"BABES-BOLYAI" UNIVERSITY CLUJ-NAPOCA
THE FACULTY OF ECONOMICS AND BUSINESS MANAGEMENT

The Summary of PhD Thesis

Contributions on projecting, realizing and introducing an information system concerning the management of the electricity production

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Cluj-Napoca
2010

Keywords: branch, energy management, Hydro-electric power station, economic elements, applications, single database, prototype, Integrated Information System

PhD Thesis Summary Content

1. The contents of PhD Thesis

2. Introduction

The well-known British economist, John Maynard Keynes said in one of his papers that "Difficulty is not present in the new ideas, but in the way of getting rid of the old ones" and Leonardo da Vinci, one of the greatest artists of the Renaissance said that "Simplicity is the last step of sophistication".

Starting from these affirmations, the author tries in this paper to bring the new and the simplicity in the management of the leadership of a branch of Energy, namely the Branch of Hydro-electric power station Cluj. (Sucursala de Hidrocentrale Cluj - S.H. Cluj).

Among the challenges that need to be taken into consideration in this context, we appreciate that the important role is given to the informational technologies and of communications, that include at the moment a large diversity of technologies, starting with the Internet and its services, continuing with the electronic management of the documents, collaborative working environments, artificial intelligence, and not least, computer aided design.

The main focus of the paper is to improve management within a company, by adapting some informatics integrated solutions. From this point of view, we consider that an important role in enhancing the efficiency of management and competitiveness of the company is designing and implementing integrated ERP information systems.

In this context, the paper focuses on the design of a prototype integrated information system called SIMPROD-Hydro, designated for the management of the production of electricity generation from hydro-power branches. In the author's opinion, the new system meets the needs of information at all levels of decision, being a software instrument of analysis, management and strategy inside the hydro energetic branches.

This works as a whole aims to capture the complexity of the phenomenon of producing electricity, as a mix of several areas: informatics, economic, technical, legal. In this context, the prototype of integrated information system proposed in the paper is considered to be a technological and economical unit absolutely necessary to the electricity units and operating new competitive conditions of the electricity market.

2.1. The thesis' objectives

The present PhD thesis includes the main theoretical and practical issues concerning the management's improvement of the business of producing electricity in a hydro-electric power station, using the most modern informatics and communication technologies.

The scientific approach of the paper focuses on analysing the present system of management from the Branch of Hydro-electric power station Cluj and on developing the most adequate strategies that should allow the company to have an efficient activity, which will bring the expected benefits.

The main objective of the paper is the conception and design of a prototype of integrated information system for the Branch of Hydro-electric power station Cluj.

The present thesis aims to achieve several objectives, namely:

- the identification and the analysis of the procedures concerning the management and use of electricity supply;
- how forecasts of production and supply of energy by using simulation methods and techniques;

- highlighting the billing of electricity;
- establishing the procedures for filtering the signals coming to hydropower, in order to eliminate noise from their composition;
- the presentation and the analysis of economic elements in the power generation companies;
- presenting the actual trends in systems analysis and design through implementation of appropriate ERP solutions;
- the analysis of ERP systems on the Romanian market and the highlight of their impact on the management of the business of energy production;
- highlighting the main technologies for developing integrated information systems;
- creating a prototype integrated informatics system for the companies producing electricity.

Under a practical aspect, the prototype of informatics system proposed by the author integrates with ERP modules, all existing independent applications within the company Hydro-electric Cluj, but also new applications, reported all in one common database. In other words, on the basic skeleton of ERP Emsys applications there develop those detailed company-specific applications, adapted to the permanently moveable needs of this activity's management.

2.2. Structure and organization of Thesis

This work was structured so as to allow, on the one hand, evidence of the current state of knowledge in the production of electricity at hydroelectric power stations, and on the other hand to allow the means of applying modern information technology and communication within the firm. Given these requirements, the work has established the following structure: introduction, five chapters specific to the investigated area, conclusions, personal contributions and bibliography.

We render further in summary, the main ideas contained in the five chapters, the author's personal contributions to the research undertaken and research directions to be taken by the author in the period ahead.

The first chapter named: Energy management includes an analysis of energy management, with reference to the concept, principles and its operation and a review of the energy sector's development in Romania. Particular attention is given in this chapter to the management of production, supply and use of electricity.

The analysis of the framework and instruments concerning the management tools of a branch of hydro-electric power station, highlights the importance of that "**scoreboard"**, that helps the management and staff at all levels to substantiate decisions on electricity production, maintenance and repair facilities.

The author also captures in this chapter, procedures for applying economic principles to problems of energy systems through analysis of concepts such as production cost, break even, demand, offer, elasticity and how they can influence the management of the company and its development over the next period. That research has been completed by putting graphics that show whether the given hydro-electric is worth to invest in upgrading or rehabilitation.

The author's own contribution in this chapter is to design and implement applications that make up "**scoreboard**" set currently available to the and the heads of departments to take the most appropriate decisions concerning electricity production and maintenance related to it..

Chapter two- Integrated ERP systems and their role in energy management – includes in this part an analysis of the alternatives of computerization of the productive companies highlighting the participation of users in the design process.

Taking into account that the main challenge in the field of information technology is the integration of all economic processes and optimization of resources available through ERP systems, the author sees in this chapter the main features of such a system and trends in Romania. At the same time, there are mentioned the activities of designing an ERP, but also the life cycle of such a system.

The core of the chapter is the presentation of the ERP Emsys Romsys with modules related to service existing at the Branch of Hydro-electric power station Cluj. In the same context, there is presented the architecture of the integrated system SAP and SIVECO Applications. The analysis has a qualitative aspect in evaluating the impact of those systems on business activity of the company.

Chapter three- Techniques and technologies for developing embedded systems treats the main techniques and technologies to develop the integrated systems, emphasis being on presenting object-oriented modelling language UML (Unified Modelling Language), SOA services (Service Oriented Architecture) and Enterprise Grid Computing. The use of these instruments is estimated to contribute decisively to improvement of technology systems analysis and design.

Chapter four - Prototype managerial information system at the Branch of Hydro-electric power station Cluj (Sucursala de Hidrocentrale Cluj „SIMPROD – Hidro") is dedicated to presenting the prototype structure of the integrated information system concerning the management of power production of the Branch of Hydro-electric power station Cluj, called SIMPROD-Hydro. The research in this chapter begins with a SWOT analysis of existing information system, followed by the presentation of the architecture of the prototype system proposed by the author based on the concept of integration.

An important part of research in this chapter is given to the description of the Business Intelligence, the basic component in the architecture of the proposed prototype system. The author's main contribution to this chapter is the design of the module Business Intelligence, starting with the definition of the Warenhouse Data at the level of Branch of Hydro-electric power station Cluj and Hydroelectric Company.

It is estimated that the proposed solution is able to provide information necessary for the company's managers present at all organizational levels, in taking decisions in due time, energy specific and structured by types of activity. In this context, it provides a specific module assembly of functional requirements, specifying for each group of indicators that can be obtained and some forecasts for electricity production, consumption, sales and receipts, etc.

Chapter five - Integrating the system of producing, transporting and invoicing the electricity at S.H. Cluj in the managerial system of the branch aims at presenting the five subsystems made by the author, and how to integrate them into the architecture of the prototype of integrated information system, proposed by the author. The basic contribution of the author is, on the one hand in the design and implementation of these applications to the Branch of Hydro-electric power station Cluj and on the other hand in designing solutions for their integration in the prototype of the proposed integrated system.

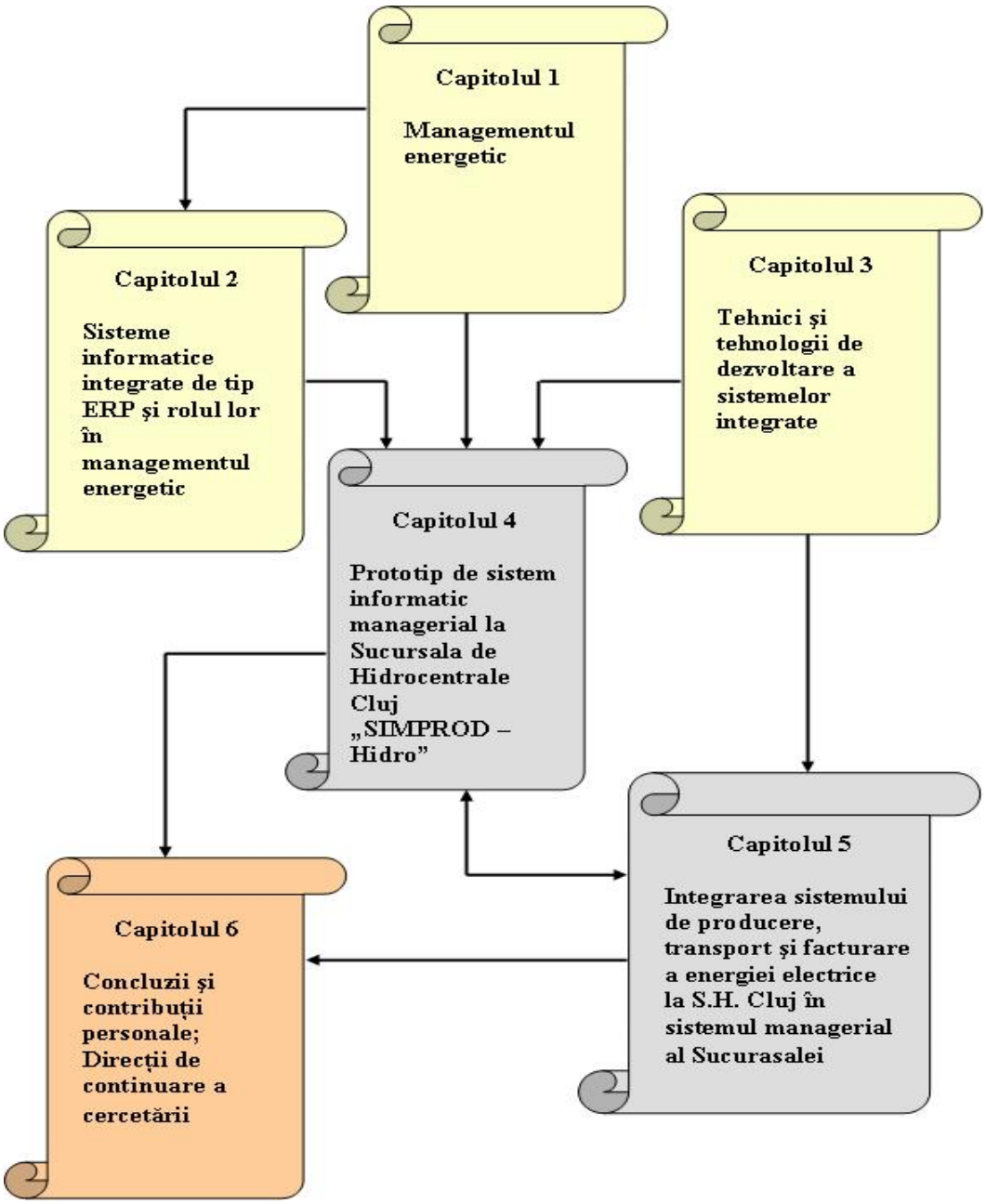
Chapter six - Conclusions and personal contributions; Guidelines for further research sets up as a summary of research in their chosen field and includes contributions by the author as such both the theoretical and the practical issue. The

conclusions made in this chapter represent in author's opinion possible ways to improve energy management.

The prototype of the proposed integrated information system together with the Business Intelligence module and integration solutions of the individual applications in the new system are major contributions to the research in the production of electricity.

In the end of the introduction we express our belief that the results of research conducted allowed the adoption of real measures meant to improve energy management. However, we are convinced that solutions and proposals contained in the paper will constitute important points for new theoretical and practical approaches in other fields of activity.

2.3. The contents of PhD Thesis:



3. Energy management

The first chapter of the paper is an analysis of the principles and economic elements involved in energy management, production management, supply and use of electricity. All these are based on energy strategy, the training and foundation level management decisions, the calculation of costs, the relationship producer-supplier-consumer of electricity. The opinions of the author concerning these issues are based on the planning of the actual existent resources and on the management of electricity use.

3.1. Economic elements in the management of electricity

The management of a company is very important to determine break-even (break-even operation of the business is called management of balance).

The charts were developed using actual data from two hydroelectric plants, during 9 months, at a plant in which there were made during that period some modernization works CHE Turnu Amenajarea Olt Mijlociu and another CHE Mărişelu Amenajarea Someş in which such works were made. All the tests on the two hydro-electric power plants, on the production of electricity, on the current cost of upgrading or repairs, on fixed and variable costs of the power station, applying mathematical formulas, help us get the real price of electricity and, very important, we get the point balance and so-called break-even in operating the plant. Based on a budget of income and expenditure and the production of electricity produced and delivered, we have made an application that can find when a hydro-electric power plant came to value profit or not, so management can take correct decisions in real time. Break-even charts obtained for the two hydro-electric power stations are as follows:

a) ***The break-even chart at a hydro-electric power station with modernization expenses at CHE Turnu Amenajarea Olt Mijlociu:***

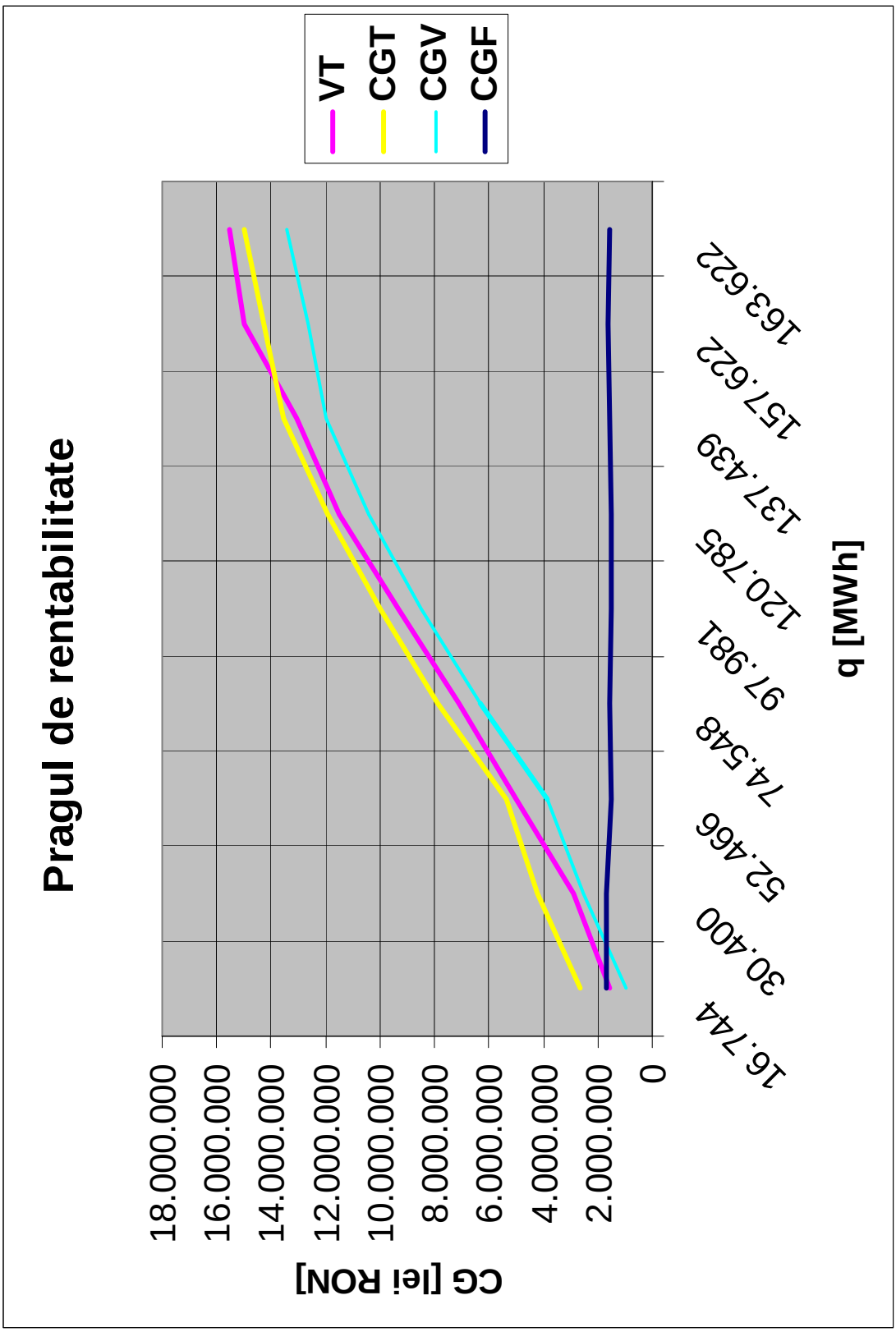


Fig. 1. The break-even chart at CHE Turnu Amenajarea Olt Mijlociu

b) ***The break-even chart at a hydro-electric power station without modernization expenses at CHE Mărişelu Amenajarea Someş:***

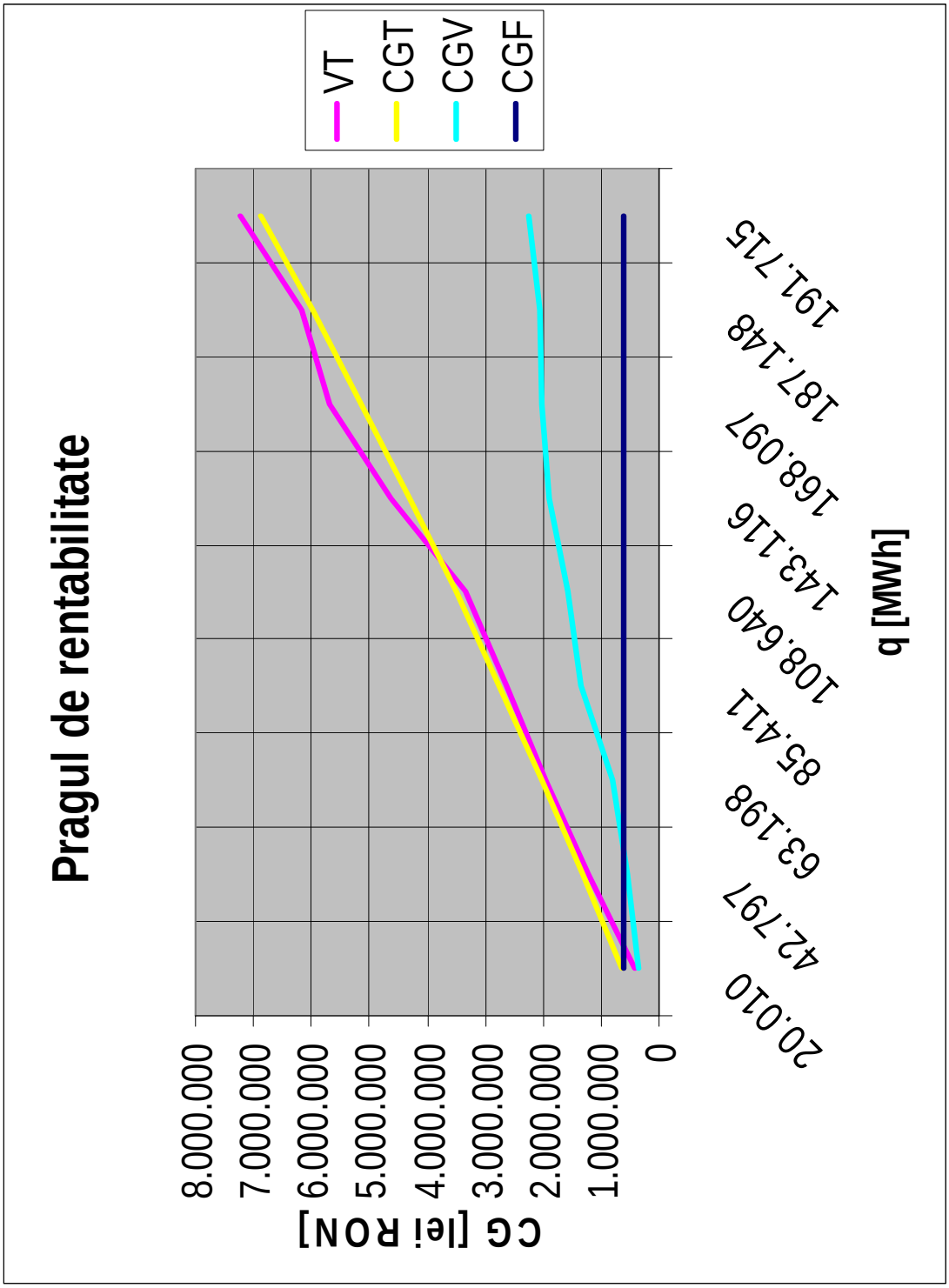


Fig. 2. The break-even chart at CHE Mărişelu Amenajarea Someş

The conclusions drawn from the analysis were presented in a paper that was published in the volume of the international conference *"HYDRO 2008 – ASIA 2008 – Water Resources&Renewable Energy Dev't in Asia".*

3.2. Management tools to lead in a hydro-electric power station

The main problem to be solved for any leadership who wants to make decisions in real time, according to the existing data, is to have that so called "**scoreboard**" to structure in the fields you want all the necessary information to take correct and timely decisions . Therefore, we have developed a dashboard that is available to the management and to all the heads of the functional departments in order to take the correct decisions at the appropriate time.

All data from hydro-electric power plants are taken up by the central monitoring, introduced in the computer system for viewing later. Data introduced during the night by the hydro-power dispatcher is incorporated by applications made by the author. This scoreboard given to the management is represented in the following figure:

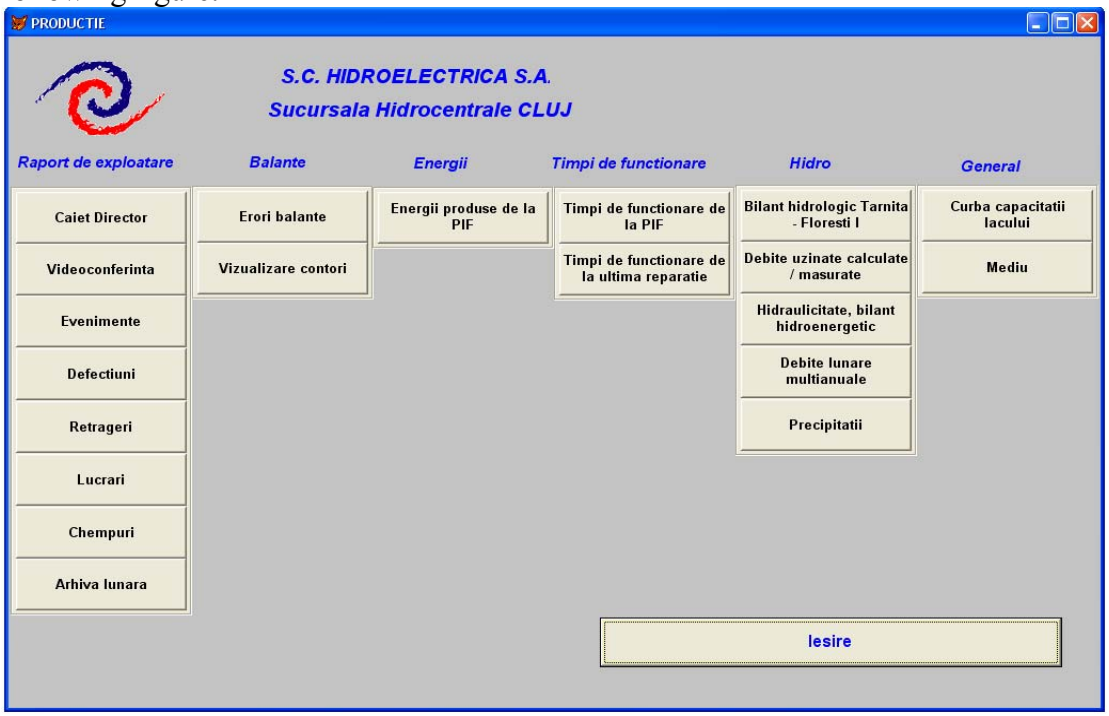


Fig. 3. Dashboard

In the following time, we shall present one of the most important sub-menus of this dashboard that is behind the most important decisions taken at the management level at the branch of hydro-electric, namely:

- *the history of repairs on the groups of hydro-electric power plants, the type of repair* done and when it should be done and it is necessary for a group to enter a particular type of repair. This sub-menu is based on a historical data for each hydro-electric power plant from its entry into function.

In this application, I proposed myself the creation of a decision tool for the management of the branch through which the equipment maintenance decisions can be taken in sufficient time and based on a history fair. The situation obtained in this case is presented in the following figure:

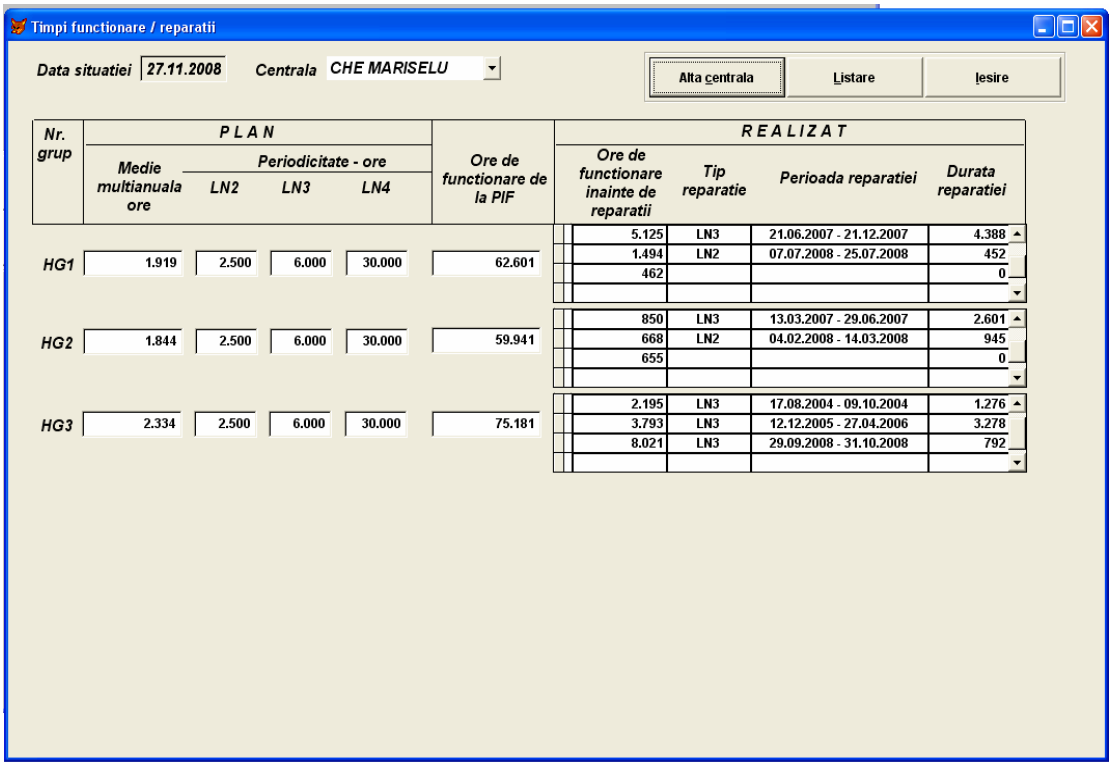


Fig. 4 . Maintenance times

I mention that the paper was published in the volume of the international conference *"HYDRO 2009 – Progress - Potential – Plans - Lyon France 2009"*[1].

Starting from the idea that achieving optimum results in any company is based on adopting rational and well fundamental decisions, we have designed, using the direct-costing method, a tool of analysis of the correlation between expenditure, production, sales and profit. The information obtained will be available for the management of the company so that they will know at any time which is the situation at the branch. All these correlations may be expressed by means of indicators, namely: the balance point, the point of the optimal activity, the coverage factor, the coefficient of dynamic security and safety range.

The direct-costing method is characterized in that only variable costs are considered production costs. This category includes expenditure on raw materials, on materials, fuel, energy, water production, direct labor, insurance rate correspondent to the wages and the associated variable of the indirect costs. At a certain period the author has analyzed taking into account the electricity production, the income and expenditure and using the graphic method she determined where the right balance would be and the point of the optimum activity in the branch S.H. Cluj. The chart made by the author based on actual data available at the branch is presented in the following figure:

[1] Eva Balint, Constantin Lazăr, *Statistics and mathematical models of the reliability of hydropower equipment for two stations namely Mărişelu and Lotru Ciunget,* International Conference and Exhibition Hydro 2009 – Lyon 2009 – France, Progress – Potential - Plans

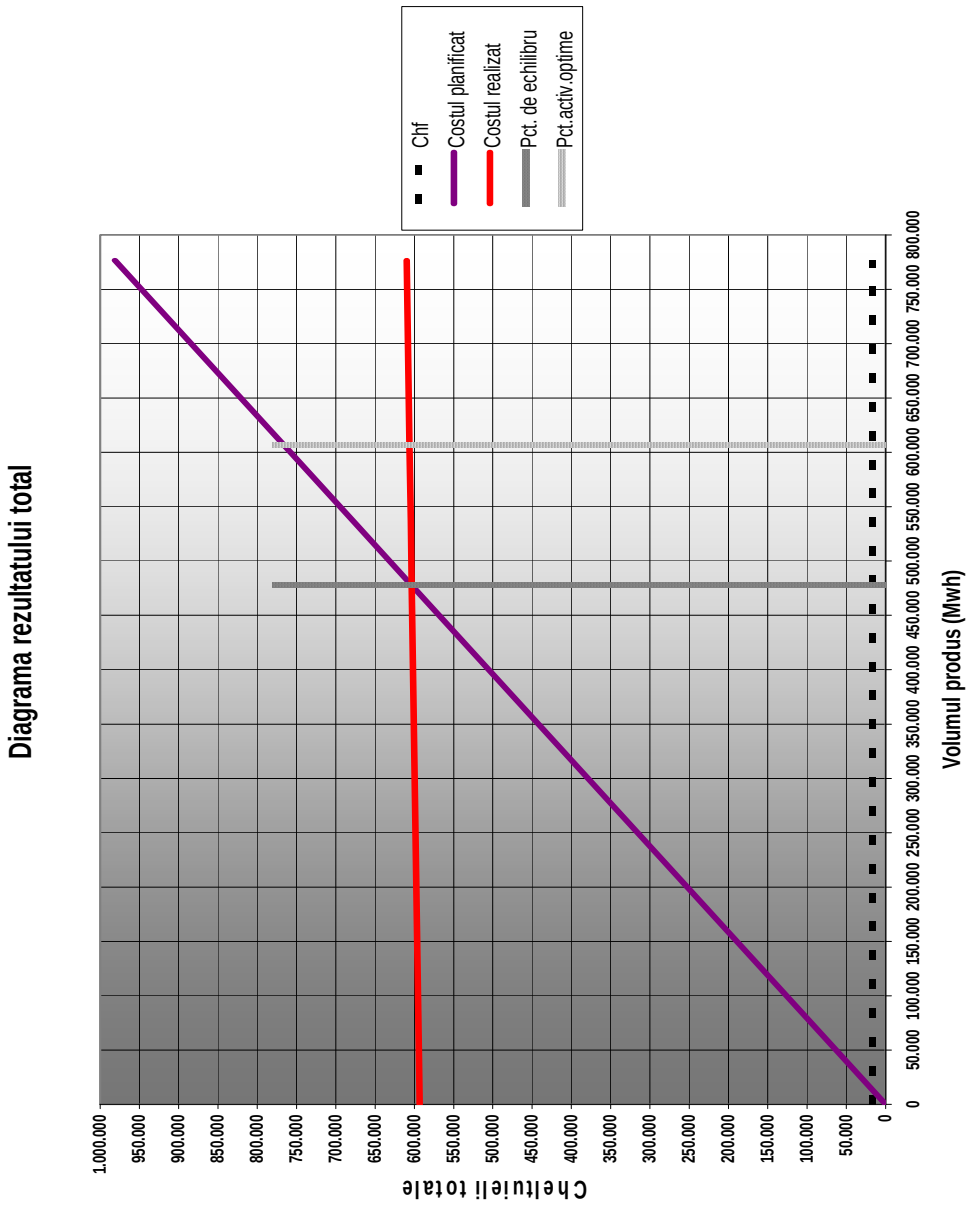


Fig. 5.The chart of the total income through the direct-costing method

4. Integrated ERP systems and their role in energy management

4.1. Integrated System Emsys ROMSYS

EMSYS is an integrated system developed under a unitary concept and as a result of global analysis, experience in software management. ERP application Emsys acts as a continual process in real time, providing information and analysis used to support decision making. The principal modules of the application can be represented as follows:

Fig. 6. The modules of the application ERP Emsys

The advantages of the ERP system can be enumerated in the following way:

-is a multi-user system;
- easy to set up;
- modular;
- easy to use,
- is a useful tool for the management of the company;
- system scalability;
- portability.

We mention that in the Branch of Hydro-electric power station Cluj the ERP system was implemented. I participated with the IT&C team at the system implementation, implementation which lasted 1 year and a half. I participated in the implementation stage at the analysis of the structure of the ERP system, at the data modelling analysis, at the division of tasks inside the IT team within the branch, at the migration of the historical data and at their modelling on the new structures of the system.

4.2. The impact of ERP systems on energy management

Production is the most important process in the value chain in a producing company, and products' marketing quality and competitiveness from the production process is essential. To achieve these goals is essential to ensure efficiency of business management information system. Only the implementation of an informatics solution perfectly tailored to a company producing activities can ensure competitiveness on the premises. For the Branch of Hydro-electric power station Cluj and for all Hydro-electric Company, I considered it fully justified the implementation of an ERP system to retrieve the history of all existing systems in advance. **The justification for investment in an ERP system** can be appreciated or evaluated by:

- Streamlining business;
- Standardization of economic processes;
- Elimination of information islands;
- Modular and open architecture that facilitates the adoption of future technologies.

If we ask '**Why to implement an ERP system in the branch?**', the answer is quite simple: *because the following figures speak for themselves about the benefits* of ERP:

- Reduce the inventory – 18%;
- Reduce the materials costs – 5%;
- Reduction of additional costs / salaries– 8%;
- Increase sales and customer – 12%;
- Improving the Financial Control – 16%.

It should be noted that ERP implementation in time, linked with business development and organizational effectiveness, allows the efficiency growth in time. All these benefits come in aid of the top management of the branch, which is able to make decisions in real time for all company managers.

5. Techniques and technologies for developing embedded systems

5.1. Possibilities of applying the new technologies in energy field

The analysis and design phase of an information system should be ready before the completion code in order to get an increased attention from different investors. For ***the analysis and design of the systems***, there have created ***modelling languages***. One of these languages is the modelling language - ***UML (The Unified Modelling Language)***. With this language there have been made all the tests that were the basis of the applications made by the author on the field of energy.

The needs of the industry and of the companies producing electricity have increased, wishing the existence of multi-platform solutions, solutions that lead to the integration of applications, services and systems, using current technologies. This integration must be achieved in a flexible manner, as required. All this leads to the design and (re) use of some standards to fulfil the requirements related to circulation, availability, maintenance, security and retrieval of data. Moreover, one should put the basis of an architecture that should be the foundations for the development of distributed applications, Web-oriented. The software should be divided into services that can be composed, designed to connect and orchestrate spontaneously within business processes. The solution is given by the SOA model.

A possible use of Grid computing in the field of energy would be the facility of an on-line collaboration between the branches, making use of creating a portal. Such a portal represents the interface with a computing infrastructure for large projects, thanks to Grid technologies. The portal can provide support for searching and retrieving information, regardless of their physical location, but may also permit the enforcement of activities (Tasks) on several machines, regarded as a single computing system.

6. Prototype managerial information system at the branch of Hydro-electric power Station Cluj („Sucursala de Hidrocentrale Cluj"- "SIMPROD-Hidro")

6.1.the arhitecture of the new prototype information system "SIMPROD-Hidro"

This chapter presents the architecture that is a basis for a solution of substantiation of a rational basis for the decision process at different levels (enterprise, branch office, company) based on the conception of a prototype of integrated information system **„SIMPROD-Hidro"**. In order to find a solution we

have started from the huge amount of data saved as electronic versions during the time, and from the diversity of their sources (folders, databases, tables, excel sheets), as well as from the necessity of giving them a certain value by turning them into information for managers at every level.

Some of the factors considered to be risk factors for information systems' function are:

- isolation of a huge amount of data without any possibility for their physical interconnection;
- different data platforms logical unique schedules;
- the necessity of connecting them at the business processes by using some complex tools of multidimensional analysis;
- the inefficient collaboration between some levels that are the basis of decision process;
- the huge amount of devices and interfaces for collecting and presenting data/information;
- the inefficient use of information technologies in the real systems.

The argument of introducing an information system **"SIMPROD-Hidro"** is considered to be the one that allows all the employers in the company to access the same informations using the same rules and tools .

Summarizing the topics regarding the limits of the existing systems, as well as the requests of realizing an integrated system, the conceptual chart of the prototype **"SIMPROD - Hidro"** introduced in our branch office by me is as follows:

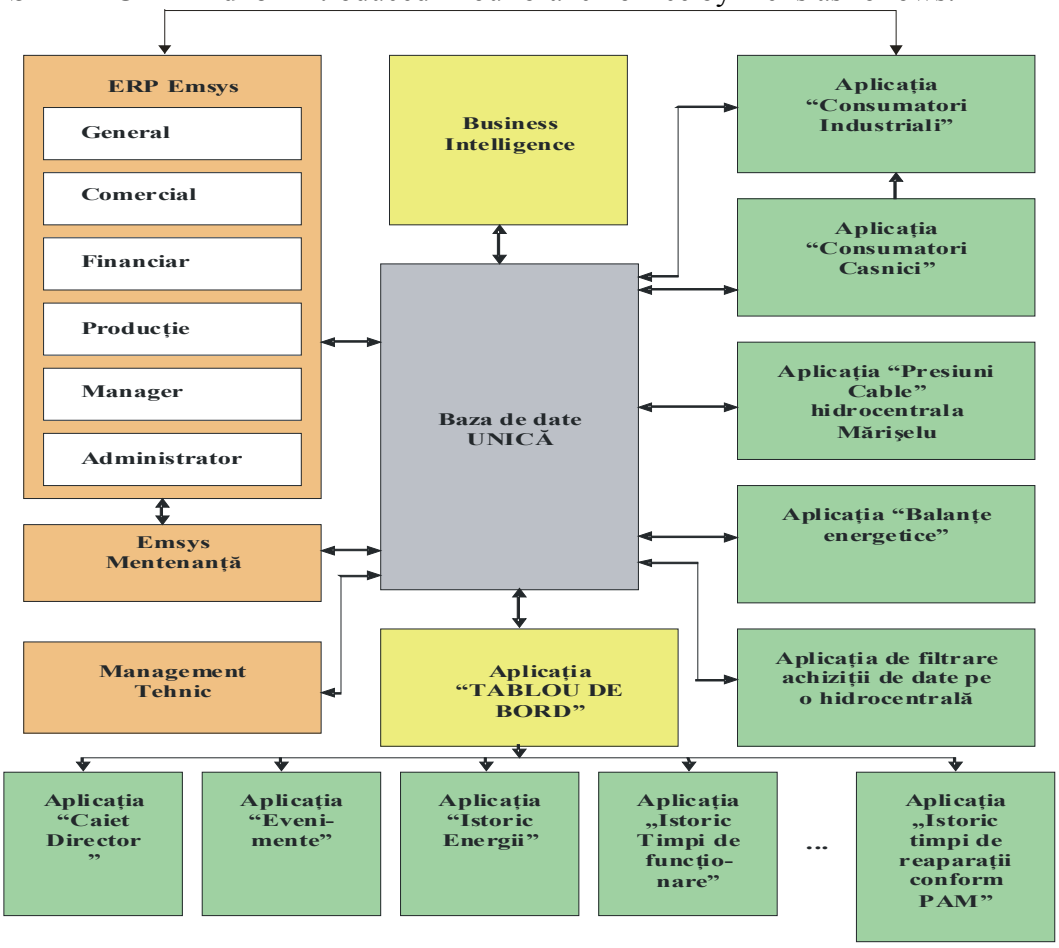


Fig. 7. The conceptual chart of the prototype information system "SIMPROD-Hidro"

In this chart have been included all the compound modules of the information system "SIMPROD-Hidro" that are centred on unique database. There ca be noticed Emsys ERP with its sub-modules: General, Commercial, Financial, Production, Manager, Administrator, as well as a module Emsys Maintenance which is related with Emsys ERP. The Technical Management Module is realized by Hydro-Electric Station All the other modules: Business Intelligence, the application "Scoreboard", which some of its modules, the application "Household Consumers", the application "Industrial Consumers", the application "Cable pressure" and the application regarding the selection of data acquisition on hydro generators are all realized by the thesis's author. I will mention some of the advantages of introducing such an integrated information system at the Branch of Hydro-electric Power Station Cluj (Sucursala de Hidrocentrale Cluj):

- allows data flows redesign;
- makes easier the development of a cutting-edge management based on information obtained in real time and on tools that automate the processes of economic management and that of making decisions ;
- allows monitoring in real time the whole activity of the company;
- assures the introduction of new quality standards;
- allows the rapid adaptation legislative changes.

If we follow the level architecture of the prototype regarding data sources at Hydro- Electric Station Cluj, it would be like this:

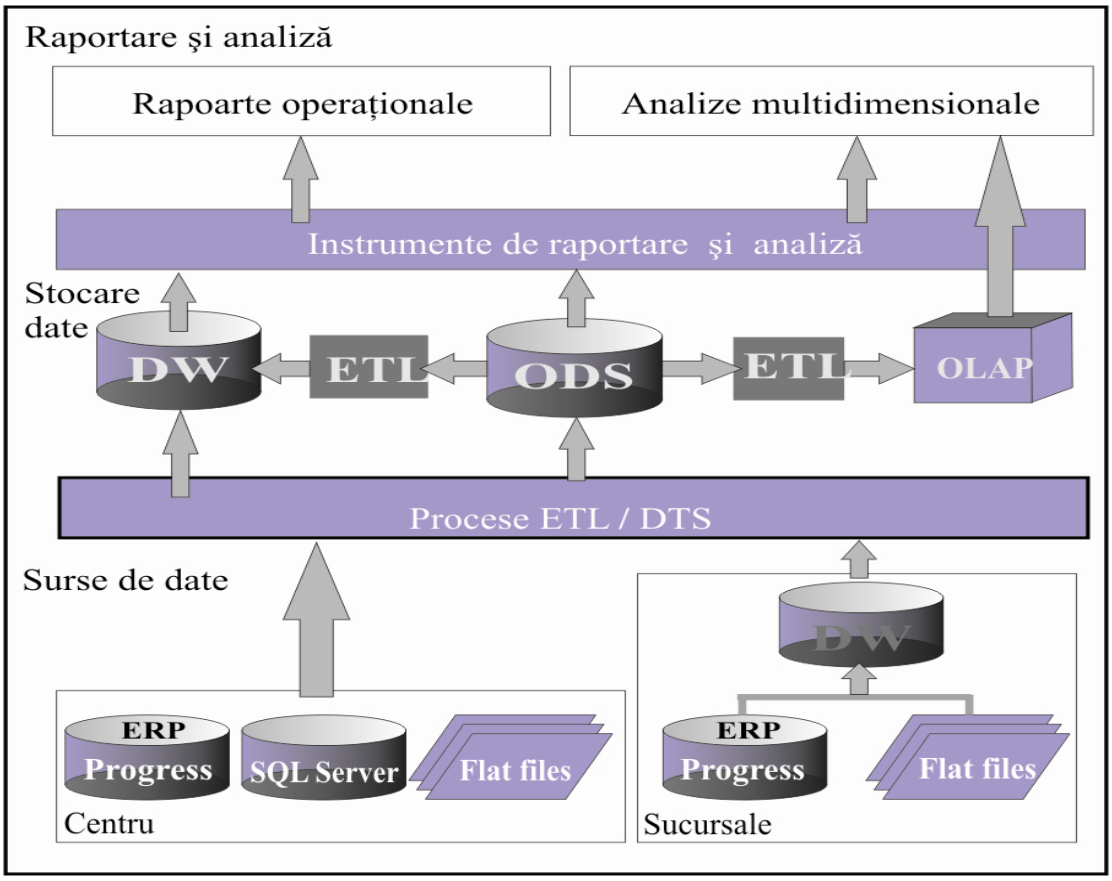


Fig. 8. The Architecture of "SIMPROD – Hidro" prototype regarding data sources and some processing procedures for obtaining reports

6.2. The presentation of "Business Intelligence" module of the prototype "SIMPROD-Hidro"

The architecture of the Business Intelligence module that I have realized could be represented:

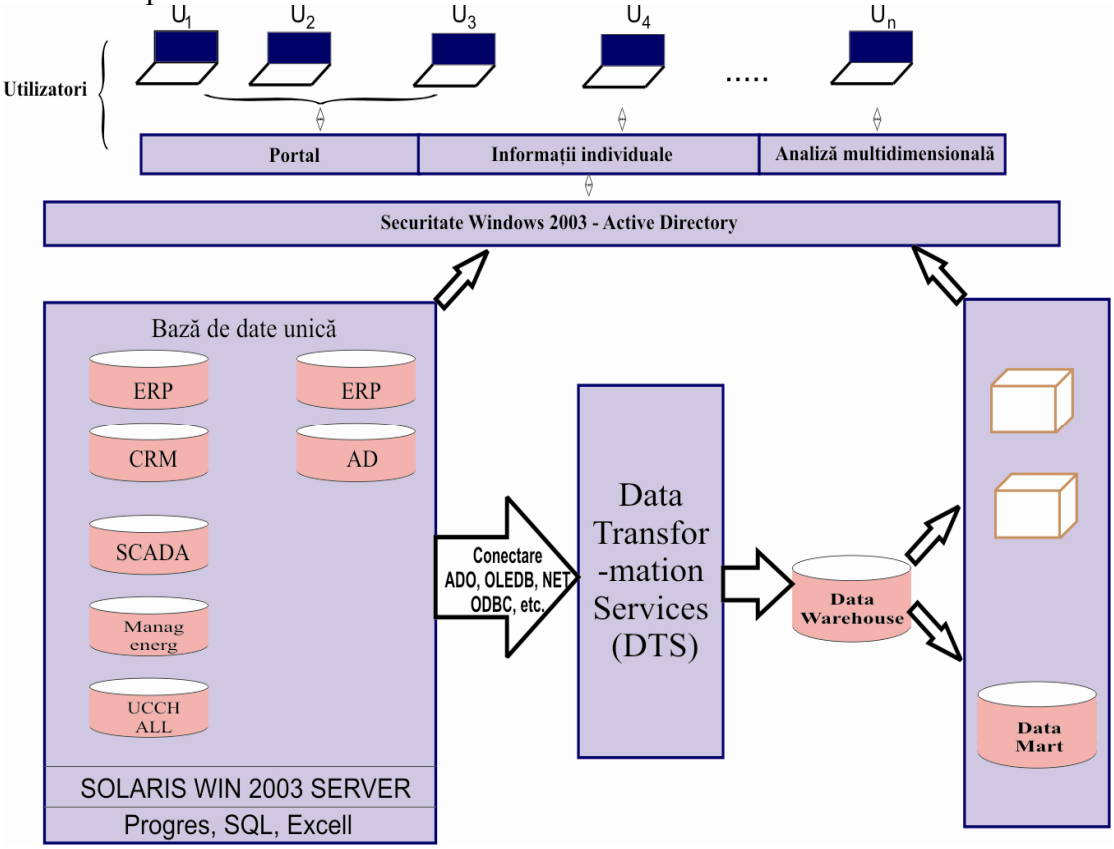


Fig. 9. The architecture of "Business Intelligence" system on a branch-office

Data can come from multiple operational systems and the information's integration is made so as the dimensions that are used in analysing are the same, no matter from which system the information come. From the remarks above we can conclude that realizing a system that helps making decision consciously, asks not only a certain technology, but also a culture to promote the intelligent business as a main component of a real-time Performance Management for the Enterprise .

Such a system starts with the organizational system of the company, branch. . Some organizational structures are involved more in making some operational decisions, and some others are involved in making strategic and tactical decision. Schematically, here is presented the part including decisions, costs, user interface and efficiency:

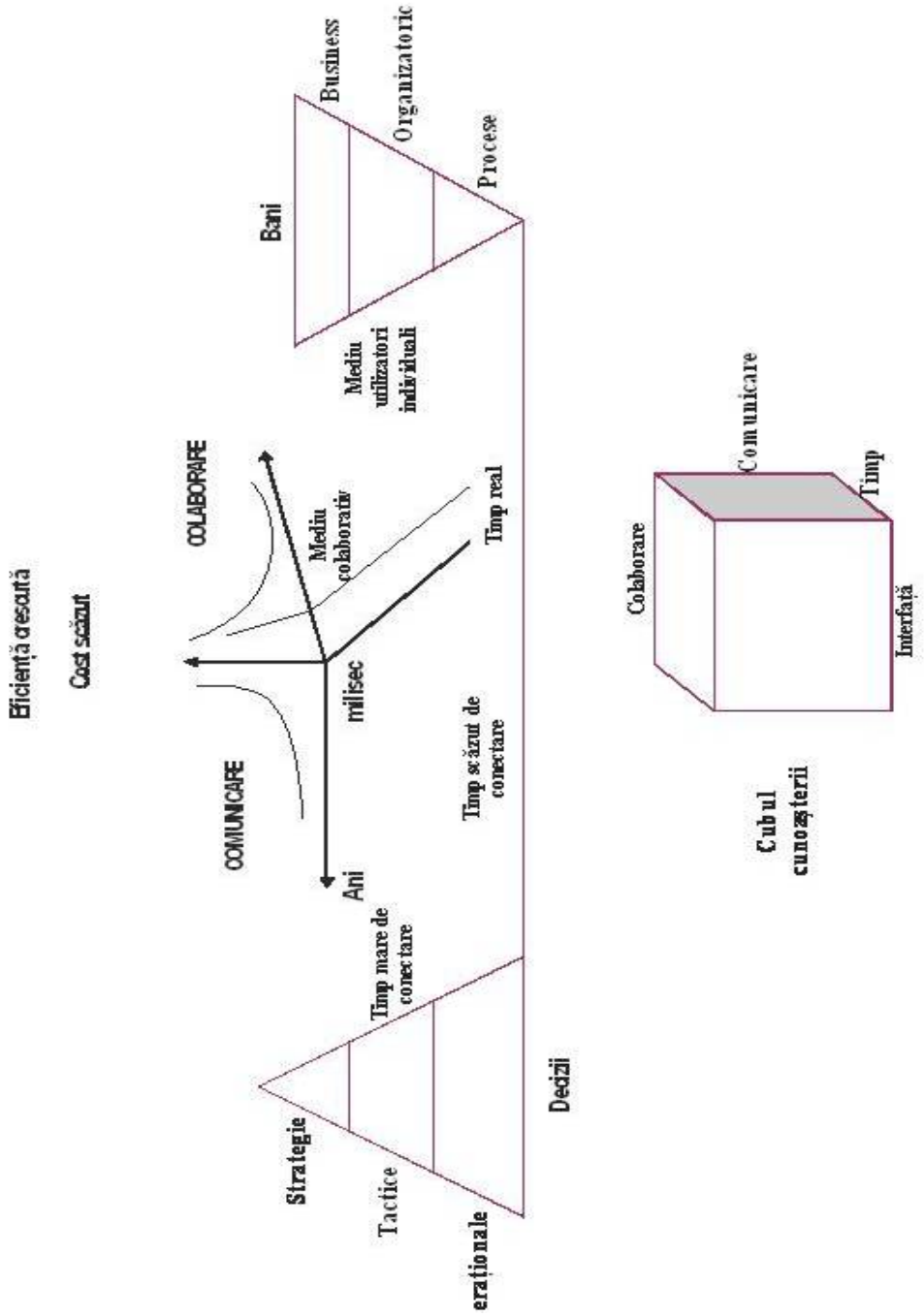


Fig. 10. Decisions, costs, user interface and efficiency

The first steps that I made in realizing Business Intelligence module were analysing and realizing some DTS (Data Transformation Services). As an example I chose creating a history for repairing times on the Stations of Hydro-electric Power Station Cluj. The diagram control flow and data flow are presented in the next charts:

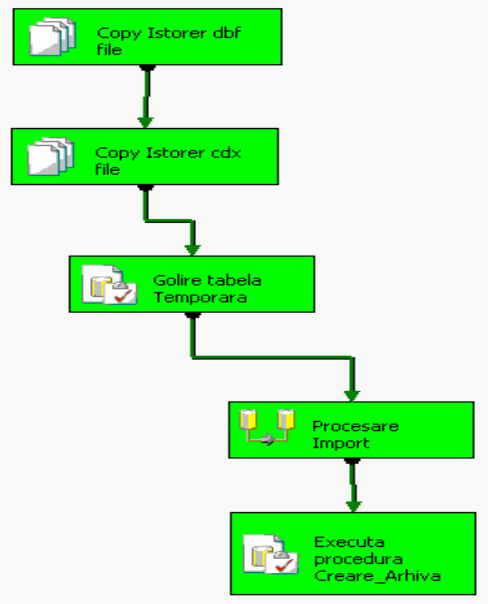


Fig. 11. The diagram control flow

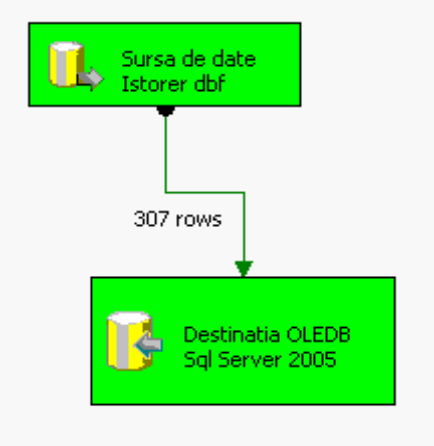


Fig. 12. The diagram *data flow*

7. Integrating the system of producing, transporting and invoicing the electricity at the Branch of Hydro-electric Power Station Cluj (S.H. Cluj) in the managerial system of the branch office

7.1. The application of measuring the produced electricity "Energetic Balances"

For each hydro-electric station of the Branch of Hydro-electric Power Station Cluj I made a program for calculating and listing the energetic balance. Moreover the counters in every station could be updated, there also could be simulated their replacement, if there come some errors in their function, they could be found and one could prevent them. For every station the balance's error could be calculated applying the following formula:

$$Er = \frac{(a+d)-(b+c)}{a+d} \times 100 \qquad [\%]$$

Normally, the error should be between -1 < Er < 1, but a, b, c, d are different for each station.

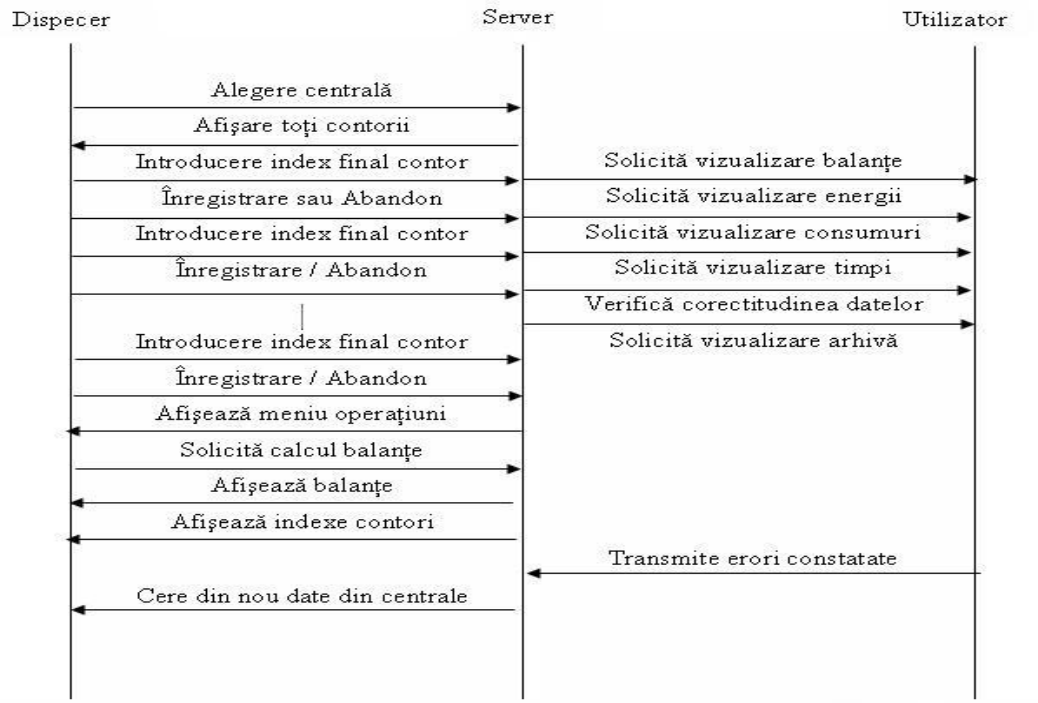


Fig. 13. The sequence of events diagram for "Balance Calculation"

The application is available for 15 years, and it is one of the first applications that I have made and which has been updated during the years, taking into account the informatics' development as hardware and software, too. The next step that should be realized is to use a SQL database, and using the application SCADA to take automatically the index of the counters in the stations. The main advantage of this application is that one can know any time about the amount of produced and delivered energy, about the changes on the transport lines and can also check the changes of the counters that are part in balance calculation, so that we can always know if they should be replaced.

7.2.The application regarding the electricity transport "Cable pressure"

The transport of produced energy in underground station Mariselu is made through some special cables. The cables are used to transport energy from the underground station to the external station, which communicates with the national energetic system.

The application is for predictive maintenance and for checking the pressure in the cables that transport energy, as a parameter for this kind of cables. One of the important problems that have been solved through this application is to check the big transport cables' functionality, special cables 220 KV, so that the evolution can be watched on every cable group from Mariselu station. So, every failure can be prevented and checked.

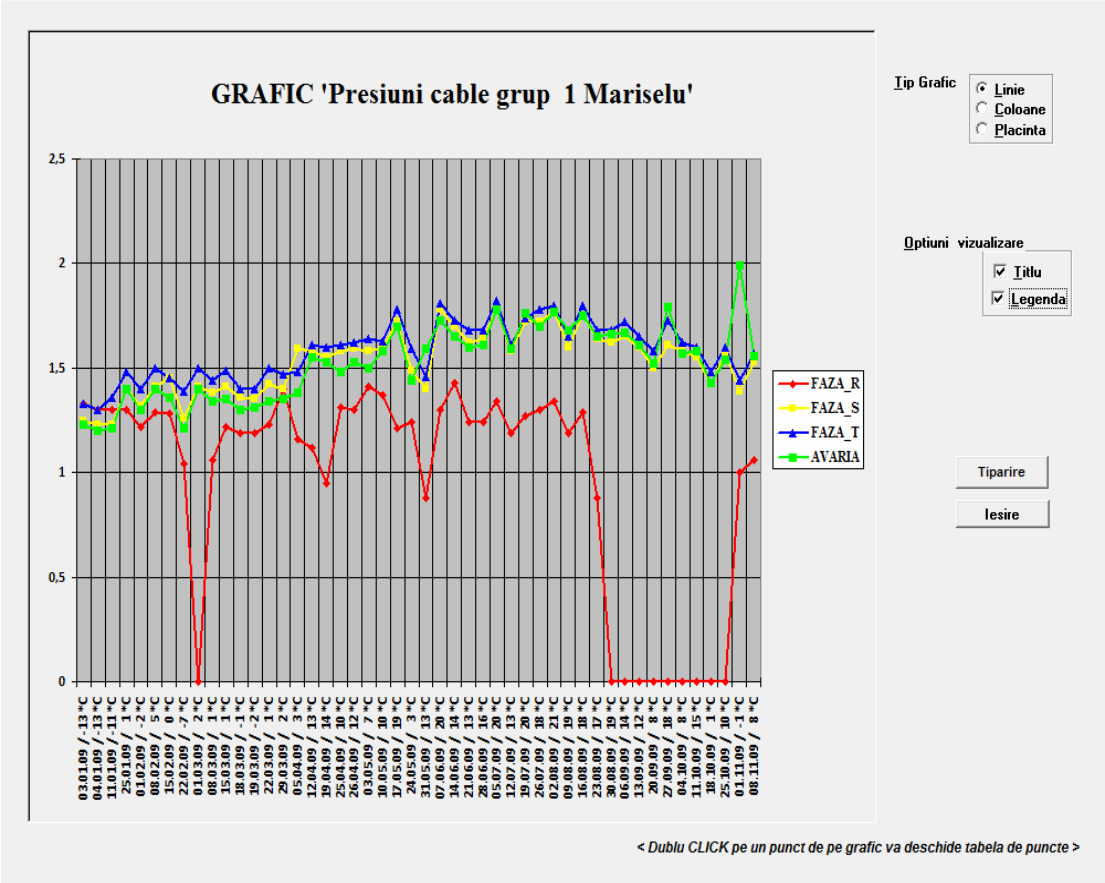


Fig. 14. Cable pressure chart- 1st group at CHE Mărişelu

7.3. The application regarding "The Invoicing of Household Consumers"

The application regarding the invoicing of household consumers was projected and introduced in many branches of Hydro-electric Company, as follows:

- The Branch of Hydro-electric Power Station Cluj;
- The Branch of Hydro-electric Power Station Sibiu;
- The Branch of Hydro-electric Power Station Râmnicu Vâlcea;
- The Branch of Hydro-electric Power Station Curtea de Argeş;
- The Branch of Hydro-electric Power Station Piatra Neamț;
- The Branch of Hydro-electric Power Station Buzău.

The application "household consumers" shows the differences between the tree kinds of consumers and supposes the updates of indexes, the replacement of counters, the changes of prices, the conception of an archive of all the invoices of a certain client; the application contains all the documents necessary for Marketing-Distribution department, including the printing of bills and the evidence of counters checking. One of the first aspects that should be mentioned is the fact that I have realized a link with the Emsys ERP application, which is the basic application for the company, so that we have managed to eliminate redundancy of introducing the invoices in the information system many times.

The main advantage of this application is that it solves taking into account the laws, the invoicing for industrial consumers is similar with that used in electricity distribution branches. We mention that our company has saved a lot of money testing

and accepting an application for invoicing made by the author. There should be known that this application will always be updated according to Romanian laws regarding the invoicing of household consumers.

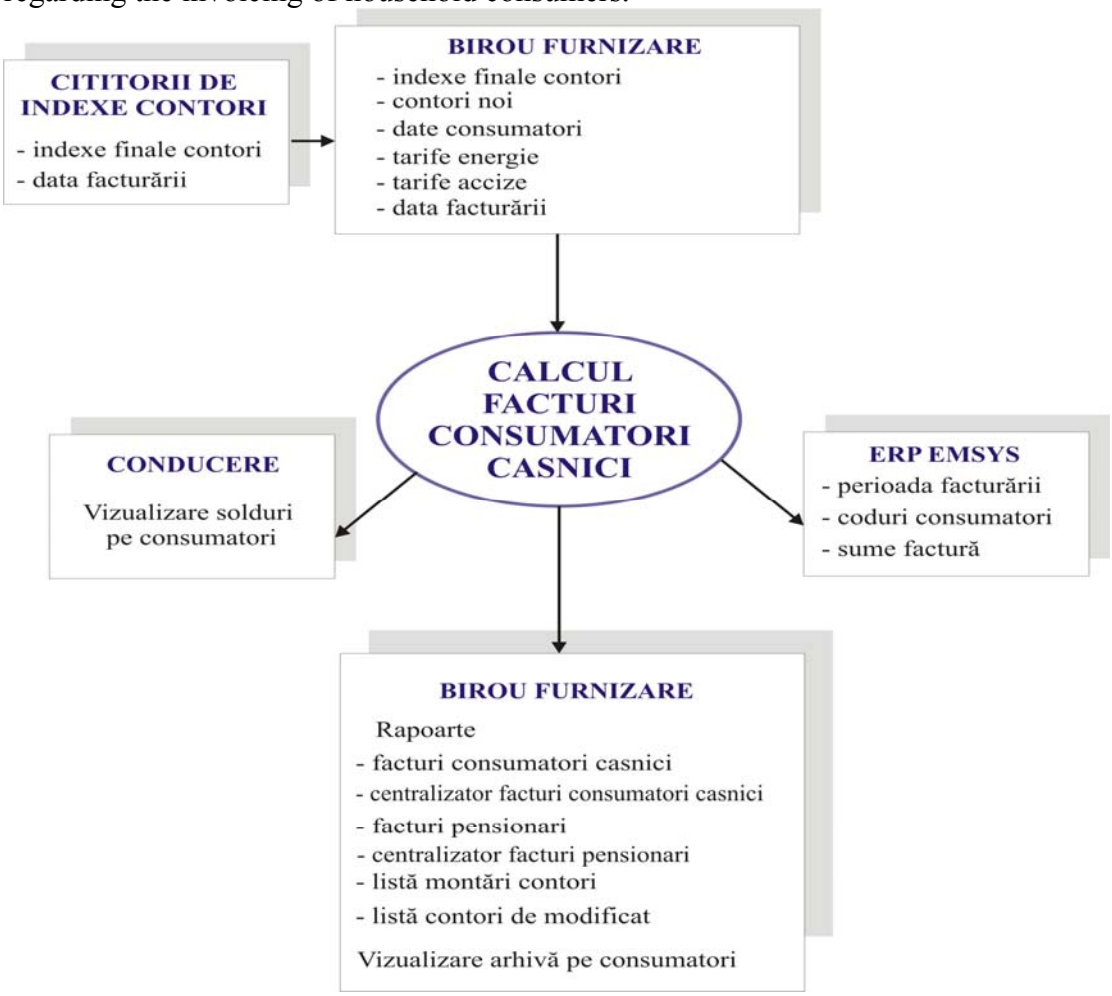


Fig. 15. Input-output diagram for "Invoicing the household consumers"

7.4.The application regarding "The Invoicing of Industrial Consumers"

The application for industrial consumers realizes the evidence of paying companies, and it supposes the updates of indexes, the replacement of counters, the changes of prices, the conception of an archive of all the invoices of a certain client; the application contains all the documents necessary for Marketing- Distribution department, including the printing of bills and the evidence of counters checking. We mention that the application has been introduces in some branches of Hydro-electric Company, as well as the application of household consumers. Moreover, I have realized a link with Emsys ERP application, which is the basic application for the company, so that we have managed to eliminate redundancy of introducing the invoices for the industrial consumers.

The main menu of the application is as follows:

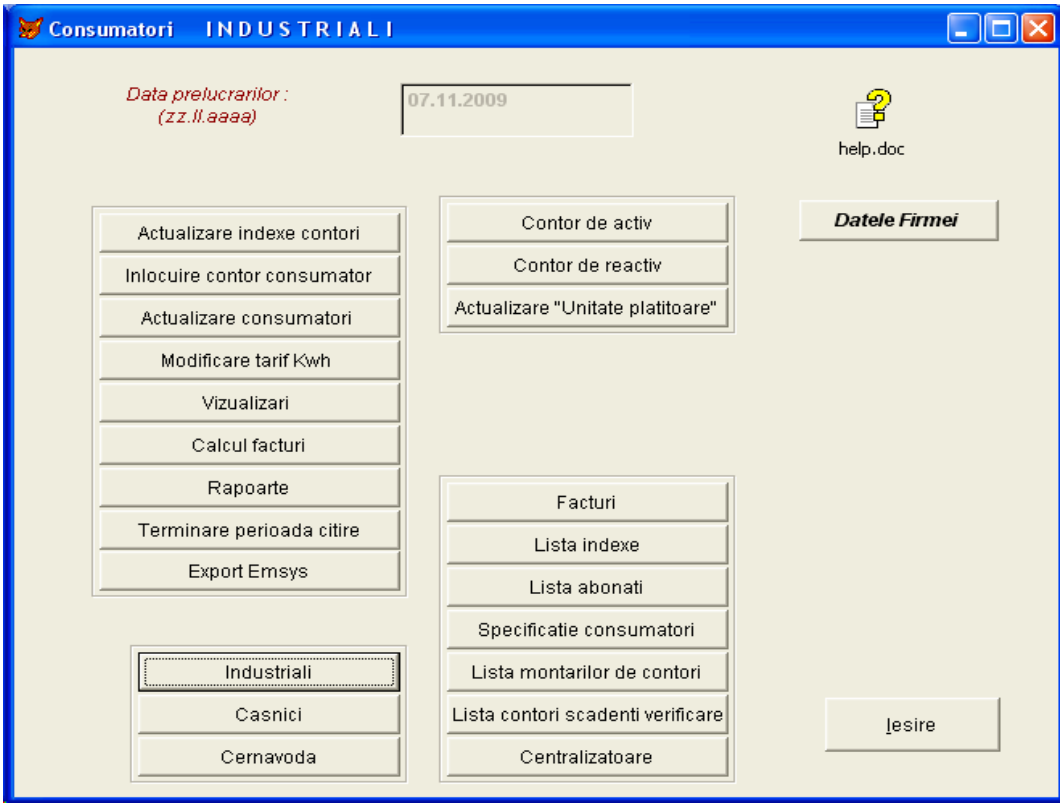


Fig. 16. Main menu "Invoicing Industrial Consumers"

The input refers to: final indexes of the counters, both on the active counter and on the reactive counter, counters replacement if necessary, measuring issues including many industrial consumers, prices for electricity, prices for duty and then it calculates the invoices according to the contract with each consumer. The energy measured by every counter is given by active energy, by reactive energy and by their power. Through this application invoices are generated automatically.

7.5. The application regarding the selection of data acquisition on hydro generators

Operation of the parameters of efficiency of the modern world of energy field in Romania should be realized, especially, following the worldwide development of energy field, by providing quality energy services to the consumer at decent prices, national energy security and financial autonomy in producing and providing electricity, by promoting efficiency in using electricity, the alignment with European standards in environmental protection and sustainable energy development.

Regarding the issue of filtering records made by groups of hydroelectric power stations to remove noise, I have realized the filter's calculation and an application that has solved one of the most important problems regarding the classification of hydro-generators from the tuning's performance point of view. The main ideas about the conception and the application's role were presented on the international energy

symposium *HYDRO 2005 – POLICY INTO PRACTICE VILLACH, AUSTRIA 2005*[2]. Using this kind of filter I have come to the following results:

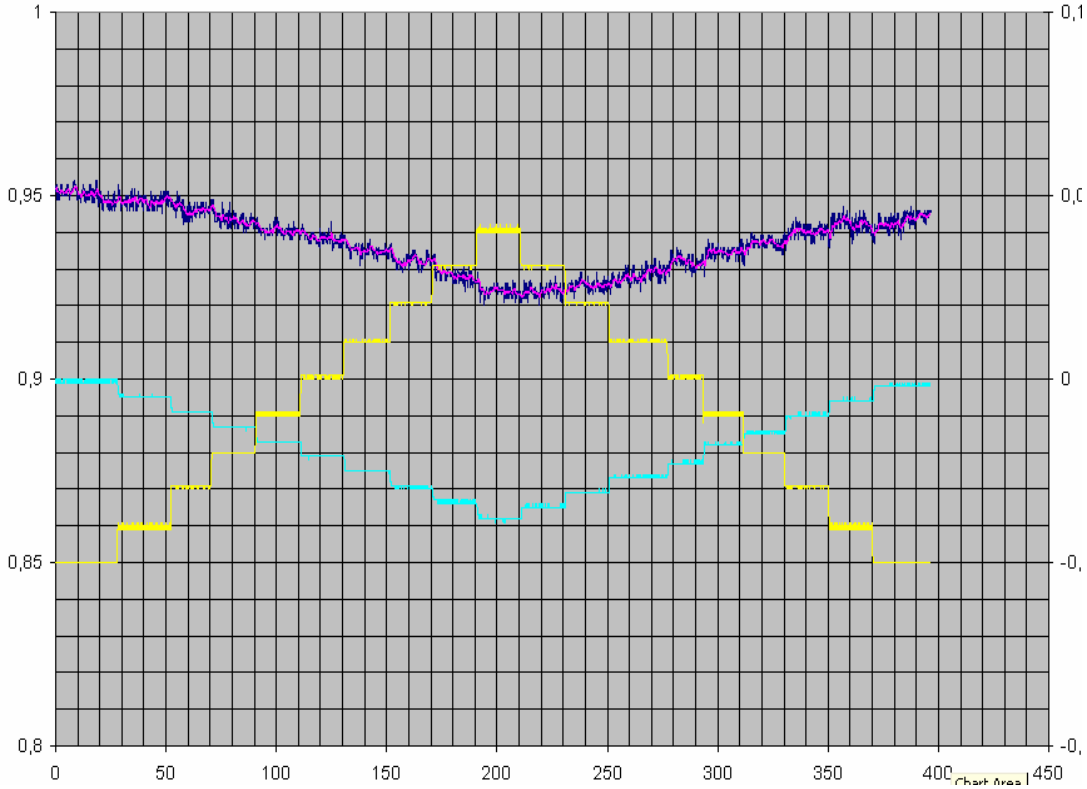


Fig. 17. The steps 10 mHz, bp 5% , at P, HG1 Tarnița, where the diagram P(t) is filtered

7.6. The integration of the presented applications in the new system

All the applications presented above, that I have projected and introduced are sub-systems of the**"SIMPROD-Hidro"** information system for the branch management. In order to achieve this challenge, to have an unique database, first of all there should be analysed data aspects like: accuracy, redundancy should be removed. The centre of the information system prototype "SIMPROD-Hidro", the unique database will allow adding new applications, new modules for realizing the aims that the managers want to fulfil and which could help to make decisions in real time.

[2] Eva Balint, Adrian Mic, The analysis regarding on data acquisition and measurements interpretation in classifying the hydrogenerators according to to regulation performances, *HYDRO 2005 – POLICY INTO PRACTICE VILLACH, AUSTRIA 2005*

8.Conclusions and personal contributions; Guidelines for further research

8.1. Conclusions, suggestions and views of the present research

Scientific approach on the present study focuses mainly on improving management in energy companies, using as efficiently as possible modern information and communication technologies.

I have begun my study with the idea that improving the energy management is the main way through companies in this field can become more competitive. Moreover, I considered that the best way to pass over this problem is to introduce modern information technologies.

The main conclusions and suggestions for the energy companies are:

Conclusions and suggestions regarding further changes and development in Romanian energy field:

From the present thesis we can outline some personal contributions on present situation analysis at the Branch of Hydro-electric Power Station Cluj, the role of informatics and communication on producing and providing electricity. As a personal contribution could be mentioned the fact that I have realized an Integrated Information System, which has a production module, an economic one and a Business Intelligence module, that should be continued and integrated with new applications and systems that will develop, but they all have to take into account the aims on local and national level, regarding electricity production.

I mention again a well-known statement for its wisdom "not energy is expensive, but its lack", we can say that in Romania the next decades wiil be dominated by the challenge of developing an energy efficient economy, a competitive one using low amount of carbon, a secure one.

Conclusions and suggestions regarding actual tendencies in energy management:

Energy management means to apply some professional techniques in using energy. It is necessary for an energy management program to work properly, to be embedded in the programs and procedures of general management. But the energy manager is the key, he should be educated how to action correctly in his company, and he should have general managers' support to fulfil aims that regard producing, providing and consuming energy efficiently.

As a personal contribution should be remarked, the conception of an application which covers a current theme, so there have been presented information necessary about electricity management, elements related to the monitory of electricity use, notions related to the information development projects and financial terms related to cost analysis, which were a basis in realizing applications necessary for branch management in electricity production field.

As a future project, I recommend all the departments to be integrated in these applications, so that managers could makes decisions having information from all the domains and activities in their branch office.

Conclusions and suggestions for implementation of methods for calculating the costs of energy companies:

A distinct and very important aspect that I have studied, as an important personal contribution, is the cost influence with hydroelectric power station modernization on producing energy, on break-even of a hydroelectric branch taking into account the structure and the compound elements of the total production cost and on a certain level costs. The conclusion that could be stated from the analysis above,

is that if we can optimize the costs for setting a branch or a hydroelectric power station, knowing at any moment the production of energy, we can calculate a production cost that is really competitive, which is the basis for a correct and attractive price, that allows Hydro-electric Company to be a very important part on the electricity market in Romania.

As a future plan every branch should be aware of the real production costs, to know when and how to make improvements on the devices in their companies and if they are really necessary, but in order to realize that, they have to have a clear budget for income and outcome.

Conclusions and suggestions regarding the importance of the scoreboard in making decisions on The Branch of Hydroelectric Power Station Cluj:

The integrated information system **„SIMPROD-Hidro"**, which is a major personal contribution of the current paper, covers the collection, registration, validation, processing, storage, transmission and dissemination of information on operation, function, maintenance and repair of devices, equipments and compound parts used in The Branch of Hydroelectric Power Station Cluj for producing electricity, from their first used still they are out of use, in order to ensure the necessary information for describing devices' characteristics in function conditions, in order to increase the security of their working and of the devices availability through their improvement of designing, exploring and maintaining, in accordance with the current legislation and needs of the electricity market.

"The Scoreboard" is a compound part of the integrated information system and one of the important personal contribution for the management, that gives the managers all the information necessary for making correct decisions in real time. *"The Scoreboard*" records, operates all the events (unpredictable and predictable) that characterize reliability, availability, maintainability of the producing and providing electricity devices.

We are going to complete this Scoreboard with all the economic issues, regarding the production of energy that are a basis in making decisions, having as a background historical data. Another request of our managers regarding this scoreboard, that will be taken into account is to make previsions, prognoses, statistics, on producing energy and also on equipments' maintainability in hydroelectric power stations.

Conclusions and suggestions for finding solutions for information systems in production companies:

A personal contribution is a prototype integrated information system "SIMPROD-Hidro", which has as basis some of the applications realized by the author that have led to the computerization of some departments from The Branch of Hydroelectric Power Station Cluj and they helped managers to make decisions in real time.

Computer's help in turning information into knowledge, and then in intelligence that helps managers on making decisions, has already been confirmed in many functional aspects of the company and this seems to be the only solution to deal with the complexity and the dynamism of the actual and future society. The task of the depth understanding of information systems role in productive companies' function, as well as finding suitable strategies for their appliance, starting with social, economic and technical situation, is very difficult. Nevertheless, we can consider that the general steps of realizing the computerization of the company should ensure a large automation of human activities, the increase of humans' intellectual work and

system's innovation that gives birth to a new company with a proper information system useful for managers when they have to make a decision.

Conclusions and suggestions regarding the analysis of ERP systems on the Romanian market and their impact on energy management:

A personal contribution is the description of paradigms, the advantages and the disadvantages of an ERP system, analysing some solutions available on the market, with their benefits and features offering conceptual schemes of each of the analysed system and making a parallel between them.

No matter which ERP is a basis for the economic department in the branch, taking into account informatics and communication, for the future we desire to continue the integration of all the data so that they can become information, knowledge and finally intelligence for the top management in the branch.

Conclusions and suggestions regarding the implementation of modern techniques and information technologies in energy field:

UML was the basis for analysing and projecting all the applications that are the roots of this paper and it is a way through information flows, the application, basis structures can be seen, and the advanced programming language that were the root for the screens, reports and the links between the huge amount of data available on the integrated information system.

Conclusions and suggestions regarding projecting and using the prototype information system „SIMPROD-Hidro":

The prototype of management information system **„SIMPROD-Hidro"** projected for The Branch of Hydroelectric Power Station Cluj and for Hydroelectric Company represents:

- a way to find necessary information for an efficient management of tangible and intangible assets, for the electricity production management, for the costumers' management, for the human resources management, for the costs management;
- the real opportunity for every decision to be based on a strong argument, not on intuition;
- a single version of truth;
- opportunities of a complex analysis of data (projections, prognosis, statistic analysis);
- discovering new opportunities for business;
- the improvement of communication and collaboration between employers in order to get the aims of the company;
- rapid access to information;
- Interest on Web;
- high security of information;
- decreasing the cost with available data introduction in the new system;
- realizing a portal for information;
- including in the system data from the available systems in the company;
- quality insuring.

Another important achievement of the author is that she has started analysing the richness and the correctness of data stored on a long period of time in the branch, through some applications, some special tools, scripts, or automate procedures „Data Transformation Services" in order to achieve the first steps for projecting the Business Intelligence module. The Business Intelligence module is going to develop having as

basis the author's analysis and the historical data available on the database integrated in the prototype information system „SIMPROD-Hdro".

Conclusions and suggestions regarding the integration of some available applications in the new integrated prototype:

We can notice and mention as personal contribution the projection, the achievement and the implementation of many applications that are very important for branch managers, and also for top managers from Hydroelectric Company. The economic efficiency of a branch of hydroelectric power station should be regarded according to:

- technical and economic parameters given by the type of the device and its equipments through the integration of SCADA systems and communication systems;
- the knowledge of the energetic balance in every single moment in order to act if there are some errors, so you can know correctly the produced energy;
- pricing MWh correctly, competitively and attractively for the electricity market in Romania;
- providing electricity to household and industrial consumers and the correct invoicing at a competitive and stimulative price;
- filtering the signals from hydro-generators in order to make possible their involvement in power frequency set-up.

These issues were analysed, studied and integrated on some applications of the Branch of Hydroelectric Power Station Cluj. I mention that they didn't exist before and they exist due to the author's work and they are described in the 7th chapter of the thesis' summary.

The integration of all the applications in an unique database at the branch level is the most important thing that led to the achievement of this prototype. All the managers' decisions should rely on rich, useful data, integrated on an unique database, proposed on „SIMPROD-Hidro"system, that could be used very easy, and could be asked in real time, and leads us to knowledge and intelligence.

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