natural for management to focus on the workforce angle of the operation. Koole (2005) provided an overview of general aspects of required tasks for this: Forecasting, Staffing and Workforce scheduling. And the tasks compose the main flow of workforce management and usually are built in WFM systems, which are software tools which are used to support them. Gans et al. (2002) emphasized the important role of WFM system in call center and some researchers (Kowal and Mielke, 2006; Wise, 2006) outlined the functions of it.

2.2 New trends in call center operations management

Besides the traditional research area, as Aksin et al. (2007) mentioned in their survey paper, the call center landscape has been altered by a wide variety of managerial and technological advances in recent years. Reduced information technology and telecommunications costs – the same forces that have contributed significantly to the growth of the call center industry – have also led to rapid disaggregation of information-intensive activities. For call centers, this has translated into increased contracting of call center services to third parties and the dispersion of service delivery to multi-sites. And there are several other changes and advances in call center operation management in recent. As a result, new strategies have become operable and call centers of various structures have emerged and infrastructures and equipments for operations of them were introduced. But traditional approach related to workforce management is still important to call centers of any structure and WFM system is an integral system for most of them. For effective management of the multiplicity of call centers, WFM system should be flexible and applicable to various sites which have different strategies, structures and characteristics. To this end, we studied flexible design of WFM system in this paper.

Currently, flexibility is assumed to be of the most important requirements for firms to survive and prosper in turbulent and unpredictable environments (Dreyer and Gronhaug, 2004) and many researchers recognized flexibility as the key success factor for organizations to sustain competitive advantage. Our flexible WFM system can help to make call centers adaptive and agile. Also, the effectiveness of call center can be enhanced.

2.3 Call centers for public sector

In recent, efficient and effective customer service has become just as critical in the public sector as in most service-oriented industries, and the necessity of call centers in public sector is emphasized (Lee, 2005). Especially, in Korea, call centers for public sector are important part of e-government project and many of them are being introduced at a good pace. But although the characteristics of public sector organizations should be studied for success of call centers in public sector (Oh, 2005), there are few researches on the operational management of them yet. And we will discuss the characteristics and projected problems of the centers, and propose a flexible WFM system in this paper.
3. Characteristics and projected problems of the call center

In this section, we introduce typical workforce management tasks and call handling structure of the public corporation at first. And some design issues will be also presented and discussed.

3.1 Basic workflow of workforce management

For typical workforce management, several steps are required. Basic workflow of workforce management is described in Figure 1. At first, forecasts should be made using historical data and forecasting models like time-series or regression models. Next, required numbers of CSRs are computed based on the forecasts. Erlang-C traffic law based on the queueing theory and several variations of the model are widely used for this purpose. Erlang-C traffic law assumes call centers to be so-called M/M/N system, sometimes called the Erlang-C model. Given arrival rate $\lambda$, average service duration $\mu^{-1}$ and $N$ servers working in parallel, performance measures of the system like the expected value of customers’ waiting time or long-run fraction of time that all $N$ servers will be simultaneously busy can be computed. Therefore, if there are service-level constraints in terms of such measures, required number of CSRs can be determined. Finally, schedule of actual CSRs should be made. This can be viewed as conventional scheduling problem and optimization algorithms or heuristics can be used. Finally, scheduled periods are processed using the schedule and observed data will be stored. And these data will be used in forecasting next period. As described in Figure 1, the basic workflow of workforce management is cyclic.

![Figure 1. Basic Work Flow of Workforce Management](image)

3.2 Call handling structure of the public corporation

Figure 2 describes the current call handling structure of our target public corporation. As panel (a) in the figure shows, the public corporation has 55 distributed branch offices. Customers must make a phone call to one branch office to talk to CSRs. Each branch office has own phone number. And the public corporation has two types of workforces, who are also distributed. One is officials and the other is CSRs. Officials have superior authorities to resolve the calls but call handling is not their main business. On the other hand, CSRs are devoted to call handling but their authorities are limited. In each branch office, incoming calls are handled by CSRs basically, but some of them should be transferred to officials in the same branch office. This is described in panel (b).

![Figure 2. Current Call Handling Structure of the Corporation](image)

The public corporation wanted to establish new call handling structure shown in Figure 3. Incoming calls arrive in call center through one number, and all calls are resolved only in the call center. Officials don’t handle the incoming calls at all.

![Figure 3. Target Call Handling Structure of the Corporation](image)
figure 3. To this end, several decisions should be made. In the rest of this section, we will discuss such design issues and their influences on WFM system.

3.3 Organizational structure of the call center

Call center in figure 3 can be centralized or distributed. Centralized call center has a single-site and it can realize the economy of scale. On the other hand, distributed one has multi-site structure and it allows for geographic risk mitigation and enables tapping different labor pools. And as Aksin et al. (2007) pointed out, the decision of a single-site versus multi-site structure is typically a strategic one. Our customer, the public corporation which has 55 distributed branch offices, considered three alternative organizational structures described in Figure 4. Panel (a) describes fully distributed structure. CSRs also will be distributed to call centers and each call center handles the calls from their own territory. Modern call center infrastructure enables such identification of incoming calls, as well as the subsequent routing of them. And the call centers can be built in each current branch office. This structure is similar with panel (a) in Figure 2 except that there is no transferring to officials. Panel (c) in Figure 4 describes the fully centralized structure. There is single call center in this structure and it handles all of incoming calls. And panel (b) describes a compromise structure. Some branch offices are grouped and there is one call center for each group. Each call center handles incoming calls from the territories of branch offices in corresponding group. Building a new call center(s) is often required for the structures in panel (b) and (c).

Unfortunately, organizational structure of our target call center was not determined after development of our WFM system started. Furthermore, modern call center infrastructure enables flexible changes in organizational structure. For example, physically distributed call centers and CSRs can be virtually centralized using call routing and workforce pooling technologies as the need arise. Therefore, WFM system should be applicable to any organizational structures. To this end, we have decided to manage call centers which have different territories separately and this was achieved by managing workforce management tasks and data by a unit called ‘management project’.

Figure 4. Organizational Structures of the Call Center
It can be thought that one management project corresponds to one organizational structure and users of WFM system should be able to create them flexibly. Management project will be explained later.

3.4 Workforce Assignment and Call Center Outsourcing

In any organizational structure, there are CSRs in each call center. So, users also should be able to assign CSRs to call centers flexibly. To this end, we used an entity called ‘management object’. It corresponds to one call center in this paper and one management project has one or more management objects. Users create a management project at first, and management objects of it, and finally, assign CSRs to each management object.

Furthermore, there was another issue on workforce assignment. In the new call handling structure shown in Figure 3, CSRs have increased workload because no transferring to officials is allowed. Therefore, number of CSRs also should be increased. And many organizations in public sector consider outsourcing their call center operations to companies that specialize in running other organizations’ call centers. But, in general, the employment flexibility is low in public sector and our target public corporation focused on co-sourcing, where some calls are kept in-house and others are outsourced. Therefore, both in-house and outsourced CSRs should be able to assign to management objects flexibly.

3.5 Flexible Forecasting Methods and Basic Information

Typical workforce management process starts with forecasting, which is the most critical step in workforce management because forecasts are used as bases of next steps. As mentioned above, forecasting models like time-series or regression can be used to compute forecasts. And forecasting model which makes forecasts with low errors should be selected for effective workforce management. But effective forecasting model for one call center can be not effective for other call centers. Furthermore, effective forecasting model also can not be effective in future on account of changes in policies or business environments. Therefore, every management project must have forecasting model which can be selected and revised flexibly.

In addition to that, basic information about call center is also required in forecasting step. For example, workforce management is unnecessary for off-hours or off days. These must be considered in management project. And forecasting models use historical call data to compute forecasts. Most of them assume call arrivals have some trends or seasonabilities and these are appeared repeatedly. And for effective forecasting, future call arrivals must be ‘similar’ with historical data and trends or seasonabilities must remain unchanged in future. But this is not the case with real call centers. Therefore, it is required that a management project is operated for a specified period, through which trends or seasonalties of call arrivals are expected to be not changed much. Similarly, period of input historical data also should be selectable by users.

There can be other information related with operation of workforce management and management project should be able to include them. That is, there is basic information required to create management project. And if forecasts are determined, next steps are relatively straightforward and we omit them in this paper.

4. Management project in WFM system

To cope flexibly with the issues mentioned in previous section, our WFM system manages tasks and data required for workforce management by unit called ‘management project’. In this section, we illustrate the concept of management project and model the structure of it.

4.1 Required Information for Workforce Management Tasks

To operate each task of basic workflow, related information is required. Some of them are policy of the call center, like service level or working hours. And others can be used for input variable to related models. Required information related to workforce management tasks is listed in Table 1. Some of them are deduced from discussion in Section 3, and others are required for basic workforce management process. Not all of them are mandate for all call centers, but call center managers should understand their meanings. The left hand column lists the workforce management tasks and the right hand column provides required information for the tasks.

4.2 Management project in our system

Related information listed in table 1 can be changed and WFM system should be able to handle such changes. And we have decided to manage tasks and data related workforce management by a unit called management project. In creating management project, users can set related information in table 1 for the project. Therefore, flexible workforce management will be possible. In practice, users create a management projects at first. And they will register it to the system. At the beginning of management period of the project, it will be started and cyclic workflow in Figure 1 is executed.

According to the list in table 1, we designed the structure of management project. It has basic information which describes the general aspects of the project, policies like working hours and off day, etc. Next, management object is very important component of management project. One management object corresponds to one call center, and the whole inbound calls are divided according to management objects. For example, consider 5 branch offices A, B, C, D and E and inbound calls are arrive to those. And let’s assume that A, B and C are managed together. And D and E are managed individually. Then,
Table 1. Required Information for Each Task

<table>
<thead>
<tr>
<th>Workforce Management Tasks</th>
<th>Required Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forecasting</td>
<td>Possible source of planning data</td>
</tr>
<tr>
<td></td>
<td>Routing options which have impact on data collection and forecasting</td>
</tr>
<tr>
<td></td>
<td>Management period</td>
</tr>
<tr>
<td></td>
<td>Period of historical data which will be used</td>
</tr>
<tr>
<td></td>
<td>Forecasting model and input variables</td>
</tr>
<tr>
<td></td>
<td>Management objects</td>
</tr>
<tr>
<td></td>
<td>Trend and seasonality in historical data</td>
</tr>
<tr>
<td></td>
<td>Impact of special events on the forecast</td>
</tr>
<tr>
<td></td>
<td>Working hours and off days</td>
</tr>
<tr>
<td></td>
<td>Call hierarchy</td>
</tr>
<tr>
<td></td>
<td>Most detailed time for forecast</td>
</tr>
<tr>
<td>Determining the numbers of</td>
<td>Policy of service level</td>
</tr>
<tr>
<td>required</td>
<td>Method for calculation of staff workload</td>
</tr>
<tr>
<td>CSRs</td>
<td>Computational model for determining the number of required CSRs and input variables</td>
</tr>
<tr>
<td></td>
<td>Factors that influence staffing numbers</td>
</tr>
<tr>
<td>Making the schedule of actual</td>
<td>Schedule optimization model and input variables</td>
</tr>
<tr>
<td>CSRs</td>
<td>Available CSRs list</td>
</tr>
<tr>
<td></td>
<td>Types of tasks which CSRs handle</td>
</tr>
<tr>
<td></td>
<td>Scheduling policies</td>
</tr>
<tr>
<td>Processing the scheduled</td>
<td>Update model for forecasts, required numbers of CSRs and schedules</td>
</tr>
<tr>
<td>period</td>
<td>Important performance measures</td>
</tr>
</tbody>
</table>

Figure 5. Structure of Management Project
three management objects are required: first one is a group of A, B and C, second and third one are for D and E respectively. Each object will manage corresponding branch offices. One management project has one or more management objects and workforces are assigned to exactly one management object. Several mathematical models or algorithms and related input variables are also required and there are three related data for a management project: (i) call statistics and forecast data, (ii) staffing data and (iii) schedule data. This structure of management project is described in Figure 5.

One management project has many attributes and related entities but they help users to design their management project flexibly. And for usability and convenience of implementation, registration of a management project in our system has several steps in our system. Whole lifecycle of a management project in our system which includes these steps is described in Figure 6. At first, basic information is set. Next, forecasting model and management objects are determined, and these steps are followed by assignment of CSRs to management objects. When all information required for a management project is determined, before the registration of it, there is an initialization process, in which historical data is organized. And next, the management project is registered to the system. Registered project will be started at the beginning of management period and finished at the end of the period. Information and data of finished management projects are remain on data storage and users can reference them.

Figure 6. Whole Life-Cycle of a Management Project

(a) web-page for setting basic information

(b) web-page for forecasting model

(c) web-page for management object

Figure 7. Registration of Management Project
Figure 8. Assignment of CSRs

Figure 9. List of Registered Management Projects

(a) Forecasting data

(b) Requirements data

(c) Schedule data

Figure 10. Workforce Management Data
5. A web-based WFM system applied to the public corporation

We have built a web-based WFM system. The concept of management project was used and this system was applied to call center of a public corporation in Korea. And the system is presented in this section. Figure 7 shows the web-pages related to registration of management project. At first, panel (a) is used to set basic information. Next, users open the web pages shown in panel (b) to register forecasting model, and (c) to create management objects.

CSRs are assigned to management objects using a web page shown in Figure 8. Users can select CSRs from the list of them, and they are assigned to management objects. Then, registration of management project is completed.

Figure 9 depicts the list of registered management projects. If users click name of one management project, they can see information of it. Also, registered management projects are editable until their management period starts.

And three types of data will be created and updated during the management period and user can see them as presented in Figure 10. After users select one of registered management projects from the list in Figure 9, they can open the web pages in Figure 10 and will be provided with data of the management project.

6. Concluding remarks

Effective call center management becomes very important in today’s business world. WFM system can be very useful tool for this purpose. But with the growth of call center industry and advances of technology, environment and strategies of call centers are changing and WFM system should be adaptive to such changes.

In this paper, we introduced a case of public corporation. Current and projected design issues of the corporation are also discussed. And we proposed a flexible design of call center WFM system and an outline of the concept and the structure of management project. Effective workforce management can be achieved with this system. This will also enhance the services of the public corporation. Because many public sector organizations have some common features, like distributed branch offices or low employment flexibility, similar issues can arise in other call centers for public sector. And our case will serve as a good reference for those.

But the concept of management project must be refined more yet. Therefore, as a further work, we’d like to apply the flexible design of WFM system to various call centers. Cooperative operations between flexible WFM system and other systems in call center are also important.

References


