# ІНФОРМАЦІЙНЕ ТА МАТЕМАТИЧНЕ ЗАБЕЗПЕЧЕННЯ ЕКОНОМІЧНИХ ПРОЦЕСІВ

# INFORMATION AND MATHEMATICAL SUPPORT OF ECONOMIC PROCESSES

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## THE SIMULATION OF THE RESULTS OF THE ACTIVITY OF FIRM INTO ITHINK

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*Соколовська З.М., Демянчук К.В. Моделювання результатів діяльності фірми в Ithink.*

Стаття присвячена проблемам створення імітаційних моделей-тренажерів функціонування фірм на базі використання методу системної динаміки. Пропонується розроблена модель діяльності типової фірми-посередника, яка займається наданням сервісних послуг користувачам з використанням Internet-технологій. Обґрунтовується залучення до реалізації модельних експериментів програмної платформи Ithink.

*Ключові слова:* фірма, імітаційна модель, імітаційний експеримент, системна динаміка, потокова діаграма

*Соколовская З.Н., Демянчук Е.В. Моделирование результатов деятельности фирмы в Ithink.*

Статья посвящена проблемам создания имитационных моделей-тренажеров функционирования фирм на базе использования метода системной динамики. Предлагается разработанная модель деятельности типовой фирмы-посредника, занимающейся предоставлением сервисных услуг пользователям с использованием Internet-технологий. Обосновывается привлечение к реализации модельных экспериментов программной платформы Ithink.

*Ключевые слова:* фирма, имитационная модель, имитационный эксперимент, системная динамика, потоковая диаграмма

*Sokolovskaya Z.M., Demyanchuk E.V. The simulation of the results of the activity of firm into Ithink.*

Article is dedicated to the problems of the creation of the imitation model-trainers of the functioning of firms on the base of the use of a method of system dynamics. Is proposed the developed model of the activity of standard firm-mediator which is occupied by the assignment of service services to users with the use of Internet-technologies. Is based attraction to the realization of the simulation experiments of the program platform of Ithink.

*Keywords:* firm, simulation model, imitation experiment, system dynamics, flow diagram

On the modern stage of computer technologies of wide distribution design development got system-dynamic approach that is used both in scientific researches and during the decision of various practical tasks [1, 2, 3, 4, 5].

**Analysis of recent researches and publications**

The method of system dynamics was worked out by J. Forrester at the beginning of 60th of the past century [6]. Since it was found considerable introduction in the different spheres of economy and business and got wide circle of followers among scientists and practical specialists-workers.

Using method expediently when a user needs receipt of aggregate data according to dynamics of object or process development. During the imitation of stream type a design is done like evolution changes without the recreation of separate elementary events. According to concept the models of the real objects are built on the base of co-operation of various nature streams. A priory stream conception envisages the high level of all elements (objects, processes) aggregating which are investigated.

The programmatic platforms of this method realization develop headily too – from the language of DYNAMO to the modern special packages of design with the high level of service: Vensim, Ithink, Poversim etc.

One of the important applied directions of approach application is a micro level design. The spectrum of corporate additions develops both main directions: creation of the so-called "mental models of management" (formed by means of causal and cause-effect diagrams) and scenario strategic researches (according to the problems of real objects).

However not having regard to considerable achievements in a system-dynamic design field there is a row of problems both theoretical and especially the applied character. In particular they are related to

the correct raising of tasks (the necessity of taking into account of setting and features of method), planning of imitation experiments and reasonable choice of programmatic platforms of realization.

Next to this necessities of modern economic practice crisis position of enterprises and hard terms of competition pull out such direction on the first plan as creation of imitation models-trainers of micro level objects.

According to the outlined problems the aim of the article is presentation the technology of creation the firm's imitation model-trainer using system dynamics method on the programmatic platform of Ithink. A research object was select typical firm-mediator that engages of service to wide circle of users with using of Internet-technologies.

**The main part**

Functioning of model is demonstrated on the example of "LiteDale" firm that was founded recently – in 2013. Short duration time of functioning in the difficult economic circumstances of home economy puts the row of not simple tasks before a firm that needs determination of management effective strategy and technologies of "maintenance" development at the market of such services.

A basic type of research object activity is creation of delivery service of various commodities from USA and Europe Internet-stores. Essence of service consists of supporting every step of users – from creating an own book-mark in a browser, passing to select Internet-store adds a commodity to the basket and processing order. On web-sites that while is not supported, there is possibility to write in support service and get the miscalculation of products automatically. It needs some expectation from a client as a technical employee must expect the cost of commodity and send it in a report to the client. Often such expectations make clients to renounce orders.

The aim of model creation was a necessity of determination of firm's development further strategy. On the first stage is located the research of next indexes' dynamics that related to its activity:

— Index of cost the performed orders;
— Index of cost the lost orders;
— Index of general amount of orders;
— Index of mean time of processing the typical order.

A model was built on the base of system dynamics method using the technology of Ithink [4, 7, 8]. The choice of programmatic platform of realization was conditioned by next arguments:

1) One of main system dynamics principles is realized in the system according to it the dynamics of any process behavior we can interpreted as a some "funds" levels changing. Changes are regulated by the rates of input and initial streams that accordingly fill or dip out funds. The brought concepts are very universal and easily adapt to the specific of productive processes imitation of the investigated firm. In particular it is possible to recreate the current amount of orders by means of funds that require treatment, common amount of treat and lost orders and other.

Fund streams design administrative decisions that increase or diminish the levels of corresponding funds. For example it is possible to design the streams of orders that came for concrete periods of time; streams the performed and lost orders and others like that.

Thus in a model the dynamics of the investigated productive processes is represented for any period of time or steps of imitation.

Practically there are no limits on the degree of process range that is investigated. If user wants he can complement a model the new aspects of the activity or to pay attention on concrete constituents, not having regard to concomitant elements. It is comfortably according the point of view to designed processes because they are permanent influent by market changes, target audiences and also various factors appearing during processes of firm activity.

2) The mechanism of feed-backs is recreated in the system due to what the design of non-trivial behavior of difficult control system (firm) becomes possible.

3) In the system changeability, vagueness of environment where the production processes of firm flow is easily recreated due to the presence of many facilities of stochastic influences imitation of the investigated processes. There are also facilities of sentinel delay of processes imitation that approaches a design to the real flowing them in time.

4) A created in the environment of Ithink model actually acts part to the trainer for managers due to an objective orientation on the various aspects of behavior of management processes. So the managers of enterprise can "play" various administrative decisions in relation to service processes organization and also its possible effects in the future on the simulation models of system dynamics. Thus resulted a mathematical vehicle is brought over to everyday operative analytically activity.

5) The positive characteristics of Ithink package are also its technical descriptions:

— Supporting the structural-functional approach to analyze and project model. Due to such technology there is possibility to realization a few levels of models' presentation: on high level it is model presentation as flow-charts using CASE-technology and on low level – construction of stream charts and diagrams.
— The built-in blocks that provides creation of different types of models. Supporting the great number of entrance data formats.
— Developed facilities of analyzing sensitiveness that provide automatic frequent implementation of model with different detains.
— Supporting authorial design that is making easier the models' using by insufficient preparation users.

A stream diagram of the model fragment is drawn on the fig. 1 and setting main variables resulted to the model fragment it is presented in a table. 1.

At mathematical level a model is the system certainly difference equalization that decide on the basis of numeral algorithm of integration (by the chart of Euler or Runge-Kutt) with a permanent step and set initial values. Imitation experiments on the brought model over can be conducted for different sentinel periods with the different steps of imitation. There are some results of imitation experiments which are developed on the base of managers' administrative decisions of firm.

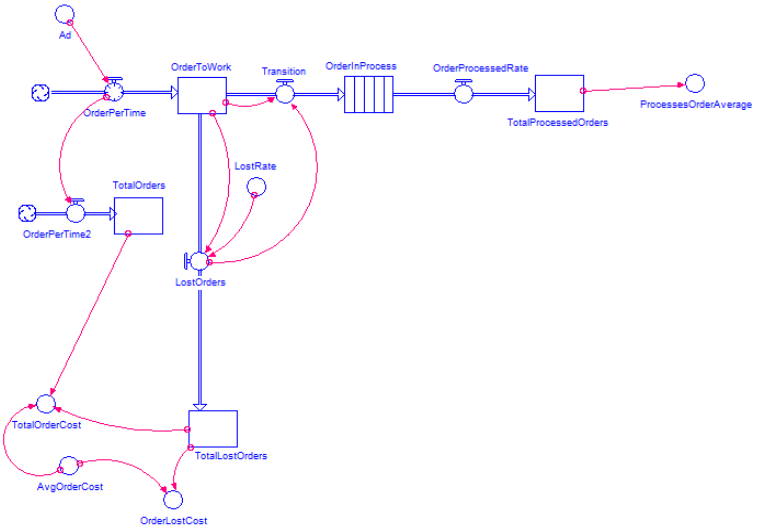


Fig. 1. Fragment of stream diagram of firm activity model

Table 1. Main variables to the model fragment

| Name of variable model | Type of variable in the model | Value or algorithm of variable calculation | Setting |
|---|---|---|---|
| Ad | Converter | Ad = INT(RANDOM(5, 20)) | amount of orders that came under act of marketing campaign |
| Order Per Time | Flow | Order Per Time = RANDOM(10, 20) + Ad | amount of orders that came for time unit |
| Order Per Time2 | Flow | OrderPerTime2= Order Per Time | amount of orders that came for time unit |
| Order To Work | Reservoir | Order To Work(t) = Order To Work(t - dt) + (Order Per Time – Lost Orders - Transition) * dt INIT Order To Work = 0 | current amount of orders that require treatment |
| Lost Rate | Converter | Lost Rate = RANDOM(0.01, 0.1) | coefficient of lost requests |
| Total Lost Orders | Reservoir | Total Lost Orders(t) = Total Lost Orders(t - dt) + (Lost Orders) * dt INIT Total Lost Orders = 0 | total amount of lost requests |
| Lost Orders | Flow | Lost Orders = Order To Work * Lost Rate | amount of lost orders |
| Avg Order Cost | Converter | Avg Order Cost = 500 | average cost of order |
| Order Lost Cost | Converter | Order Lost Cost = Total Lost Orders*Avg Order Cost | a volume of lost requests in a value term |
| Total Orders | Reservoir | Total Orders(t) = Total Orders(t - dt) + (Order Per Time2) * dt INIT Total Orders = 0 | common amount of all requests that came |
| Total Order Cost | Converter | Total Order Cost =Total Orders*Avg Order Cost – Total Lost Orders*Avg Order Cost | a volume of the performed orders in a value term |
| Order In Process | Converter | Order In Process(t) = Order In Process(t - dt) + (Transition – Order Processed Rate) * dt INIT Order In Process = 0 TRANSIT TIME = varies INFLOW LIMIT = INF CAPACITY = INF | amount the performed orders |
| Order Processed Rate | Flow | Order Processed Rate =CONVEYOR OUTFLOW TRANSIT TIME = RANDOM(0.6, 1) | intensity of requests' maintenance |
| Total Processed Orders | Reservoir | Total Processed Orders(t) = Total Processed Orders(t - dt) + (Order Processed Rate) * dtINIT Total Processed Orders = 0 | total amount of treat orders |
| Processes Order Average | Converter | Processes Order Average = Total Processed Orders / TIME | mean time of requests' treatment |

During the design process of firm managers get the values of next indexes:

— General amount of lost orders as a result of expectation the calculation of product cost by commodity service;
— General amount of all orders that came for certain period of time;
— Volumes secured and lost orders for certain period of time in a value term;
— Intensities of orders' treatment.

On the fig. 1-4 there are dynamics of the enumerated indexes gotten as a result of imitation of sentinel period with a step in one minute.

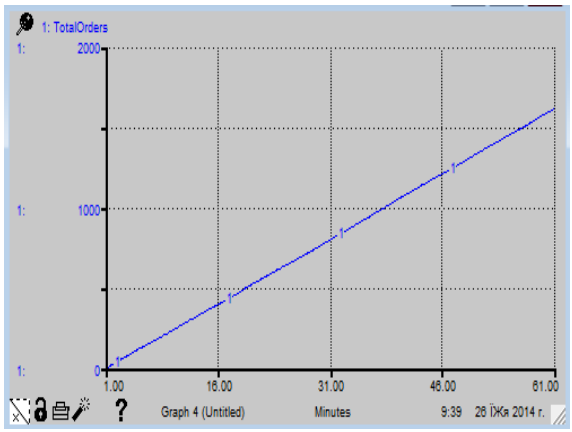


Fig. 1. Dynamics of general amount of orders that came to service during time

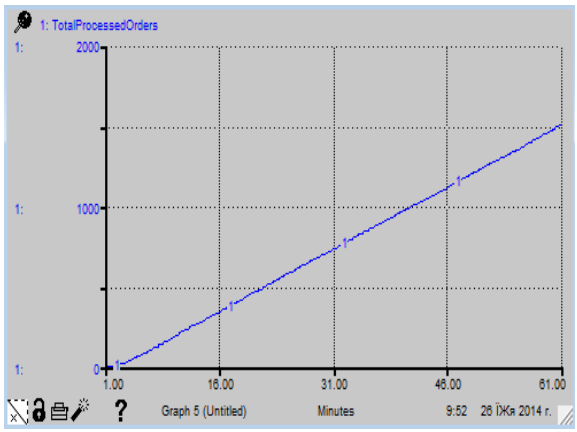


Fig. 2. Dynamics of general amount of really treat orders during time

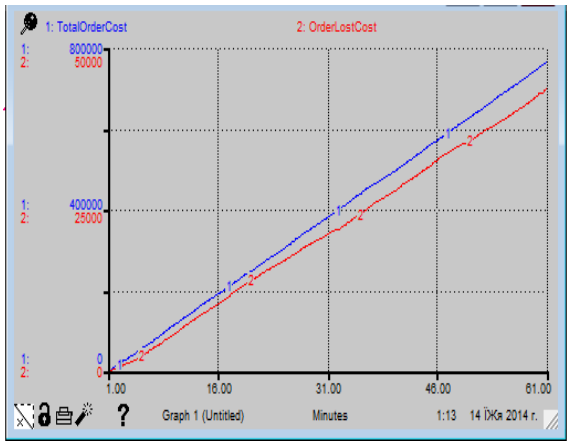


Fig. 3. A change of volumes performed and lost orders during time

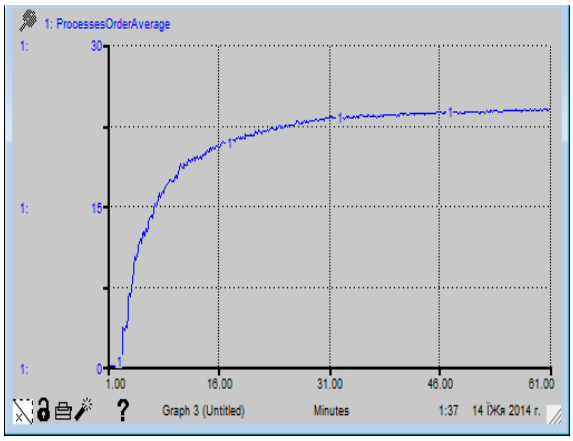


Fig. 4. Dynamics of intensity of orders' treatment

On the fig. 1 and 2 there are dynamics of general amount of orders that acted to service and amount of really treat orders (in natural units of measuring) accordingly. The change of volumes performed and lost orders in value cost is presented on fig. 3. The dynamics of intensity (mean time) of orders' treatment is shown on fig. 4.

The conducted imitation experiments proved that the amount of the lost orders increased as well as total amount of all orders. Accordingly its cost increases. For a firm it is important to erect the amount of clients' refuses to the minimum. A high competition in the field of delivery services of various products from America and Europe make value by every client.

To decrease the amount of lost orders it is necessary to improve work of service and extend the amount of supported Internet-stores. For the performance of this objective it is necessary to extend composition of workers on firm who will be able to improve service and increase the amount of Internet-stores that allow expecting automatically cost of foreign products in Ukraine in the earliest possible dates.

It considerably will make simpler the ordering process to the clients and will allow saving their time. And thus customers will not renounce an order. Intensity of orders' treatment at first increases headily and then becomes level and lasts approximately at the same level. The firm should increase the state of

supporting service that will allow increasing intensity of orders' treatment, decreasing time of clients' expectation and increasing a profit from orders. But after service work's improvement the necessity in great numbers employees of support service will diminish.

The results of experiments were analyzed in comparing to data of the financial reporting of firm "LiteDale" [9].

**Conclusions**

A model carries open and module character. It creates the circumstance of it further development. In future considerable expansion of model is planned due to including of the modules of different aspiration. The charges of firm will be taken into account:

— Marketing campaigns (an advertisement in social networks, advertisement in a mixture of blogs, using of original packages which will be used for delivered products to the customers, magnets with the logotype of service, various booklets);
— Producing of the special sights for determination of the size of clothing and shoes;
— Fund of salary;
— Cost of equipment using for service development;
— Firms' payment of services that will deliver products actually to the clients on Ukraine.

Thus the prognosis of profit and net income of firm will be done and also to profitability of its services. Due to general efficiency of firm's activity and directions of its further increase will be determined.

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