

EXPERIENCE IN THE DEVELOPMENT AND APPLICATION OF SIMULATION IN RUSSIA: REVIEW, ANALYSIS OF PROSPECTS

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ABSTRACT

The paper deals with the historic aspects of simulation development in USSR. It shows that due to the improvement of economic situation in Russia and CIS countries interest in simulation started to resume. A brief review of the market of simulation tools used now in Russia is made. The necessity of establishing the Russian Simulation Society is emphasized. The paper includes a list of activities aimed to make simulation one of the most popular technologies in Russia.

HISTORY OF SIMULATION DEVELOPMENT IN USSR AND RUSSIA

The basics of research and developments in simulation and its application in Russia (USSR) were laid in the 60s-70s. Simulation was one of the most developed aspects in the study of complex systems (systems analysis and study of operations). The achievements in simulation of scientific schools of that time in Moscow, Kiev, Novosibirsk and other cities are known all over the world.

Besides fundamental research, we have a number of important practical results. For example, such famous simulation systems were developed, as SLENG and NEDIS (Institute of cybernetics of Academy of Sciences of USSR), STAM (Bauman Moscow Higher Technical school), MODEL 6 (Computation Centre of Novosibirsk Academictown). Also various special-purpose systems were developed.

Orientation for the creation and use of home software and hardware was the reason why most of simulation means used at that time in the world were not widely used in USSR. The only exception were GPSS systems, which were rather popular. This was due to a number of circumstances:

- translation into Russian of application packages PMDS (GPSS/360) and PMDS 2.0 (GPSS V) and deliveries of mainframe series with these packages to Kazan Computer plant;

- issue of 10 thousand copies of Red book by T. Schreiber "Simulation using GPSS" at "Mashinostroenie" publishing house;

- intensive cooperation within CMEA with the experts from GDR and deliveries of SIMDIS (GPSS/360) and SIMDIS 2.0 (GPSS V) systems to USSR.

There were also single applications of SIMULA and GASP languages, which were developed jointly with experts of Czechoslovakia, Hungary and other countries.

Thus, due to the synthesis of its own scientific ideas, original developments and the best foreign technologies the Soviet school of simulation was recognized worldwide.

CURRENT STATE OF SIMULATION IN RUSSIA AND CIS COUNTRIES

Unfortunately, after the disintegration of USSR and as a result of the crisis in industry and science, most of this potential was lost. Scientific contacts were broken, financing became unstable. But most important was that in the 90s practical application of simulation methods and means completely disappeared or was replaced by foreign firms, which delivered closed loop turnkey systems.

But gradually, when the economic situation in Russia and CIS countries started to improve, *interest in simulation began to rise*.

Now, we can say that simulation crisis in Russia is coming to its end. These are the main facts confirming our conclusion:

Firstly, activity of simulation experts in the Internet rose steeply.

A number of fundamental Internet-resources about simulation appeared: www.xjtek.ru, www.gpss.ru, www.simulation.org.ua, www.gpss-forum.narod.ru. Statistics of www.gpss.ru portal is a visual proof of growth of interest in simulation. It exists more than 3 years and every year the number of total visits increases more than thrice as much. At present more than 300 experts visit the portal every day. The geography of visits is either wide: more than 30 countries of the world.

Secondly, academic application of simulation is also constantly growing.

By the most conservative estimate, about 200 higher schools of Russia graduate annually more than 10000 experts who know the basics of simulation research.

Thirdly, a large number of works on this subject have been published.

These include not only simulation symposia and conferences proceedings. Many respectable journals started to publish such works (“Exponenta Pro”, “Computerra”, “Automation in industry”, “Automation and telemechanics”, “Information technologies and computation systems”, etc.).

A number of books about simulation have been published. They include four books, with 3 thousand copies each about GPSS World.

A landmark is the issue of the translation of one of fundamental books on simulation - “Simulation Modelling and Analysis”, third edition, Averill M. Law, W. David Kelton.

Fourthly, companies working professionally with simulation appear again.

There are a lot of them: XJ-Technologies (St Petersburg, www.xjtek.ru), B-Club Engineering (Ivanovo, www.b-club.ru), “Elina-Computer” (Kazan, www.elina-computer), Department of simulation of IBS company (Moscow, www.ibs.ru), Lengiprometz (St Petersburg). New research and developments are carried out in organizations of the Russian Academy of Sciences (RAS): Computation Centre of RAS, Institute of Control Sciences of RAS, Institute of System Analysis of RAS, Institute for Information Transmission Problems of RAS, Institute of Informatics Problems of RAS, St Petersburg Institute for Informatics and Automation of RAS, institutes of Siberian Branch of RAS, etc.

Fifthly, a number of Russian developments have appeared which are highly competitive in the world market.

These developments include: AnyLogic by XJ-Technologies, Fantomat by IBS, Object GPSS by Korolev A.G. (Severodonetsk, Ukraine), etc.

Sixthly, practical interest in simulation appeared in the real sector of the economy.

Important simulation-based projects have been carried out at a number of enterprises.

For example, at Nizhni Tagil Integrated Iron-and-Steel Works a simulation model is used to control productive capacity of the main workshops and process units. At Magnitogorsk Integrated Iron-and-Steel Works simulation is used in the enterprise system resources control subsystem. At “Severstal-Group” metallurgical enterprise simulation is used to evaluate the ways of reconstruction of the main workshops and their logistic flows. Simulation models, developed by Institute of Control Sciences of RAS, were used for the analysis and

implementation of projects of reconstruction of several foreign metallurgical works, built jointly with USSR and Russia.

Simulation models, integrated into production program optimization system (RPMS), developed by Petrocom JV, are widely used at most of petroleum refineries of Russia and at some foreign petroleum refineries.

At present, simulation is widely used to evaluate the quality of information control and transmission in general-purpose geographically-distributed systems.

OTHER ASPECTS OF SIMULATION APPLICATION IN RUSSIA

Taking into account the quick growth of Russia’s economy, gradual transition from mining to the high-level processing of extractives, the started modernization of industry and attempts of enterprises to increase their compatibility, it is natural to assume, that the use of such effective research tool as simulation will increase.

Facts show us, that interest in simulation methods appear now in many spheres.

Academic (educational) application

In spite of the unfavourable situation of previous years and due to enthusiasm and patience of experts of many higher schools, the backbone of highly qualified simulation experts, mainly the teachers of technical universities, was preserved. Simulation is widely used now in training.

The following courses were introduced into the standards for some specialities in Russia: “Modelling of systems”, “Simulation”, “Computer modelling”.

The same situation is in the higher schools of Ukraine, Byelorussia, Kazakhstan and other republics of former USSR. During last years a course of modelling was also introduced in the university syllabus for students of economics. The fact that higher school is the most active participant of discussing and solving simulation problems is proved by the statistics of www.gpss.ru portal. The rises and falls in the number of visits coincide fully with terms of semesters and holidays.

There is a long list of university experts, who have made a lot in simulation in recent years:

- Professor S.A. Yakovlev (St Petersburg Electrotechnical University “LETI”), Professor Yu.I. Ryzhikov (Mozhaisky Academy), Professor A.G. Varzhapetyan (St Petersburg State University of Aerospace Instrument-Making), Assistant Professor B.K. Yeltyshev (State Marine Technical University), etc. in St Petersburg;
- Professor V.M. Chyornenky (Bauman Moscow State Technical University), Professor Ye.M. Kudryavtsev (Moscow State Civil Engineering University), Assistant Professor N.N. Lychkina (State University of Management), etc. in Moscow;
- Professor S.A. Rodionov (Siberian State University of Telecommunications and Informatics), Assistant Professor V.V. Okolnishnikov (Novosibirsk State

University), Professor Ye.B. Tsoi (Novosibirsk State Technical University), etc. in Novosibirsk;
 - Professor V.N. Tomashevsky (National Technical University of Ukraine “KPI”) in Kiev.

This list could be continued. We established and maintain contact with more than 250 university teachers. Many universities are changing their program-technical base and buy modern licence software. Thus we hope that the standard of teaching simulation will improve even more.

Home developments

During the last decade a number of companies appeared in Russia with simulation as the main direction of their activities. These companies have many highly qualified simulation experts. On the basis of their research and work a number of simulation tools have been created, which are now widespread and generally recognized.

Among them are: simulation platform Fantomat (IBS, Moscow), professional simulation tool AnyLogic (XJ-Technologies, St Petersburg), etc.

We would like to emphasize the achievements of XJ-Technologies. In 13 years it became a company known to all in the simulation world. Their system AnyLogic is used at many world-known companies, such as Boeing Company, Hewlett-Packard, General Motors, etc. They constantly take part in many conferences and exhibitions (including WSC) and have their representatives in many countries of Europe and USA.

Table 1 gives brief information about the main simulation tools, developed in Russia and CIS countries.

Table 1: Simulation Tools, Developed in Russia

No.	Name	Manufacturer
1	Fantomat Simulation platform	IBS Department of simulation systems (9-b, Dmitrovskoe shosse, Moscow 127434, www.ibs.ru)
2	AnyLogic Professional simulation tool	XJ-Technologies (21, Politekhnicheskaya st., St Petersburg 194021, www.xjek.ru)
3	ISS2000 Interactive simulation system	National Technical University “Kiev Politechnical Institute”, Kiev, Ukraine (V.N. Tomashevsky)
4	Distributed simulation system for local network in QNX environment (OS UNIX)	Institute of Computational Mathematics and Mathematical Geophysics (Computing Centre), 6, Akademika Lavrentjeva prospect, Novosibirsk 630090, http://www.ssc.ru ,

5	“Queuing system”	Tomsk Polytechnic University (B.G. Oslin)
6	Object GPSS General-purpose simulation system	Severodonetsk Technological Institute, Severodonetsk, Ukraine (A.G. Korolyov)

Use, distribution and support of world-known simulation tools

The present stage of application of simulation in Russia is characterized by the use of advanced simulation tools, which are used worldwide. It’s an objective process, and it allows our researchers to choose the simulation tool, which is most suitable for them, taking in account their financial situation. Let us divide all simulation tools into two groups – general-purpose and commercial simulators.

Table 2 gives information about support of some general-purpose systems in Russia.

Table 2: General-purpose simulation systems in Russia

No.	Name	Manufacturer	Use and representatives in Russia
1	Extend	Imagine That, Inc. 6830 Via Del Oro, Suite. 230 San Jose, CA 95119 USA www.imaginethatinc.com	In use, no official representatives
2	Automod	5245 Yeager Road Salt Lake City UT 84116-2877 USA www.automod.com	In use, no official representatives
3	Process Model	ProModel Solutions 556 East Technology Ave. Orem, UT 84097 www.promodel.com	B-Club Engineering, Ltd. (Ivanovo) www.b-club.ru
4	Arena	Systems Modeling Corp. 504 Beaver St. Sewickley, PA 15143	Interface Ltd. Moscow, Russia www.interface.ru

5	GPSS/H	Wolverine Software Corporation 3131 Mount Vernon Avenue Alexandria, VA www.wolverinesoftware.com	In use. Consultant: Professor G.A. Varzhapyan St Petersburg State University of Aerospace Instrument-Making bnm@aanet.ru
6	SLX	Wolverine Software Corporation 3131 Mount Vernon Avenue Alexandria, VA www.wolverinesoftware.com	In use. Consultant: Professor G.A. Varzhapyan St Petersburg State University of Aerospace Instrument-Making bnm@aanet.ru
7	GPSS World	Minuteman Software Corporation P.O Box 131 Holly Springs NC 27540-0131 USA www.minutemansoftware.com	P.O.B. 577, Kazan 420111 Russia www.elina-computer.ru www.gpss.ru

Certainly, the use and quality of support of the above mentioned products is different. In some cases their use is limited to student versions and single commercial applications, as there are no Russian companies that would localize the product and support it.

Arena and GPSS World are the most widely used simulation systems in Russia. They have documentation translated into good Russian, guarantee and technical support. Dozens of enterprises bought licenses for these systems, and they were used in many simulation studies. Besides general-purpose systems, commercial simulators are also used in Russia. Table 3 presents a list of commercial simulators, known to be used in Russia.

Table 3: Commercial simulators in Russia

No.	Name	Manufacturer	Representatives in Russia
1	eM-Plant System of simulation, optimization and visualization of systems and business-processes	TECNOMATIX GmbH Israel www.tecnomatix.com	TECNOMATIX GmbH, Moscow Bureau 6-3-56, Vostrukhina st. Moscow 109542, Russian Federation vt.tecnomatix@gtel.ru 23.relcom.ru

2	Catia Solution Program simulation subsystem	Dassault Systems www.catia.com	Bee Pitron, Ltd. 4, Vilenskiy pereulok St.-Petersburg 191014, Russia www.bee-pitron.com
3	NETRAC System of development and research of communications networks	TTI TELECOM M www.tti-telecom.com Israel	“Prioritet” Research-and-production centre 15, Sadovnicheskaya st. Moscow 113035 www.priortelecom.ru

As a rule, commercial simulators are designed for various branches of industry (eM-Plant – machine-building, Catya – shipbuilding, NETRAC – communications and telecommunications). When using these simulators the user’s attention is not distracted by the peculiarities of this or that simulation system, but he concentrates fully on the application domain. Using opportunities of visual simulation, and modern dialog and animation technologies he can substantially speed up the research process. Commercial simulators are known to be used in Russia at metallurgical enterprises (Severstal-Group JSC), in motor-car construction (Avtovaz, JSC), etc. The main factor, limiting distribution of these systems is their price. For the most part, Russian enterprises cannot pay \$50000 and more for simulation system, though it is usual practice for western companies, which often buy even several different simulation systems.

Establishing interaction between simulation experts in Russia

It is well-known, that joint efforts yield greater results. That is why during last three years intense consultation has been carried out and work has been started on establishing Russian Simulation Society. Most likely, that registration of the Society and its practical work will start this year already.

Before that, integration of experts and their communication was done mainly virtually (via the Internet) and at various conferences. The first Internet-resource designed to integrate simulation experts and give them special-purpose information was www.gpss.ru portal. Due to this portal we managed to start a dialogue between experts, exchange information, publish several books on simulation and discuss issues of uniting experts in a society. And the most important result was the first all-Russian conference IMMOD-2003, held in 2003. More than 200 experts from Russia, CIS countries and Germany took part in the conference. There were many responses to the conference and its

proceedings are the most asked content at www.gpss.ru portal. The second conference IMMOD-2005 will be held in St Petersburg on 19-21 October 2005.

Prospects in the foreseeable future

It is obvious, that the potential market for simulation tools in Russia is rather large. But it will take a lot of efforts and money to develop it. The experts are eager to solve these problems, and growth of economy and interest of enterprises in simulation products make the expansion of the market possible. At present, according to the information we have, less than 10% of Russian enterprises use simulation-based research. Thus, one of the most powerful and promising research tools is not used at its full capacity. In view of the fast growth of competition between enterprises, the coming entry of Russia into WTO, the role of research and tools (including simulation) that can allow to reduce production costs and provide competitive advantages, increases.

To make simulation an up-to-date and widely used technology in Russia, the following work should be done:

- finish creation of the Russian Simulation Society and popularize and promote simulation ideas in the society, especially in the real economy and industry;
- improve the quality of teaching simulation by retraining the teachers and improving the material and technical basis of university simulation courses;
- create a working simulation services and means market; give the Russian experts the most complete range of simulation systems, available in the world, provide their distribution and support;
- help home companies, working in this market, to search for the ways of their development.

In conclusion, we can say that simulation in Russia is coming out of the crisis and we are expecting soon important achievements in the application of simulation in different spheres of economy, industry, science and technology.

CONCLUSIONS

In conclusion, we can say that simulation in Russia is coming out of the crisis. There are important changes in academic sphere: investigation methods are being developed, institutes buy modern licence software, the number of courses, where simulation is used, is increasing. We are expecting soon the appearance in Russia and CIS countries of new theoretical and application developments, as well as the wider introduction of simulation into different spheres of economy, industry, science and technology.

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