STATE UNIVERSITY OF JAN KOCHANOWSKI
DEPARTMENT OF ENTREPRENEURSHIP AND INNOVATION

NATIONAL ECONOMIC DEVELOPMENT AND MODERNIZATION: EXPERIENCE OF POLAND AND PROSPECTS FOR UKRAINE

Volume 2

Collective monograph
edited by A. Pawlik, K. Shaposhnykov

Kielcach, Poland
2017

UDC 338.242(438+477)
LBC 65.050.9(4Pol)+65.050.9(4Ukr)
N 27

Recommended for publication
by the Academic Council State University of Jan Kochanowski

National Economic Development and Modernization: experience of Poland and prospects for Ukraine – Collective monograph. – Vol. 2. Poland: "Izdevnieciba "Baltija Publishing", 2017. – 348 p.

ISBN 978-9934-8643-4-6

6. Malchyk M .V., Popko O. V. Marketing researches of the state and prospects of development of the agricultural machinery market in Ukraine – [Electronic resource]. – Access mode: http://dspace.nbuv.gov.ua/bitstream/handle/123456789/113927/26-Malchik.pdf?sequence=1
7. Yakymenko O. S. Features of strategic management of the agricultural engineering enterprises development / O. S. Yakymenko // Recent economic problems. – 2013. – № 9. – P. 138–144.
8. Voinarenko M. P. Applied rinciples of investment of the of agricultural engineering enterprises. – [Electronic resource]. – Access mode: http://www.economy.nayka.com.ua/ ?op=1&z=5523
9. Karachyna N. P. Concept of development of domestic machine-building enterprises in the context of safety of their economic behavior / N. P. Karachyna // Актуальні проблеми економіки. – № 3(117). – 2011. – С. 115–130.
10. Karachyna N. P. Functioning of the branch of agricultural mechanical engineering of Ukraine and potential of its development Функціонування галузі сільськогосподарського машинобудування України та потенціал її розвитку – [Electronic resource]. – Access mode: http://karachyna.vk.vntu.edu.ua/file/2bd6369c3fe521e8e4c0244cab6a5ea5.pdf
11. Strategies of the enterprise: monograph / Kovtun O. I. – Lviv: Publishing house of Lviv Commercial Academy, 2008. – 424 p.
12. Shershnova Z. Ie. Strategic management: Textbook. – 2nd ed., Revised. and add. – K .: KNEU, 2004. – 699 p.
13. Savchenko Iu. T. Establishment of the development strategy of machine-building enterprises in a chain of deliveries [Electronic resource]. – Access mode: http://ena.lp.edu.ua:8080/bitstream/ntb/29526/1/049_316_324.pdf
14. Muliar T. S. Establishment and implementation of enterprises' strategies [Electronic resource]. – Access mode: http://nbuv.gov.ua/UJRN/znptdau_2013_2%286%29__35
15. Kolesnikov A. A. Synergetic theory of management: concepts, methods, development tendencies [Electronic resource]. – Access mode: http://cyberleninka.ru/article/n/sinergeticheskaya-teoriya-upravleniya-kontseptsiimetody-tendentsii-razvitiya
16. Poberezhnyi R. O. Formation of the development strategy of machine-building enterprise on the basis of the balanced system of factors [Electronic resource]. – Access mode: http://repository.kpi.kharkov.ua/bitstream/KhPI-Press/17677/2/dysertatsiia_2015_Poberezhnyi_ Formuvannia.pdf
17. Sokolova L. V. Kolisnyk O. Scientific and methodical approach to formation of management strategy of small enterprises [Electronic resource]. – Access mode: http://dspace.uzhnu.edu.ua/jspui/bitstream/lib/10963/1.pdf

Sokolovskaya Z. N.
Doctor of Economic Sciences, Professor,
Head of Department of Economic
Cybernetics and Information Technologies
Odessa National Polytechnic University

Kapustyan I. V.
Postgraduate Student
Odessa National Polytechnic University

THE METHODOLOGY OF BUSINESS PROCESS MODELLING IN PHARMACEUTICAL ENTERPRISES MANAGEMENT

Summary

The study's aim is to consider the modern directions business processes modelling in pharmaceutical enterprises management. The research determines problems of functioning of pharmaceutical industry in Ukraine. It classifies the main business

processes of the pharmaceutical enterprises by taking into account the specifics of the industry. The analysis of domestic developments in business process management of pharmaceutical enterprises is conducted by using the economic-mathematical and simulation methods. The study justifies the necessity of using a multi-approach paradigm of simulation modelling and fuzzy expert systems of approximate reasoning as a complex method of researches. The software platforms for implementing the recommended mathematical apparatus are viewed. The current directions of research for the future are identified.

Introduction

At the present stage of the development of the domestic economy, a special importance is attached to the improvement of the efficiency of the functioning of industrial enterprises as the main business entities at the micro level. The transition from a functional to a process management paradigm attracts attention to the basic business processes that determine the final indicators of their activities. Under these conditions, researches of supply-side business processes, taking into account the specifics of industries, are central to the list of management tasks facing enterprise management.

Despite significant development problems, the pharmaceutical industry of Ukraine is one of the spheres of the industry with the highest potential for innovative growth. Ukraine ranked fourth among the CIS countries in the consumption of pharmaceutical products. At the end of 2016, the volume of pharmacy sales of all categories of goods reached 60 billion UAH for 1.6 billion packs, which indicates the growth of the market in both monetary (at the level of 21.9%) and in natural (5.7%) expression [20]. At the same time, in the total number of producers operating on the pharmaceutical market, only a third part is domestic enterprises. According to statistics, the needs of Ukrainian consumers are provided medications of their own production on average by only 25%, while 75% are medicines of foreign production [20]. Structure of pharmacy medicines sales for the period 2014-2016 years is shown in Figure 1.

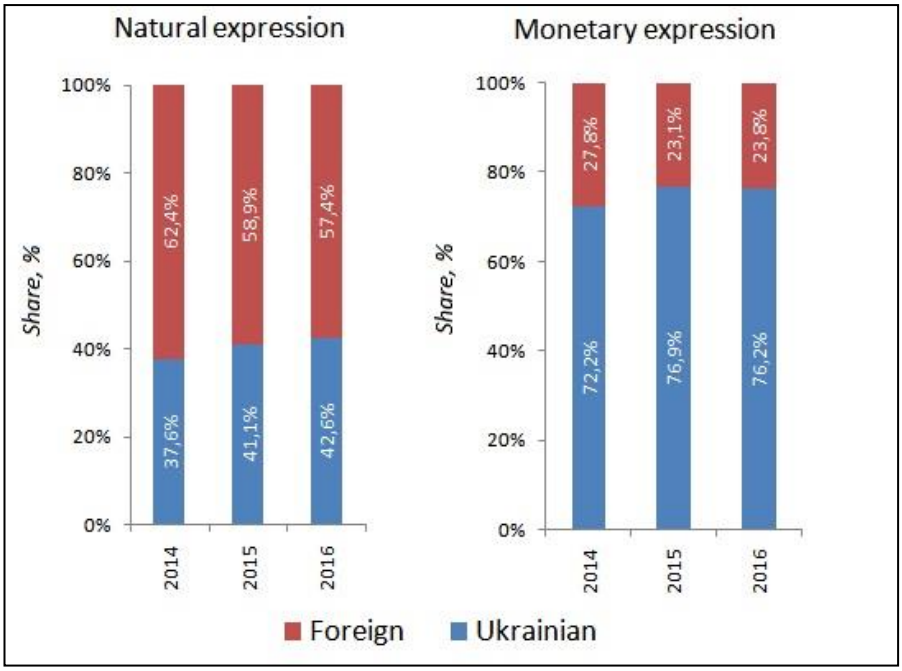

Fig. 1. The structure of pharmacy medicines sales for the period of 2014-2016 years

Source: [20]

Among factors, constraining the pharmaceutical market growth, one can note its imbalance in monetary and natural expression, the excess of supply over demand and the high degree of fragmentation. The effectiveness of domestic producers is affected by the inadequate use of the resource potential and lack of a quality management system. High level of competition, import dependence, tight state regulation with insignificant financing, insufficient volumes of attracted investments are exacerbating the problems of the enterprises of the pharmaceutical industry.

The researchers and practitioners have devoted a significant number of works to a wide range of tasks of the functioning of pharmaceutical enterprises, among them [1-4; 6; 9; 11; 12; 16-19; 23-25; 28-33] and others. At the same time, full-fledged research is impossible without the involvement of a serious mathematical apparatus.

A highly competitive environment with a significant degree of entropy, intensive changes in the supply of new products and market demand, the seasonal component, special requirements to storage and transportation of medicines etc. are put forward significant requirements to the mathematical basis of research pharmaceutical enterprises activities: flexibility, adequacy of real objects, optimal complexity, promptness of obtaining the necessary results of calculations. In this regard, it is advisable to conduct an analytical review of existing developments in this field.

The necessity to take into account the specifics of the functioning and development of pharmaceutical industry in Ukraine limits further analysis of results by studying the works only Ukrainian specialists and authors of the CIS member countries.

Part 1. Analytical review of the solved tasks and used mathematical apparatus

At the present stage of development of market relations, the commercial success of a pharmaceutical enterprise depends not so much on the efficiency of production management, as on the quality of organized business processes. The corporate strategy is developed on the basis of the solving problems in logistics, management, and marketing.

Analytical review of the literature on existing models and methods of managing business processes of pharmaceutical enterprise allowed distinguishing the following groups:

- assortment management;
- analysis of demand for products;
- forecasting of sales volumes;
- inventory management;
- pricing management;
- logistics optimization;
- planning of costs and incomes;
- assessment of competitiveness;
- risk analysis.

A system analysis is a complex approach to study the business processes of a pharmaceutical enterprise, it is mainly used in practice research of assortment management, forecasting of sales volumes, inventory management, pricing management, assessment of competitiveness and risk analysis [4; 16; 17; 19; 28-30].

The business process of assortment management of a pharmaceutical enterprise is sufficiently studied among domestic and foreign authors. As a rule, optimization of the commodity assortment is carried out, using the operations research methods (linear and nonlinear programming), statistical and simulation modelling, methods of game theory.

The study [3] highlights the idea of initial problem decomposition and its reduction to the approved mathematical programming methods with limitations that reflect the probabilistic nature of the problem. In the study [28], the key indicators for assessing the assortment management effectiveness indicators are singled out and analysed. In the study [25], the assortment optimization tasks are solved by using the dynamic assortment classification model, which is based on the cluster analysis methods and the retail network organization principles of the pharmaceutical enterprise. In the study [5], the author applies the game theory to choose a preferred supplier and the simplex method for order nomenclature forming from the selected supplier, which allowed automating the decision-making process and significantly simplifying the algorithm for choosing the supplier and forming his order through the use of a two-level analysis.

The pharmaceutical enterprises' assortment policy is formed on the basis of studying the market demand for finished products. The specificity of the industry implies the presence of non-stationary processes, the necessity to take into account seasonal variations and territorial needs in various medicinal products (depending on the ecology of the region and the frequency of related diseases).

In view of this, the mathematical apparatus of research of this business process group is presented, mainly, by statistical and simulation modelling. The sources [17; 24; 31] analyse the demand for pharmaceutical products using the system dynamics and discrete event modelling in the AnyLogic software environment, justify the application of the demand function normal distribution, study the dependence of demand volume on the determined factors as a linear function with the demand curve construction and definition of its elasticity.

The methods of statistical modelling, the method of dynamic indicators and the time series research methods are mainly used for forecasting sales volumes. So, in the research [32], the author studies the sales volume as a random event and conducts series of statistical tests, the set of obtained results are processed by mathematical statistics methods that allow obtaining an approximate estimate of the sales level.

In the work [24], a special attention is paid to studying consumer behaviour and forecasting the dynamic sales volume to maximize the satisfaction of needs by using the trend-based extrapolation method. Trend-based extrapolation includes: collection of empirical information from historical indicators; the choice of the optimal function form (logarithmic, exponential, parabolic or straight line equation), describing the indicated series taking into account its smoothing and equalization; calculation selected parameters or the extrapolation function; implementation of the forecast for the future to the selected function. In the study [28], the author analyses the time series of sales to determine the seasonality of each product. Next, he analyses the estimate of the accuracy of forecasting for categories of seasonal and non-seasonal products. Statistical processing of results is carried out using the Fisher and Sheffe criteria. From the researcher's point of view, for the forecasting of seasonal medicines sales, the method of extrapolation with taking into account seasonal variations is the most optimal and for the forecasting of non-seasonal medicines sales method of simple extrapolation should be used.

The traditional direction of economic business processes research is the inventory management tasks solution in relation to various industries enterprises. However, for pharmaceutical companies that have a clearly defined specificity of maintaining stock levels (accounting for the medicines shelf life and special requirements for storage conditions), these studies are not very broad.

Simulation modelling as a method of pharmaceutical enterprise inventory management is used in studies [4; 21; 25; 28; and 31]. They offer a technology for

constructing a simulation mathematical model of inventory management that is based on a system approach and allowing building adequate models in the changing market of medicines. Statistical methods and models of inventory management have found application in studies [24; 28 and 30]. Thus, for the purpose of modelling the process of managing material flows and products inventories, the characteristic features of the pharmaceutical market commodity mass as a whole and product groups, in particular, were identified, taking into account the consumer properties medicines specific features and medical products. In the research [11], the author proposes the application of game theory methods in managing the processes of creating optimal stocks of raw materials, billets, and packing in warehouses and pharmacies.

One of the urgent problems arising in the field of the pharmaceutical industry is pricing. The industry specificity presupposes a flexible, ever-changing policy for the pharmaceutical products pricing, taking into account the influence a large number of factors of the external and internal environment.

The most significant contribution to the solution of this problem belongs, in our opinion, to A. Stepanov [28]. The author's works reveals the complex of issues such as: the justification of the methodology for assessing price changes in the pharmaceutical market; the description of algorithms for determining the base prices and approaches to individual price proposal formation on pharmacies; the systematization of time series of price changes; the implementation of a client-oriented price control strategy for price-sensitive pharmacy organizations.

A large class of pharmaceutical logistics management tasks is solved by using the operational research methods (linear and nonlinear programming, transport tasks) [6; 11; 30; and 32]. This is a complex approach to modelling the overall task of commodity circulation optimal management in a multilevel logistics network as a set of interacting economic-mathematical models of optimization and forecasting managerial logistics solutions. The economic-mathematical model of the optimal goods distribution by warehouses is aimed at minimizing the company's costs associated with inter-warehouse transportation. The scarce goods management model takes into account the penalty size for short delivery, allows reducing the amount of goods reserved for a particular customer, prioritizing the most important of them.

The recent years, developments in the pharmaceutical logistics management field include the use of simulation methods. In studies [1; 28; 31; and 33], the various models' modifications of pharmaceutical products warehouses are presented, in particular, the authors study the problems of commodity items placement in the warehouse (splitting into slots) and selection opportunities of the optimal routes for pre-order production and further products shipment.

In practice, specialists use time series analysis and economic-statistical methods in order to plan costs and incomes [2; 11]. The authors are proposing a technique for forecasting the pharmaceutical company performance indicators on the basis of one-dimensional time series. Correlation-regression analysis is used to study the impact of commodity turnover on the circulation costs level (pair correlation) and the group structure of commodity turnover on the level of circulation costs (multiple correlation). With the help of this technique are analysed the labour productivity, the number of personnel, the level of trade overlaps depending on the commodity turnover, its structure and a number of factors reflecting the under-investigation process specificity. Planning of circulation costs level is carried out based on the established in analysis baseline indicators of the reporting year taking into account the expenditure levels dynamics over a number of years.

Among the researchers dealing with the problems of assessing the pharmaceutical enterprises' competitiveness, it should be noted, in our opinion, the authors of researches [12; 18; 23; and 29]. Their works reflect interesting approaches to the application methods of statistic, dynamic indicators, and game theory.

So, in works [18; 23] an effective mechanism is proposed to strengthen the financial-investment potential of the pharmaceutical industry in Ukraine by the cluster formation method. Clusters are seen as an important precondition for increasing the competitiveness, productivity, and success of both a single pharmaceutical enterprise and the industry as a whole by providing improved services, knowledge infrastructure, co-financing, risk sharing. The clusters development in the pharmaceutical industry allows the goals and tasks coordination to participants in the pharmaceutical regional cluster in order to achieve a synergistic effect of cluster member's innovative activity development, the introduction of original medicines, the latest technologies for their production, modern management methods, medicines promotion organization in the Ukraine's pharmaceutical market and beyond.

The author of the research [29] shows the necessity to improve and carefully model competitiveness management systems that take into account flexibility, rapid response to changes in the internal and external environment that ensure a high level of competitiveness in the short and long term. The research is based on the application of applied economic-statistical methods: data grouping, comparative analysis method, organizational-structural modelling, expert evaluation method.

In the work [12], the estimation of pharmaceutical enterprise competitiveness is proposed by means of a business game. In the gaming environment, the unity of knowledge principle is effectively realized. Wherein, knowledge is acquired not abstractly but in the real process of information support for game actions participants, in the dynamics of the business game plot development, in the formation holistic image of a professional situation.

With regard to risk assessment, traditionally numerous studies are conducted on the basis of medical institutions. In the direction of the risk analysis associated with the production and marketing of pharmaceutical products, the research methods' implementation is based on simulation approaches [9]. The given work is devoted to problems of risk estimation on the basis of simulation stochastic modelling, in it the algorithm of a risk quantitative estimation based on simulation. The author suggested a classification of the main risk factors, presented analyses of the approaches to quantifying risk based on simulation modelling. He showed that the main approaches, which take into account the features of innovative projects, are methods based on the stochastic graphs analysis. The author suggested a mechanism for constructing business processes information models in the stochastic graphs form with cycles to study the influence of risk factors on the innovative projects' efficiency.

Thus, based on the review we can conclude that the most applicable mathematical apparatus are investigating operations methods, statistical, and simulation modelling. Concerning the latter, it is necessary to emphasize a limited number of typical complex developments. The prevailing are applications aimed at researching narrowly specialized spheres of pharmaceutical industry entities activity.

As for the nomenclature of tasks solved by using economic-mathematical and simulation methods, it is rather limited and does not fully meet the necessity of managing the main industry business processes.

The literature review on the problems under consideration of the pharmaceutical industry and the various research methods application is presented in Table 1.

Table 1

The literature review on the application of the mathematical research apparatus in the tasks of business process management in the pharmaceutical industry

	Assortment management	Analysis of demand for products	Forecasting of sales volumes	Inventory management	Pricing management	Logistics optimization	Planning of costs and incomes	Assessment of competitiveness	Risk analysis
Simulation modelling	[28]	[31]		[4; 21; 25; 28; 31]		[1; 28; 31; 33]			[9]
Statistical methods and models	[25]	[17]	[28; 32]	[24; 28; 30]	[28]		[2; 11]	[18; 23; 29]	
Methods of linear programing	[3]					[6; 11; 32]			
Methods of time series research			[28]		[28]		[2].		
Method of dynamic indicators		[24]	[24]						
Methods of game theory	[4]			[11]				[12]	
System analysis	[19; 28]		[4; 30]	[28]	[17]			[29]	[16]

Specific gravity of the solved problems in the investigated field is presented in Figure 2.

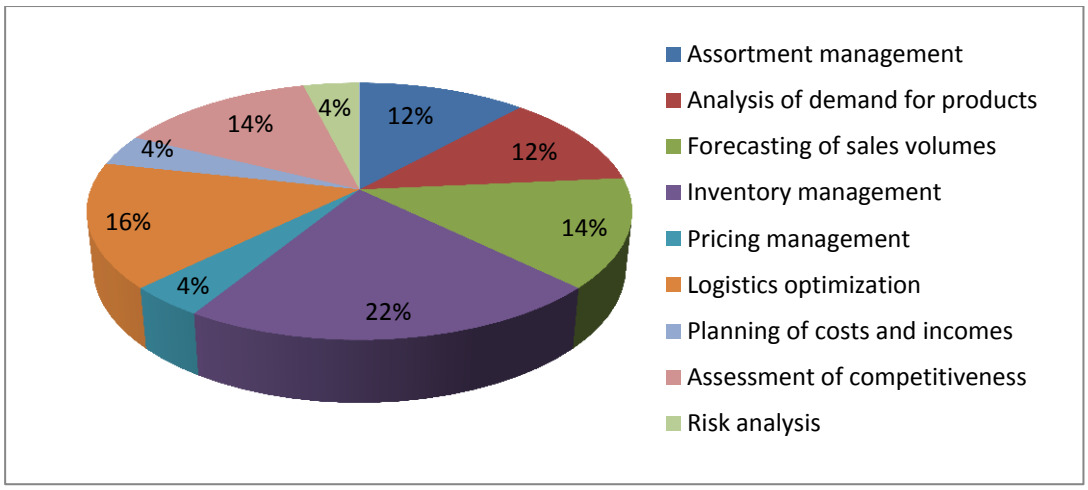

Fig. 2. Specific gravity of the solved problems

Source: the author's development

The specific gravity of the used mathematical methods for solving various problems in the pharmaceutical industry management is presented in Figure 3.

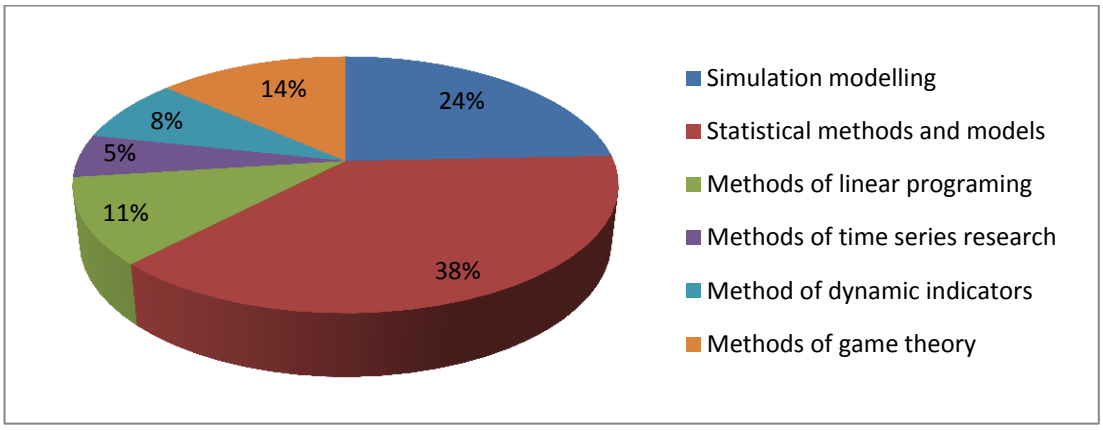

Fig. 3. Specific gravity of the used mathematical methods

Source: the author's development

The above review does not consider the application methods of fuzzy mathematics and expert systems because the authors do not know any significant applications (domestic origin) of this apparatus in the study area.

The functioning of pharmaceutical enterprises as complex economic systems requires a comprehensive solution of diverse tasks arising in the external and internal environments their activities. This, in turn, requires the involvement of a diverse mathematical apparatus that allows obtaining solutions from different viewpoints.

Part 2. Simulation modelling and expert systems – complex apparatus of researches

Conditionally, the whole set of applied methods can be divided into quantitative and qualitative, proceeding from the results that they are able to provide. The authors consider this division is justified from the viewpoint of the factors of nature, affecting the final activities results of the enterprises under study: quantitative – factors that can be completely formalized; qualitative – factors that are subject to formalization only partly or are not amenable to at all. If the class of the first one is relatively applicable in practice (which is confirmed by the above review), the second one is represented very little or not represented generally. However, the attraction of fuzzy mathematics methods and expert systems (ES) based on the fuzziness apparatus can provide interesting and even unexpected results that have a significant impact on the management decisions taken.

With regard to quantitative methods, the industry specifics require the construction of stochastic models that are flexible enough, with a parametric setting that can take into account the pharmaceutical market dynamics and, accordingly, the production-marketing processes. The modern approach that meets the set tasks is simulation modelling, which, according to the results of the presented analytical review, gradually finds its place in the mathematical research arsenal.

According to the authors, the symbiosis of simulation modelling and the expert systems apparatus (for example, fuzzy expert systems of approximate reasoning) can become an analytical basis for making managerial decisions in the pharmaceutical industry.

Simulation can implement a significant set of tasks, in particular, due to the modular and open nature of models, it is possible to attract various methods (for example, optimization methods) in individual model blocks.

In the methodological plan at the present development stage of simulation modelling, three main approaches are allocated [5; 8; 10; 13-15; 22; and 26]:

– System Dynamics modelling;
– Discrete Event modelling (process-centric);
– Agent-Based modelling.

The discrete event approach is used, as a rule, at the operational and tactical level. System dynamics provides a high level of abstraction and can be used to solve strategic tasks. The spectrum of agent-based models application includes tasks of any abstraction level. The discrete event approach looks at the system from the top down, analysing it at the system level. Agent-based modelling is the bottom-up approach: the model focuses on the behaviour of individual objects.

Discrete event modelling provides a detailed simulation object representation; the dynamics of its development is determined by generating elementary events in a certain sequence. The process of simulation is a dynamic system transition from one state to another based on the event concept. When using this approach, the task of the researcher is to describe events changing the system state and determine the relationship between them.

With the help of this approach, for example, the managing production processes of specific medicinal products can be modelled, it will solve the operational scheduling tasks, warehouse stocks management of raw materials and finished pharmaceutical products and so on, that is tasks requiring a high detail degree.

Stream simulation methods are used when the simulation object dynamics is determined in the evolutionary changes form, without the reproduction of individual elementary events. Objects models are represented in this case as the interaction of diverse flows. The flow concept provides for a high degree of processes aggregation that occurs at the research object.

The flow approach is implemented based on the method of system dynamics proposed by Jay Forrester in the early 1960s [10]. Fundamental notions of the method are the flows and fund concepts (accumulator, reservoir). The simulation object is represented as a dynamic system consisting of funds interconnected by flows. The content of the funds is measured by their level, and the intensity of the flows is determined by the tempo or speed of funds contents movement.

These notions are sufficiently universal and can be easily interpreted in terms of the subject area being researched. For example, in the form of funds can be: individual pharmaceutical production units or departments apparatus of enterprise management; raw materials or finished products warehouses; distribution links – pharmacies, wholesale pharmaceutical companies, medical-preventive institutions; advertising budget in the framework of enterprise marketing strategy; the incoming investments volume, pharmaceutical companies settlement accounts, distributors including importing firms and so on.

Flows can reflect various processes – material, financial, information, human resource movement and other. Their paces are determined by management decisions forming based on information about the state of the levels. As flows can be: orders for the medicines production; production process capacity; deliveries of finished products to the enterprise warehouses and to the pharmacy network; sales intensity in the retail network, by specific pharmacies; raw materials supply; enterprise financial

flows; cash flow on settlement accounts; logistic business processes; labour resources movement in enterprise units, sales system and so on

The researching purpose an object with help the system dynamics method is to study the dynamic features of the system, its behaviour in time for a given initial state and control parameters values.

Agent-based modelling is the relatively new modern approach in simulation modelling. The agent-based model defines the investigated object in the form of separate specified active subsystems (agents). From the viewpoint of practical use, the agent-based modelling studies the decentralized agent's behaviour and its effect on the behaviour of the entire system as a whole [5, 13, 14 and 22]. The developer enters agent parameters, determines their behaviour and model environment, and establishes the relationships between agents and the environment of their operation during the construction of the agent model.

Agent-based models purpose is to get an idea of the global rules, the general system behaviour based on assumptions about the individual behaviour of individual active objects and their interaction in the system. Such models are used for the decentralized systems study, their functioning dynamics are determined not by global rules and laws but, on the contrary, global rules and laws are the results of group member's individual activity.

Thus, the method basis is not to find the optimal economic equilibrium but to determine the nature of complex phenomena and processes. Emergent behaviour is the result of the system elements interaction. In this regard, the correct reproduction of behaviour and elements interaction mechanisms has a great importance.

Medicines buyers, orders for the production of specific nomenclature items, medicines packages, distributors, raw material suppliers and others can act as agents in the studied subject area. A whole tasks complex of marketing pharmaceutical enterprises management can be solved used the agent-based approach since its specificity corresponds to the ability to reproduce changes in the pharmaceutical market, in particular, seasonal fluctuations in demand, price changes, actions of competing firms.

The choice of a methodological approach to modelling ultimately depends on the tasks specific and the ultimate objectives of the study. At the same time, in real practice, there is a constant need for a combined use of different approaches within a single model that is in multi-approach modelling [14; 22].

The necessity of using a multi-approach paradigm of simulation modelling arises in the following cases:

1. The simulated system contains various objects, the modelling of which implies the use of different approaches.
2. Within one model is a necessity the variation of different abstraction levels.
3. It is easier to describe individual parts of the model by using different approaches.

Modern simulation modelling involves a symbiosis of diverse information technologies with a developed graphical interface and results animation, provides a significant basic concepts choice of formalization and structuring simulated systems and processes.

The dominant special simulation software platforms are GPSS, BPsim, PowerSim, Ithink, Simplex, Modul Vision, Triad.Net, CERT, ESimL, Simulab, NetStar, Pilgrim, MOST, COGNITRON, ARENA, AnyLogic, and others.

One of the most common is the AnyLogic system, which supports all the above approaches on a single platform in recent years [5; 13; and 15]. The examples of

simulation models in the pharmaceutical enterprises' management and their sales systems implemented on multi-approaches platforms are in [21; 31].

In our opinion, one of the productive directions analyses of the pharmaceutical companies business processes implementation complementing the quantitative results of simulation experiments can be considered the attraction of approximate reasoning fuzzy expert systems, for example, the fairly common shell of CLIPS and its numerous clones, in particular, FuzzyCLIPS [26; 32].

The using fuzzy expert systems advantages are briefly considered on the example of FuzzyCLIPS:

1. The system allows taking into account the vagueness of the input variables, that is, the primary facts, which influence the final results of various economic situations arising in the pharmaceutical enterprises' production and distribution activities. Within the system, it is possible to describe the membership functions of the fuzzy variables used, that is, to define fuzzy sets within the framework of universal factors (facts) sets. Wherein, the number of fuzzy variables is not limited. Different types of membership functions can also be used.

2. In the system along with the fuzzy, it is possible to complex use of clear variables (not requiring the assignment of membership functions). Thus, the set of factors (facts) that make up the knowledge base maximally reflects the real the object under study state from the viewpoint of the influence diverse nature factors on its activity.

3. By the conclusion of the consultation, the user receives diverse results. First, it is a fuzzy result, that is, the dynamics of the possible process development. Secondly, there is a clear result obtained during the transformation of fuzzy resultant dynamics, concentrating the researcher's attention on the most probable area of finding the future result.

4. The system does not require any special knowledge from the user (except knowledge of the subject domain), it is easy to master. In other words, apparatus under study can be used by non-professionals.

5. A flexible built-in meta-component is available. This is important because the ES explains the mechanism of its reasoning and conclusions after the process of analysing the situation described by the user. Wherein, the user can ask fuzzy questions.

6. The main operational characteristics of the system are portability, capacity, and ability to expand.

7. The system has a friendly user interface. User communication with the system is realized in a limited natural language by using a multi-window interface.

Various foreign studies have shown that the influence of qualitative factors on the resulting economic indicators can be much stronger and more prevalent than the influence of quantitative factors. In addition, it can be multidirectional influences. In such conditions, an adequate assessment of the investigated business process development can be formed only through an all influences complex analysis.

The use case library formation and storage is the user-friendly feature of expert systems. The experience of past expert consultations and the results of really accepted management decisions are taken into account by the ES in the logical reasoning course and the recommendations formation to users. This feature perfectly complements the capabilities of powerful simulation platforms (such as AnyLogic) for storing the numerous model runs results, carrying out various experiments types (for example, sensitivity estimation, optimization, parametric experiments, and others).

The joint operation of the above mathematical apparatus can be included in the contour of decision support systems at the pharmaceutical enterprises level and the industry as a whole because it facilitates the formation database and knowledge base in relative to the dynamic development of the business processes under study.

Conclusions

The results of the analysis carried out allow making a number of conclusions and proposals.

For stable development and dynamic growth of the Ukrainian pharmaceutical market, an important condition is an increase in the efficiency of the domestic pharmaceutical enterprises functioning. The attracted mathematical tools play an important role in improving the business processes management of the studied objects.

The review of the most significant developments in the sphere in question allowed generalizing the main using directions mathematical methods and models in the context of the solved problems with their assignment to certain business processes management groups. The analysis carried out showed the uneven coverage of business processes by research involving mathematical tools. Among the problems often solved are the tasks of assortment management, the forecasting of sales volumes, inventory management, and logistics optimization. The most common mathematical apparatus is methods of operations research, statistical, and simulation modelling.

In general, the existing level of attracting special mathematical tools is clearly insufficient taking into account the analysis a set of directions and tasks to be solved. Further dynamic industry development dictates the necessity for a wider and more systematic use of the modern mathematical base, as an analytical basis for the adoption of operational and strategic management decisions.

In line with the problem posed, the involvement of a complex research apparatus (simulation modelling and fuzzy expert systems of approximate reasoning) is seen as relevant and expedient.

Simulation models are training apparatus for the development and adoption of management decisions can be used as a day-to-day device for tracking the various business processes progress in order to identify bottlenecks in time and to take action to eliminate them. The expert systems recommendations will supplement the picture of the forecasted facilities development in the conditions of an uncertain, fuzzy pharmaceutical market environment.

The proposed toolkit inclusion in the pharmaceutical companies IT infrastructure will significantly improve the efficiency of business process management at the operational and strategic levels.

References:

1. Babina O. I. Development of an optimization simulation model to support the warehouse systems planning processes / O. I. Babina // Computer Studies and Modelling. – 2014. – T. 6. – № 2. – p. 295−307.

2. Baldin V. V. Statistical analysis and forecasting of the pharmaceutical trading company activities : Dis. cand. econ. sciences : 08.00.12 / Baldin Victor Victorovich. – Moscow, 2002. – 164 p.

3. Bautov A. N. Formation and calculation of the optimal assortment for random demand / A.N. Bautov // Marketing in Russia and beyond. – 2003. – № 3. – P.18–31.

4. Belousov E. A. Logistic approach to inventory management : Dis. cand. farm. sciences: 15.00.01 / Belousov Evgeniy Aleksandrovich. – Kursk, 2004. – 134 p.

5. Borschev A. V. From system dynamics and traditional simulation modelling to practical agent-based models: causes, technologies, tools [Electronic resource] / A. V. Borschev. – Access mode: http://www.gpss.ru/paper/borshevarc.pdf.

6. Brodeckiy G. L. Method of decision tree for multicriteria optimization in supply chains / G. L. Brodeckiy // Logistics today. – 2008. – № 5. – P. 320–329.

7. Chastikov A. P. Expert systems development. CLIPS environment / A.P. Chastikov, T. A. Gavrilova, D. L. Belov. – Spb: BHV-Petersburg, 2003. – 608 p.

8. Cysar I. F. Modelling the economy in Ithink_Stella. Crises, taxes, information, banks / I. F. Cysar. – Moscow : DIALOG_MIFI, 2009. – 224 p.

9. Demkin I. V. Management of innovation risk based on simulation modelling. Basic approaches to the assessment of innovation risk / I. V. Demkin // Problems of risk analysis. – 2005. – T. 2. – № 3. – P. 249–273.

10. Forrester J. Fundamentals of enterprise cybernetics / J. Forrester. – Moscow : Progress, 1971. – 765 p.

11. Gorenkov V. F. Economy of the pharmaceutical enterprise / V. F. Gorenkov // Chemistry (pharmaceutical activities). – Minsk : BSU, 2012. – P. 29–38.

12. Gromovik B. P. Development of the business game methodology «Pharmacy competitiveness evaluation» [Electronic resource] / B. P. Gromovik, K. I. Pushak, S. I. Tereschuk. – Access mode: http://www.provisor.com.ua/ archive/2003/N18/art_14.php.

13. Ivashkin Y. A. Multi-agent simulation of large systems / Y. A. Ivashkin. – M.:MSUAB, 2015. – 238 p.

14. Katalevskiy D. Y. System dynamics and agent modelling : the necessity for a combined approach [Electronic resource] / D. Y. Katalevskiy. – Access mode: http://simulation.su/uploads/ files/default/incomplete-katalevsky.pdf.

15. Kiselyova M. V. Simulation modelling of systems in AnyLogic environment / M. V. Kiselyova. – Ekaterinburg: USTU. – UPI, 2015. – 258 p.

16. Kovalenko A. V. Risk management of a pharmaceutical company : Dis. cand. econ.sciences:08.00.13/Kovalenko Aleksandr Vladimirovich.–M.:2009.–173p.

17. Lisovskiy P. A. A system approach to planning the assortment of the pharmacy network / P. A. Lisovskiy // New pharmacy. – 2012. – №2. – P. 37–43.

18. Matviiv O. V. Pharmaceutical industry clustering as the strengthening method of it financial-investment potential / O. V. Matviiv // Current problems of economics. – 2014. – № 8. – P. 81–89.

19. Mnushko Z. N. Marketing in Pharmacy / Z. N. Mnushko, N. M. Dihtyareva. – Kharkov, NFUU: Golden Pages, 2008. – 536 p.

20. Pharmacy market of Ukraine by the results of 2016: Helicopter View [Electronic resource]. – Access mode: http://www.apteka.ua/article/398728.

21. Pozhidaev V. A. Simulation model development for managing the pharmaceutical company inventory [Electronic resource] / V. A. Pozhidaev. – Access mode: https://www.hse.ru/edu/vkr/ 182595452.

22. Pyosikov E. B. Complex multi-agent models of analysis and risk management of a virtual enterprise [Electronic resource] / E. B. Pyosikov, A. V. Dorogin. – Materials of IMMOD -2013. – Access mode: http://www.anylogic.ru/articles.

23. Sagaydak-Nikityuk R. V. Create a pharmaceutical clusters in Ukraine based logistics management and international quality standards / R. V. Sagaydak-Nikityuk, O. V. Posylnikova // Farmitek. – 2011. – № 3. – P. 24–31.

24. Savelyeva Z. A. Basis of economic planning and forecasting / Z. A. Savelyeva, O. V. Kartashova // Pharmacy economics basics. – M., 2003. – P. 23–35.

25. Shabelnik T. V. Models marketing-oriented pharmaceutical enterprise management : Dis. dr. econ. sciences : 08.00.11 / Shabelnik Tatyana Vladimirovna. – Poltava, 2016. – 383 p.

26. Sokolovskaya Z. N. Application models of system dynamics: Monograph / Z. N. Sokolovskaya, O. A. Klepikova. – Odessa : Astroprint, 2015. – 308 p.

27. Sokolovskaya Z. N. Expert systems in economic research: Monograph / Z. N. Sokolovskaya. – Odessa : Astroprint, 2005. – 240 p.

28. Stepanov A.S. Methodological approaches to the work optimization of regional wholesale pharmaceutical organizations (on example of Far East) : Dis. cand. farm. sciences : 14.04.03 / Stepanov Aleksey Sergeevich. – M., 2014. – 313 p.

29. Tretyakova E. A. Conceptual modelling of the competitiveness managment dynamic system of pharmaceutical industrial enterprises / E. A. Tretyakova // Bulletin of Perm University.Series «Economics». – 2013. – issue 2. – P. 42–51.
30. Umnova S. A. Modelling of material management processes at the pharmaceutical market enterprises : Dis. cand. econ. sciences : 08.00.13 / Umnova Svetlana Aleksandrovna. – Ivanovo, 2013. – 199 p.
31. Zahodyakin G. V. Using simulation methods in the Anylogic software environment for solving logistics tasks in the pharmaceutical industry / G. V. Zahodyakin, A. S. Degtyaryov // Successes in chemistry and chemical technology. – 2011. – T. XXV. – № 13(129). – P. 50–54.
32. Zubov N. N. Mathematical methods and models in pharmaceutical science and practice / N. N. Zubov, S. Z. Umarov, S. A. Bunin. – SPb: Publishing house of Polytechnic. University, 2008. – 249 p.
33. Zyazin O. N. Modelling of the commodity circulation processes based on the information system of the pharmaceutical trade network : Dis. cand. econ. sciences : 08.00.13 / Zyazin Oleg Nikolaevich. – SPb, 2001. – 168 p.

Kharun O. A.
Candidate of Economic Sciences, Associate Professor,
Senior Lecturer at Department of International Economic Relations,
Khmelnytskyi National University
Rodionova I. V.
Candidate of Economic Sciences,
Research Scholar,
Khmelnytskyi National University

INFLUENCE OF CORPORATE CULTURE ON LABOUR POTENTIAL MANAGEMENT AT INDUSTRIAL ENTERPRISES

Summary
The article overviews scientific approaches to defining the essence of corporate culture. Basic levels and types of corporate culture are characterized. It is pointed out the required components of enterprise corporate culture. The most significant features and specifics of the formation and development of corporate culture are considered. It is found the impact of corporate culture on the management of labour potential and revealed its benefits of development based on corporate culture. Basic techniques that quantify the impact of corporate culture on working capacity and efficiency of the enterprise are investigated by the author.

Introduction

The experience of market economy countries is a convincing proof that corporate culture is a significant lever of labour potential quality and increasing the innovative activity of companies' and organizations' employees. Corporate culture creates value orientations behaviour management and employees of the enterprise, uniting them in a common aspiration to full flowering of the organization, image formation team capable of developing and implementing advanced, original ideas, and innovations [1].

Corporate culture creates behaviour value orientations of the company's management and employees, uniting them in a common aspiration to achieve the