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SIMULATION MODEL OF THE RESTAURANT ACTIVITY

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Соколовська З.М., Ляпін М.О. Імітаційна модель діяльності ресторану.

Стаття присвячена проблемам застосування імітаційного моделювання в процесах оцінки діяльності суб'єктів ресторанного бізнесу. Пропонується розв'язати задачу шляхом побудови імітаційної моделі на платформі системної динаміки з використанням технології Ithink. Наведена фреймова структура моделі та фрагменти потокових діаграм. Проведено аналіз основних результатів імітаційних експериментів. Визначені перспективи подальшого розвитку запропонованої моделі-тренажера.

Ключові слова: ресторанний бізнес, імітаційна модель, імітаційний експеримент

Соколовская З.Н., Ляпин М.А. Имитационная модель деятельности ресторана.

Статья посвящена проблемам применения имитационного моделирования в процессах оценки деятельности субъектов ресторанного бизнеса. Предлагается решить задачу путем построения имитационной модели на платформе системной динамики с использованием технологии Ithink. Представлена фреймовая структура модели и фрагменты потоковых диаграмм. Проведено анализ основных результатов имитационных экспериментов. Определены перспективы дальнейшего развития предложенной модели-тренажора.

Ключевые слова: ресторанный бизнес, имитационная модель, имитационный эксперимент

Sokolovskaya Z.M., Lyapin M.A. Simulation model of the restaurant activity.

The article is devoted to problems of simulation modeling in the evaluation processes of activity subjects of the restaurant business. It is proposed to solve the problem by building a simulation model on a platform of system dynamics using technology Ithink. Presented frame model structure and fragments of streaming diagrams. Conducted the analysis of the main results of the simulations. Identified the prospects of future development of this simulator model.

Keywords: restaurant business, simulation model, simulation experiments

The restaurant business is part of the urban infrastructure, which is very sensitive to changes in economic climate, even in a stable economy, and when a crisis occurs − the restaurant business will incur significant losses. The last two years is difficult for the Ukrainian economy − the economic downturn in the country and the desire of Ukrainians to save significantly affected the sphere of public catering. Experts note that during the crisis the profits of restaurants in Ukraine decreased by 30% [1]. It is influenced by many factors − both those that depend on the activities of restaurateurs, and shared factors (for example, reduction of the welfare level of citizens). The main reason for the loss of profit restaurants the increase in the price due to the devaluation of the hryvnya food and drinks, as well as unaffordable, in such circumstances, rents.

According to the problem of improving the efficiency and survival of specific actors in the restaurant business is becoming very serious. The process of making management decisions in a rapidly changing environment in operational mode, require the use of particularly flexible instrumentation. In particular, it can be proposed the simulation methods, which are widespread in the universe.

Analysis of recent researches and publications

The problems of simulation modeling of business entities in various sectors of the economy highlighting the significant amount of publications of domestic and foreign scientists and practitioners [2-6] and other. Although the model subjects of the restaurant business have already become classical [7], the development of both the restaurant field and the emergence of more powerful methods and software simulation platforms generate new possibilities for creating existing simulation models.

As one of the fundamental methods of modeling it is possible to offer a system dynamic approach. The feasibility of using system dynamics due to the need for a sufficient degree of aggregation processes, which are studied; the study of the dynamics of their deployment time, as well as the necessity of considering many stochastic factors of different nature. System dynamics as a methodology of simulation is growing rapidly since the creation of the method by J. Forrester [8].

Unsolved aspects of the problem

In parallel with the development approach introduces new problems related to both the

specificity of the creation of models, simulators, specific facilities and efficient software framework and with planning of simulation experiments on models.

The aim of the article is performance of the applied system dynamics application models of the model entity of the restaurant business, is developed on the platform Ithink [9, 10].

The main part

The object of the study selected restaurant "GoodFood".

The network focuses mainly on European cuisine, so during the crisis of the restaurant business 2014 special difficulties restructuring the menu does not had any. The management has found a way to revise the prices of some menu items preserving prices for high-end meals. Revised technological maps of some of the dishes in the first place, this applies to fish dishes. As some foreign varieties of fish in the current environment are extremely expensive, the decision was made to replace their domestic counterparts, or in case of impossibility of such substitution is to eliminate the dish from the menu, and create a new one. A significant role in the retention position in the market was the fact that the restaurant chain has already established contacts with domestic suppliers of meat products, vegetables and other products. Having gone through a difficult period in Ukrainian restaurant business, the management decided to undertake the implementation of the investment project on opening a new restaurant. This has necessitated the development of a model simulator for developing appropriate management measures, the more that typical restaurants are already operating on the network. The operation of such a model will enable the timely identification "bottlenecks" of the functioning process and development of appropriate preventive measures.

Since the activities of restaurant is a complex dynamic process, which includes a large number of business processes that are connected with causal links, the simulation method best suited to predict. Due to the fact that the purpose of the study is to examine the overall dynamics of the final performance of the restaurant to determine the effect of complex stochastic factors of the environment of functioning, it is appropriate to involve system dynamics.

The restaurant field analysis determined that the most influential on the result of the activities of the restaurant are the following indicators: volume and price of traded goods; the number of customers, the purchase price of raw materials, the number and composition of staff. General structure of the model is presented in Fig. 1.

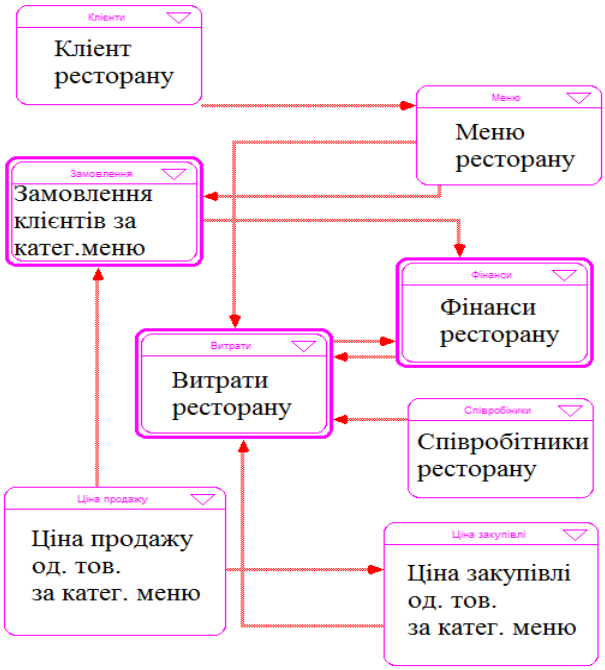

Fig. 1. Model of the restaurant activities

Let us consider briefly the processes that are simulated in each of the blocks.

"Finance"

The main block of the simulation model, where the fund profits of the restaurant and the flows of income and expenditure [10]. The formation of this unit comes at the expense of the other two blocks – "Order" and "Expenditure", which in turn, are connected with all other blocks of the model-simulator.

"Restaurant customer"

This block determines the category of restaurant customers. For a typical restaurant of the middle class presents these categories: poor customers – students,

average income – middle class, wealthy visitors – VIP. In the model it contributes to the achievement of the following objectives: first is constitutive for the number of sold dishes per month, and also serves as a factor for the creation of reports on the revenue of the restaurant.

"Menu"

Simulates the volume of goods sold to customers (due to the connection with the unit "Customers").

"Sale price"

Determines the selling price of the item in each menu category. The restaurant is also able to influence directly. Since the product categories of dishes, the price will be determined as the average price of dishes in a category (of course, with fluctuations in both directions within the average price).

"Ordering"

This is the block that displays the number of orders by category of customers. Also it is responsible for displaying the distribution of the total number of products between categories of clients. For example, the share of food orders meat categories among students, middle class and VIP were taken as 0,10, 0,55 and 0,35 percent, respectively. Data from this block fall under the "Finance" income stream.

"Staff"

Reflects all the staff who participates in the activities of the restaurant and forms part of the expenditure in the "Expenditures ". Each post variable contains data on the number of people in this position and their salary.

"Purchase price"

This block identifies the cost of restaurant procurement of raw materials for food. The purchase price is closely linked to the price sales ratio margin.

Fragment streaming chart of the unit "Costs" shown in Fig. 2.

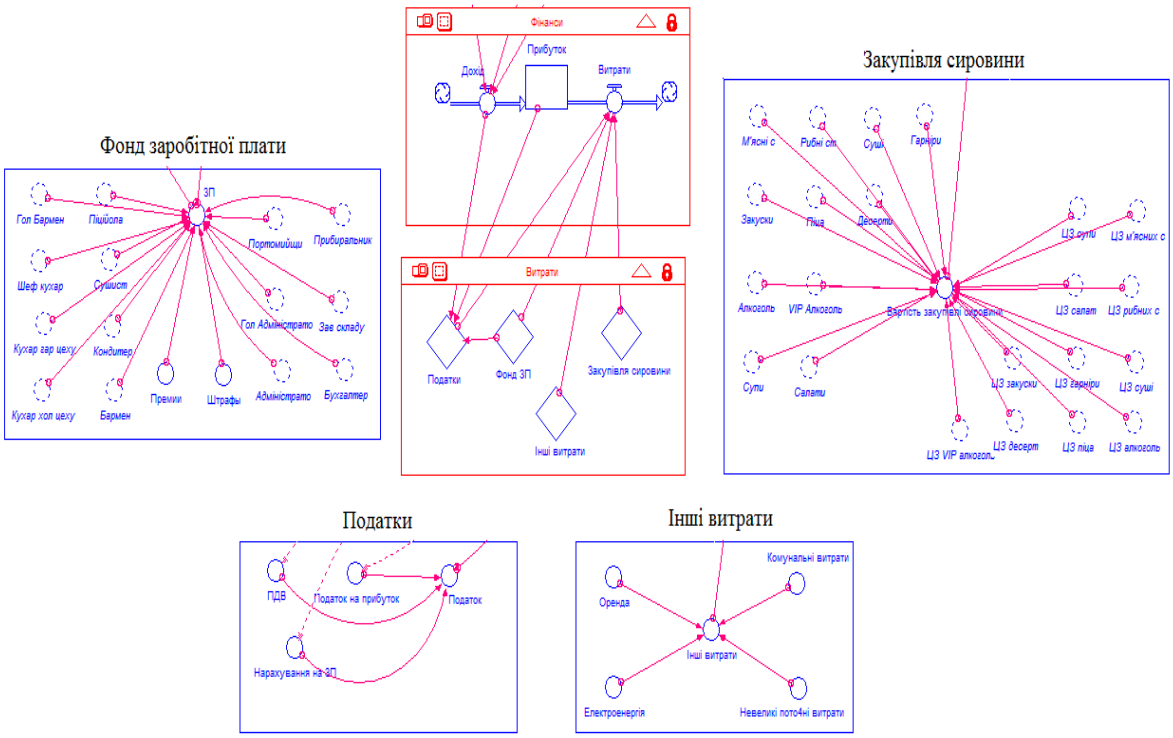

Fig. 2. Flow chart of unit "Costs"

In the formation of this unit, participating in almost all variables of the simulation model, because the costs of the restaurant include:

— expenses labor: payroll (payroll fund) which is generated on the basis of the unit "Staff". From the process "Payroll fund" are two connectors: one is associated with costs in the sector "Finance"; another is tied to taxes inside the unit;

— purchase of raw materials (purchase price of raw materials for the manufacture of a product unit specific category menu);

— variable "taxes" are most difficult for the formation and contain the following components: the accrual of the payroll, which includes UST and insurance; income tax. VAT is calculated from the income of 20%. Accrual on salary is computed as payroll fund * (rate UST + insurance rate). The income tax from 2015 is 18% of the profit (excluding expenses) and is paid once a year by legal persons, the profit of which does not exceed 20 million UAH.

— other costs which include monthly expenses on rent and warehouse, electricity bills, utility costs and small running costs.

On the model we conducted several experiments for a period of three years with step the simulation is the month. The results of some experiments in fragments consider the following.

Dynamics of financial turnover of the restaurant is shown in Fig. 3.

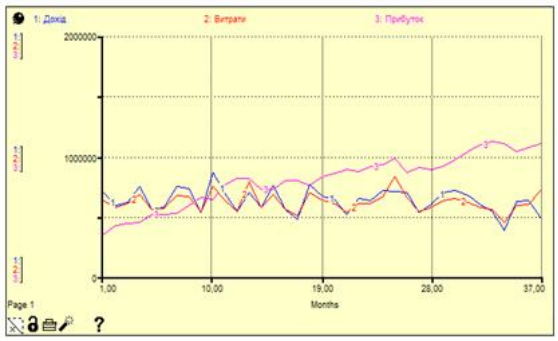

Fig. 3. The Financial turnover of the restaurant (UAH)

The figure shows that when the price level and the number of customers, the restaurant receives a steady profit: it's activities is not in danger.

However, in the situation of uncertainty that has developed in the restaurant business, there is a need for the evaluation of the restaurant activities for various possible values of indexes.

Variation in the clients number.

The stream of clients is generated, as a stochastic variable with a uniform distribution lawThe initial boundaries of the interval used in the model, the following: students from 150 to 350 people/month, the middle class − from 350 to 650 people/month, VIP − from 80 to 150 people/month. The indicators established approximately based of the situation throughout the network of restaurants "GoodFood". With this level of customers, and at other invariable parameters (selling prices and procurement) model after a series of runs shows the related results − revenue growth. This suggests that this level of visitors is sufficient for normal operation of the restaurant and income.

In the next series of experiments we change the number of clients decreased by 25 percent. This reflects the outflow of customers due to the general decrease of the population's solvency. This will adjust the amount of clients by coefficient 0,75. For each of the next series of runs will increase the number of customers by 5% to previous level (Fig 4). Such an experiment aims to search for the minimum value of the indicator of number of clients, at which the restaurant will still have a profit.

So experimentally it was established that a restaurant at the loss of 25% of clients cannot exceed losses and will be forced to close down. The highest possible level of customer loss, which normally operates a restaurant, about 10%. That is, it can be noted that the dependence of profits on the number of clients is quite sensitive. This is a negative trend, since in crisis situations and an inability to affect other indicators, the restaurant is on the verge of bankruptcy. But on the other hand, the restaurant in a normal economic environment always has the ability to influence customers through promotional activities.

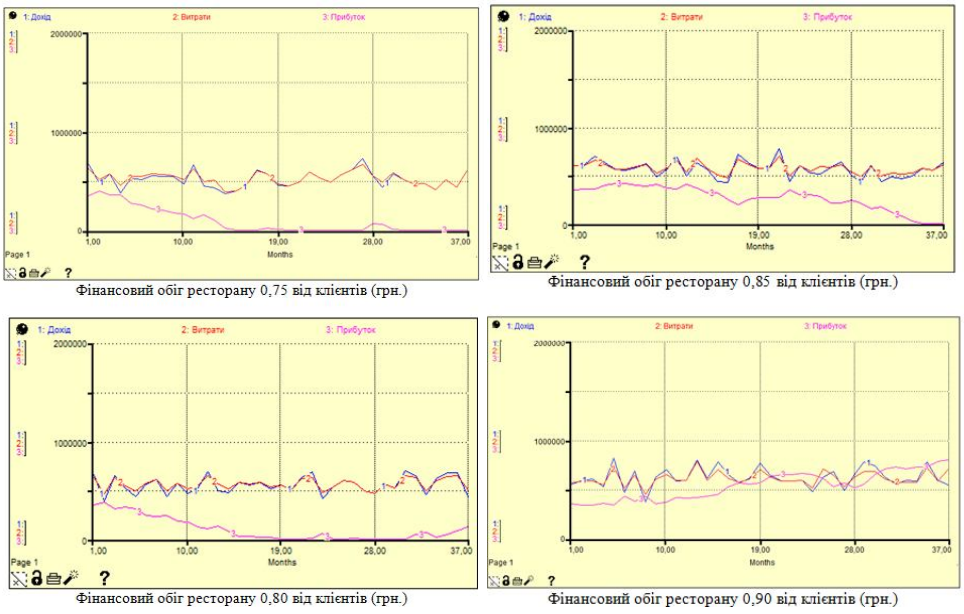

Fig. 4. Simulation experiments with the variation in the clients number

The next indicator is the selling price. With him performed the same experiments as with the number of clients. For starters we will reduce the selling price of each category of dishes by 25%: this is done using the coefficient, but it should be remembered that the purchase price will also change accordingly

connection, which is formed in the model. It turned out that this price change is too abrupt, especially when she passes in all categories of dishes. But in terms of the generalized analysis do not change the prices on each category individually and attempt to find the general decline in sales prices, in which the school will receive the profit. Each of the next series of runs is carried out in 5% increments (Fig. 5).

During the simulation it was found that stable profits can be obtained with an overall decrease in prices in the range of 10-15% of the initial level. Of course, the profit in such circumstances below, but it is stable.

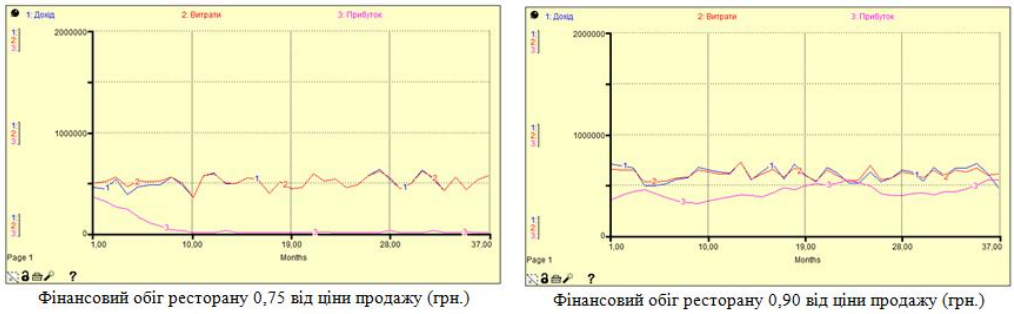

Fig. 5. Simulation experiments with variation sale price

As for the price increase, it positively affects the level of profit, but in this model, the estimate of growth rates is not the most accurate, as it is not possible to assess the degree reacts customers at higher prices. Perhaps the price increase even by 5% will entice customers to visit another restaurant.

Another indicator that is experiencing the indirect impact of the external environment is the purchase price. The impacts through the ratio of the markups, which is determined by chief administrator, restaurant owner, or a common solution. Of course, this ratio is different for each category. Therefore we will increase this ratio to 5%, 10%, etc. and will conduct a series of experiments (Fig.6).

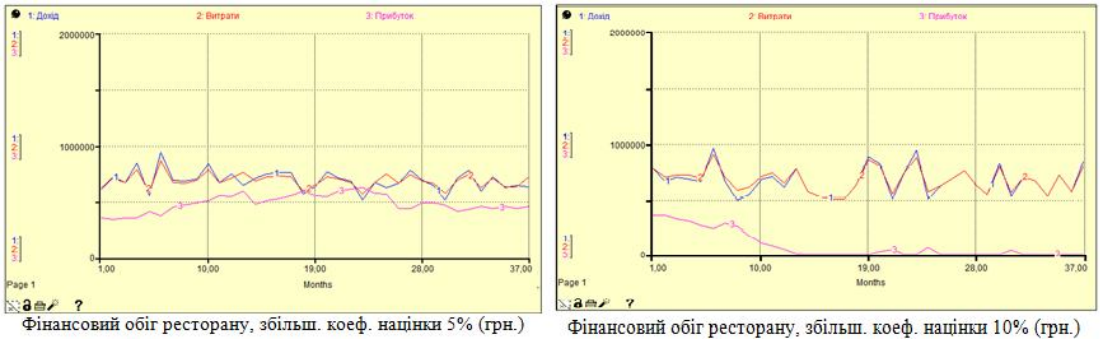

Fig. 6. Simulation experiments with variation in the price of the purchase

The results of the experiment it became clear that purchase price is a parameter that has the greatest influence on the formation of income. At the same time, it is the factor that is most difficult to influence.

Conclusions

Thus, after experiments according to these indicators, we can conclude that each of them has its influence on the formation of profit. More sensitive indicator is the purchase price. Even with a small variation of this ratio has a strong and sharp impact on the profit of the restaurant, but along with this, the purchase price is the most difficult to influence.

Sale price and the number of customers is also significantly influenced by the income. Unlike procurement prices, on these indicators is quite easy to influence. But it should be noted that if the price of the sale must assess the realities of competition is because even a small change in the price of goods may alienate the client in favor of the restaurant rival.

Simulation experiments and the results obtained prove that the use of simulation for analysis of further development of the restaurant is very efficient, especially in times of unstable economic situation in the state. The simulation model allows the study company to not only best use of available resources, but also to determine the possibilities of its further development.

A promising direction for further research can be considered an extension of the model of the restaurant due to the new processes and relationships, e.g., attraction to the model of relations with suppliers, and conduct more complex, multivariate simulation experiments.

Interesting results can be obtained in the case of immersion of developed system-dynamic blocks in

agent-based environment, such as on the platform AnyLogic, Arena. The application of the combined paradigms of simulation modeling − system dynamics and agent-based approach allows to study not only the General dynamics of the object, and will help to focus on specific details. For example, as flow agents can be used by customers, vendors, restaurant staff, transport unit, and the like. Simulation objects (agents) and processes, which are interrelated and generate each other, will lead to the creation of not only overall, but daily picture of the functioning of the restaurant.

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