



POLISH ACADEMY OF SCIENCES
Systems Research Institute

**APPLICATIONS OF INFORMATICS
IN ENVIRONMENT ENGINEERING
AND MEDICINE**

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This book consist of the papers describing the applications of informatics in environment and health engineering and protection. Problems presented in the papers concern quality management of the surface waters and the atmosphere, application of the mathematical modeling in environmental engineering, and development of computer systems in health and environmental protection. In several papers results of the research projects financed by the Polish Ministry of Science and Information Society Technologies are presented.

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CHAPTER 3

Informatics and Economy in Environment and Health Protection



CREATING KNOWLEDGE BASES AND METHODS OF AUTOMATIC DATA ANALYSIS AS THE BASIS FOR REGIONAL STRATEGY IN ENVIRONMENTAL PROTECTION

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In the paper analysis of registration process of several devices destined for environment protection parameter recording supervised and made by labs being in agenda of province administration was made. An assessment of possibilities of usage of unique sources and archived the data bases from the scope of protection of atmosphere, water and soil by scientific workers of universities and institutes representing this discipline of knowledge shows occurring of several barriers. Possible for obtaining synergy effect of share of scientists and many performers of diploma works in the frame of several study programs from the scope of environment protection is blocked through closing access to archive and up-to-date measurement data in realization of those works. It is necessary an initiation of new rules of recording and making accessible of unique data from the scope of environment protection for researchers dealing with ecological problems.

Keywords: Multi-data bases, environmental monitoring and protection, automatic data analysis.

1. Introduction

In this paper we are going to present some aspects of the multi-data bases which are created in different specialist laboratories equipped with modern measurement devices. This equipment often is used for environmental monitoring in the stations for monitoring pollution produced by some companies. The stations are supervised by Province Office departments and units.

The most important problem with unique data bases is that the data is not made accessible to numerous research units dealing with environmental protection. Data created in the stations and the data controlled by measurement stations in the companies are archived solely in the Province stations, and rarely are sent to research units, usually in small chunks.

The analysed problems indicate a dangerous situation in which a more precise and broad information retrieved from automatic measurement stations does not contribute to the adequate knowledge increase about the state of the environment in the region. Particular interests of organisational units (laboratories) established for

the source data archiving and supervising the processes decide about the reluctance to making this information accessible to the researchers from universities or research institutes. Very often these organisations, e.g. GUS (Central Statistical Office) or IMiGW (Institute of Meteorology and Water Management) offer such access, however they charge a lot of money.

This complex environmental data is perfectly collected in all the organisational units of the province administrative authorities. The growing number of students graduating Environmental Protection faculties and scientists in this research area decides that the access to this data would give them an opportunity for knowledge creation. This enormous amount of data covering various areas of knowledge when made accessible would potentially increase the quality of many engineer and master's degree work. This data combined with building data warehouse, mathematical models and Information Technologies is also a perfect empirical material for diploma, graduate and post-graduate thesis.

2. The concept of creating knowledge base in the environmental protection

The laboratories mentioned in the Introduction which possess regional databases should ensure the continuity and safety of monitoring the varied features in the environment. This frequently unique data has a great influence on the wide range of changes in the environmental dynamics and the forecasted tendencies as well as on the state of the knowledge about the environment. Recording and archiving data concerning complex activities of the changeable factors creating the natural environment hardly contribute to knowledge creation. During the last ten years the scope of university education for students in the environmental protection has been much broadened and as a result many research units have been created. Therefore, hundreds of persons are doing their graduate and master's degrees and the possessed source data could decide about the level of their usefulness. For the last decade universities and research institutes have been financed with lower investments (from 0.72% GNP in 1995 to 0.43% GNP in 2004), however they could have increased the effectiveness of their research work if they had common and free-of-charge access to data.

Progress made in ICT justifies the need to access data from the devices which record the conditions in the environment, which would be converted into the standard for creating knowledge bases. This process would require an extremely laborious and important phase of creating meta-data. As a result all the information included in the knowledge base would be subject to standardisation. The aim formulated here would require extremely laborious activities on the regional scale realised by numerous engaged research units which would be motivated to work hard as on the other hand they would be ensured free access to the trustworthy knowledge base comprising various aspects of the environmental conditions in the

region. Co-operation of research groups from different scientific organisations would create an opportunity to achieve synergy and contiguity of the researchers representing various fields of knowledge. For example, changes in the atmosphere, soil and waters examined by specialist teams working independently would in fact ensure better explanation for the changes occurring in the environment. A large synergy effect can be also seen in the application of mathematical models and IT, which are particularly effective when we possess adequately large data resources, identified with complementary information. Knowledge bases together with the methods of automatic data analysis constitute a more useful research tool for global corporation management, banks or stock exchange. Also in the correctly prepared knowledge base the methods of AI (neural networks and genetic algorithms) could be successfully applied.

The possibilities for creating demographic, economic data base in the micro-regional aspect and their application in GIS technology would allow to analyse information derived from the proposed knowledge bases with these sectional data and to detect new interactions. In this way a more precise assessment of the social and economic factors influencing the environment in their complex and parallel dynamic understanding would be possible. The issues mentioned here will not be realised with individual and time-limited activities (projects), because they constitute a great undertaking both in qualitative and quantitative aspects. The proposed processes enable to realise the stated idea of creating regional knowledge base about the natural environment with the socially lowest possible costs.

3. Technological, organisational, psychological and legal conditions for the realisation of the proposed knowledge base

Knowledge management is becoming part of development of ICT, the goal of which is to restrict the barrier for different user groups in order to support basic activities with knowledge bases necessary in the different areas of operation. Among the numerous accessible publications we can find the monographic work "Knowledge Management in Information Systems" (Abramowicz, Nowicki, Owoc, 2004; Drelichowski, 2004) paper which focuses on different aspects of knowledge management in corporations. The following research work includes Baborski and Boner (2004), Kisielnicki(2004) and Drelichowski(2002).

Modern environmental protection requires the processing and analysis of data created from automatic measurement devices. This seemingly obvious statement is not an easy task as the simple measurement data must be supplemented with code connections in different aspects of their relationships. Finding solution to different problems in regional environmental protection can become a useful source for activating companies in the MSE sector. These firms can co-operate in the production of equipment for environmental monitoring and measuring control

systems. Organisational and technological problems in creating knowledge base require contributing intellectual added value to the existing costly control and measurement equipment for data recording. Synergy in the complex and interdisciplinary areas of knowledge in the conditions of the reduction of material and cash investment can be achieved by the application of modern forms in management organisation. This includes the implementation of virtual solutions in the co-operation of different organisations representing state administration units, universities and research institutes.

Common access to all the recorded environmental parameters is the condition for the increased efficiency of their use. The phase of constructing metadata, which is a necessary stage in knowledge base creation, is not possible without interdisciplinary co-operation of many partners. Supplementing the existing databases with code connections which allow to identify core connections between these parameters is a key element deciding about the quality of the created knowledge base. This phase of co-operation should comprise constant e-mail contact and meetings in smaller workgroups as well as organising conferences and scientific congresses.

The organisation which is going to be set up as part of the project - Virtual Centre for Knowledge Management - could be located in e.g. the University of Technology and Agriculture or any other university in Poland. This virtual organisation will be a research-training center oriented towards creating standards for training and building specialized knowledge base with the use of SAS Institute and Microsoft. University rectors and Presidents of the Province Funds for Environmental Protection would be the founders of the Centre by ordering the project entitled "Creating domain knowledge base for supporting sustainable ecological development by activating MSE sector and successful realisation of environmental protection policy". Technical support would be ensured by purchasing computers and software necessary for the Knowledge Management like SAS Institute and MS SQL Server. These standards would ensure equipping scientific partners with tools for the creation of environmental knowledge base. In the recent years restriction has been introduced that scientific projects cannot be financed from environmental funds. However, in this case the restriction should not concern the discussed project, as actually it is of practical nature.

The usefulness of this project undertaken by different scientific organisations has already been described in many different papers published by Systems Research Institute. A one of examined research problems were proposals of analyzing of pollutions in the rainfalls. This class of problems includes also methods of measurement of maximum rainfalls to design drainage systems (Licznar, 2004; Burszta-Adamiak, Lomotowski, Stodolak, 2004). In the second paper the authors concentrates on application of kriging methods for calculations of maximum flows in sewer works (Bogdan, Kozlowski, 2004).

Next two papers concentrated on the problem of optimization of gas emission in a view of Protocol Kyoto regulations where attempts of possibilities of making transactions concerning greenhouse gas limits owned by different countries were taken (Horabik, Nahorski, 2003). Similar problems considering uncertainty factor as an element destined for verification of Kyoto obligations. The final verification of the obligations should take into account uncertainty of reported emissions. The authors worked out methods of solutions of mentioned above problems (Nahorski, Jęda, 2003).

The proposed organizational solutions comprise interaction and co-operation of employees from software companies with research employees from universities and institutes. One of the more difficult tasks is to define inter-modular connections between different measured parameters recorded in different areas of the supervision of the environmental condition. Growing requirements in environmental protection on the regional, national and EU scale cannot be met without creating selective knowledge base and methods of automatic analysis of the numerous historical and current databases. The staff from the universities on the national and European scale which represents competences from different scientific fields gives an opportunity to find a complex solution to many problems resulting from the existing and new threats to the environment. One of the methods that facilitates the new dimension in the co-operation is the unlimited access of all the researches to the knowledge bases created as a result of their co-operation which would be quality processed by a large and creative group of researchers. Failing to access the newly created knowledge bases or lack of new approach in aggregating this data and the new use of this data can lead to establishing negative and uncontrolled processes. Useful tools for the scientific work can be: OLAP system and data mining system, as well as the Artificial Intelligence solutions like neural network or genetic algorithms.

The discussed assumptions and aims for knowledge base creation focus on the analysis of the effects from the point of view of the participants in the project. Another important, though only mentioned effect, is the possibility to perform cheaper trainings in new technologies for company and public administration staff. This group of effects can also refer to the more efficient education of students who would have a chance to take part in a creative project and to acquire the latest technologies.

4. Integration of data on the environmental protection and an effective method of accessing as the source of progress in the ecologic research in the region

The proposed project, which demands low investment, can hardly be referred to advanced cooperation of the leading software companies worldwide with universities and authorities of Regional Administrative Centres. The scale of the future investment can become the first necessary step in transferring knowledge

from commercial units to regional management support and the research and academic process in a university. It would be important to prepare a base for the professional research work, training in data warehouse and knowledge management in environmental protection. This solution attempts to stop the decrease in the quality of academic education, especially in the high-tech area where the shortage of devices and overloaded staff and difficulties in obtaining the „know-how” are the main reasons.

The Virtual Centre for Knowledge Management and the fulfillment of the adopted tasks would allow to work out successful projects financed by the EU. The example of such an initiative is the Hinz Nixdorf Institute which exists as part of the Paderborn University and works on the development of a wide range of information and communication technologies.

Limited or a lack of access to the empirical data gathered by different environment protection labs is a reason of barriers to built up Decision Support Models and their introduction to practice is the problem in all cited papers made in Systems Research Institute. A one of possible of effective solution of that problem will be creation of virtual centers of Environment Protection Knowledge Management on the base of research workers and recourses located in the different regional universities.

5. Conclusions

1. Actual system of creation and archiving of different parameters concerning state of environment determines a location and distribution of information in environment protection divisions of administrations units.
2. Such a method of management with environment protection resources limits access to the data for workers of universities and research institutes.
3. An effective solution of analyzed problem can be virtual centers of Environment Protection Knowledge Management opened for co-operation with universities and other research centers.

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(Editors)**

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The purpose of the present publication is to popularize applications of informatics in environment and health engineering and protection. Runned papers are thematically chosen from the works presented during the conference *Multiaccessible Computer Systems (Komputerowe Systemy Wielodostępne)* that has been organized by the Systems Research Institute and University of Technology and Agriculture of Bydgoszcz for several years in Ciechocinek. Problems described in the papers concern quality management of the surface waters and the atmosphere, application of the mathematical modelling in environmental engineering, and development of computer systems in health and environmental protection. In several papers results of the research projects financed by the Polish Ministry of Science and Information Society Technologies are presented.

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