Network service systems for chemical engineers

J. Savkovic-Stevanovic, L. Filipovic-Petrovic, R. Beric

Abstract–Process operation makes history data base of manipulates object variables. User can make different service databases model. Input data bases are linked with routines which realized heuristic algorithms and scenarios for customer satisfaction. The results are stored in a database for further use. In the process analysis and product planning simulation various models and conditions were included. This work illustrates network product system coordinating interface events with its functionality events.

Keywords— Service system, methods, model network, real experiment, simulation, evaluation, linking parameters.

I. INTRODUCTION

PROCESS operation involves analysis of users and vendors, their attributes, simulation behavior and parameters estimation, real time optimization and safety. Optimization provides optimal working conditions, equipment services, troubleshooting, advanced control and waste minimization. However, these will support people decision to prevent abnormal situation, not replace the people. Process safety involves detection process disturbance before they cause significant disruption.

Services modelling is an inductive process used frequently in a controlled task such as design of artifacts or in explaining the behavior of the system. Both of analysis and design facts of the modelling enterprise can be characterized by down words through the levels of specificity and synthesizing partial results in to coherent structure called a model.

In recent years, many applications of expert systems to simulation have evolved as a computer aided knowledge engineering tools. The integrated simulation systems development typically consist of phases such as requirements analysis, design, and implementation[1]. Requirements analysis investigates user needs and translates them into simulation model specifications, including performance requirements such as the response time of various outputs. In order to ensure a successful implementation of the system, these requirements are evaluated. Such an evaluation needs to be done during the requirements analysis phase because the cost of fixing the system at a later stage can be high due to design revision, code revision, retesting, and maintenance[2]-[5].

Simulation is widely used tool for checking the performance requirements [6[,[7]. It offers several benefits to the systems analyst and designer including the ability to identify the behavior and performance of the system prior to its design, and to check the efficiency of a system within a specific resource environment. I addition this system can be configured in several ways, with each configuration having varying performance and cost. The simulation of these configurations helps in understanding and evaluating the tradeoffs between performance and cost. Simulation can also aid in the design of information systems [8]. This paper indicates how to go about making suitable choices by providing examples of particular kinds of system. Faced with practical problem, the first decisions to make are how to represent concepts and examples. Suitable forms of concepts representation will be dictated by the requirements of the knowledge based system and the kind of examples available. A many number of modelling and simulation systems have been developed to aid in process and product system engineering[1]-[3]. The most important goal in the chemical process is increasing quality of product, and the best way to reach goal is increasing process control and optimization. In this paper as a case study network plant-services-product-market was used.

II. SERVICE MODEL

The computer supported work with data bases, modelling and simulation products and processes services can provide management support tools [4],[5]. The network model shows how do you seek out a new way to create products and design, how do you model life cycle of the center and how do you make history of the project.

The model network can be defined by the following equation:

$$M_N = \sum_i^n M_i < T, P, A, F, E, Q(T), Q(P), Q(A), Q(F), Q(E) > \quad (1)$$

where M_N -model network, M_i -network unit model, T- set of elements, P- set of rules, A-set of expression, F-set of semantic rules, E-set of uncertainty events, and Q(J),J=T,P,A,E changeable functionality.

The first author Jelenka Savkovic-Stevanovic is with University of Belgrade, Faculty of Technology and Metallurgy, Department of Chemical Engineering, 11000 Belgrade, Karnegijeva 4, Serbia (e-mail:savkovic@tmf.bg.ac.rs, stevanoviccace@yahoo.com) .
The second author Lepa Filipovic-Petrovic is with Zorka-Research Center,Hajduk Veljkova 1, 15000 Sabac, Serbia (e-mail: zorkaci@ptt.rs).
The third author Ruzica Beric is with Zorka-Research Center,Hajduk Veljkova 1, 15000 Sabac, Serbia (e-mail: zorkaci@ptt.rs).

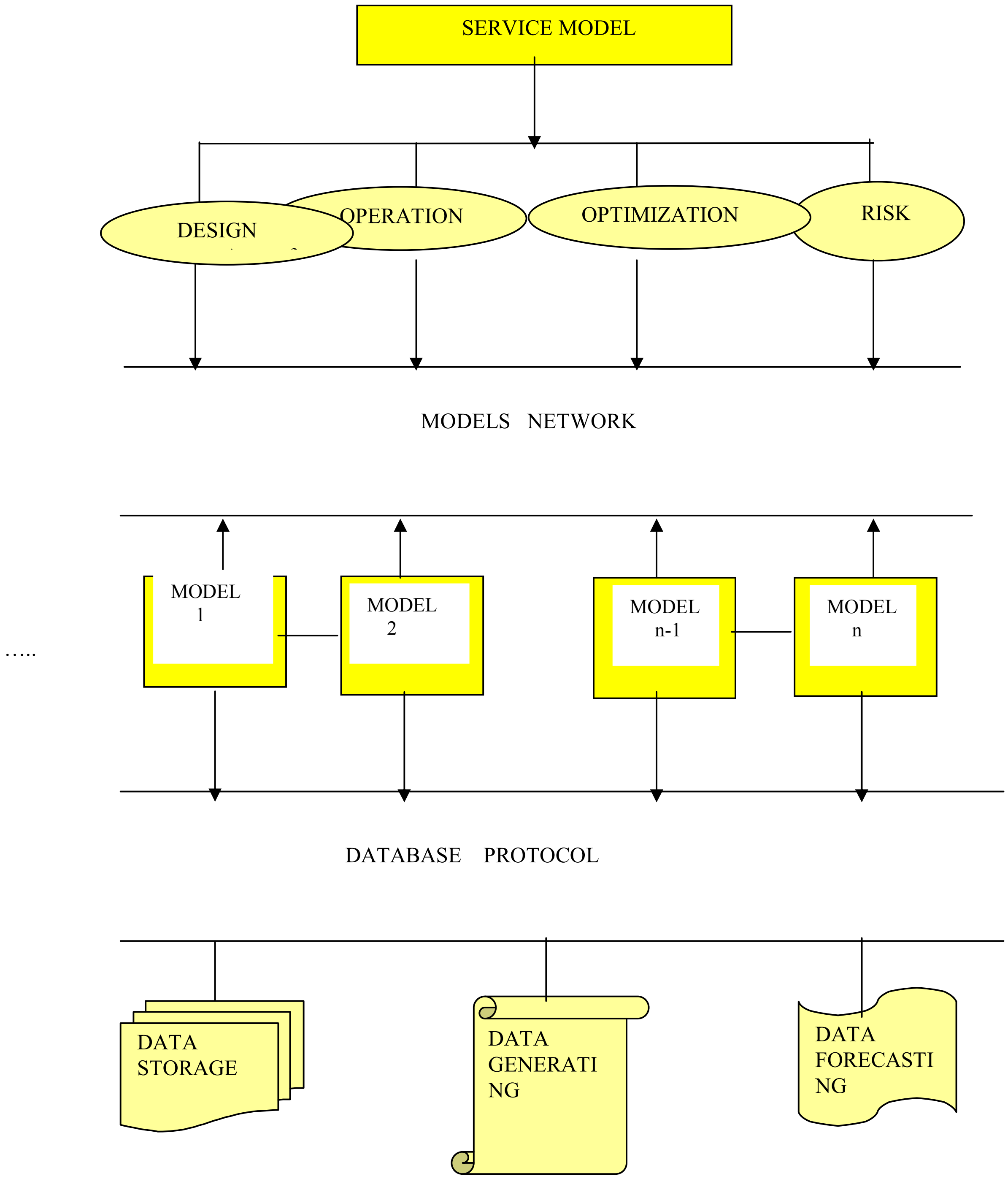


Fig.1 Scheme of model network integration

In design focuses to users, vendors and accessibility centers. Process and product operation connecting users and vendors based on expert question answering. Questions and answers based upon, and generating, research results and data base reports can be employed. Optimization provides multicriterion services requests, troubleshooting, control and waste minimization. In the process safety analysis model "what if" builds risk allocation model [6],[7].

The network centre workflow is shown in Fig.1. The model workflow can be used for the new product quality, the model operation network optimization and generating new data and specified tools. Automatically creates operation models requires based software tool for system identification which claimed to enable users to automatically create high fidelity models of the environment, process and products. System identification is technique that creates model of an operation service from input and output data, eliminating the need for detailed knowledge. Software automated the service operation, enabling engineers to perform modelling and simulation studies.

Advanced commercial simulation systems also come, with an intelligent user interfaces, which speed the development of error free simulation problems and provide some help.

The model network optimization request maximum flow, minimum cost, concern to assignment problem, the matching and minimum spanning trees, computer implementations and heuristics.

Model operation in the network shows how do you seek out a new way to create services operation, how do you model history databases of manipulation and objects. The model services operation manager is given by the following eq.(2).

In the service operation and control safety models "what if" help to build intelligent management support. They shoot uncertain events E=f{Q(E)} a day to day. It is improves service operation reliability.

$$M_O = \sum_{k}^{m} M_k < T, P, A, F, E, Q(T), Q(P), Q(A), Q(F), Q(E) > \quad (2)$$

where M_O -model operation, T- set of markets, P- set of environmental rules, A-set of operation rules, F-set of products attributes, E-set of uncertainty events, disturbances and Q(J),J=T,P,A,E changeable functionality.

Process operation involves analysis of users and vendors, their attributes, simulation behavior and parameters estimation, real time optimization and safety as shown in Fig.2. Optimization provides optimal working conditions, equipment services, troubleshooting, advanced control and waste minimization. However, these will support people decision to prevent abnormal situation, not replace the people. Process safety involves detection process disturbance before they cause significant disruption. Detection involves analysis of the all components.

Research into the development of qualitative or goal based reasoning models is motivated by the desire to overcome these limitations based on an understanding of the causal relationships peculiar to the domain. Because these causal relationships are relatively well known for physical processes qualitative models emphasize these stable causal behaviors. However, current models are resistant to discovering causal relationships for the inconsistent behaviors characteristic of competitive environment or problem spaces involve multiple, competing goals [8].

These limitations of the current symbolic learning models motivates an alternative approach to provide a more complete theory of memory. Within the contest of adaptive system theory, a small body of research into the use of closed loop connectionist, reinforcement learning models has demonstrated the power of this formalism in learning both symbolic and spatiotemporal relationships. To data however, representation of these models have been limited using a dedicated reinforcement channel. In addition, they have not yet been demonstrated in problems of high dimensionality.

III. SERVICE OPERATION DECISION SYSTEM

A model products manager, which shows how do you seek out a new way to create product and how do you model product life cycle, and how do you make products history was developed.

These systems will be available to analyze user requirements and performed information processing in the aim objective achieving.

Policy modeling emphasizes formal modelling techniques serving the purposes of decision making. These systems Modelling aided products engineering, Modelling aided market control, Modelling aided manufacturing and Modelling aided safety provide distributed computing.

To use models to support decision making is proliferating in both the public and private sectors.

Advances in computer technology and greater opportunities to learn the appropriate techniques are extending modeling capabilities to more and more people.

As powerful decision aids models can be both beneficial and harmful. At present, few safeguards exist to prevent model builders or users from deliberately carelessly data, or recklessly manipulating data to further their own ends.

Perhaps more importantly few people understand or appreciate, the harm can be caused when builders or users, fail to recognize the values and assumptions on which a model is based or fail to take into account all the groups who would be affected by a model's results.

Simulation models provides a setting for a dialogue about ethics and show the need to continue and define a vocabulary for exploring ethics concerns. It will become increasingly important for model builders and users to have a clear and strong code of ethics to guide them for making the ethical decisions they surely have to face.

Decision support system aimed at helping engineers and managers optimize all phases of the process service operations. Also, decision support system is useful for supervision of process operation, optimization and control as well as development. Some techniques are very important for

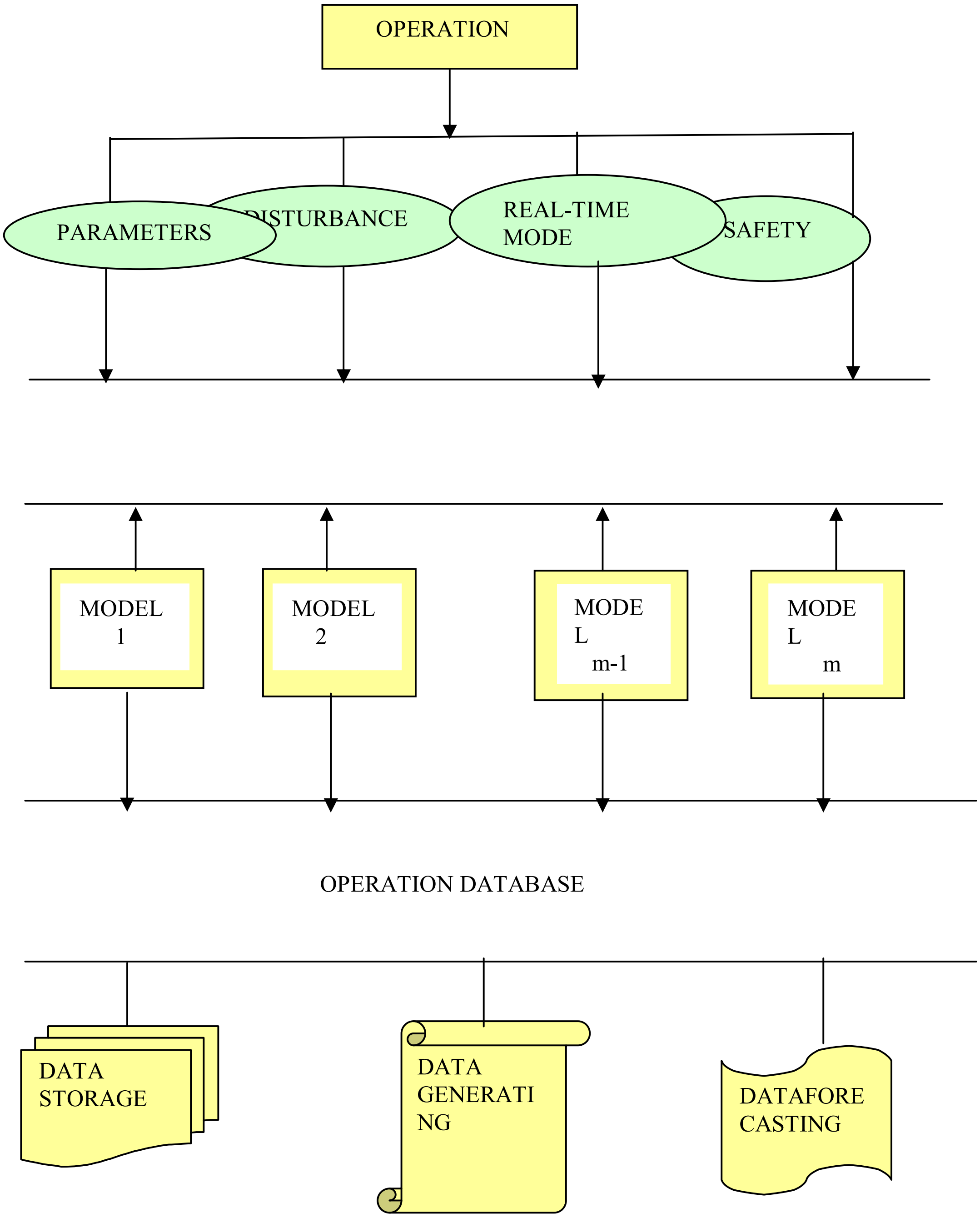


Fig.2 Scheme of the service operation

implementing and evaluating decision support system which expand such diverse areas as computer supported cooperative work, data base management, decision theory, economics, modelling, artificial intelligence, user interface management system and others.

Decision support system principles, concepts, theories and frameworks develop methods, tools, and techniques for developing the underlying functional aspects of a decision support system solver/model management, rule management and artificial intelligence coordinating and decision support system functionality within its user interface.

Decision support interface develop methods, tools, and techniques for developing the overt user interface of a decision support system, knowledge, help facilities, coordinating decision support interface event with its functionality events.

Decision support system impacts and evaluation show economics, measurements, impact on individuals users, multiparticipants users, evaluating and justifying. Decision making tree it will be very useful.

IV. KNOWLEDGE AQUICITION

The two areas of model development and analysis are addressed through the discussion of generic simulation environment. The knowledge based simulation environment is an expression of some control law or cognitive theory. To the extent that the rule base is derived from set of assumptions about the environment and performance expectations, it is a belief system. However, in the existing form, the goals are not expressed and the underlying assumptions are not evident. Consequently, they are opaque to the analyst and cannot be directly applied to the learning process. When expressed in hierarchical form the relationship that exist between goals and subgoals provide a basis for relating overall goal based system performance to specific assumptions about the variability and contribution of the supporting subgoals. In this form, the belief system is a full expression of some control theory in that the system's relationship with the environment, as expressed in a set of feasible state conditions, can be related either in overall system performance measures to be relationships and the subgoals that support them.

The research and development in this disciplinary has continued for several years, and its effort has produced three types of intelligent simulation systems: single expert systems, coupling systems and integrated intelligent systems.

Single expert systems only process symbolic information, and provide assistance to system engineers in decision, making process for of- line simulation and modelling.

Coupling systems that couple numerical computation programs into expert system such that in can be used to solve engineering simulation problems.

Integrated intelligent systems are large intelligence integration environments, which can integrate different expert systems or numerical packages together to solve complex problems.

In the analysis and synthesis of engineering systems, simulation is a major technique. The traditional simulation techniques are algorithm based. They are often inflexible and provide limited means to the user. In fact, such techniques can not clearly simulate the dynamic behavior of the real processes. The segregation of the database, knowledge base and inference engine in the expert system allows us to organize the different models and domain expertise efficiently because each of these components can be designed and modified separately.

The expertise knowledge for the problem is described by a set of production rules. The typical production rule is described as IF (condition)….THEN (action). Inference engine in executor. It must determine which rules are relevant to a given knowledge base and select one of them to apply. This control strategy is called conflict resolution.

Specifically, in this article a network based approach to constructing a simulation model was described. The overall methodology consists of a two-step process. First knowledge pertaining to the target system gathered by an analyst during requirements analysis is synthesized into a network model. This model is then utilized for automatically building the simulation model. The approach has the benefits of shortening the system development cycle, economical and fast development of simulation model from the specifications obtained during requirements analysis, allowing analysts with little training in simulation to test the process.

V. SIMULATION MODEL OF THE EXPERT SYSTEM NETWORK

Knowledge based system must represents information abstractly so that it can be stored and manipulated effectively. Although experts have difficulty formulating their knowledge explicitly as rules and other abstractions. They find it easy to demonstrate their expertise in specific performance situations. Scheme for learning abstract representations, or concepts, from examples to interact directly with systems to transfer their knowledge is shown in Fig.3.

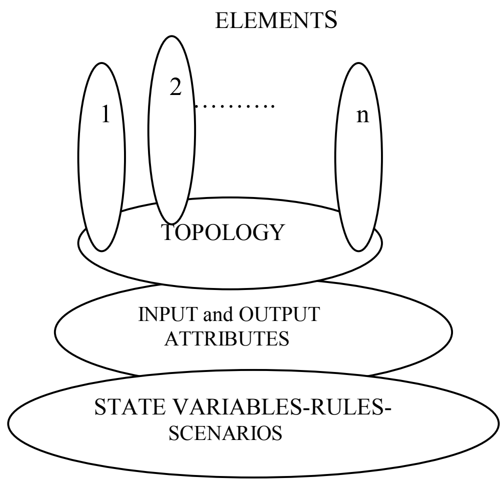


Fig.3 Knowledge and data collection

Expert systems can be used to develop rules, based models and augment other types of models. Since can capture the experience, of experts, they can be used to forecast problems, advice, operators, validate data and ensure that the results from other are reasonable.

A functional approach to designing expert simulation systems was proposed many authors. They chose the differential games models is described using semantic networks. The model generation methodology is a blend of several problem solving paradigms, and the hierarchical dynamic goal system construction serve as the basis for model generation. Discrete event approach, based on the geometry of the games, can obtain the solution generally in much shorter time. Cooperation between systems is achieved through a goal hierarchy.

Many expert systems have been introduced in such areas as medical diagnosis, chemical and biological reaction synthesis, pharmaceutical manufacturing, mineral and oil exploration, circuit analysis and equipment fault diagnosis.

These expert systems have emphasized the development of the knowledge acquisition process, the knowledge base, the inference procedure or control structure and maintaining the independence of each of these functions.

Many days, computers have been widely used in simulation, but the use has been limited almost exclusively to purely algorithmic solutions. Many engineering problems are partial structured problems that deal with the non-numeric information and non-algorithmic procedure, and suitable for the application of artificial intelligence techniques. Expert systems provide programming methodology for solving non-structured problems which are difficult to be handled by purely algorithmic methods. The experience from building expert systems has shown that their power is most apparent when the considered problem is sufficiently complex.

In simulation, both qualitative and quantitative analysis are often applied together. Usually, qualitative decision efficiently made with symbolic and graphic information, and quantitative analysis is more conveniently performed by numerical information. Both methods often complement each other. Any numerical solution is only an approximation to the true solution, which is always represented analytically. Analytical solutions can only be obtained by symbolic processing.

The next section discusses the properties desired of a modeling formalism in order to facilitates the derivation of a simulation model for the systems.

Transaction that take place the environment affect the system as its inputs, while the outputs that leave the system affect its environment. A transaction entering a simulation model may pass through several processes before its transformation to an output. In addition to the input-process-output relationship, several complex relationships among these processes often exist. In general, any two processes may be mutually exclusive, order dependent, order independent, or concurrent. Two processes are mutually exclusive when only one of them can be performed. Two processes are order dependent when one must be performed before the other. Two processes are order independent when both can be performed in any order or simultaneously, i.e. performing one of these does. There are many approach to model integrated networks. Two of them are frequently used: hierarchical and Petri net approach. Petri nets have been utilized extensively in a number of application areas, including design of distributed computing systems, general purpose information systems, production planning, and flexible manufacturing systems. In this paper the relational approach for system was employed

Most of the existing expert systems were developed for specific purposes. Usually, they were implemented with the symbolic language, and production rules were used to represent domain expertise. In light of application, such expert systems can only process symbolic information and make heuristic inference. Lack of numerical computation and uncoordinated single application make them very limited on the capability of solving the real engineering problems. Expert systems need data processing.

The coordination of symbolic reasoning and numerical computation is required heavily for simulation with expert systems. A few developers tried to develop expert systems with conventional languages. Other suggested to field expert systems in conventional languages, in order to achieve integration. Another disadvantages is that the procedural language environment cannot provide many good features that the symbolic language provides, such as easy debugging allowance for interruption by human experts.

Numerical languages often have a procedural flavor, in which the program control is command driven. They are very inefficient when dealing with processing strings. Symbolic languages are more declarative and data driven. However, it is very slow for symbolic languages to execute numeric computations. Complex problem can not be solved by purely symbolic or numerical techniques. Coupling of symbolic processing and numerical computing is desirable to use numeric and symbolic languages in different portion of software system.

The coupled systems approach is often required when domain expertise is needed to provide the user suggestion or to direct the problem solving process. The most appealing approach is to achieve deep coupling of numerical and symbolic module representing the modules function, inputs, outputs, usage constraints. This allows the system to be applied to a wide range of problems, and makes it more robust system.

VI. A SIMULATION MODEL CONSTRUCTION

In general, modeling begins with an observation of the system and then translating these observations into a model. Some systems such as manufacturing systems may be modeled by beginning with the print of the facilities, followed by defining the materials flow, and then defining the interfaces between system components (Fig.4).

Mutually exclusive processes are represented by making a place that has a single token become an input to multiple transitions corresponding to these mutually exclusive processes. Places that are outputs of a transition but not inputs to any transition indicate the transactions that leave the system. These places define boundary of the system and help identify system interfaces with the environment. A model that is too abstract may be refined to show greater detail. Developing simulation models hierarchically offers several advantages such as hierarchically simplification and ease of simulation.

In the development of software application object oriented transformation method was used. The objects of complex process are modeled by heterogeneous program packages. Development of the engineering program packages directly incorporated in software applications.

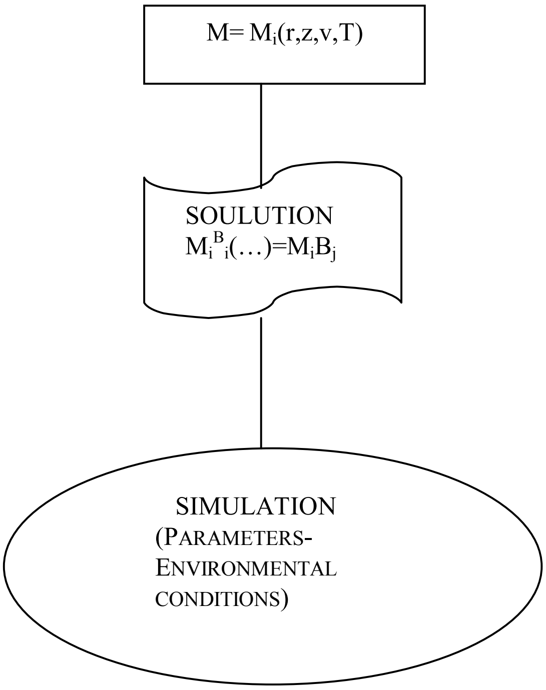


Fig.4 Simulation scheme

The integration level may be enhanced with decreasing of a number the used program packages.

For all study phases the owns program components may be generated by heterogeneous program packages. The program components include the structure of mathematical model, the algorithm for model identification and parameters estimation as well as validity testing model.

The program components include the structure of mathematical model, the algorithm for the model and parameters estimation. All program components are integrated with data bases in an absorber environment. Several software segment may be independently executed, to the objective of studying of the services component, the software development and a fresh integration. One of most interesting and encouraging trends in process simulation is its use in many more of the total range of activities concerned with process plant design and operation. This still remains an important purpose of simulation but is now joined by range of other functions so that the overall value of process modeling is of benefit throughout the full life cycle of the plant. Design of various capacity plant using serial or parallel process systems schemes can be simulated. The models manager operations performs real time process operations on various levels between network (Fig.5). Model manager shows how do you seek out a new way to the operation life cycle model and how do you make process history. It provides rigorous on-line modeling tools for the process design and operation and raw material and energy minimization. Energy minimization was provided by heat recovery simulation. From a definition of the process a rigorous model is developed that permits use steady state design, for dynamic simulation and in optimization. The creation of that model may be motivated initially by use in the development of a new process design. However rather than generation of those results being the end of the exercise, they become just the starting point for fuller use of the process model.

The opportunity for this wider applicability is derived largely from technological advance in simulation technology itself, and especially from the emergence of equation-solving systems. The established technology employs the sequential modular approach and its use is widespread. In the sequential modular approach the calculations proceed successively from unit operation to unit operation to arrive at final answer. By contrast the equation-oriented technique represents a complete plant as a large global set of equations, all of which are then solved simultaneously.

The advantage of the equation-oriented technique is its flexibility. No constraints are imposed on the type of problem to be tacked. A single problem definition may be used for study of steady state or dynamic behavior and it can also be used for optimization purposes. However the technique is much more demanding in terms of numerical technique and it is only in recent years that such systems have maturated sufficiently for use as a day-to-day production tool.

VII. SERVICE NETWORKING EVALUATION

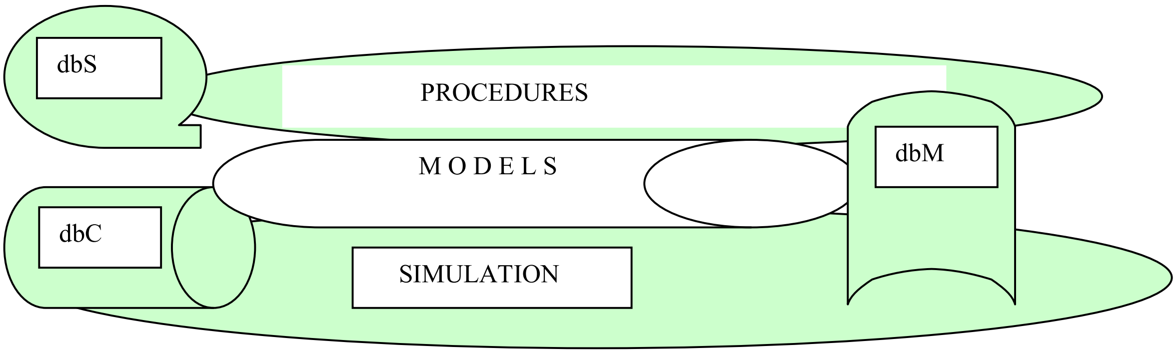
As a cooperative function training is a subsystem within the vendors - users service large organizational system.

When training strategies ensure acquisition of knowledge, skills and attitudes which results in improved performance or safety on the job, the training subsystem makes a positive contribution to organizational goal and effectiveness, so its like a cognitive personalized effectiveness. Performance, then, is the criteria of success in training.

Superior customer support request model evaluation. The evaluation model has shown in Fig.6. This future model is called assess and control.

Asses means:

-uncertainties not currently amenable to mathematical solution
-people involvement , and
-advanced technologies support people.



dbS – service component data base, dbC- customer data base, dbM-markets data base

Fig. 5. The simulation networks

Control means:
-must work automatically,
-uncertainties can be handled rigorously,
-people eliminating, and
advanced technologies support automatic operation.

Inherent softness exists in product pieces and forecast demands. In this frame it will throw lots of technology at these uncertainties or soft-areas-expert systems, neural networks, data reconciliation etc.. However, these will support people decision to prevent abnormal situation management, not replace the people.

VIII. RESULTS AND DISCUSSION

The simulation of outlets, as a function of inlets and constrain rate were provided. Service systems productivity simulation for different inlets and environment parameters, in the continuous products flow was performed. The optimal chosen parameters for service productivity as a function of environment and market parameters are shown in Fig.7.

IX. CONCLUSION

In this paper function and operation of the chemical engineering services was illustrated. Basic targets were defined. The service models network system which including products and processes design, operation, optimization, safety and decision support system was considered. It will facilitate systematic cooperation amongst members network and between networks, stake holders and agents.

The networks technology combines simultaneous solution of the models, regression based estimators, expert systems, control algorithms and off line models. Furthermore, models network requires the development of new types of research skills. These models were linked with appropriate data bases.

Thus, this multiscale integrated approach will also be of great help, in responding to the increasing environmental, societal and economic requirements.

Models "what if" help to build intelligent decision support system and allows engineers to efficiently build advanced applications.

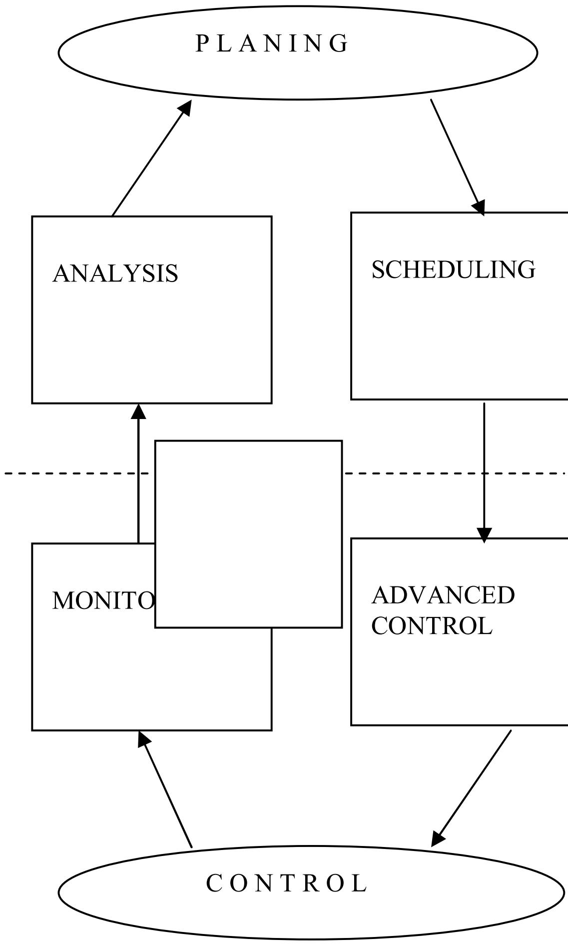


Fig. 6 Evaluation scheme

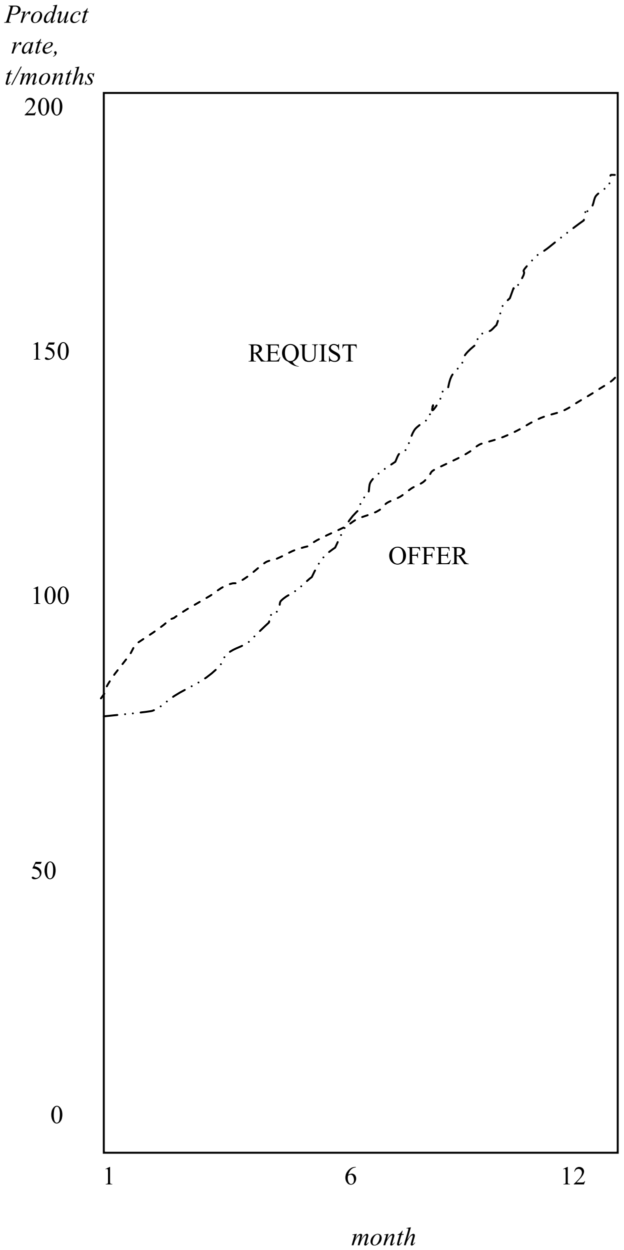


Fig. 7 The service operation simulation results

ACKNOWLEDGMENT

The authors wish to express their gratitude to the Fund of Serbia for financial support.

Notation

M_i -network unit model,
MN - model network
MO -model operation
T- set of elements
P- set of syntax rules
A-set of expression,
F-set of semantic rule,
E-set of uncertainty events
Q-changeable function

Index

i-model
n-total network service models
m-total network operations models

REFERENCES

[1] J.Savkovic-Stevanovic, Informatics, Faculty of Technology and Metallurgy, Belgrade University,2007.
[2]J.Savković-Stevanović, Industrial plant management system, *Bull. Chem.Techol. of Mac.*, vol.22**,** 159-168, 2003.
[3]J.Savković-Stevanović, Model network for managmement of the chemical plant, *Comput.Ecol.Eng.**1**,(1)92-101,2005(a)*.
[4] J.Savković-Stevanovič, T.Mosorinac, Complex system for cognitive products modelling, Proc.EUROSIM 2007(B.Zupančič R.Karba, S.Blazić) ,pp.393, 9-13 September, Ljubljana , Slovenia, 2007.
[5] J.Savković-Stevanović J.,*Process Engineering Intelligent systems*, Chapter 3, RAJ, Memphis,1999.
[6] J.Savković-Stevanović, Plant operation management system, *16th Inter.Congress of Chem. and Process Eng.*, Praha, Czech, p. 0833, August 27- September 1,2004.
[7] J.Savković-Stevanović J., Product and process cognitive modelling, *The 16th Symposium and Seminar on Information and Expert Systems in the Process Industries*,pp.29, Beograd, October 19-20,2005(b).
[8]J. Savković-Stevanović, An agent traveling simulation,*Comput. Ecol.Eng.*, vol.2(1)8-12,2006.
[9]EU FP6-2005-IST- 5" CASPER" ,2.5.11, no. 83590, participant no.11- Faculty of Technology and Metallurgy Belgrade University.

Authors Biography

[1]Faculty of Technology and Metallurgy, Belgrade University,Karnegijeva 4, Serbia, savkovic@tmf.bg.ac.rs,stevanoviccace@yahoo.com

Jelenka B.Savkovic-Stevanovic is full professor at the Department of Chemical engineering Faculty Technology and Metallurgy the Belgrade University, Belgrade, Serbia. She received_ her B.Sc. degree and M.Sc. degree at the University of Belgrade and Ph.D. Thesis at the Technishe Universitat Berlin and University of Belgrade;.

She has research interest in the field Modelling and Simulation, Transport phenomena, Multistage Operation, Chemical Synthesis, Process System Engineering, Analysis and Operation, Synthesis, Design, Control and Optimization of Chemical Processes. Advanced Numerical Methods On-line Optimization, Safety, Risk analysis, Loss Prevention, Information Systems, Data Bases, Expert Systems, Learning Systems, and Artificial Intelligence; Informatics, Management, and Pharmaceutical and Biomedical Engineering, Biopolymers and Bioinformatics.

Prof. Dr Jelenka B.Savkovic-Stevanovic has published over 900 papers, 8 books, many patentees in the field. Consultant in companies, member of many national and international professional organizations. Reviewer of many journals. She has cited in numerous monographs and list of top 100 World Scientists - ICB-Cambridge, U.K., 2007 and list of top 200 World Scientists from IBC-Cambridge foundation,2008,2009. List of top 100 World Engineers –IBC Cambridge, U.K., 2010. The best achiever scientist of the World 2010-IBC- Cambridge, U.K..

[2]Zorka-C..I., Sabac, Hajduk Veljkova 1, Sabac,Serbia, zorkaci@ptt.


Dr Leposava DJ. Filipovic-Petrovic is head of the „Zorka Sabac- Research Center“, Serbia. She received her B.Sc. degree at the Faculty of Technology in Tuzla, The University of Sarajevo, M.Sc and Ph.D. at the Faculty of Technology and Metallurgy, The University of Belgrade.

She has worked in the Ceramic field, Row materials, Ceramic Products, High-temperature Reactions of Silicates, Mechanical-Chemical Activation of Bentonite Clay, and Process System Analysis and Operation, Correlation and Design.

Dr Lepsava E.Filipovic-Petrovic is member of SHD (Serbian Chemical Society) and SHTS (The Association of Chemists and Chemical Engineers of Serbia).

[3]Zorka-C..I., Sabac, Hajduk Veljkova 1, Sabac,Serbia, zorkaci@ptt.


Mr Ružica D. Berić retaired. She fellows „Zorka Sabac- Research Center“, Serbia. She received her B.Sc. degree at the Faculty of Technology in Tuzla, The University of Sarajevo and M.Sc at the Faculty of Technology and Metallurgy, The University of Belgrade.

She worked in the field of Chemical Synthesis, Herbs Extraction, Optimal Design of Experiments, Correlation, Process Operation, Parameters Analysis and Design.