

The Dynamic Model Of Customer Focus Management In The Hotel Business Based On Markov Chains

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Abstract: The requirements of tourists for hotel service are growing as worthy competitive offers appear on the market. In current conditions, the hospitality industry is facing a high level of competition and the high volatility of customer preferences. To develop and maintain their financial position, hotels are forced to look for new ways to effectively manage. Management methods based on anonymous mass production are again giving way to Customer Relationship Management. The transition of companies to customer-oriented business allows you to increase their profits and work efficiency. The article reflects the main trends of customer focus management in the hotel business. Methods are also proposed that will allow:

1. To adapt the main provisions of the personnel movement model to the task of managing the client base of the company, which will enable us to consider as a control object not a single client, but a group of clients.
2. When distributing clients into groups, take into account such indicators as the period of interaction with the hotel, the number of bookings made, the categories of services purchased, the socio-demographic characteristics of the client to take into account the varying degrees of influence of marketing events on different groups of clients.
3. As a management criterion, consider increasing the amount of net profit from the client, and not the likelihood of a purchase being made by the client.

Index Terms: Customer Focus Management, Estimation model, Hospitality, Hotel Business, Markov Chains, Probabilistic models, Regression model.

1 INTRODUCTION

The value of customer focus and trends soon. Customer focus is the ability of a company and employees to timely determine the desires of customers to satisfy them with their products or services with maximum benefit. In the context of business, customer focus creates a flow of loyal customers, increases sales and helps to rebuild from competitors. The technology that has embraced service companies in the past few years has not spared the hotel business. Hospitality enterprises are increasingly focusing on attracting and retaining customers [1-5]. In the medium term, to maintain market positions and economic growth, hotels will be forced to use the latest trends in customer-oriented management, such as a comprehensive study of the client and personalization of client experience (Fig. 1). A detailed analysis and application of all kinds of data about guests is becoming increasingly widespread. The ability to work with Big data today, if it still does not solve everything, allows hotels to win in the competition with a large margin. It is big data that has become the cornerstone of the business strategy of many hotels.

How and how does the client find out about the hotel, how much time he spends on the site, what interests him on the social network page and what exactly prompts him to choose a particular hotel? Hotel management can get answers to these questions from its reservation system, hotel website and from social networks. Moreover, some hotels go further by introducing guest recognition tools already at the hotel entrance to also formulate targeted offers.



Fig. 1. The main trends in customer management in the hotel business

Thus, generally accepted primary data (gender, age, country of residence and marital status) are mandatory for analysis; the trend indicates the need to possess extended information about the guest. Besides, priority is given to data received about the guest during the stay (length of visit, willingness to

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pay for upgrading the room during check-in, profit from the sale of additional services, etc.). The importance of obtaining the maximum amount of customer data is not in doubt, but the management efficiency and maximizing profit depend on how these data are used. Not to get lost in the massive amount of information and use it efficiently for hoteliers using modern analysis methods. One of the most common is predictive analytics, which is to analyze the data and based on the results obtained, use them to predict customer behaviour and future demand levels. The further introduction of qualitatively new analytics in operational, marketing, financial processes will become more and more popular. The next step will be the ability to make management decisions as quickly as possible, without the need to create and maintain analytical tools, integrating them into a centralized hotel management system. Speaking of customer focus, another significant trend is the personalization of customer experience. The fact that today hotel guests are interested in a unique experience and new experiences no less than at a bargain price is undeniable. However, now this experience should be individual, which is based on the preferences of each guest. The most modern technologies allow the hotel to adapt its services, taking into account the individual wishes and emotions of the client, which he would like to receive as a result. This applies not only to leisure but also to corporate travellers and business groups. The main task of this personalization of customer experience is to create a particular emotional atmosphere from the moment of booking to the after-sales service. Such uniqueness helps the hotel to position its services at a qualitatively new level, especially in the highest price segment. For the hotel industry, such unique properties are especially important, given the variety and similarity of accommodation facilities at any price category. It is essential to convey to the guest the possibility of personalization, communicating with him not only through his website, but also through pages on social networks, newsletters, and, of course, directly at the hotel. Also, now, integrated hospitality is actively used in the hospitality industry. This model demonstrates a significant advantage in the intensified struggle for the client of the new formation. Such clients are very informed and prefer to learn as much as possible about them. According to studies, the average traveller visits 38 sites before booking a hotel, and a week before the planned trip, the time spent by him on the Web doubles. This may be the most effective period for the sale of additional services to a guest before his arrival, but how many hotels actually contact the client before checking in? More often, reports on proposed excursions or exciting events even before using the service can be obtained from online booking services or airlines that have long learned how to use omnichannel. There is a tendency towards a gradual transition to a new approach, which is headed by the guest himself and interaction with him in different channels, based on client data. Thus, omnichannel quality changes the attitude towards the client, to gain access to the entire volume of accumulated personalized data, a particular hotel should understand that it is not the only one with which this client interacts. Of course, the real implementation of the omnichannel approach sets itself the task of recognizing the guest in all channels and the subsequent personification of services, based on the history of previous contacts with him.

This also means that hotels need to develop their omnichannel strategies, preparing for possible transformations in the market and ensuring business sustainability. An important fact also remains the growing role of mobile applications. While the share of hotel bookings from smartphones is still small, hoteliers should consider mobile sales when drawing up their strategies and adjusting current sales plans. It is necessary to develop a system of interaction with a potential guest at all stages of the decision on booking and at different points of contact. Updated versions of the applications of leading hotel chains are becoming more interactive - customers want to use the application not only as a tool but as a way to get the feeling of staying in a hotel even before arrival. Three-dimensional guides on the territory of the hotel, online concierge support and video communication with the call centre, accessible through applications today allow us to talk about the imminent need for mobile apps to combine real and virtual realities. Recent statistics show that the hotel is increasing its conversion rate by 68% and booking revenue by 52% after the launch of Accelerated mobile pages. Studies also show that mobile pages significantly increase hotel load and decrease the failure rate:

- increase in mobile transactions by 83%;
- increase in conversion rates by 68%;
- increase in income from bookings 53%.

Mobile payments are also becoming the focus of attention.

The trend towards the development of the direct bookings segment will continue, focusing on increasing guest loyalty. Despite the desire of hotels to reduce the share of bookings made through Online Travel Agencies, it is worth recognizing that hotels cannot compensate for this amount using their resources. Improving discounting will only help increase sales for a short period. A more effective way to increase sales is to add value, a unique feature to make a reservation on the hotel's website. This should be an understandable and significant reason to encourage the client to choose a specific hotel and loyalty system and return in the future. Such efforts by hotel companies to increase direct bookings are not only a reduction in distribution costs but also an essential step towards understanding the needs, interests and expectations of the client, which helps to improve communication and increase sales.

2 HOSPITALITY CUSTOMER MANAGEMENT METHODS

In the current economic situation, characterized by a high level of competition and high volatility of consumer preferences, hotels are forced to look for new ways to effectively manage. In the unstable financial situation, companies with a significant level of customer loyalty were able to maintain a leading position in the market. This once again proves that management methods based on mass anonymized production are still giving way to Customer Relationship Management. The transition of companies to customer-oriented business allows you to increase their profits and work efficiency primarily due to the following factors:

- The influence of loyalty level on the dynamics of the number of customers. There is a statistically significant inverse relationship between the level of loyalty and the

disposal rates of the customer base - the higher the loyalty rate, the lower the price of customer retirement.

- Profit growth per client. One of the advantages of a long-term relationship with consumers is that over time the occupancy rate of the hotel has a positive trend, primarily due to the increase in the number of cross-selling and the growth of customer needs over time.
- Lower customer acquisition costs.
- Lower transaction costs. Reducing operating costs occurs in several directions, in particular by reducing the duration of customer service, optimizing inventory management processes and reducing storage costs.

Customer-oriented business, in turn, requires the reorganization of existing, based on product-oriented strategies, company business processes, changing planning principles and developing new approaches to hotel management. There are two basic directions of managing the client base of the company: based on indicators of customer loyalty and long-term value of the client. According to the generally accepted definition, those consumers who are positive about the company's activities, the services it offers, its personnel, etc. are loyal. Depending on the type of loyalty (commitment, behavioural dedication and mixed type), several approaches are distinguished for assessing the loyalty indicator of each client. Behavioural loyalty is characterized by the number of repeat purchases and shares of the client's wallet. Commitment is measured by calculating a customer loyalty score for the company based on customer surveys. Such models include the Hofmeir and Rice' The Conversion model [6], the Lamben method for assessing customer satisfaction [7] and the SERVQUAL method for evaluating satisfaction with service quality (A.Parasuraman, V. Zeithaml, L. Berry) [8]. The scope of these assessments is the analysis of the current state of the client base. However, these indicators do not allow predicting the state of the client base in the future time interval; therefore, it cannot be used to develop a long-term strategy for the hospitality industry. Thus, the analysis of customer base management models built based on the loyalty indicator revealed the following limitations on their application:

1. The calculation based on retrospective data does not allow forecasts to be built on a long-term time interval.
2. The company's costs of attracting and servicing customers are not taken into account.

A new approach to business management entails a change in the methods for calculating critical indicators of business performance. In particular, hotel profits should be calculated depending on the size and quality of the client base and not the service. Company costs should also be accounted for per customer, not per service unit. In addition to modifying existing indicators, the effective management of the customer base requires the development of new signs that reflect the quality of the company's customers and the effectiveness of interactions with them. One of these indicators that allow us to evaluate the effectiveness of customer base management is CLV (Customer Lifetime Value). Customer Lifetime Value - the aggregate of net income expected from the client in the future. CLV is the income received from the client during the entire

period of interaction between the client and the company, minus the cost of attracting, selling and servicing this client, taking into account the time value of money. The frequency of trips shows how many trips a person takes on average over a certain period:

$$CLV = \sum_{t=1}^T \frac{D_t - Z_t}{(1+d)^t}, \quad \square\square\square$$

where t is the number of the period in which revenue from customers is calculated;

Dt is income from the client in a period l;

Zt is the total cost of income Dt in period t;

T is the total number of periods during the life cycle of the client;

d is the discount rate.

Using the CLV metric as a criterion for managing your customer base has several advantages. But they all come down to one thing - the goal of company management is to maximize profits over a limited period, therefore, the criterion for managing a client base is to maximize the benefits that customers bring for a given period, or maximize the CLV. Also, the calculation and analysis of the CLV indicator allow hospitality companies to:

1. Create a distribution system for all customers, depending on their value, and based on this, optimize their costs of servicing and retaining the most valuable of them.
2. Correlate the profits that the client of the hotel brings, and those forces and funds that have been spent on finding and retaining this client. In other words, this allows you to correlate the nature of the "profile" of the client and the goals of the hotel - the "profile" of the ideal client for this company, as well as to set the maximum cost level for attracting and retaining it.

3 APPLICATION OF A CUSTOMER FOCUS MANAGEMENT MODEL IN THE HOTEL BUSINESS BASED ON MARKOV CHAINS

3.1 Client base management model groups

There are several groups of customer base management models based on the CLV metric:

1. Regression models (M. Berry and G. Linoff [9], E. Malthouse and R. Blattberg [10]), in which the task of managing the client base is reduced to the task of identifying customers with the maximum CLV, with the aim of their subsequent promotion for loyal behaviour. The limitations of this model include, first of all, high sensitivity to the initial data and the lack of management tools from the company, i.e. CLV dependence on the marketing activity of the enterprise is not considered.
2. **Probabilistic models:** NBD-model (Negative Binomial Distribution) (A. Ehrenberg, D. Schmittlein, D. Morrison and R. Colombo [11-13]), Parego/NBD model (Fader P. S., Jerath K., Hardie B. G. S., Lee K. L. [14-17]). The main task of management is to determine the likelihood of a customer making a purchase in the next period, taking into account the history of his transactions in the past. Limitations of using probabilistic models are the complexity of estimating model parameters and sensitivity

to the source data.

3. Models of Markov chains (P.E. Pfeifer, R.L. Carraway [18])
In their work, P.E. Pfeifer and R.L. Carraway consider the behaviour of an individual client over a given period as a Markov process. Researchers have identified five possible conditions for finding a customer, depending on the likelihood of their purchase. The client's transition from one state to another depends on the size of the time interval since the last purchase (Fig. 1).

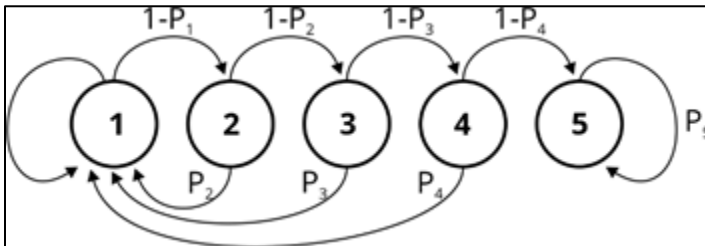


Fig.2 Customer life cycle in a company

Marketing services of the company interact with the client to stimulate customer activity. At the same time, the company bears the cost of these communications in the amount of g. Thus, the model for evaluating the CLV parameter for time T has the following form:

$$V^T = \sum_{t=0}^T [(1+d)^{-1}P]^t R \quad \square 2 \square$$

where P is the probability matrix that the customer's prescription at time 1 is 3, provided that at the beginning of the period the prescription of purchases was equal to K is the vector characterizing the number of marketing expenses (r ^ per client, depending on the indicator of prescription of customer purchases;

T is the value the time interval for which the indicator of the long-term value of the client is calculated;
<1 - discount coefficient.

As a proposed tool for optimizing costs in the model, it is supposed to reduce marketing costs if the client is in a particular condition. Thus, an optimal strategy for interaction with the client is developed depending on the current state of the client, i.e. cost optimization for the client is carried out by changing the vector R.

The analysis of customer base management models based on the CLV indicator revealed the following limitations:

1. In existing scientific papers, the movement of an individual client of a company, rather than groups of clients, is considered.
 2. In these works, the probability of a customer making a purchase depends only on the time of the last purchase and such factors of influence as the total time of cooperation with the company and the number of purchases are not taken into account.
 3. The effectiveness of using a marketing tool for various customer groups is not calculated.
2. The main stages of building a model

To build a model for managing a client base of a company,

it is necessary to solve the following tasks:

1. Develop a model for estimating the abundance of each segment. To do this:
 - a. Segmentation of the customer base and determine the critical parameters of each group of customers.
 - b. Build a matrix of customer transitions from one group to another.

3.2 Assess the main parameters of the model.

2. To determine the mechanisms for managing the client base of the company.
 3. Build models for assessing income and expenses for each group of customers.
 4. Calculate CLV and formulate a statement of the problem of managing the client base of the company.
 5. Define the boundary control conditions. Each of these steps is discussed in more detail below.
3. Development of a model for estimating the abundance of each segment

Let the company's customer base be divided into K disjoint subgroups.

Then the type of model for predicting the size of the customer base by segments will have the following form:

$$N(t) = N(0) - R * T * N(0) + P^T * R * T * N(0) + (c_2 - c_1) * t \quad \square 3 \square$$

- where N (t) is the number of groups at time t (vector);
- N (0) - the number of groups at the initial time (vector);
- R is the intensity of exits from groups (vector);
- P = {p_{ij}} - the matrix of mathematical expectations of finding an individual from group i in group j;
- t is the time interval for which the number of groups is calculated;
- c₁ and c₂ are the disposal and arrival vector of customers, respectively.

R and P indicators can be estimated using the matrix of customer acquisition and loss. The matrix of attracting and losing consumers was first used by F. Reichheld to analyze customer purchasing behaviour [19]. This approach was used to evaluate the parameters of the forecasting model for the number of the company's client base.

The matrix of attracting and losing consumers has the following form (Table 1).

TABLE 1

MATRIX OF ATTRACTING AND LOSING CONSUMERS

	Group 1	Group 2	Group 3	...	Group K	External
Group 1	x ₁₁	x ₁₂	x ₁₃	...	x _{1k}	c ₁₁
Group 2	x ₂₁	x ₂₂	x ₂₃	...	x _{2k}	c ₁₂
Group 3	x ₃₁	x ₃₂	x ₃₃	...	x _{3k}	c ₁₃
...
Group K	x _{k1}	x _{k2}	x _{k3}	...	x _{kk}	c _{1k}
External	c ₂₁	c ₂₂	c ₂₃	...	c _{2k}	

Elements on the diagonal show how many customers are left in this group, rows indicate the number of customers who have moved from this group to other groups. Columns show the number of customers who have come to this group from other groups. A separate line at the bottom of the table shows the number of customers who first contacted the company. So, the matrix shows that out of all the clients who were in group 1, x11 people retained their shopping intensity, x12 people moved to group 2, and c11 people left the company. Of all the clients of group 3: x31 people moved to group 1 (i.e. increased their shopping intensity), and x33 did not change their habits. Of the newly arrived customers, c21 people fell into group 1, c2k people fell into group K. Let a_{ij} be the intensity of the transition of customers from group i to group j , which is calculated by the formula:

$$a_{ij} = \frac{x_{ij}}{\sum_{i=1}^k x_{ij}} \quad \square 4 \square$$

Then the intensity of the exit from the group can be estimated as:

$$r_i = \sum_{i=1}^k a_{ij} - a_{ii} \quad \square 5 \square$$

and the probability of finding an individual from group i in group j is calculated as

$$p_{ij} = \frac{a_{ij}}{r_i} \quad \square 6 \square$$

Thus, using the matrix of customer acquisition and loss, we can estimate the values of R and P indicators in the forecasting model of the number of customers. The forecasting model for the number of customers using a_{ij} will be:

$$N_i(t) = (1 + a_{ii} * t)N(0) + \sum_{i=1}^k a_{ij} * t * N_i(0) - \sum_{i=1}^k a_{ij} * t * N_i(0) + (c_{2i} - c_{1i}) * t \quad \square 7 \square$$

3.3 Definition of mechanisms for managing the client base of the company

Consider what factors affect the intensity of movement of customers between a_{ij} groups. Clients move from group to group when critical indicators of their purchasing behaviour change: frequency of purchases, average check, category of purchased goods. In this case, the change in the frequency of purchases and the size of the average check occurs under the influence of two factors:

1. External impact (market development trends, technology).
2. Internal impact (the impact of company marketing).

We assume that the influence of external factors is constant and does not change in time, i.e. characterizes a linear trend in changes in the intensity of purchases. Let us consider in more detail the influence of marketing communications of the company on the purchasing behaviour of customers. As applied to market activities, communication is understood as the transfer of information from a source (enterprise) to a recipient (potential consumer), to generate a consumer reaction that is planned by the message source. Marketing communications are a combination of marketing tools that provide information to the consumer, as well as maintaining or changing the behaviour of the final consumer to promote goods and services at all stages of the purchasing decision-

making process.

Marketing communication includes two main components:

- Way of communication.
- Type of offer.

By the method of communicating information to the client, marketing communications can be divided into:

Personal connections, including:

- a. mailing list
- b. Email
- c. SMS
- d. phone call.

Mass communications, including:

- e. Media (television, radio, press),
- f. outdoor advertising
- g. point-of-sale advertising,
- h. the Internet [20].

By type of offers, discounts can be divided depending on the type of discount, and the moment it is received:

- Discount at the time of purchase for a product/service.
- Discount at the time of purchase for a combination of goods/services.
- Deferred discount in the future. We will also consider the accrual of points for purchase as a partial discount.
- Gift. The effectiveness of marketing communication depends on factors such as:
 - socio-demographic characteristics (gender, age, marital status, education, employment),
 - buying behaviour (frequency of purchases, amount of investments, categories of purchased goods).

Depending on the set of characteristics of data, different marketing communications are used for each group of customers. So, for a group of regular customers, personal communication through a phone call with an individual offer or a gift may be most effective, and for a group of occasional customers with a low frequency of purchases, advertising at points of sale with discounts on a specific product group. In addition, the transfer of clients from one group to another is carried out not only by increasing the rate of departure from the group as a whole (i.e., reducing the a_{ii} indicator) but also by reducing the intensity of transfers to other groups. Therefore, the intensity of the transition from group i to group j for each combination ($i; j$) has a different functional dependence on the type of marketing communication and the number of expenses for its implementation. Mathematically, this dependence can be represented as follows:

$$a_{ij}(t) = F_{ij}(Z_i(t), T_i(t)) + const \quad \square 8 \square$$

where F_{ij} is a function reflecting the dependence of the intensity of transitions from group i to group j on internal factors;

$Z_i(t)$ - the value of marketing expenses for group i at time t ;

$T_i(t)$ - type of marketing communication for group i at time t , is a set of the following parameters: communication method, type of proposal;

$const$ - the influence of external factors.

Then, the forecasting model for the size of the client base, taking into account the change in a_{ij} over time, will take the following form:

$$N_i(t) = \left(1 + \sum_{h=1}^t a_{ij}^h\right) N(0) + \sum_{h=1}^t \sum_{i=1}^K a_{ij}^h * N_i(0) - \sum_{h=1}^t \sum_{i=1}^K a_{ij}^h * N_i(0) + \sum_{h=1}^t c_{2i}^h - \sum_{h=1}^t c_{1i}^h \quad \square 9 \square$$

In some cases, when it is enough for the company to manage the overall intensity of leaving the group (for example, a company to retain a customer base), it is more convenient to use the dependence of $r_i(t)$ on marketing initiatives:

$$r_i = \sum_{i=1}^k a_{ij} - a_{ii} = \sum_{i=1}^k F_{ij}(Z_i, T_i) + const \quad \square 10 \square$$

Denote by

$$\sum_{i=1}^k F_{ij}(Z_i, T_i) - F_{ii}(Z_i, T_i) = F_i(Z_i, T_i) \quad \square 11 \square$$

then the dependence of the intensity of exit from group i on the marketing impact of the company has the following form:

$$r_i(t) = F_i(Z_i(t), T_i(t)) + const \quad \square 12 \square$$

where F_i is a function reflecting the dependence of the intensity of exit from group i on the marketing impact of the company;

$Z_i(t)$ - the value of marketing expenses for group i at time t;

$T_i(t)$ - the type of marketing communication for group i at time t, is a set of the following parameters: communication method, type of proposal;

3.4 Revenue estimation model for each group of customers

Customer value for the company can be estimated using the frequency of purchases and the size of the average check. In their work, Fader and Hardie suggest that simple statistics, such as the frequency and time of the last purchase, can provide a fairly accurate estimate of future value. Based on this assumption, the income received from the company's customers for some time t can be described by the following equation:

$$D(t) = \sum_{h=1}^t \frac{1}{V_h} \sum_{j=1}^K N_j^h F_j^h M_j^h \quad \square 13 \square$$

where N_j^h is the size of the group j at time h;

F_j^h is the average purchase frequency for group j at time h;

M_j^h is the value of the average check-in group j at time h;

K - the number of groups obtained as a result of segmentation of the customer base;

V_h is the discount factor at time h.

3.5 Model for estimating expenses for each group of customers

The expenses incurred by the company for managing the client base can be attributed to two categories: expenses for attracting new customers and expenses for retaining existing customers and increasing their loyalty, in particular, expenses for marketing events, promotions, etc. Then the mathematical record of the cost function of the company to manage the customer base will be as follows:

$$Z(t) = \sum_{h=1}^t \frac{1}{V_h} \left(\sum_{j=1}^K (N_j^h * Z_{1j}^h + c_{2j}^h * Z_{2j}^h) \right) \quad \square 14 \square$$

where N_j^h is the size of the group j at time h;

Z_{1j}^h - the number of new customers in group j, respectively, at time h;

c_{2j}^h - the average cost of the company per 1 client from group j at time h;

Z_{2j}^h - the average cost of the company to attract the 1st new customer to the group j at time h;

K - the number of groups obtained as a result of the segmentation of the customer base.

3.6 Statement of the problem of customer base management

Let us formulate the main assumptions of the problem again:

Assumption 1. All customers of the company can be divided into K disjoint subgroups depending on the frequency of purchases, the size of the average check and the socio-demographic situation.

Assumption 2. The movement of customers between different groups in the case of an undetected influence of the history of the relationship between the client and the company can be described using the adapted model of personnel movement Staroverov [21].

Assumption 3. The change in the frequency of purchases and the size of the average check occurs under the influence of two factors:

- External impact ("popularization" of technology, market development, etc.).
 - Internal exposure (effect of company marketing).
- Assumption 4. The customer value for the company can be estimated using the frequency of purchases and the size of the average check.

Assumption 5. The costs incurred by the company to manage the customer base can be classified into two categories: the cost of attracting new customers and the cost of retaining existing customers and increasing their loyalty. The criterion for optimal customer base management is the maximization of the long-term value indicator (CLV) of the company's customer base for the time interval T.

Thus, the mathematical record of the client base management task can be formulated as the following system of equations:

$$\begin{cases} \sum_{h=1}^t \frac{1}{V_h} \sum_{j=1}^K N_j^h F_j^h M_j^h - N_j^h Z_{1j}^h - c_{2j}^h Z_{2j}^h \rightarrow \max \\ N_i(t) = \left(1 + \sum_{h=1}^t a_{ij}^h\right) N(0) + \sum_{h=1}^t \sum_{i=1}^K a_{ij}^h * N_i(0) - \\ \sum_{h=1}^t \sum_{i=1}^K a_{ij}^h * N_i(0) + \sum_{h=1}^t c_{2i}^h - \sum_{h=1}^t c_{1i}^h \\ a_{ij}(t) = F_{ij}(Z_i(t), T_i(t)) + const \\ t \in [1, T] \end{cases} \quad \square 15 \square$$

As a rule, financing of marketing companies is carried out within the framework of a previously agreed budget; therefore, we introduce budget constraint B in our task. Then the sum of all expenses by groups at time t should not exceed the budget allocated for this period:

$$\sum_{i=1}^K Z_i(t) \leq B(t) \quad \square 16 \square$$

At the same time, budget constraints vary in each period. Then the control problem takes the following form:

$$\left\{ \begin{array}{l} \sum_{h=1}^t \frac{1}{\nu^h} \sum_{j=1}^K N_j^h F_j^h M_j^h - N_j^h Z_{1j}^h - c_{2j}^h Z_{2j}^h \rightarrow \max \\ N_i(t) = (1 + \sum_{h=1}^t a_{ij}^h) N_i(0) + \sum_{h=1}^t \sum_{i=1}^K a_{ij}^h * N_i(0) - \\ \sum_{h=1}^t \sum_{i=1}^K a_{ij}^h * N_i(0) + \sum_{h=1}^t c_{2i}^h - \sum_{h=1}^t c_{1i}^h \\ a_{ij}(t) = F_{ij}(Z_i(t), T_i(t)) + \text{const} \\ \sum_{i=1}^K Z_i(t) \leq B(t) \\ t \in [1, T] \end{array} \right. \quad \square 17 \square$$

The solution to this optimal control problem will be such a set of pairs $(Z_i(t), T_i(t))$ for $i \in [1, K]$ each moment in time at which the maximum CLV will be reached. Thus, a control action will be found that, along with optimizing company expenses and increasing the efficiency of the client base, will simultaneously allow:

1. To manage not individual clients, but groups of clients of the company in accordance with the model developed by the author, which is adapted for groups of client's model of the movement of personnel Staroverov O.V.
2. Take into account differences in customer purchasing behaviour and track changes in the quality characteristics of the customer base, such as the frequency of purchase and the average bill, which positively affects the accuracy of the calculation of the CLV indicator.

In other words, the paper considers the model of customer management of the company, which, based on the revealed changes in the structure of the client base of the company at various stages of its development, allows to increase the efficiency of planning and the effectiveness of management decisions in the medium term.

4 CONCLUSION

The trends in customer focus management in the hotel industry are changing as fast as the external business environment. Being a sector that is directly and acutely dependent on customer behaviour, the hotel business feels the changes taking place in related services. The high pace of development set by retail, tourism and mobile operators is instantly reflected in the expectations of customers and from hotels. Among the most important trends, it is worth highlighting the rapid introduction of customer focus and mobile applications in the activities of the entire hotel. Today, these two components directly depend on the income of the hotel. If a few years ago, introducing innovation, hotel managers decided to adapt the client to innovation; today, hotels are forced to change after the growing expectations of their customers. Of course, we are witnessing the rapid development of the industry, where each hotel can take advantage of the trends, skillfully managing its income through the introduction of new technologies or increasing profits due to a qualitatively new strategy. The considered model of customer management of the company based on the revealed changes in the structure of the client base of the company at various stages of its development allows increasing the efficiency of planning and the effectiveness of management decisions in the medium term. The article uses a new approach to assessing the parameters of the forecasting model of the number of customers using the matrix of customer acquisition and retirement. The developed model for predicting the size of the customer base takes into account the

intensity of customer transitions between groups, for the case of constant and time-varying intensity. The work identifies factors that influence the intensity of customer transition. A comprehensive model of managing the client base of the company allows you to take into account the features of customer behaviour and socio-demographic differences of groups of customers, both in the presence of a budget constraint and in the absence of a budget constraint. The solution to the mathematical programming problem delivers the optimal, in the sense of accepted quality criteria, the solution to the problem of managing the client base of the company. The dynamic model of customer focus management in the hotel business based on Markov chains is optimal for solving one of the essential tasks of tactical hotel management and takes into account an expanded set of characteristics of the client base and the degree of influence of marketing events on various groups of customers.

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