AZERBAIJAN REPUBLIC

KHAZAR UNIVERSITY

OBJECTIVES: STUDY FOR THE PURPOSE OF OBTAINING MASTER DEGREE DIPLOMA

THESIS: DISTRIBUTED INTELLIGENT SYSTEMS

SCHOOL: ENGINEERING & APPLIED SCIENCES

SPECIALITY: COMPUTER ENGINEERING & MANAGEMENT

INSTRUCTOR: SALAHADDIN I. YUSIFOV

STUDENT: AYGUN N. ALASGAROVA

BAKU-2001

Page

1. INTRODUCTION

"Between Mind and Computers presents a wealth of information about fuzzy logic and its applications. In my view, it is a must-read for everyone who is interested in developing a thorough understanding of the theory and an up-to date familiarity with its applications".

Soft Computing (SC) - unlike traditional hard computing (HC) - is tolerant of imprecision, uncertainty and partial truth. Thus the guiding principle of soft computing is: Exploit the tolerance for imprecision, uncertainty and partial truth to achieve tractability, robustness and low solution cost. Underlying this principle is an obvious and yet frequently neglected fact, namely, that precision carries a cost. What this implies is that to achieve a low cost - or to be able to solve a problem - it is necessary to aim at a solution which is precise enough but no more than necessary. The same applies to uncertainty and partial truth.

Exploitation of the tolerance for imprecision, uncertainty and partial truth plays a key role in data compression and especially in (HDTV), audio recording, speech recognition, image understanding and related fields. But what should be recognized is that the guiding principle of soft computing has much wider implications-implications which cut across disciplinary lines and transcend specific application areas. Actually, SC - based concepts and techniques are already playing an essential role in the conception, design and manufacturing of high Machine Intelligence Quotient products and systems.

Today, we are beginning to see a shift in the orientation of mainstream Artificial Intelligence. More specifically, what we see is a significant growth in the number of papers presented at Artificial Intelligence conferences or published in Artificial Intelligence journals which deal with neural networks, genetic algorithms and belief networks. What this indicates is that Artificial Intelligence is nudging closer to soft computing. In fact, it may be argued that it is soft computing - rather than hard computing - that should serve as the foundation for Artificial Intelligence.

This is the collective message put forth by the contents of Soft Computing: Fuzzy Logic, neural networks and Distributed Artificial Intelligence. All of these lead to the solution of real-world problems.

Foreword by Lotfi A. Zadeh

Berkeley, California (USA)

The word distributed is defined as the dispersion of functions and powers from a central authority to regional or local authorities. A Distributed System (DS) is constructed from several entities in which each independently is able to perform some functions and has to some extent the authority and the power to control its own functions. These entities can communicate together to work in the same special-time domain toward a common goal or separate goals. Although there are many types of distributed systems, this work will focus on distributed systems that exhibit some sort of "intelligence".

Distributed Artificial Intelligence (DAI) found its way into industrial applications. During the past three decades much effort has been devoted to practical applications of Artificial Intelligence. Advances in computer technology have created many futuristic ideas and "science fiction" based dreams to be realized through various Artificial Intelligence applications. Combined with the advances in computer hardware, many new mathematical methods and concepts have helped the quantum leap in practical applications of intelligent systems and controllers. As a result, "Soft Computing" as a concept was born. Fuzzy Logic, Neural networks and Distributed Artificial Intelligence are three major components of soft computing.

Distributed Artificial Intelligence (DAI) research has been expanding quickly since the early eighties. It is not our intent here to present a detailed review of this vast research field. Instead, we will on some issues that should be considered when building a multiagent system.

A multiagent system (MAS) can be defined as " a loosely-coupled network of problem solvers that work together to solve problems that are beyond their individual capabilities". These problem solvers, often called agents, are autonomous, potentially preexisting the MAS and may be heterogeneous.

A MAS has significant advantages over a single, monolithic, centralized problem solver: faster problem solving by exploiting parallelism; decreased communication by transmitting only high-level partial solutions to other agents rather than raw data to a central site; more flexibility by having agents with different abilities dynamically team up to solve current problems; and increased reliability by allowing agents to take on responsibilities of agents that fail.

Here are some application domains where DAI techniques are applied:

-Distributed interpretation applications collect, interpret and integrate distributed data to elaborate a semantic data model;

-Distributed planning and control applications involve developing and coordinating the actions of agents to perform desired tasks;

-Cooperating expert systems applications allow several expert systems to work together to solve a common problem;

-Computer-supported cooperative work applications in which agents can assist persons in managing distributed data, filtering information and coordinating activities among groups of users. Artificial agents, behaving as human personal assistants, improve team coordination by solving coordination problems such as scheduling meeting or routing messages to relevant people. Besides relieving users from several coordination tasks, artificial agents can work in parallel and "behind the scenes" to share information and improve coordinated decisions.

This work consist of 7 sections and each of them will be described bellow.

In the section 2 the state of existing approaches describes solving of complex problems of oil production control.

In the section 3 the system analysis of gas lift production will be presented and advantages and disadvantages of gas lift well will be underlined.

In the next section expert systems for different oil production will be described.

Section # 5 will be consider the structural syntheses of Distribution Intelligence Systems including coordination of Distributed Intelligence Systems: centralized and decentralized systems.

Section # 6 will cover the core study of this work "Description of two levels optimization of distribution working agent between gas-lift wells in distributed intelligent systems". In this section the structural and mathematical model of solving problem of two levels optimization of distribution working agents between gas-lift wells in distributed intelligent systems.

Section # 7 will be described the solving problem of optimization of distribution working agents between gas-lift wells in distributed intelligent systems.

The attachments enclosed are:

1) The structural and mathematical models of two levels optimization of distributed working agents between gas-lift wells in distributed intelligent systems (slide).

2) A centralized and decentralized coordination structures (slide).

3) Construction of distribution working agent system and characteristic mode of gas-lift.

4) The scheme of gas lift well.(slide)

5) Functional scheme of corporate information system

2. THE STATE OF EXISTING APPROACHES FOR SOLVING OF COMPLEX PROBLEMS OF OIL PRODUCTION CONTROL

Distributed Intelligent Systems are powerful tools for cooperative distributed solving of problems. The term "distributed" in Distributed Intelligent Systems indicates the decompositional character of problem to be solved and allocation of decision making elements. The Distributed Intelligent System is the network which integrates all necessary intelligent and nonintelligent means used in cooperative decision making process. Systems integrated by Distributed Intelligent Systems communicative knowledge and data to each other because their mam goal is to get missing knowledge. Currently there are two types of Distributed Intelligent Systems architecture: contract networks and hierarchical network.

Distributed Intelligent Systems with architecture of contract network is used in such problems areas where the same problem can be solved by a number of systems included into network. The contract network consists of nodes separate into the following three classes:

- control node, this node defines the problem to be solved and transfer it to other nodes for its solving;
- buyer, the node which suggests its surveys to solve the problem;
- contractor, lucky which suggest the problem solving cost that satisfies the control node.

The mechanisms of contract network working is in the following:

The intelligent system (control node) which is in capable to solve the problem sends queries to all intelligent systems of the network (buyers) then analyzing messages from source system defines the systems for establishing the contracts for the time of problem solving considering the expenses to these contracts.

Distributed Intelligent Systems with contract network architecture is used in such problem areas where system included into networks have certain non-overlapped capabilities and interact with systems hierarchy principles. Hierarchical network consists of a number hierarchically subordinated levels which integrate a large amounts of working nodes. The mechanism of hierarchical network working is based on the following interaction rules: working nodes of one level can interact only through coordinating nodes of the given level but working nodes of different levels only through coordinating nodes of corresponding levels.

The important feature of Distributed Intelligent System is the method of intelligent systems interaction. There are two methods of intelligent systems interaction, organization in Distributed Intelligent Systems: directly through there on communication means and by means of some special system.

Communication means are adapters and formers. Adapter is intended for transformation of messages from other nodes into the input language of given system. Former is used for transformation of information represented on internal language of give system into the input language of other systems. Interaction methods have the following specific features: for direct communications a corresponding number of adapters must be provide.

As indicated above Intelligent systems included into Distributed Intelligent Systems can have different formalisms of knowledge representation and languages for interaction with external world. Hence, one of the most important features of Distributed Intelligent Systems is the language of internodes interaction. That is language which is used for communication between nodes. Two varieties of internodes interaction languages are used:

The internodes language base on the limited natural languages and artificially limited internodes language that is the language based on this slang comprehensible for interacting intelligent systems. In cases when information to be communicated is secret the artificially limited internodes language is more efficient.

Distributed Artificial Intelligence (DAI) has become the main concern of many researchers in artificial intelligence. As a new field DAI lacks theoretical foundations and a full understanding of its many aspects and problems.

There are three main areas in which parallel and distributed architectures can contribute to the study of intelligent systems: Psychological modeling, improving efficiency, helping to organize systems in a modular fashion.

These areas are often overlapping and complementary. For example, the production system model. The production system was originally proposed as a model of human information processing and it continues to play a role in psychological modeling. Some production system models stress the sequential nature of production systems, the manner in which short-term memory is modified over time by the rules. Other models stress the parallel aspect, in which all productions match and fire simultaneously, no matter how many there are. Both types of models have been used to explain timing data from experiments on human problem solving.

SOAR is the production system architecture that has a dual mission. On the one hand, it is intended as an architecture for building integrated Al systems; on the other hand it is intended as a model of human intelligence. SOAR incorporates both sequential and parallel aspects of production systems by operating in cycles. In the elaboration phase of the processing cycle, production fire in parallel. In the decision phase, operators and states are chosen, and working memory is modified, thus setting the stage for another elaboration phase. By tying these phase to particular timing, SOAR accounts for a number of psychological phenomena.

Distributed problem-solving is a basic method of attack for solving problems which are too complex to be solved by a single processor: the problems may require too much information or too much processing power. The knowledge sources needed for cartographic expert systems are so varied and the data so voluminous that this approach appears most promising.

In distributed problem-solving, a complex problem is subdivided into a set of distinct sub problems which are easier to solve. Each sub problem can than be assigned to a processor for solution. Distributed problem solving has several advantages: each processor need only solve a more limited problem. The total input to the limited problem should be correspondingly smaller. Distributing the problem among several processors allows parallel processing to take place. In cases which require real-time processing, parallel processing may be absolutely necessary in order to accomplish the tasks. If multiple processors are used then parts of the system can fail or degrade but still allow partial results to be obtained, or at least the cause of failure to be determined. Finally, distributed problem-solving allows a modular structure which can be easier to expand or be more adaptable to change, If properly constructed.

Intelligence service and exploitation of oil field:

- Increasing accessibility of data and enlargement range of on-line data. Independence accessibility to data from situation of their sources. Effective access to data on the side of applied programming maintenance, which was created by different manufacturer. Absence of accessibility to actual information with conditions of significant dispersion of structural subdivision of companies doubt the possibility of realizing operating control and analysis of exploitation state and making effective decisions by achievement of planned extraction, regulation and optimization of exploitation.

- Dilatation of stored data. External memory size of direct access necessary for storage geophysical data, geological model and models of filtration process, information about field exploitation history measured by some terabyte at shelf life 20 and more years.

- Reliability control of data storage. Most of geophysical and geological production data irreplaceable that present higher requirements to storage reliability.

- Data security organization against unauthorized access. In the absence of effective security violation of confidentiality access to data may cause the substantial damage.

- Solving these problems assumed logical unit of all information resources of company in the common integrated information environment, that provide common mechanism of data management and do controlled development process of data ware.

Application of geographical information system (GIS) is essential data ware of modern oil and gas production enterprise. Using GIS solved preparations task, storage, regulating and analysis of geographical information that is information about objects associating with place. GIS allow to realize control over all territorial objects NK on the different control levels -from corporate level till shops and fields level.

Analytical scope of GIS allows to execute set of operations which inaccessible by tradition approach to problem of geographical information.

Since oil production is the main activity of NK there is actual the creation problem of interface information system of Intelligence service and exploitation of oil field with financial systems, for example, R/3 of SAP firm.

As the sources of large number data are wells then assumed system should have interface with Technological Control Management oil production. Functional scheme of corporate information system shown in the Figure 1.

The main problem of building the corporate system of Intelligence service and exploitation of oil field is creation and application of corporate standards for the presenting and using data which consistent with international standards. For that necessary forming the group of experts dealing with this problem on the corporate level.

For the successful application of information system necessary creation the corporate and regional designed and analytical centers and data management service.

The Distributed Intelligent Systems (DIS) Section conducts basic and applied research ranging from cooperating robots to quantum communications. DIS also conducts research into and development of tools for high performance computing and heterogeneous distributed computing.

As the world's computing systems become more numerous and more highly connected, new behaviors appear. As people delegate more autonomy to programs, and put more trust in their results, new concerns arise. The Massively Distributed Systems group at IBM's Thomas J. Watson Research Center conducts research into some of the implications of a highly-connected world.

In agent-based systems, humans delegate some of their decision-making processes to programs which are (in some sense) intelligent, mobile, or both. "Intelligent" agents have reasoning capabilities, e.g., rule-based inferencing, probabilistic decision analysis, and/or learning.

"Mobile" agents move between different machines to execute their code; the vision is that this will be particularly useful for mobile users and mobile communications.

These agent-based systems also require new thinking, to avoid both security holes and unexpected global effects. When agent-based systems are combined with electronic commerce, the need for all aspects of security is particularly strong.

Today, we are witnessing the first steps in the evolution of the Internet towards an open, free-market information economy of automated agents buying and selling a rich variety of information goods and services. We envision the Internet some years hence as a seething milieu in which billions of economically-motivated agents find and process information and disseminate it to humans and, increasingly, to other agents. Over time, agents will progress naturally from being mere facilitators of electronic commerce transactions to being financial decision makers in their own right. Ultimately, inter-agent economic transactions may become an inseparable and perhaps dominant portion of the world economy.

The goal of the information economies project is to anticipate the likely behaviors of large-scale information economies, and to exploit this understanding to formulate desirable principles for agents and agent markets. When large numbers of programs interact in a connected environment, various phenomena occur which are not explicable in terms of the programming or behavior of any single agent. It is necessary to understand these phenomena in order to keep the overall systems both secure and efficient.

3. SYSTEM ANALYSIS OF GAS-LIFT PRODUCTION OBJECTS AND FINDING THE BASIC PROBLEMS OF CONTROL PROCESSING

Gas-lift well - is a well in which gas passes from surface by special channels. Gas-lift application field - is a high production well with great bottom pressure, wells with high Gas Oil Ratio (GOR) and bottom pressure low than point pressure , fluid contains sand , also wells in difficult production condition. Gas-lift method available by deviated well bore production , multiple formation reservoir development , also when there are enough quantity of gas for injection. All these give high efficacy factor. Gas-lift production system consist of reservoir, production tube, collection tube from well to gathering station , separator, gas compressor, gas injection line. Defects may possible in any elements of gas-lift system.

The advantages of gas-lift application are: high technical and economical efficacy , absence of lifting mechanism and friction elements, large period between repairs, simplicity service of gas-lift and regulation of production regime, reliable surface equipment's and so on.

The disadvantages of gas-lift application are: low efficacy of all gas-lift system which includes compressor station, gas pipeline and well, high expenditure for service of compressor station .The scheme of gas-lift well is illustrated in the figure 2

Comparative analysis of native and foreign works shows that one of the main ways of perfect Technical Object Control of gas-lift oil production and increasing quality of control and management is transition from centralized system to distributed multiagent systems on the base of modern facilities of computer techniques. As a result of this important actuality obtain utilization of new control approaches in such distributed systems, on the base of models and algorithms building for optimization of different control processes by gas lift method of oil production.

As a complex control system gas lift well is characterized by totality of modes of its elements. This totality is defined technological mode of gas lift well and described by the following parameters: charges and pressure of injected working agent, seam pressure in oil gathering reservoir. By these parameters defined the parametric control of gas lift well operations. Depending on output control objectives as a rule considered debit of gas-liquid mixture, liquid, oil or injected gas discharge intensity.

Unlike parametric control, the operations of gas lift wells may control due to realization of technical actions, that is by the structure modifications. Under structural control the main influence objects are: gas lift unit, (diameter of NKT, distribution of tube wells, bottom hole choke), gas lift valve (type, saddle size, charging pressure), discharge collector (diameter, length), gas flow controller (type, saddle size).

Gas lift system consists on layers, wells, loop pipe lines, separators, gas compressors and gas injected lines. Defects may arise in any elements of system.

Diagnosis of technical state of gas lift wells realized on the tubing-string analysis. The main feature of possible defects of well operations is pressure difference that is consequence of other features, for example pressure difference on the other well site, open filter, expenditure change of working agent injection and so on. Abovementioned features set up slump or glide of debit (Q). This may be caused by a whole series of defects: by plug in lifting pipes or in ring space, waxing and pickling of lift pipes.

During the process of finding, developing, producing and finally decommissioning oil and gas field, each field is re-evaluated many times by teams of geologists and engineers with skills and technologies from a wide range of disciplines. Major oil and gas operators, Shell companies among them, describe this area of the oil and gas business as 'Exploration and Production (EP)' or 'the Upstream'. The major activities of finding and then bringing into production, oil and gas fields are covered in the Upstream essentials issue of the Shell Briefing Service.

The nature and dimensions of production operations have changed dramatically during the last two decades and more so over the last few years. First, the cost of operating fields is under continuous pressure: mature fields tend to produce increasing proportions of water, which need to be disposed of in an environmentally acceptable way; production needs to be mechanically assisted as natural reservoir pressure declines; more complex operations have evolved, for example separate treatment and sale of oil and gas; ageing facilities need more maintenance; and manpower costs in many areas of new world are rising steadily. At the same time, oil prices have declined in real terms over the last decade and no sustained increase can be expected, at least in the next few years.

Continuous innovation and technological development have made possible new ways of producing more oil and gas from a field. In some cases, this has resulted in facilities needing to be operated for much longer than originally envisaged. This puts particular attention on the management of safety and the environment: integral considerations in every phase of exploration and production, but of even greater significance in the prolonged period of production operations.

The changing focus on production operations means that new processes, technologies and techniques have been developed to hold down operating costs, maximize production of oil and gas and increase the overall profitability of each venture.

The life of every oil or gas field is governed by economics. In the early stages of a field's development, when production is usually at its highest, operating costs are only a small part of expenditure. In later life, as production declines and maintenance becomes more extensive, the cost of producing each barrel increases. Eventually, costs exceed revenues and the field is abandoned.

Although much of the dramatic growth of hydrocarbon production since the end of World War II has been due to new developments, oil and gas fields in many areas have been in production for many decades - much longer than first predicted.

The period of high oil prices in the 1970s and early 1980s stimulated oil and gas exploration and production, providing scope for ambitious high-cost projects based on increasingly sophisticated technology. One focus for this was the North Sea, from which oil production began 20 years ago. Fields developments were planned for life spans based on the information then available. The effect of the oil price decline from the early 1980s and the collapse of 1986 has been to present industry with the challenge of operating many projects at oil prices less than half those envisaged at the time they were planned.

In the increasingly complex environment in which production operations are carried out, modern management techniques are needed to ensure that activities are effective and under control at all times. Most large modern operators have management systems that 'cascade' from corporate vision/mission statements, key business objectives, polices and strategies down to divisional management systems where they are put in place through procedures and standards with audit controls. The principles of plan/schedule/execute/ analyze/feedback/improve are essential for success, reflecting the continuous but changing nature of oil and gas production over the life of a field.

These processes must be seen against a background or matrix of elements that allow control. These can be summarized as:

-Policies and objectives: what must be done;

-Organization, responsibilities and resources: how it will be done;

-Standards and procedures: how it will be carried out in practice;

-Implementation and performance monitoring: how to ensure it is being carried out; and

-Audit and review: how to monitor and ensure compliance, and to correct deficiencies.

Flows from wells in the field were previously measured using large test vessels. Each phase oil, water and gas had to be separated and measured individually. Today multiphase meters which can simultaneously measure oil, water and gas flows with the necessary accuracy are increasingly used.

Sensor technology has advanced dramatically over the years. Reliable and effective gas, smoke, heat and flame detection systems are now available to protect installations. Indeed this success is reflected in the simple, reliable and cheap smoke detectors now used in the home.

Lifetime cost considerations are stimulating the use of such alternatives to conventional steel piping as special stainless steels, glass reinforced epoxy (GRE) and glass reinforced polymer (GRP) pipes.

In the drive to improve business performance, high quality, easy-to-use computing tools are needed that can increase production, reduce failures and power consumption, take over routine tasks and data reporting and make more effective use of manpower. Considerable advances have been made in the use of computing technology to assist operations, commonly known as CAO (Computer Assisted Operation) or SCADA (Supervisory Control and Data Acquisition).

Computing has increased efficiency and effectiveness in all phases of the plan/schedule/execute/analyze/feedback management cycle. Computer can help produce plans that match actual production against demand and ensure that maintenance and engineering activities have the least possible effect on production. Although the tools mainly maximize economic operation, they can also be used to minimize the use of scarce or expensive resources.

The introduction of Distributed Control Systems (DCS) or SCADA systems has had a tremendous impact on the way facilities, platforms, gathering stations and terminals are operated. These control systems not only enable operations to be conducted with up to 60% fewer people; the results are also normally better and more consistent. Control room technology has changed from pen recorders/pneumatic controllers to visual displays/electronics, with correspondingly greater reliability and reduced maintenance.

In working with these systems, operations staff have needed to be more computer-literate, able to run various technically complex applications on different operating systems while maintaining the essential skills necessary to operate oil and gas fields.

Computer modeling of an oil or gas field, to predict production levels and ensure that the integrated production system is running at peak efficiency, has begun to play an important role in field management. These will be the tools for the production engineer to ensure that the process is continuously optimized-taking account of, for example, changes in well flow rates in order to maintain production objectives.

Well maintenance is usually carried out for three main reasons:

- Changes in reservoir productivity, the rate at which oil or gas flows from the reservoir rock into the well;
- The replacement of well bore equipment; and
- To obtain data on the reservoir and conditions of the production conduit.

These activities are known as workovers, and may involve a drilling rig, a work over hoist (a small drilling rig), a wire line unit (by which tools or accessories are lowered down the well) or increasingly the use of coiled tubing. This latter techniques involves the insertion or retrieval of a continuous reel of steel tubing into the well, instead of the normal practice of screwing together lengths of drill pipe. Although currently constrained by the diameter of the pipe (3.5 inch maximum), the main advantages is that such tubing can be inserted while the well is still under pressure without the well first having to be killed by filling it with fluids.

All these well activities are aimed at maximizing or optimizing flow-either from the reservoir into the well or up the well to the surface. The former may involve stimulation by applying chemicals, usually acids, to the formation; 'fracturing' (cracking the reservoir rock) to improve flow to the well bore; or mechanical methods such as drilling horizontally into the reservoir. Measures in the latter category center around the flow tubing - the steel tubing which is inserted down the well and acts as a conduit to bring the oil to the surface. Flow may be assisted artificially either by pumps or by gas lift, in which gas is injected to lighten the fluid column in the flow tubing and help it to the surface. Corrosion might require the flow tubing to be replaced so that the well can continue to produce oil and gas safely.

Energy demand projections indicate that the exploration and production industry could face the challenge of delivering twice as much oil and gas in the next three decades as in the past three. Extending its reach into deeper water, better exploration tools and the opening of new parts of the world to capital and expertise may enable the industry to find and develop significant new resources. Nevertheless, much of the additional volumes must come through industry's ability to increase recovery from existing and increasingly mature production areas. Continuing focus on production operations, thereby reducing lifetime costs while maintaining safety, environmental and operational standards, can substantially extend the life of today's oil and gas fields-helping to meet world energy needs into the next century.

4. DESCRIPTION OF EXPERT SYSTEMS FOR DIFFERENT OIL PRODUCTION PROCESSES

Expert Systems are computer programs that emulate the reasoning process of a human expert or perform in an expert manner in a domain for which no human expert exists.

They reason with uncertain and imprecise information. There are many sources of imprecision and uncertainty. Knowledge they embody is often non exact, in the same way that a human's knowledge is imperfect. The facts or user supplied information is also uncertain.

An expert system is typically made up of at least three parts; an inference engine, a knowledge base and a global or working memory. The knowledge base contain the expert domain knowledge for use in problem solving. The working memory is used as a scratch pad and to store the information gained from the user of the system. The inference engine uses the domain knowledge together with acquired information about a problem to provide an expert solution.

In the past most expert systems have distributed the knowledge (for example, into discrete rules, frames, etc) but have kept the control or processing burden on a highly centralized controller. For applications with a very high information and processing load, such as all image understanding expert systems, the burden rapidly taxes the capabilities of most systems. In order to construct useful image understanding expert systems, the processing burden will have to be distributed. This means new expert system architectures need to be developed.

The distributed expert system has several advantages. First, it allows different types of knowledge representation and the appropriate problem solving methods to be included in one system. This advantage is extremely important for cartographic expert systems, since there is a large amount of very different kinds of knowledge needed for the interpretation of remotely sensed images. The requirement of only one knowledge representation and corresponding problem-solving method is too restrictive. This subject is explored in more detail in the next section. Much of the control and "focus of attention" problems are alleviated since control can only pass along the lines of the hierarchy. The distributed architecture does have disadvantages. The domain knowledge must be carefully structured in a hierarchy. In a large complex system communication through the blackboard may be difficult to implement efficiently.

Expert System is a class of Artificial Intelligence system. They are able to perform various functions namely they can consult and advice, analyze and classify, make search, exchanger information between system and represent in the requirement from, identify and interpret, diagnose and test.

They also can control design, explain, investigate, generate concept, predict and schedule. Expert System must solve problem which always require human experts participation. There are large number of Expert System which have attained such a 'qualification' level that the Expert system may be considered as the real expert in their domains. Expert system are created with participation of specialist who are able to explain their sequins of thoughts during concrete problem solving process. An important problem in research on Expert System is the attain of functionally level similar to human expert who are able to solve separate in various situation. In such case to be the specialist means to achieve they high quality results in possible minimal time. Also the expert utilities logical interferon method and scheme which were acquired by intuition during many years of work with given problem.

The structure of Expert System is shown in figure 1. The Expert system consist of five main components:

- knowledge acquisition module;
- knowledge base that is the kernel of any Expert System;
- inference subsystem;
- solutions display and explanation block;
- user interface.

The user's interaction with Expert System is realized through uses interface in problem-oriented language of non-procedural type or in some reduced variant of natural language. In the user interface the natural language sentences or sentences of other problem-oriented language of non-procedural type are transform into internal language of knowledge representation of a given Expert System. The user's problem description in chosen knowledge representation language enters into logical interface subsystem. (Inference engine). This subsystem, using information from knowledge base, generates the recommendation for concrete problem solving. In the interface subsystem some strategy of corresponding rule selection from knowledge base is realized. This strategy is closely connected with techniques of knowledge representation in Expert System and with nature of solved problems. The solution explanation module serves for increase of the user confidence to information about solution inference process.

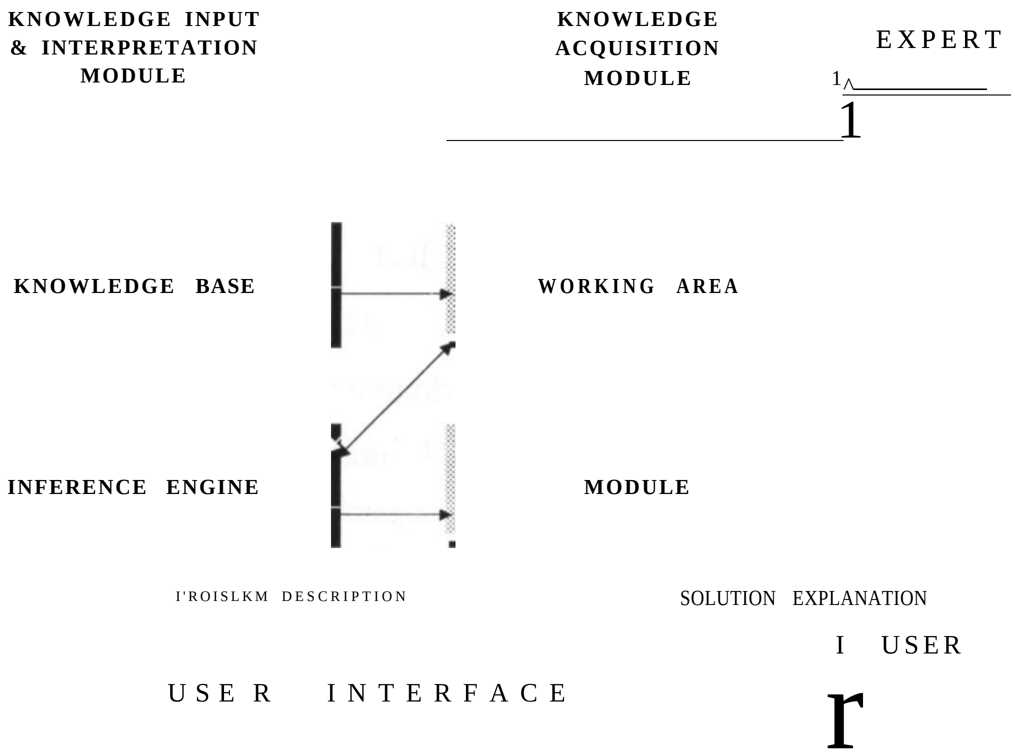
The knowledge acquisition module's function is the support of acquisition process of knowledge about corresponding narrow specialized problem domain. As a rule, these knowledge have empirical character. Moreover, they are badly formalized and are absent in the special literature: manuals, instructions, report et. c. Such knowledge are acquired in the result of prolonged experience. In the knowledge input and interpretation module the acquires knowledge are transformed into knowledge representation language in the expert's system's knowledge base. The process of knowledge acquisition from experts and they transference to Expert System, are the narrow place under Expert System design. Therefore at present the knowledge acquisition module's functions almost in all systems is performed by knowledge engineer.

Knowledge and Data are the information base of Expert System. Knowledge as the information, which describe the main regularities of problem area and allow the user to solve certain problems. Different facts, concepts, estimations, rules, heuristics and decision making strategies in this area are examples of knowledge. The kind of infonnation, saved in knowledge base reflects expert know how of certain problem area and number of all current states of objects and method of transitions from one object description to others belong to concept of knowledge in Expert System. In other words: 'knowledge=facts+beliefs+rules\

There are following types of knowledge:

- about object and categories of environment;
- about events, which determine temporal sequences and cause-effect relations;
- about activities, about capability to execute some actions;
- metaknowledge, knowledge about size of our knowledge are about limits of our capabilities.

FIGURE 2. The structure of Expert System



For the knowledge representation in the shell of the expert system ESPLAN was suggested developed form of production rules. The antecedent of the rule shown in the following Figure 3. For example , let us take a rule from the knowledge base in Figure 3.

OR

-.•IF Object

AND

I—то—»-1—Ohjeot. ^

AND

Fig.3. The Production rule diagram.

Knowledge base example:

1. IF Oil Production = "Weak_Decreasing " and P_{work} ="Fall_till_Minimum" THEN Recom="Plug_in_column_first_row"

CONFIDENCE FACTOR =0.7

2. IF Oil Production = "WeakDecreasing " and P_{work} = " Fall_till_Minimum" THEN Recom = first row

CONFIDENCE FACTOR =0.6

3. IF Oil Production = "StrengthDecreasing" and P_{work}= " IncreasetoMaximum" THEN Recom = Repeat operation

CONFIDENCE FACTOR =89%

On the base of following parameters and features realized the technological diagnostic gaslift wells state :

1. Well=How the state of well?
2. P_{inj} constant =Is that pressure injection constantly?
3. V_{m}=How the state of gas injection expenditure?
4. Corking=Is there corking in going line?
5. Pdes>Pinj= Pdes>Pinj on the upper valve?
6. Pdes<P$_a$iiocr Pdes<Paiioc on the each valves?

7. IF P_{mj}-P_{dp}=Greater

Psu • Psep Less

The well is closed by plug =Yes

Pi_{nj}_constant=Yes

Vinj=constant

Corking=No

THEN Recom=Probably mutually influence of valves.

Recom=Valves are invalid.

8. IF Pinj-Pdpf^Greater

Psurf⁻ P s e p ⁻ **S S**

The well is closed by plug =Yes

Pi_{nj}_constant=Yes

V_{mj}=change

THEN Recom= Turn of tendention of the next valve.

Recom=Increase the expenditure of the injection gas.

Recom=New Processes.

5. THE STRUCTURAL SYNTHESES OF DISTRIBUTED INTELLIGENT SYSTEMS (DIS)

The Distributed Artificial Intelligence (DAI) has become the main concern of many researchers in artificial intelligence. As a new field, DAI lacks theoretical foundation and a full understanding of its many aspects and problems. In particular, the problem of coordination which is central to DAI needs addressing. The objective of the research presented here is an attempt to develop a coherent body of coordination theory for distributed intelligent systems. This theory can be used to analyze when, which, and why a coordination technique is appropriate. Also it can be used as a tool for designing good coordination.

To visualize the abstract perspective of coordination, consider the following example: a work-cell contains two agents, A and B. Each agent has its own exclusive workbench and all the resources it needs to build a certain product (product-1 for A and product-2 for B) except for two tools, tool-1 and tool-2, which both agents share. The final product which combines product-1 and product-2 cannot be assembled by a single agent.

In a distributed environment such as the above Assembly scenario, agents have to coordinate their efforts to achieve goals. For instance, agents A and B have to share their use of tool-1 and tool-2, although, they can work independently at their respective workbenches. Nevertheless, they have to meet in a shared work-space in order to combine their products.

In this case coordination is the act of managing interdependencies between activities performed by agents to achieve some goals. Activities are physical or mental efforts such as the move action or the process of information respectively. Goals are the ends that activities are directed toward such as product-1 at shared-floor. Interdependencies are goal-relevant relationships between activities. For example, agent A and B each has a goal that cannot be achieved without using tool-1 and consequently this imposes some sort of interdependence between the agents activities. Finally, to manage means to provide coordination structure and mechanism which constitute the two main components of coordination.

Coordination structure is the pattern of decision making and communication among a set of agents who perform tasks in order to achieve goals. Two basic types of coordination structure can be identified, centralized and decentralized. In the centralized (Fig. 4) only one agent is allowed to be a decision maker or a coordinator, whereas, in the decentralized (Fig. 5) each agent is allowed to contribute to the coordination.

FIGURE 4. A centralized coordination structure.

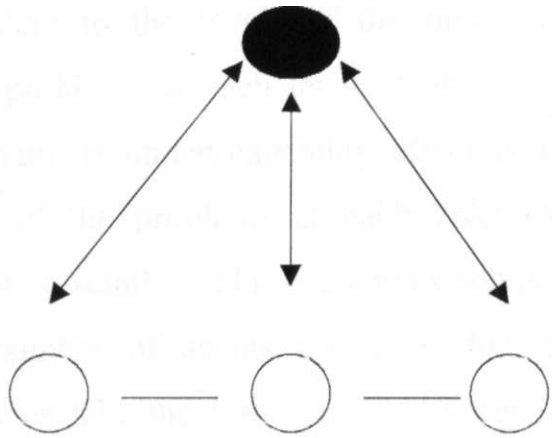
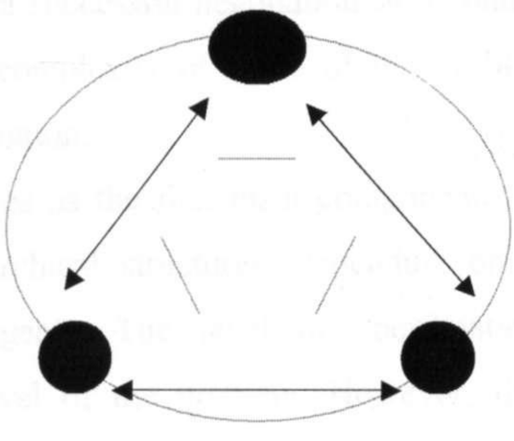


FIGURE 5. A decentralized coordination structure.



In many cases however, problems have a considerably large size and complexity to the extend that the limits of agents capabilities are reached. Solving such problems using the basic structures become very costly or perhaps impossible to solve. Nevertheless, it is easy to build on these basic types of structure to fit the problem characteristics of size and complexity with respect to the agents bounded-capability. Firstly, the number of agents have to be increased in order to reduce the bounded-capability effect. For example, if two agents are not enough to build a tower starting from the designing stage down to painting the walls a much larger number of agents might be enough to paint a wall.

Secondly, dividing the coordination structure into levels (multilevel hierarchy) that are equivalent to the levels of the problem abstractions becomes a natural extension. Sub problems at each level of abstraction can be solved only within its knowledge domain. Bounded-capability effect then can be diminished by reducing the complexity of the problems at each level by decomposing a large and (or) complex problem to smaller and less complex sub problems.

As the number of agents increases due to problem size and complexity, multiagent systems take the form of a multi-organization society, where a group of units interact at some level of problem abstraction. An organization unit is a group of agents that has its own intra-coordination structure. For a multi-organization society market is an appropriate coordination structure, where a number of disjoint organization units are assumed to be available for providing a service. Activities are initiated after a successful negotiation of a contract between the units. By which, the size and the complexity of some of the problems can be reduced to messages of contract negotiation.

Structures as the first main component of coordination ranges from strict one level to hierarchical structures, depending on the problems size, complexity, and number of agents. The level of coordination structure is corresponds to the abstraction level of the problem. However, the type of coordination structure, in general, remains centralized or decentralized.

Coordination mechanism, as the second component of coordination, is a device or a collection of devices which can be used to handle the coordination parameters: informally, type of interdependence and uncertainty. In distributed systems three types of interdependence, can be identified: (1) physical, such as interdependence imposed by sharing tool-1; (2) mental, for example an agents activity depends on some knowledge produced by another agent; (3) time, such as a sequential temporal order between some agents activities. Each type of interdependence may exhibit a different topology which affects the flow of coordination, and thus its difficulties. Although a different coordination technique is required for each interdependence type and topology, coordination difficulties arise due to the uncertainty of interdependence.

Hence, uncertainty, as the second parameter, is characterized in terms of: incorrectness, which refers to the amount of error that the knowledge manifests, and incompleteness which refers to the lack of having the necessary requirements. Uncertainty is exhibited in three forms, task-knowledge, control, and environment. However, the main focus of this research is the incompleteness aspect of task-knowledge and control uncertainty and their impact on coordination.

Knowledge, here is treated as a set of propositions and it is available if it is presented explicitly or implicitly in the agent's memory. Task-knowledge is the knowledge that is required to perform a task. Hence, incompleteness of task-knowledge is the difference between the necessary knowledge to perform a task and the available knowledge.

Control, here, is treated as a set of decision points at which knowledge is required to detennine the next activity in order to reach the desired goal. This control is exercised either by the agent or for the agent. Two types of control can be identified for a distributed environment local-control and coordinated-control. Local control is a set of decision points which determine the cheapest sound set of activities (the optimal solution) or the closest set to the optimal. Nevertheless, this research is concerned with coordinated-control. Coordinated-control is a set of decision points which represent the influence of the existence of the other agents on the local-control. This influence is caused by interdependency and coherency. It is obvious that in distributed environments decision points have to consider which and when a physical interdependence is to be acquired or released, a mental interdependence is to be produced or consumed, and activities should act in sequential or synchronized fashion. This is called interdependency -knowledge.

Incompleteness of interdependency-knowledge is the difference between the shared resources, the other agents capabilities as well as their goals and the available knowledge. In spite of this the selected activities which are locally the best should also be globally the most beneficial. In terms of this solution-coherency, incompleteness of coherency-knowledge is the difference between the other agents goals as well as their solutions, and the available knowledge. From this perspective the main objective of a coordinated-control is to provide the local control with the ability to determine which alternative set of activities requires less interdependence and leads to solutions that are globally the most beneficial.

Coordination is an interdisciplinary concept and moreover it is central for distributed intelligent systems. The real-world problems cannot be solved in distributed systems without coordination. Coordination and many related concepts are ill-defined and there is no complete body of coordination theory that can be used to analyze when, which and why a coordination techniques is appropriate

The concept of coordination has been determined in terms pf parameters and components. Parameters are informally types of interdependencies and uncertainty. Components are structure and mechanism. Coordination structure is either centralized or decentralized however it is easy to build on these two basic types to fit problem characteristics of size and complexity with respect to its bounded-capabilities. Coordination mechanism is comprised of a collection of devices to handle different types and topologies of interdependencies and uncertainty of task-knowledge and control. Uncertainty in coordinated-control, is the most crucial for coordination.

6. DESCRIPTION OF TWO LEVELS OPTIMIZATION OF DISTRIBUTION WORKING AGENT BETWEEN GAS-LIFT WELLS IN DISTRIBUTED INTELLIGENT SYSTEMS

This work describes the ways for solving problem of optimization of distribution working agent between gas-lift wells in distributed intelligent systems.

In the field experience the working agent entered to each GDS (Gas Distribution Station) from several compressor stations. In compressor oil production the distribution of working agent system may present as two-level hierarchical control system.

In the presence of distribution limited resources by component system which has hierarchical structure, there arising a specific distribution problem.

The given work consider the problem of optimization of distribution working agent charges between GDS by separate fields or Oil and Gas Production Enterprise (OGPE) on the base of earlier developed model for optimization of distribution working agent between compressor wells supplied by GDS. Solving of such kind problem allows to decrease the production cost due to minimizing of mean discharge intensity of working agent.

If the total power of all compressor stations related to the given OGPE denoted by **Vtotai** then the balance equation will be:

$$V_{tot}al = \sum_{j=l}^{q} V_{0j} = \sum_{j=l}^{q} \sum_{1=1}^{m,} Vji \qquad (1)$$

where q - the number of GDS in the given OGPE; nij - the number of compressor wells connected to j of GDB.

In it necessary to note that the mam activities of distribution working agent system is the mean specific charge of working agent

$$R\,(R = \sum^{q} V_J / \sum_{J=I}^{q} Q_J)$$

which required to minimize. As the resultant power of compressor stations is constant then maximizing of resultant production accord to minimizing R. Therefore, during construction of the model of distribution working agent system as aim function using the resultant production which is the main figure of OGPE. There are two ways for solving problem of optimization of distribution-working agent between compressor wells by OGPE.

In the first case all the well related to given OGPE, independently from the number of attached GDS, considering together and the charges of working agents for a given GDS detennining by summation of obtained values of the charges of working agent well, which are connected to this GDS, that is

$$V_{of}= \sum_{i=1}^{mj} Vji \quad , \qquad j=1, q$$

Herewith the value of charges of working agent by the individual wells detennining from the following model:

It is necessary to find $\max F^{\wedge}V) = \sum_{i=1}^{m} Q$ (2)

By limitation of $Q-p_r \ln V_1 - p_2 < \ln Vi)^2 = p_0'$ $i=1,m$

$$\sum_{J=1}^{m} Vi = Vtotai \qquad V_j < Vj < Vj \quad , \qquad \imath=1,m \qquad (3)$$

where n - it is a common amount of compressor well in reviewing OGPE; $V_{toto}/$ - is a resultant importance the charge of working agent of all the compressor station. F (V) is a resultant production by the OGPE: p_0,Pi,P2 coefficients characterizing **j-**well, which determined on basis of given researches.

In the second case the solving of the problem is realizing by the two-stage procedure. On the first stage for each GDS solving problem of distribution and detennining dependence of total production from the given working agent charges. On the second stage - solving problem of optimization of total working agent charges between GDS using dependences Fj (V) = f (V_{0J}) , j=1,q which are determined on the base of discrete values and receiving on the first stage.

The essence of second case consider as strength well, which characterized by coefficients p_0', P_1', P_2' and which determined by results of distribution problems on the first stage.

The model for solving distribution problem will be:

Find max $$F'(V) = \sum_{H}^{q} Fj(V) \qquad (4)$$

by limitation of

$$Fj(Vj) - P'_{,j} \ In V_{0J} - p'_{2j} (In V_{2j})^2 = p'_{0J}, \quad j=1,q$$

$$\sum_{j=i}^{q} V_{0J} = \mathbf{Vtotaj} \qquad V_{0J} < \mathbf{Voj} < V_{oj}, \qquad \mathbf{j}=1, q \qquad (5)$$

where $P'_0j, P'ij, p'_{2j}$- are coefficients, which characterized j of GDS. Low meaning of the given working agent charge by each GDS in model (4) and (5) may changes in the following diapason:

$$(VjO min < V_0 j < \sum_{i=1} Vji$$

where $(\mathbf{Vji})_{min}$ the minimum of the low meaning of working agent charges for wells, comiected to j of GDS.

In the presence of details of distribution problems $V_{to}tai < \sum_{J=1}^{q} V_{01}$

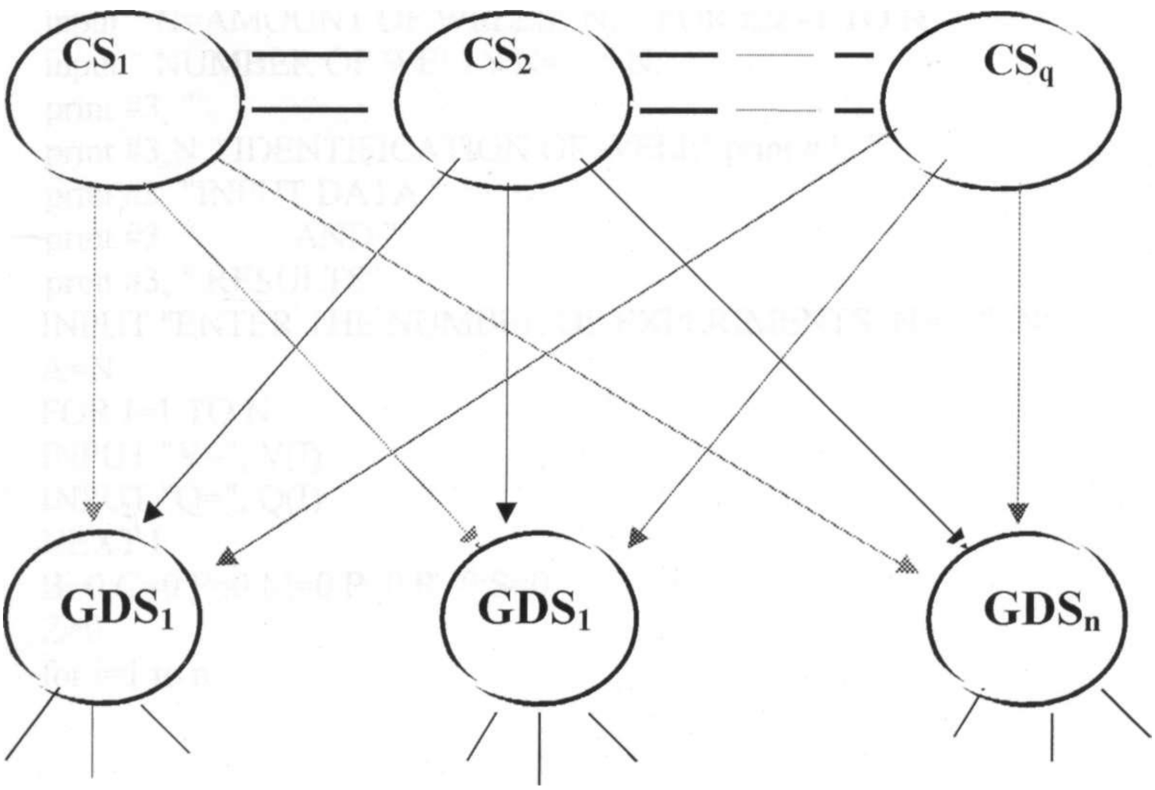
in model (4) and (5) the low limit of the given working agent charge by each GDS should take the minimum meaning $(\mathbf{Vji})_{min}$ from details (6), that is in this case the limits on the variables should be:

$$(\mathbf{Vji})_{mm} < V_{01} < V_{01}, \quad j = 1,q \qquad (6)$$

For solving the concrete problem on the models (2), (3), (4), (5) using their approximate variant [3].

It is necessary to note that the solving problem of optimization of distribution working agent charges between compressor wells by the first variant is more common and may to applied by small quality of GDS. By more quality of GDS (consequently compressor wells) in considering OGPE the problem of Distribution working agent charges necessary to solve on the base of the second variant of supported model it related that by changing of characteristics one of wells the problem of optimization of distribution necessary to solve on the first variant of model with beginning that required often solving and take a lot of time as on the second variant of model first stage of optimization problem will solve only for GDS, which has well with changing characteristics and it make economy for time by matching with first variant.

Efficient of the given methodic was tested by solving concrete distribution problem on the first stage between 15 wells, by which optimization by 5% oil production is increased. There fore, solving optimization problem of Distribution working agent charges between compressor wells on the stage of OGPE in each case require analyze and selection according variant from supported. The structural and mathematical models of two levels optimization of distribution working agent between gas-lift wells in distributed intelligent systems is illustrated below.



7. SOLVING PROBLEM OF OPTIMIZATION OF DISTRIBUTION WORKING AGENT BETWEEN GAS-LIFT WELLS IN DISTRIBUTED INTELLIGENT SYSTEMS

Let's to solve problem of optimization of distribution working agent between gas lift wells in distributed intelligent systems.

By parametric control an identification problem of well characteristic is solved by log-parabolic subordination which allows to increase accuracy of identification by each wells and identification an optimal modes by group of wells. The problem of optimization by planning and analyzing and resource principles for analyzing are constitute the scientific foundation of analysis and allow to increase the effectiveness of parametric control.

For finding an optimal way for distribution working agent between 8 gas lift wells in distributed intelligent systems and providing minimum mean-square rejection were developed stated bellow program.

```
CLS
      PRINT " PARABOLIC REGRESSION"
      open "170L.bas" for output as #3
      print #3, "IDENTIFICATION OF WELLS"
      print #3, ""
      dimV(30), Q(30)
      input ":N=AMOUNT OF WELLS" N:    FOR zzz=l TO N
      input" NUMBER OF WELLS:N=    " N:
      print #3,""
      print #3,N " IDENTIFICATION OF WELL" print #3, ""
      print #3, "INPUT DATA "
      print #3, "        AND "
      print #3," RESULTS"
      INPUT "ENTER THE NUMBER OF EXPERIMENTS: N=    " N:
      A=N
      FOR 1=1 TO N
      INPUT "V=", V(I)
      INPUT "Q=", Q(I)
      NEXT I
      B=0:C=0:F=0:M=0:P=0:R=0:S=0
      Z=0
      for i=l to n
```

```
B=B+LOG(V(I)):   C=C+L0G(V(I))^2:  F=F+LOG(V(I))^3
M=M+LOG(V(I))^4:  P=P+Q(I):  R=R+LOG(V(I))*Q(I)
S=S+Q(I)*L0G(V(I))^2
NEXT  I
T=B: E=C: K=C: L=F
V=T/A:   E=E-V*B:  F=F-V*C
R=R-V*P:  V=K/A:  L=L-V*B
M=M-V*G  S=S-V*P:      V=L/E
B2=(S-R*V)/(M-F*V):    B1=(R-F*B2)/E
B0=(P-B*B1-C*B2)/A
PRINT #3,USFNG  "    B0=#####.###"; BO
PRINT  #3,USING  "  Bl  =#####.###"  ;B1
PRINT #3,USING  "    B2=#####.###"; B2
PRINT #3, ""
SG1=0
FOR 1=1  TO N
Q1(I)=B0+B1*LOG(V(I))+B2*LOG(V(I))^2
NEXT  I
FOR 1=1  TO N
SG1=SG1+(Q1(I)-Q(I))^2
NEXT  I
SG=SQR(1/(N-1)*SG1)
PRINT #3, USING "    SG=###.###";SG
PRTNT #3,""
PRINT #3,"————————————————————————————"
PRINT #3,"  ROW        V          Q         Ql
PRINT #3,"————————————————————————————"
for i=l  to  n
PRINT  #3,using  "###.###     ";i,V(i),q(i),ql(i):  next ı
PRINT #3,"————————————————————————————"
PRINT #3,""
PRINT #3,""
NEXT  ZZZ
END
```

Let's write the problem of optimization of distribution working agent between gas lift wells in distributed intelligent systems for 8 wells.

Necessary to find:

MaxQ=^,oQii+^iiQi2+112Q13+A,13Q14+^14Q15+^15Q16+^16Q17+^17Q18+

+^18Q19+^19Q20+^2oQ21+^21Q22.............+^8oQ81+^81Q82+^82Q83+^83Q84

With the following values:

Max V^,oV11+^11Vi2+^12V13+X13V14+^i4V15+X15V16+^16V17+X17V18+

+Xi8Vi9+Xi9V20+^2oV21+A,21V22............+A.8oVsi+^81 V82+^82V83+^83 Vs4

^1oV11+^1 | 1V12+^12Vi3+A,i3Vi4 <= 23 >
^2()V2i+^2 | 1 V22+^22 V23+^23 V24 <=23
Ä,3oV3i+A,3 | 1V32+A,32V33+A,33V34 <=35,1
A40V41+A.4 | 1V42+X42 V43+A43 V44 <=20,9 {
^5oV5i+A.5 | 1V52+X52 V53+X53 V54 <= 28,2 '
^6oV61+A,6 | [V62+A62V63+^63V64 <=33
XJOV-JI+X- | UV72+A/72V73+A/73V74 <= 38,2
^8oV81+A-8 | V82+^82V83+^83V84 <= 23,6J

Vi2+A,]2Vi3+A,i3Vi4 =>18,1^
^2oV21+^2 | V22+A,22V23+A-23V24 =>17
^3oV3i+A,3 | V32+A,32V33+X.33V34 =>24
A40V41+A4] | V42+^42V43+A,43V44 =>16,8
^5oV5i+A-5] | V52+^52V53+^53V54 =>25,2
^6oV6l+A,61 | V62+^62V63+A-63V64 =>26
A-70V71+X71 | V72+X72V73+^73V74 =>35,5
^8oV8l+A,81 | V82+^82V83+A,83V84 =>20,5 J

$$\lambda_{10}V_{11}+\lambda_{11}V_{12}+\lambda_{12}V_{13}+\lambda_{13}V_{14} =$$

$$\lambda_{20}V_{21}+\lambda_{21}V_{22}+\lambda_{22}V_{23}+\lambda_{23}V_{24} =$$

$$\lambda_{30}V_{31}+\lambda_{31}V_{32}+\lambda_{32}V_{33}+\lambda_{33}V_{34} =$$

$$\lambda_{40}V_{41}+\lambda_{41}V_{42}+\lambda_{42}V_{43}+\lambda_{43}V_{44} =$$

$$\lambda_{50}V_{51}+\lambda_{51}V_{52}+\lambda_{52}V_{53}+\lambda_{53}V_{54} =$$

$$\lambda_{60}V_{61}+\lambda_{61}V_{62}+\lambda_{62}V_{63}+\lambda_{63}V_{64} =$$

$$\lambda_{70}V_{71}+\lambda_{71}V_{72}+\lambda_{72}V_{73}+\lambda_{73}V_{74} =$$

$$\lambda_{80}V_{81}+\lambda_{81}V_{82}+\lambda_{82}V_{83}+\lambda_{83}V_{84} =$$

Note that in the abovementioned program we have replaced $\boldsymbol{X}$ by X.

Input data:

WELL N 109		WELL N397		WELL N24		WELL N406		WELL N451		WELL N389		WELL N364		WELL N276	
V	**Q**	**V**	**Q**	**V**	**Q**	**V**	**Q**	**V**	**Q**	**V**	**Q**	**V**	**Q**	**V**	**Q**
22.6	22	22	14	24	62	18.1	9	27	9	26	10	35.5	6	21,9	6
20.9	26	19	14	26.7	70	20.9	9	25.2	10	32.4	11	37.5	7.5	22.8	8
23	24	17	12	35.1	49	16.8	7	28.2	9	33	9.5	36.9	9	23.6	7
18.1	22	23	14									38.2	6.9	20.5	7

In order to find Ql (the values received from the statement) will be use the following statement: $Q = p_0 + Pi \ In\ V + p_2 \ (In\ V)^2$

$V = exp\ (-P!\ /20_2)$

$V = exp\ (1-p, / 2p_2$ **-V** $(pi / 2p_2)^2 - Po/ P_2+1)$

$Q = Po-pi^2/2p_2$

$Q = 2p_2$**+Vp!**$^2\ -4p_0p_2+4p_2{}^2$

$R = exp(-p_1/2p_2)/(p_0-Pi^2/4p_2)$

$R = exp\ [1-P! / 2p_2$ **W** $(Pi / 2p_2)^2 - p_0 / p_2+l] / [\ 2p_2 +$ **V** $fa^2 - 4p_0p_2+ 4\ p_2^2\ ]$

V]=V

V_2=V+AV

V_3=V+2AV

V_4=V+3AV=V

For four point and three intervals AV will be find by the following formulas:

$$AV=V_G-V_L/3$$

Consequently: $AV=V_G-V_L/3$ = (23-18.1)/3=1.6
$AV=V_G-V_L/3$ = (23-17)/3=2
$AV=V_G-V_L/3$ = (35.1-24)/3=3.7
$AV=V_G-V_L/3$ = (20.9-16.8)/3=1.4
$AV=V_G-V_L/3$ = (28.2-25.2)/3=l
$AV=V_G-V_L/3$ = (33-26)73=2.3

$AV=V_G-V_L/3 = (38.2-35.5)/3=0.9$

$AV=V_G-V_L/3 - (23.6-20.5)73=1.03$

AV= 1.6 V=82.1		AV=2 V=80		AV= 3.7 V=118.2		AV= 1.4 V=75.4		AV= 1 V=106.8		AV= 2.3 V=117.9		AV= 0.9 V= 147.4		AV= 1.03 V=88.2	
V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q
f 18.1	22.4	17	12.1	24	60.8	16.8	7.2	25.2	9.9	26	10.1	35.5	6.8	20.5	6.7
f 19.7	24.4	19	13.8	27.7	72.8	18.1	8.8	26.2	9.6	28.3	10.3	36.4	7.1	21.5	6.9
21.3	24.6	21	14.3	31.4	66.8	19.6	8.5	27.2	9.2	30.6	10.3	37.3	7.5	22.6	7.1
23	23.2	23	13.9	35.1	48.6	20.9	9.1	28.2	8.8	33	10.2	38.2	7.8	23.6	7.2

IDENTIFICATION OF WELLS

IDENTIFICATION OF WELL N 109

INPUT DATA AND RESULTS:

B0=-•1180.014
Bl= 795.550
B2= -131.336

SG= 1.323

ROW	V	Q	Qi
1.000	22.600	22.000	23.673
2.000	20.900	26.000	24.703
3.000	23.000	24.000	23.221
4.000	18.100	22.000	22.404

IDENTIFICATION OF WELL N 397

INPUT DATA AND RESULTS:

B0= -462.791
Bl= 313.645
B2= -51.545

SG= 0.173

ROW	V	Q	Qi
1.000	22.000	14.000	14.208
2.000	19.000	14.000	13.835
3.000	17.000	12.000	12.074
4.000	23.000	14.000	13.883

IDENTIFICATION OF WELL N 24

INPUT DATA AND RESULTS:

BO-5372.074
Bl= 3265.094
B2= -489.482

SG= 1.471

ROW	V	Q	Ql
1.000	24.000	62.000	60.796
2.000	26.700	70.000	71.639
3.000	35.100	49.000	48.564

IDENTIFICATION OF WELL N 406

INPUT DATA AND RESULTS:

BO- -785.364
Bl= 533.424
B2= -89.505

SG= 0.203

ROW	V	Q	Ql
1.000	18.100	9.000	8.769
f 2.000	20.900	9.000	9.079
3.000	16.800	7.000	7.152

IDENTIFICATION OF WELL N451

INPUT DATA AND RESULTS:

B0=-155.372
Bl= 109.840
B2= -18.168

SG= 0.253

ROW	V	Q	Ql
1.000	27.000	9.000	9.289
2.000	25.200	10.000	9.887
3.000	28.200	9.000	8.824

IDENTIFICATION OF WELL N 389

INPUT DATA AND RESULTS:

B0= -143.309
B1= 90.397
B2= -13.297

SG= 0.730

ROW	V	Q	Q1
1.000	26.000	10.000	10.060
2.000	32.400	11.000	10.241
3.000	33.000	9.500	10.198

IDENTIFICATION OF WELL N 364

INPUT DATA AND RESULTS:

B0= -110.524
B1= 52.063
B2= -5.378

SG= 1.187

ROW	V	Q	Q1
1.000	35.500	6.000	6.793
2.000	37.500	7.500	7.526
3.000	36.900	9.000	7.314
4.000	38.200	6.900	7.766

IDENTIFICATION OF WELL N 276

INPUT DATA AND RESULTS:

B0= -108.108
B1= 70.838
B2= -10.869

SG= 0.793

ROW	V	Q	Qi
1.000	21.900	6.000	6.986
2.000	22.800	8.000	7.119
3.000	23.600	7.000	7.205
4.000	20.500	7.000	6.691

QuickQuant Plus Report

SOLUTION TO LINEAR PROGRAM

FORMULATED LINEAR PROGRAM

Maximize P =

+ 22 4 X10	+ 24 4 Xll	+ 24 6 X12	+ 23 2 X13
+ 12 1 X20	+ 13 8 X21	+ 14 3 X22	+ 13 9 X23
+ 60 8 X30	+ 72 8 X31	+ 66 8 X32	+ 48 6 X33
+ 7 2 X40	+ 8 8 X41	+ 8 5 X42	+ 9 1 X43
+ 9 9 X50	+ 9 6 X51	+ 9 2 X52	+ 8 8 X53
+ 10 1 X60	+ 10 3 X61	+ 10 3 X62	+ 10 2 X63
+ 6 8 X70	+ 7 1 X71	+ 7 5 X72	+ 7 8 X73
+ 6 7 X80	+ 6 9 X81	+ 7 1 X82	+ 7 2 X83

Subject to:

Cl: + 18.1 X10	+ 19.7 Xll	+ 21.3 X12	+ 23 X13
+ 17 X20	+ 19 X21	+ 21 X22	+ 23 X23
+ 24 X30	+ 27.7 X31	+ 31.4 X32	+ 35.1 X33
+ 16.8 X40	+ 18.1 X41	+ 19.6 X42	+ 20.9 X43
+ 25.2 X50	+ 26.2 X51	+ 27.2 X52	+ 28.2 X53
+ 26 X60	+ 28.3 X61	+ 30.6 X62	+ 33 X63
+ 35.5 X70	+ 36.4 X71	+ 37.3 X72	+ 38.2 X73
+ 20.5 X80	+ 21.5 X81	+ 22.6 X82	+ 23.6 X83 <571

C2: + 18 1 X10	+ 19 7 Xll	+ 21 3 X12	+ 23 X13
+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 <23

C3: + 0 X10	+ 0 Xll	+ 0 X12	+ 0 X13
+ 17 X20	+ 19 X21	+ 21 X22	+ 23 X23
+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 <23

C4 :	+ 0 x10	+ 0 X11	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 24 X30	+ 27 7 X31	+ 31 4 X32	+ 35.1 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 < 35.1

C5 :	+ 0 x10	+ 0 X11	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 16.8 X40	+ 18.1 X41	+ 19.6 X42	+ 20.9 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 < 20.9

C6:	+ 0 X10	+ 0 x11	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 25.2 X50	+ 26 2 X51	+ 27 2 X52	+ 28 2 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 < 28.2

C7 :	+ 0 x10	+ 0 x11	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 26 X60	+ 28 3 X61	+ 30 6 X62	+ 33 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 <33

C8:	+ 0 x10	+ 0 x11	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 35 5 X70	+ 36 4 X71	+ 37 3 X72	+ 38 2 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 < 38.2

C14 :	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X2 0	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 25 2 X50	+ 26 2 X51	+ 27 2 X52	+ 28 2 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83>25.2

C15:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X2 0	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 26 X60	+ 28 .3 X61	+ 30.6 X62	+ 33 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 >26

C16:	+ 0 XIO	0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 35 5 X70	+ 36 4 X71	+ 37 3 X72	+ 38 2 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83
				>35.5

C17:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X2 0	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 20 5 X80	+ 21 5 X81	+ 22 6 X82	+ 23 6 X83
				>2 0.5

C18:	+ 1 XIO	+ 1 Xll	+ 1 X12	+ 1 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 =1

C19:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 1 X20	+ 1 X21	+ 1 X22	+ 1 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 = 1

C20:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 1 X30	+ 1 X31	+ 1 X32	+ 1 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 =1

C21:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 1 X40	+ 1 X41	+ 1 X42	+ 1 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 =1

C22:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 1 X50	+ 1 X51	+ 1 X52	+ 1 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 =1

C23:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 1 X60	+ 1 X61	+ 1 X62	+ 1 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 =1

C24: + 0 XIO + 0 X20 + 0 X30 + 0 X40 + 0 X50 + 0 X60 + 1 X70 + 0 X80	+ 0 Xll + 0 X21 + 0 X31 + 0 X41 + 0 X51 + 0 X61 + 1 X71 + 0 X81	+ 0 X12 + 0 X22 + 0 X32 + 0 X42 + 0 X52 + 0 X62 + 1 X72 + 0 X82	+ 0 X13 + 0 X23 + 0 X33 + 0 X43 + 0 X53 + 0 X63 + 1 X73 + 0 X83 =1

C25: + 0 XIO + 0 X20 + 0 X30 + 0 X40 + 0 X50 + 0 X60 + 0 X70 + 1 X80	+ 0 Xll + 0 X21 + 0 X31 + 0 X41 + 0 X51 + 0 X61 + 0 X71 + 1 X81	+ 0 X12 + 0 X22 + 0 X32 + 0 X42 + 0 X52 + 0 X62 + 0 X72 + 1 X82	+ 0 X13 + 0 X23 + 0 X33 + 0 X43 + 0 X53 + 0 X63 + 0 X73 + 1 X83 =1

»

SOLUTION TO LINEAR PROGRAM

Original Variable	Value
XIO	0.00000
Xll	0.00000
X12	1.00000
X13	0.00000
X20	0.00000
X21	0.00000
X22	1.00000
X23	0.00000
X30	0.00000
X31	1.00000
X32	0.00000
X33	0.00000
X40	0.00000
X41	2.618347E-07
X42	0.00000
X43	1.00000
X50	1.00000
X51	0.00000
X52	0.00000
X53	0.00000
X60	0.00000
X61	1.00000
X62	0.00000
X63	0.00000
X70	0.00000
X71	0.00000
X72	0.00000
X73	1.00000
X80	0.00000
X81	0.00000
X82	0.00000
X83	1.00000

Objective Value: P = 156.00000

Slack/Surplus Variable	Value
51	364.79996
52	1.70000
53	2.00000.
54	7.40000
55	0.00000
56	3.00000
57	4.70000
58	9.536743E-07
59	4.768372E-07
510	3.20000
511	4.00000
512	3.70000
513	4.10000
514	0.00000
515	2.30000
516	2.70000
517	3.10000

QuickQuant Plus Report

SOLUTION TO LINEAR PROGRAM

FORMULATED LINEAR PROGRAM

Maximize P =

+ 22.4 XIO	+ 24.4 Xll	+ 24.6 X12	+ 23.2 X13
+ 12.1 X20	+ 13.8 X21	+ 14.3 X22	+13.9 X23
+ 60.8 X30	+ 72.8 X31	+ 66.8 X32	+48.6 X33
+7.2 X40	+8.8 X41	+8.5 X42	+9.1 X43
+9.9 X50	+9.6 X51	+9.2 X52	+8.8 X53
+10.1 X60	+10.3 X61	+10.3 X62	+ 10.2 X63
+6.8 X70	+7.1 X71	+ 7.5 X72	+7.8 X73
+ 6.7 X80	+6.9 X81	+7.1 X82	+ 7.2 X83

Subject to:

Cl: +18.1 XIO	+ 19.7 Xll	+ 21.3 X12	+ 23 X13
+ 17 X20	+ 19 X21	+ 21 X22	+ 23 X23
+ 24 X30	+27.7 X31	+ 31.4 X32	+ 35.1 X33
+ 16.8 X40	+18.1 X41	+ 19.6 X42	+ 20.9 X43
+ 25.2 X50	+ 26.2 X51	+ 27.2 X52	+ 28.2 X53
+ 26 X60	+ 28.3 X61	+ 30.6 X62	+ 33 X63
+ 35.5 X70	+ 36.4 X71	+37.3 X72	+38.2 X73
+ 20.5 X80	+ 21.5 X81	+ 22.6 X82	+ 23.6 X83<734

C2: + 18 1 X10	+ 19 7 Xll	+ 21 3 X12	+ 23 XI3
+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83<23

C3: + 0 X10	+ 0 Xll	+ 0 X12	+ 0 X13
+ 17 X20	+ 19 X21	+ 21 X22	+ 23 X23
+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83< 23

C4:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 24 X30	+ 27 7 X31	+ 31 4 X32	+ 35 1 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ ü X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83<35.1

C5:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X2 0	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 16 8 X40	+ 18 1 X41	+ 19 6 X42	+ 20 9 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 <20.9

C6:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 25 2 X50	+ 26 2 X51	+ 27 2 X52	+ 28 2 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 <28.2

C7 :	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 26 X60	+ 28 3 X61	+ 30 6 X62	+ 33 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 < 33

C8:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 35 5 X70	+ 36 4 X71	+ 37 3 X72	+ 38 2 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 < 8.2

C9:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 XI3
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 20 5 X80	+ 21 5 X81	+ 22 6 X82	+ 23 6 X83 < 3.6

CIO : + 18 1 XIO	+ 19 7 Xll	+ 21 8 X12	+ 23 X13
+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 > 18.1

Cll: + 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
+ 17 X20	+ 19 X21	+ 21 X22	+ 23 X23
+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 > 17

C12 : + 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
+ 24 X30	+ 27 7 X31	+ 31 4 X32	+ 35.5 X33
+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 > 24

C13: + 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
+ 16 8 X40	+ 18 1 X41	+ 19 6 X42	+ 20.9 X43
+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 > 16.8

C14 : + 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
+ 25 2 X50	+ 26 2 X51	+ 27 2 X52	+ 28.2 X53
+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 > 25.2

C15 :	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X2 3
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 26 X60	+ 28 3 X61	+ 30 6 X62	+ 33 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83> 26

C16:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 35 5 X70	+ 36 4 X71	+ 37 3 X72	+ 38.2 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83>35.5

C17:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X2 3
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 20 5 X80	+ 21 5 X81	+ 22 6 X82	+ 23.6 X83>20.5

C18:	+ 1 XIO	+ 1 Xll	+ 1 X12	+ 1 X13
	+ 0 X2 0	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 = 1

C19:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 1 X20	+ 1 X21	+ 1 X22	+ 1 X2 3
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 = 1

C20:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 1 X30	+ 1 X31	+ 1 X32	+ 1 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 = 1

C21:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 1 X40	+ 1 X41	+ 1 X42	+ 1 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 = 1

C22:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 1 X50	+ 1 X51	+ 1 X52	+ 1 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 = 1

C23:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 1 X60	+ 1 X61	+ 1 X62	+ 1 X63
	+ 0 X70	+ 0 X71	+ 0 X72	+ 0 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 = 1

C24:	+ 0 XIO	+ 0 Xll	+ 0 X12	+ 0 X13
	+ 0 X20	+ 0 X21	+ 0 X22	+ 0 X23
	+ 0 X30	+ 0 X31	+ 0 X32	+ 0 X33
	+ 0 X40	+ 0 X41	+ 0 X42	+ 0 X43
	+ 0 X50	+ 0 X51	+ 0 X52	+ 0 X53
	+ 0 X60	+ 0 X61	+ 0 X62	+ 0 X63
	+ 1 X70	+ 1 X71	+ 1 X72	+ 1 X73
	+ 0 X80	+ 0 X81	+ 0 X82	+ 0 X83 = 1

C25: + 0 XIO + 0 X20 + 0 X30 + 0 X40 + 0 X50 + 0 X60 + 0 X70 + 1 X80	+ 0 Xll + 0 X21 + 0 X31 + 0 X41 + 0 X51 + 0 X61 + 0 X71 + 1 X81	+ 0 X12 + 0 X22 + 0 X32 + 0 X42 + 0 X52 + 0 X62 + 0 X72 + 1 X82	+ 0 X13 + 0 X23 + 0 X33 + 0 X43 + 0 X53 + 0 X63 + 0 X73 + 1 X83 = 1

SOLUTION TO LINEAR PROGRAM

Original Variable	Value
XIO	0 .00000
Xll	0 .00000
X12	1 . 00000
X13	0 00000
X2 0	0 00000
X21	0 00000
X22	1 00000
X23	0 00000
X30	0 00000
X31	1 00000
X32	0 00000
X33	0 00000
X40	0 00000
X41	2 . 618347E-07
X42	0 00000
X43	1 00000
X50	1 00000
X51	0 00000
X52	0 00000
X53	0 00000
X60	0 00000
X61	1 00000
X62	0 00000
X63	0 00000
X70	0. 00000
X71	0. 00000
X72	0. 00000
X73	1. 00000
X80	0. 00000
X81	0 .00000
X82	0. 00000
X83	1. 00000

Objective Value: P =   156.00000

Slack/Surplus Variable	Value
51	527.80005
52	1.70000
53	2.00000
54	7.40000
55	0.00000
56	3.00000
57	4.70000
58	9.536743E-07
59	4.768372E-07
510	3.20000
511	4.00000
512	3.70000
513	4.10000
514	0.00000
515	2.30000
516	2.70000
517	3.10000

8. REFERENCES

1. A. A. Aliev and R. A. Aliev. *"Fuzzy Distributed Intelligent System For Continuous production".* Azerbaijan Oil Academy, Azerbaijan, pp.301-319.

2. Edited by M. J. Coombs. *"Developments in Expert Systems"'.* Department of Computer Science. Univeristy of Strathclyde Glasgow Gl 1HX Scotland, pp. 221-234; pp. 135-157.

3. *«Pa3eedKU u Pa3pa6omm He(pmxHHhix MecmopojtcdeHuü».* TeMa **HOMepa:** HH(J)**OpManHa H CBA3L B** He(])**T5IHOH npOMbllUJieHHOCTH**. He(**JDTflHOe X03JIHCTBO,**
No 8/98.

4. C. H. K)**cH**(f)**OB.** *«HeKomopbie eonpocu onmuMU3ctuuu pacnpedejieuufi pacxoda paöonezo azeuma Meotcdy KOMnpeccopuuMu CKeaotcuuaMU ua ypoene HFJfV».* **A3ep6aö;j,)KaHCKHH HHCTnryT He**(J)**TH h xhmhh hm**. M. **A3H36eKOBa.**

5. R. A. Aliev and R. R. Aliev *"Soft Computing"* , Azerbaijan State Oil Academy , 1997, (in Russian)

6. F. Aminzadeh and M. Jamshidi (eds) ." *SOFT COMPUTING : Fuzzy Logic , Neural Networks and Distributed Artificial Intelligence ",pp. 29-41; pp. 229-259; pp.261-292,* 1994 .

7. R. A. Aliev, G. Mamadova, R. Aliyev " *Fuzzy Sets Theory and its application ",* Tabriz University , TABRIZ - Islamic Republic of IRAN, 1993.

8. C. H. K)**ch**4)**ob.** *«BonpocbiKoMWieKcnozo YnpaejieuuH npoueccaMU 2a3Jiu<ftmH0ü ue(pmedo6bmu».* **ABTOMaTH3an,ira h BtmncjiHTejibHaa Texronca. A3ep6aH^aHCKa^ rocyzıapcTBeHHafl** He(J)**T5iHHaii** *A^KSLJXQMHÄ.* YneHbie **3anncKH, N°.** 4, 1997.

9. R.M. Akhmedov, S.I. Yusifov and A.A.Alaskarova *"Fuzzy Expert System of Dynamical Diagnose of Technical State of Gas-lift Equipment".* Fourth International Conference on Application of Fuzzy Systems and Soft Computing. Siegen, Germany, 27-29 June, 2000

10. Internet materials. *"Intelligent agents, mobile agents and electronic commerce".*

11. Kenneth C. Laudon and Jane P. Laudon; *Management Information Systems;* Sixth Edition; Organization and Technology in the networked enterprise; wmv.prenhall.com/laudoii; New York University

9. ATTACHMENTS

1) The structural and mathematical models of two levels optimization of distributed working agents between gas-lift wells in distributed intelligent systems.

2) A centralized and decentralized coordination structures.

3) Construction of distribution working agent system and characteristic mode of gas-lift.

4) The scheme of gas lift well.

5) Functional scheme of corporate information system

FIGURE 1. A CENTRALIZED COORDINATION STRUCTURE.

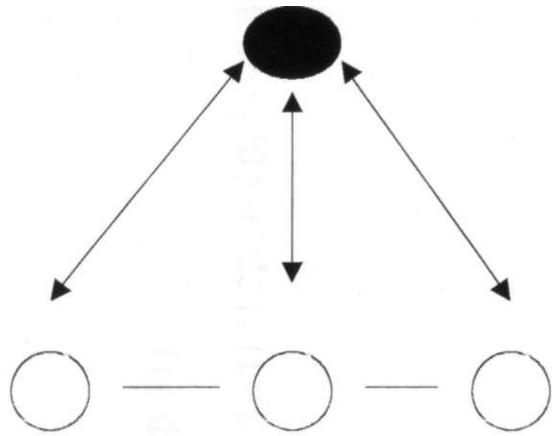


FIGURE 2. A DECENTRALIZED COORDINATION STRUCTURE.

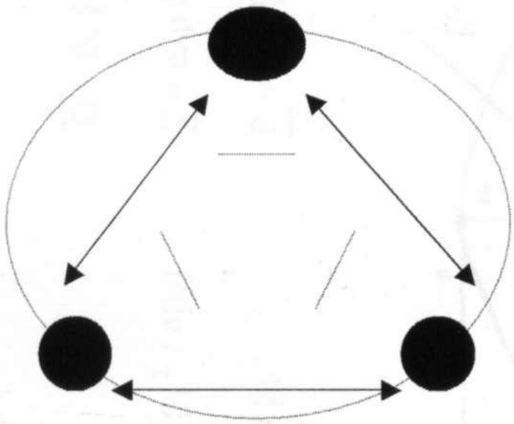


FIGURE 3. CONSTRUCTION OF DISTRIBUTION WORKING AGENT SYSTEM AND CHARACTERISTIC MODE OF GAS-LIFT .

$Q = Po + p_1 \ln V + p_2 (\ln V)^2$

$V = exp(-pV2p_2)$ $\quad$ $Q = Po - Pi^2/2p_2$

$R = exp(-p_t/2p_2)/(Po - Pi^2/4p_2)$ $\quad$ $V = exp\ Cl\text{-}P1/2p_2 W(Pi/2p_2)^2 - p_0/p_2 + l)$

$Q = 2p_2 + V p!^2 - 4p_0p_2 + 4p_2^2$ $\quad$ $R = exp[l - p_T/2p_2 - V(P,/2p_2)^2 - p_0/p_2 + l]/[2p_2 + V fa^2 - 4p_0p_2 + 4p_2^2]$

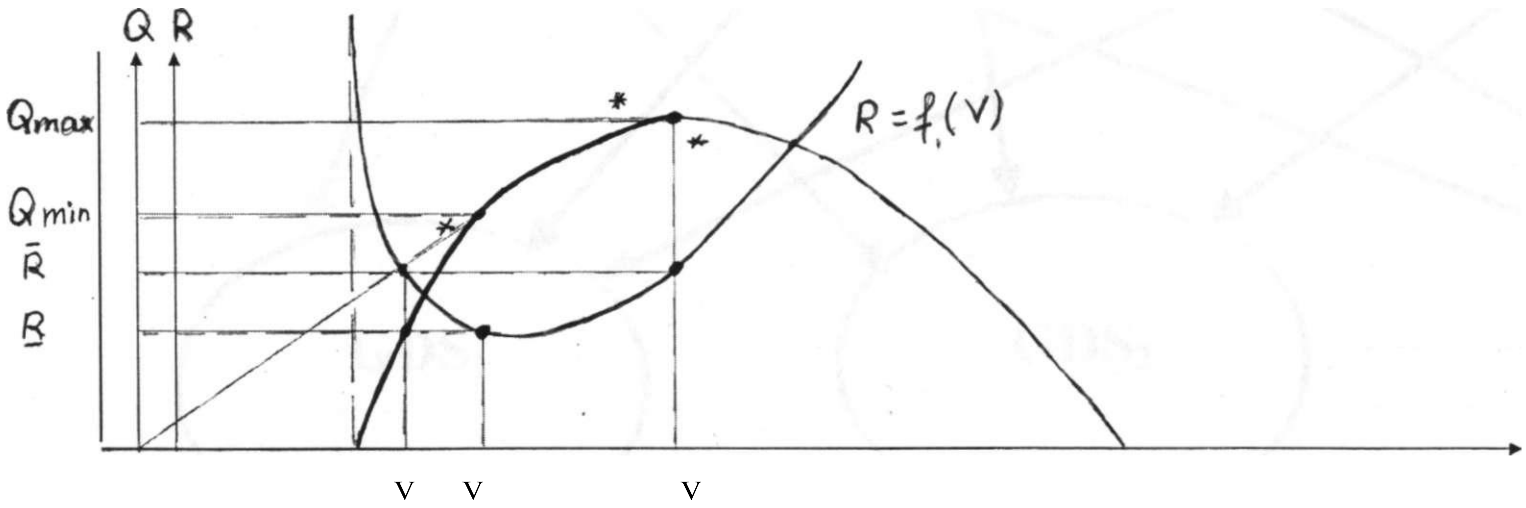


FIGURE.4. THE STRUCTURAL AND MATHEMATICAL MODELS OF TWO LEVELS OPTIMIZATION OF DISTRIBUTION WORKING AGENT BETWEEN GAS-LIFT WELLS IN DISTRIBUTED INTELLIGENT SYSTEMS.

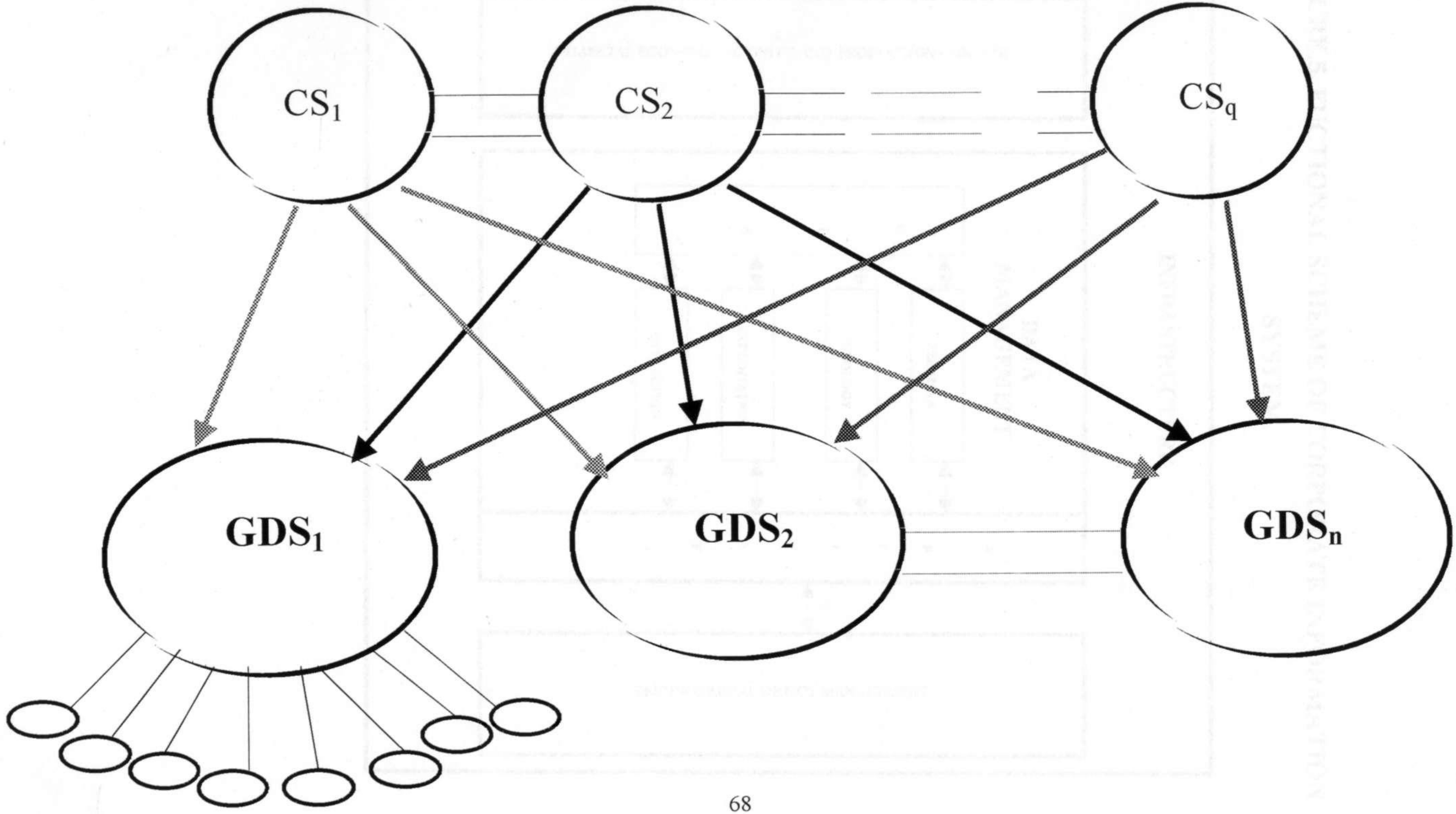


FIGURE.5. FUCTIONAL SCHEME OF CORPORATE INFORMATION SYSTEM.

INFRASTRUCTURE

DATA
MANAGEMENT

SEISM1KA

GEOLOGY

EXPLOITATION

EXTRACTION