Using Information Technology on Customer Relationship Management

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Abstract: - The hotel industry takes the quality of services as its priority. How to control customers’ habits of livelihood, dining, and activities is the key to provide high quality services. Therefore, data collection of customers is indispensable for promoting customer relationship. Establishing a good customer relationship is a focus in enterprise management, however, this principle has altered its manner along with the coming of E-Commerce. In the past, the customer relationship was built based on long term and direct business interactions. The relationship between hotels and customers now connects through the internet, which changes traditional business patterns as interactions between hotel and customer become increasingly frequent and leads to difficulties integrating information. For example, the system of room reservations cannot progress synchronously with the system of habitations. The first line attendants are unable to know customers’ information and this drawback decreases the quality of service. We will supply hotels a new system in order to deal with this trend, and its new challenges. The new platform will combine exterior website and interior hotel management systems to provide complete and effective information and service. In terms of customers’ benefits, our new system will offer abundant, relevant hotel information, such as facility introductions, but also integrate with reservations for rooms, restaurants, and conference centers. In other words, it helps customers to access services much easier. Concerning hotel preferences, RFID room cards transfer customers’ consumption habits to our system, which will statistically analyze the data, predict customers’ needs, and simultaneously provide first line attendants this reference. In this way, the attendants can know the customers’ preferences and offer satisfactory service. The hotel’s administrators will also instantly obtain hotel’s operational conditions, such as the frequency of facility employments or reports of restaurant revenues. The purpose of this system intends to narrow the distance between the customer and hotel operators. By utilizing this system to statistically analyze information and design individual services, customers will experience thoughtful considerations from the hotel. This strategy will further raise the customers’ values, build up a solid customer loyalty, and eventually promote the hotel’s market competitively.

Key-Words: - IT, CRM, Data Visualization, Data Analysis, Local

1  Introduction
1.1 Research background and movies
In the electronic era, using information technology and Internet in enterprise operation refers to the key factor to assist the business managers in transforming the data collected into valuable information, provide analysis, help make policies on operation and management, control enterprise performance and development, which is to improve the enterprise’s competition edge. According to Chou, in enterprise operation, in addition to improving the sales and profits by means of enlarging the market share, customer management should be a more important loop for profit making. The value of customer relationship management lies in assisting the enterprise and customer in establishing a one-on-one relationship model, strengthening the enterprise’s ability of marketing, selling and providing services [1].

Application of wireless technology in daily life has been the trend. Some countries such as Europe, America and Japan have played an active role in applying wireless technology to industrial logistics, daily life, business and other relevant fields [2]. Radio Frequency Identification (RFID) is the automatic identification technology targeting RF radio frequency identification. In this technology, RFID Reader is used to transmit radio wave and read the memory ID planted or pasted on the object Tag via a contact less method for identification and capture of radio data. Currently, RFID is mainly used in logistic tracking and warehouse management,
as well as Taipei Easy Card in everyday life, automatic book borrowing and returning machine used in libraries, campus IC card and door access control and hospital supervision systems. RFID is at present used in a variety of places. Therefore, it shall be quite appropriate to apply RFID in contactless object identification and positioning [3]. The enterprises shall continue investing more in RFID to integrate this technology and CRM (Customer Relationship Management) system. The trend in the CRM market is to further integrate the enterprise value chain. The enterprises are required to integrate or even transform the entire point-to-point value chain system. Only by doing this, can the customer relationship be deepened. For instance, in the pharmaceutical industry, tags can be reserved on the inventory and these data can be integrated into the CRM solutions. If a batch of medicine is proved wrong, the manufacturer can quickly trace the entire flow and notify the personnel in service center and sales department to warn the clients [4]. When resorts, conferences, theme parks, amusement parks, restaurants and department stores are penetrating business hotels, franchises, branches, groups and alliances, etc, many difficulties are confronted in integrating information and resources while relying on informationization. For instance, reservation cannot be synchronized with the housing system and the front-line service personnel cannot control information on customers, which can severely compromise the service quality.

1.2 Research purposes
This research aims to explore potential and useful information from the possessed data and provide service providers with an entire new platform by utilizing and combining the relationship between customers and service providers via a radio identification system and following the concept of CRM data storage and data exploration and by using research information analyzing tools. Meanwhile, the research directly combines information technology with the front-line working environment, assists managers at various departments in supervising businesses in real time. Still, the research must provide “must know” information and transmit these key data. In addition, the research shall integrate external websites and internal management systems to provide complete and valid information and services. As for customers, the research shall provide abundant relevant visual information, including room 3D tour and introduction to leisure and facilities as well as integrating services such as room reservation, restaurant seats reservation and conference hall reservation, etc, which can help customers make online reservations easily. As for restaurants, RFID room card can help collect information on customers’ consumption. If restaurants could record the basic information of consumers’ consumption via RFID technology, perform statistical analysis on customer information collected, it can better provide tailor-made services and improve customers’ loyalty.

2 Research Method
2.1 Literature review
According to Chen, customer relation management refers to the process to search extensively and store all the data of relevant customers by using information technology and analyze them to acquire useful knowledge behind, and then apply this information to assist in making decisions and planning relevant corporate operations and implement them [5].

In the electronic era, the technology of computers and network predisposes the industry to meet various internal expectation and demand of each customer, interact with and support customers to improve the value of service quality that satisfies the customers and strengthen the customers’ loyalty, which is regarded an advantageous win-win operation model and becomes the kernel technology for corporate competition. In addition, it could help keep potential regular customers and even attract more new customers. In terms of establishing the customer relationship service system, the sales personnel and the senior supervisors are expected to play an active part in establishing and maintaining good customer relationship, which is to keep their commitment to and show the responsibility for customer relationship. The electronic era requires a service system with higher quality, better reliability, low cost and high added-value to strengthen the service agency of customer relationship and create a win-win situation with the customers. As a result, the competition edge can be sharpened and a cooperative relationship with the customers can be stabilized by bridging a channel for customers’ demand and operation model aided with information technology.

According to Peppers & Rogers, after a website provides appropriate one-on-one Internet marketing in consideration of customer differences, both the website and customer could make a profit, which reaches the goal of implementing one-on-one
Internet marketing [6]. According to Lin & Chen, the structure of one-to-one Internet marketing consists of Customer Interaction Platform and Customer Knowledge Platform [7], [8].

1. Customer Interaction Platform enables the enterprise and customers to keep in touch and communicate mutually without being interrupted. On the one hand, various interfaces enable the enterprise to implement the plan for sales operation and the enterprise may at the same time collect various types of information on customers via these channels, including static sales records and dynamic customer feedback, etc, which can be used as the authentic data for analysis.

2. Customer Knowledge Platform uses information technology to build data storage and make analysis on the data. Meanwhile, it collects relevant returned customer data. In addition, it helps locate the knowledge hidden behind a huge amount of data by applying various analyzing methods. Such a program is called Knowledge Development in Database.

This research, based on the theories of above-mentioned scholars, integrates the on-line service system and the internal customer management system inside hotels by using the customer relationship management and analyzing tool that is supported by an IT-structured RFID hotel customer management system to manage the interactive relationship between hotels and customers via the chain hotel verifying method, which is convenient for customers in making reservation.

2.2 Research structure

In this research, the customer relationship management and analyzing tool that is supported by an IT-structured RFID hotel customer management system is applied to actually control the interactive relationship between hotels and customers. It is developed with VB.net being the system base and connected to the back-end MySQL database through ODBC (Open Database Connectivity). RFID readers are set in the entrance of all the facilities inside the hotels, including the swimming pool, gym, SPA, bars, and various types of dinning halls. Each customer shall be provided with an Identification Card (with RFID carded tag) that represents his or her status, stipulating that the customer is allowed to use various facilities inside the hotel only if he or she presents the Identification Card.

As shown in Fig 1 on the system structure, when the hotel customer comes in/out of the doors of various facilities inside the hotel, the Reader set in the door shall induce automatically and transmit the signals to the Client end through RS-232 interface. With the help of Internet, it transmits the data (ID value, the time to read Tag and the Reader position point to read this Tag) into the Server end and stores them automatically in MySQL database. Please refer to Fig 2 for the flowchart of customer services.

![Fig.1 System Structure](image1)

![Fig.2 Flowchart of Customer Services](image2)
The controller may explore the data stored in the database and analyze them to identify the customers’ hobbies and provide tailor-made services, which shall strengthen the interaction with customers and improve their loyalty. For instance, in order to identify customers’ hobbies, questionnaires are used for records. This research takes a customer who is fond of SPA water therapy for example. Once the customer checks in the hotel, he or she shall often visit the SPA facilities or use them for longer hours. The habit of this customer shall be recorded automatically through RFID. Analysis results show that this customer likes SPA water therapy. Therefore, in consideration of the customer’s likes, some sort of discount coupon or message for SPA facilities can be sent to the subject customer to attract him or her for another visit to the hotel.

The internal management system (Figure 3) is designed to support hotel operation. This system provides various management functions required in daily activities according to the requirements of different departments and authorizations of different levels are set.

According to the history data of all the customers who used the facilities, a series of analysis can be performed. From various facilities inside the hotel, the service condition of these facilities can be further analyzed at various levels (such as gender, residence and occupation, etc), which enables the managing personnel inside the hotel to have a clear general picture of rooms, dinning halls, conference halls, leisure facilities in terms of their general service condition and the customers’ preference to a particular type of services. This information may be used to help marketing and promoting events that target the special customers.

3.2 Prediction on the possibility of customer consumption

In order to reach the goal of customer relationship management, this system utilizes six attributes (gender, age, education, average monthly income, residence and occupation) that might affect the customers’ consuming behavior. In addition, it uses the method of data exploration to analyze data on customer consumption in the hope of locating the customers’ potential demand, which aims to provide services that better satisfy the customers (As shown in Figure 4). The analyzing method is as follows: Each consumption record should be kept with the customer’s ID number representing this customer who consumed. Each customer is provided with a mix of customer attribute variables (Refer to customer group attribute table for variables of various customer attributes). It can be deduced that each consumption record has a combination of customer attribute variables.

Suppose the product items are marked with P1, P2, …..PX.

Select a customer Y to be surveyed on potential demand. The customer has six attributes, namely, gender, age, education, average monthly income, residence and occupation and suppose they are Y1, Y2, Y3, Y4, Y5, Y6.

Taking Y1 as condition, retrieve consumption record in which customer data is in line with Y1 from customer consumption database, i.e., all customer consumption records of customers whose sex is same as customer Y; add up commodity items of each consumption record and after it is completed, data recording consumption status of each commodity of Y1 customer group is generated; “single commodity PX statistical data of Y1

Fig.3 Structure of Internal Management System

3 System Features

3.1 Multi-level analysis of customer data
customer group/all commodity statistical data of Y1 customer group” is the percentage of single commodity PX statistical data of Y1 customer group in all commodity statistical data of Y1 customer group. For six attributes influence customer consumption behaviors, the following equations are deduced:

\[
W1X = \frac{\text{single commodity PX statistical data of Y1 customer group}}{\text{all commodity statistical data of Y1 customer group}} \times \frac{1}{6}
\]

Substitute Y1 with Y2, Y3, Y4, Y5, Y6 respectively to yield the following equations:

\[
W2X = \frac{\text{single commodity PX statistical data of Y2 customer group}}{\text{all commodity statistical data of Y2 customer group}} \times \frac{1}{6}
\]

\[
W3X = \frac{\text{single commodity PX statistical data of Y3 customer group}}{\text{all commodity statistical data of Y3 customer group}} \times \frac{1}{6}
\]

\[
W4X = \frac{\text{single commodity PX statistical data of Y4 customer group}}{\text{all commodity statistical data of Y4 customer group}} \times \frac{1}{6}
\]

\[
W5X = \frac{\text{single commodity PX statistical data of Y5 customer group}}{\text{all commodity statistical data of Y5 customer group}} \times \frac{1}{6}
\]

\[
W6X = \frac{\text{single commodity PX statistical data of Y6 customer group}}{\text{all commodity statistical data of Y6 customer group}} \times \frac{1}{6}
\]

Add up percentages of 6 properties:

\[
TX = W1X + W2X + W3X + W4X + W5X + W6X
\]

Putting commodity item P1, P2…PX into equation TX to work out utilization probabilities T1, T2…TX of individual commodities for this customer.

**Fig.4 possible forecast flowchart of customer consumption**

### 3.3 deduction of customer service utilization probabilities

In order to provide new customers sound service, this system is designed to calculate the probabilities of new customers using various facilities of the hotel by grouping customers (e.g. customers of same sex taken as one group) according to different attributes of customers (such as age, sex) and recording the events and analyzing the records after customers have used the facilities. Probabilities of various facilities’ utilization are calculated with historical data analysis regarding faculties’ utilization by different customer groups and different attributes of new customers, thus assisting service staffs in providing new customers suitable services.

### 3.4 combinations with RFID

Through the combination of management system and RFID, RFID Tag is integrated in each room card and each tag has an ID that cannot be modified, which not only lowers possibilities of room card forgery, but also puts in place room access control management with ID verification to prevent theft from happening.
3.5 real-time mastery of operating status
Managers can collect latest information and various analytical data (chart, rank list) through only the link between system and database, and make real-time judgment and decision with the analytical information collected, thus reaching better operating target.

3.6 Web interface
This system provides comprehensive web interfaces. When users would like to use this system, they can have full room access to this system through browser after connecting to the network without having to install other software. Therefore this system is highly flexible in terms of software and hardware requirements and can reduce start-up time of the system.

4 Hotel website and management system function
4.1 introduction of hotel website
This system is split into hotel website and hotel internal management system. Website provides customer with promotion information, introduction to internal facilities of the hotel and customers can room access guided tour of the rooms of their interests by clicking on individual links. It also provides detailed introduction of SPA center and gym facilities of the hotel including the latest information of service items. Customers can therefore learn about each service item in details and disparities among different treatment courses at home, thus identifying the type of treatment course of their desire. It also supplies information regarding features, styles and capacities of various conference halls of the hotel to make it easier for customers to select conference halls suitings their needs and easily make on-line booking. It also covers introduction of various leisure facilities and dining halls and incorporates aesthetic online services such as online room reservation, restaurant seats reservation and conference hall booking etc., thus letting customers enjoy the beauty of the website visually while experiencing the convenience of the design of this system.

Before room accessing the online service, one has to register as member in order to enjoy online service function. Customers enter account name, password information which is then verified with SQL order through matching the information entered with account names and passwords stored in member information database. If information matches, customers can select online services such as online room reservation, restaurant seats reservation and conference hall booking according to their needs.

4.2 Management system function
4.2.1 Room management

![Online room reservation interface](image)

The system automatically inputs the member’s basic information

![the application of hotel plan in room management](image)

After online room reservation, through SQL order the basic information of the member will be automatically entered into online room reservation interface, as shown in figure 5. Because this customer is already a member, all basic data has been entered into database, the customer therefore only needs to enter the dates of the reservation and check-out, and types of the rooms reserved. All other information is directly output from the database without having to be filled by members again.

Room management system incorporates the floor plan of rooms on each floor of the hotel, as shown in Figure 6, the digitized and visual room area management plan lets managers know the relative location of the room when assisting customers in room reservation. A room will appear in gray if it is
empty; rooms already reserved will be marked in green (room C206); rooms in use will be marked in red (room A201). In this way hotel staffs will have a clear image of the room status on each floor.

Through the analysis of historical data, this system would supply managers with various types of analytical tables, covering room rank, customer group analysis, and monthly analytical table and annual report, helping managers learn about utilization status of various facilities and distribution of consumer groups with graphics and tables supplied, and adjust service and promotion approaches.

4.2.2 RFID card management and room access management

The anti-forgery feature of RFID is combined with hotel room access management. When customers check in the hotel, the hotel counter will assign the user a RFID card that contains customer ID number while backstage database stores the ID number of this customer, room number and serial number of customer’s RFID card. The room access authorization through RFID card is checked by matching customer ID number in RFID card and backstage database (Figure 7 shows RFID room card verification mechanism and Figure 8 shows room access verification mechanism).

![Fig.7 RFID room card verification mechanism](image)

![Fig.8 Room access verification mechanism](image)

4.2.3 Consumption database management

For facility department, this system can provide basic data of customers and past hotel facility utilization record. With this record, the frontline service staffs of facility department can be identified, which can help service staffs collect customer information in the first place, and provide customized services of best quality; it can effectively record facility utilization data analyze reports for all customers; such as customer group analysis and utilization rank list, and provide management for service items such as addition, deletion and modification of service items.

With consumption records listed with SQL grammar, the frontline service staffs identify this customer as regular customer or else, and display the past service status for this customer through graphics (Figure 9) as well as all consumption information under “remark” that is cross-referenced to status information, thus showing the unique needs and taste of this customer. The frontline service staffs can learn about this customer’s preference and matters to be noted with past record’s remark data, letting regular customers feel being attended by the hotel. Through analysis of historical data, this system analyzes data and supplies resulting analytical table to managers, including rank list of facility utilization, customer group analysis, monthly analytical table and annual report, helps managers learn about utilization status of facility service and distribution of consumption customer groups with visual datasheet and adjust service method and determine promotion approaches.
4.3 Service item management
Since different facility departments can add, modify service items, this system features service item management functions (Figure 10). When managers modify internal service item data, through SQL orders, they can also concurrently modify service item information on frontline service staffs’ computers as well as service contents information on external websites, thus letting consumers learn about the contents of latest service items in the first place and avoiding the inconsistency between website information and actual service contents.

4.4.1 Deduction of customer service facility utilization ratio
Customized analysis is conducted for each customer; first, customers are grouped, and then the consumption records of this group are analyzed to predict the possible consumption behavior of new customers (Figure 11 Possibility prediction of facility utilization ratio of customers).

4.5 Management work of managers
Through analysis of customer consumption data, interfaces are displayed in graphics to let managers better learn about utilization status of various facilities and services. This type of interface is a departure from the traditional pattern of the reports that are displayed in words rather than graphics. Managers can clearly identify which service items are most favored by customers according to the lengths of the bars (Figure 12 Monthly analytical report of facility utilization).

5 Conclusions and Suggestions
The emergence of tourism drives the competition of hotels even more intense. How to create customer value and enhance customer loyalty has been presented to hotel managers as a major challenge. This research therefore combines RFID technology and sets up a set of hotel customer relation management system through which it intends to identify potential needs of customers and provide service of better quality. It has the following features:
effectively tracing the activities of customers in hotel, such as meal, leisure and consumption by taking advantage of RFID’s real-time tracing feature; through multifaceted analysis provided by this system, various types of graphics are generated, such as customer group analysis table, service utilization statistical table, annual utilization rank list etc., thus helping high management of the hotel learn about the operating status of the hotel and assisting them in making strategic operating decisions.

by taking advantage of the anti-forgery and unique ID attributes of the RFID cards, a set of room access system is designed based on room number<=>ID number<=>RFID ID verification mechanism. Card loss and personnel room access can all be controlled and managed for the sake of customer safety, thus giving rise to high level safeguard for the security of hotel operation.

with past customer data, and judged by various attribute of new customers and aided by grouping and data mining technologies, the influence of customer preferences on this product (service) is analyzed, which can serve to deduce the facility utilization ratio of new customers, identify potential needs of new customers in order to provide customized service and create the competitive edge for hotel runners.

Suggested direction for the future development of the system:

by combining with hotel POS system and referring to the concept of incorporating various operating items designed in this system into cashflow, providing managers more complete report function covering balance sheet etc., assisting high management of the hotel in all-around decision-making.

combining e-wallet with the system by taking advantage of the large storage capacity of the RFID card to provide customers with more convenient payment methods, which can be made even better by combining room card with Easy Card so that one card can be used for multiple purposes to make the world a better place.

the ultra-high frequency RFID technology can be applied in the system. With the feature of long distance reading, once customers enter into the hotel, RFID reader can automatically read their membership cards and customers’ data and past consumption records will be immediately displayed on the system and customers’ preferences analyzed. Before customers come close to the service counter, the tailor-made service is already prepared for customers, thus creating higher customer value.

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