ГОДИШНИК НА МИННО-ГЕОЛОЖКИЯ УНИВЕРСИТЕТ "СВ. ИВАН РИЛСКИ", Том 51, Св. II, Добив и преработка на минерални суровини, 2008
ANNUAL OF THE UNIVERSITY OF MINING AND GEOLOGY "ST. IVAN RILSKI", Vol. 51, Part II, Mining and Mineral processing, 2008

SUPPORTING ROLE OF INFORMATION MANAGEMENT SYSTEMS IN LAND RECLAMATION AT THE COAL OPEN PIT MINES

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ABSTRACT. For the purposes of Electric Power Industry of Serbia, a Study on need of establishment of computer information system aimed to support the environmental protection, land reclamation, revitalization and arrangement of the degraded areas of coal open pit mines is completed. The paper gives a short review of the real system, functions of information support system, data classes system, communicational integration of the system, and a description of system architecture.

Key words: INFORMATION SYSTEM, INFORMATION SUPPORT, LAND RECLAMATION, SPATIAL ARRANGEMENT, KOLUBARA, KOSTOLAC, ELECTRIC POWER INDUSTRY OF SERBIA

ПОДРКРЕПЯЩА РОЛЯ НА ИНФОРМАЦИОННА СИТЕМА ЗА УПРАВЛЕНИЕ ПРИ ДЕЙНОСТИ ПО РЕКУЛТИВАЦИЯ НА ТЕРЕНИ, ЗАСЕГНАТИ ОТ ОТКРИТ ВЪГЛЕДОБИВ

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РЕЗЮМЕ. За нуждите на електроенергетиката на Сърбия е извършено проучване на необходимостта от създаване на компютърна информационна система, която да оказва съдействие при дейностите по опазването на околната среда, рекултивацията, възстановяването и устройството на терени, нарушени от минната дейност. В доклада е представена накратко действащата система, функциите, които изпълнява, комуникационната обвързаност на системата и описание на нейната архитектура.

Ключови думи: Информационни системи, рекултивация на терени, устройство на територията, Колубара, Костолац, Електроенергетика на Сърбия

1. INTRODUCTION

Data and information, available in different forms (numerical, textual, alphanumerical, graphical, photographs, video files, animation, hybrid, multimedia, etc.) of dispersed functional features and purposes (mining, geodetics, geology, urbanism, spatial planning, civil engineering, hydrology, biology, forestry, agriculture, landscape architecture, chemistry, geochemistry, pedology, meteorology, economy, sociology, anthropology, medicine, etc.), spatially and temporally dislocated, are the foundation for support to decision making and management over land reclamation, revitalization and spatial arrangement of the degraded areas, and also for management of newly created resources. Therefore, the assumption behind the successful management over land reclamation, revitalization and spatial arrangement of the degraded areas is an appropriate information support that encompasses identification, selection, acquisition, processing, interpretation, storage and distribution of relevant data and information in real time.

The organized, computer supported information support to the environmental protection, land reclamation, revitalization and arrangement of the demoted areas of mining field is not yet developed at open pit mines, of the Electric Power Industry of Serbia (EPIS). This is a problem appearing when putting legislation in effect, introducing standards, operational monitoring, providing short and long term prognostics, planning, decision making and management over these sensitive multidisciplinary processes.

Mining operations at EPIS coal basins occupy approximately 9,000 (ha) of land, with approximately 32(%) of these surfaces reclaimed. The land reclamation and arrangement of areas degraded by exploitation works is one of more important tasks of EPIS. The degree of success of realization depends on the level of integration of anticipation, planning, design, realization, surveillance and management over activities. The reclaimed and arranged areas will have a positive influence on the environment condition, and, according to the criteria of sustainable development, the economic effects and benefits that can be achieved, have big specific weight and significance for the EPIS and the country in whole. Services at basins and EPIS that should realize substantial and complex tasks of land reclamation and arrangement of areas degraded by coal exploitation by coordinated mechanisms, and in later phase to manage newly created terrain and land resources, will find hard to meet the demands of these tasks without the appropriate information support.

International integration courses in which is our country involved are causing the application of certain legislation, standards, declarations and resolutions in environmental

protection and informatics organization. By reviewing, for instance, ISO 14000 set of standards that relate to the environmental management, and are mandatory for certification purposes; or numerous references on international legislation in environmental protection and sustainable development (Stockholm 1972, World Charter for Nature – UN General Assembly 1982, Nairobi Declaration 1982, Declaration on Environment and Development – Rio de Janeiro 1992, Lisbon resolution 1998) brought under auspices of the United Nations, aimed to stop or to diminish demoting influences on the environment, and on the other side the excessive exploitation of renewable and non-renewable natural resources, the need for establishing the procedures for identification, storing and deposition of data is well pointed out.

All this knowledge and problems present, have initiated the rendering of the Study on establishing the system for informational logistics of reclamation, revitalization and spatial arrangement of the exploitation fields at coal mines of EPIS, completed in 2006, by the Department of Applied Computing and System Engineering of the Faculty of Mining and Geology, University of Belgrade. The paper presents a concept of the subject system of informational support.

2. REAL SYSTEM ENTITIES

The ratio of coal in the production of electric power amounts to 56(%). All the active lignite open pit mines are a part of the EPIS. If, due to international circumstances, Kosovo coal basin is left behind, opencast mining of lignite is taking place in two basins, Kolubara and Kostolac. From the functional aspect of environmental protection, land reclamation of areas demoted by mining activities, arrangement of areas created by lignite exploitation, and information coverage of these processes, there are three entities within the EPIS system:

1. Department for Strategy and Investment, with specialized service:
   Sector for Environmental Protection;
2. Mining basin Kolubara, with specialized service:
   Service for land reclamation and environmental protection;
3. Economic association “Thermal Power Plants and Mines Kostolac”,
   without specialized service for land reclamation

The functions of the entity are subordinated to coal i.e. electric power production. However, with respect to problems in question, entities differ, belonging to one of two groups.

Group “A”: Sector for Environmental Protection at the Department for Strategy and Investment in Belgrade, as the carrier of coordination, creative initiatives, counselling, innovation and harmonization of activities and environmental protection operation at the level of EPIS. As the users of information resources of the SIL, the Department for Energy Production, Service for Standardization and the Management Board of EPIS are also belonging to this group.

Group “B”: RB Kolubara and EA TPMM Kostolac. The common features of those are that they are the entities of the system in which lignite production, i.e. mining works that lead to land demotion and other negative influences on the environment takes place. Land reclamation and spatial arrangement taking place in these entities. Hence, the characteristic of group “B” entities is that inside of them the concrete problems of environmental protection are created and solved.

3. FUNCTIONS OF INFORMATION SUPPORT SYSTEM

By analyzing the real system and actions in the field of environmental protection, land reclamation and arrangement of space created after the completion of mining works at the EPIS open pit mines, seven functional entities were identified. This classification is optional, by authors accepted as the rational, accurately positioned on the common level for all three entities of the real system, and a good depicter of the processes.

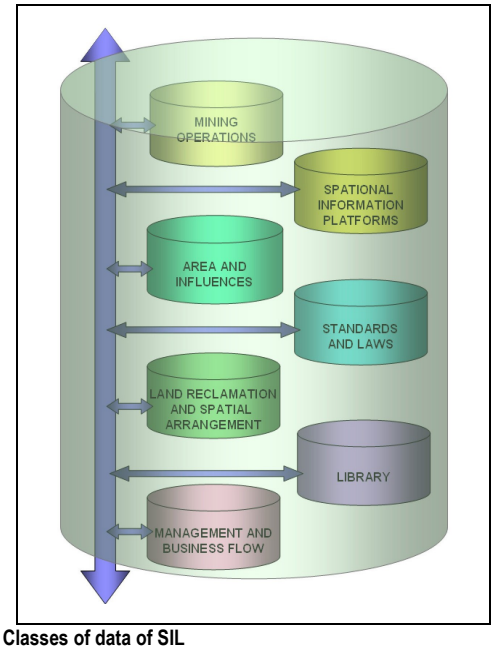

Fig. 1. Classes of data of SIL

Functional entities of the SIL are:

- ACQUISITION functional entity consist of collecting data on working environment and the area in on/offline regime, control, selection, thematic integration, archiving, management and updating;
- HEALING-EXTERNAL functional entity contains the cadastre of works, plans and designs. Individually or in a complex, they are digital or analogue platforms depicting geological structure and deposit boundaries, geometry of mining fields, designed and actual boundaries of open pit mines and waste dumps, objects of infrastructure, dewatering system objects, boundaries of protected zones, developed areas, boundaries of real estates, urban and spatial planning, dynamic planning, regulation planning, pedology maps, cadastre maps of agricultural parcels, expropriation plans, boundaries of reclaimed areas, satellite and aero photo shots, geo-coded ortophoto plans etc;

- CREATIVE functional entity contains activities in the field of prognostics, analysis, mathematical modelling, simulation, engineering creativity (planning and design), econometry, surveillance and management;
- LOGISTIC functional entity contains legislation and norms, standards, internal regulations, bibliography of literature units, documentation etc.;
- BUSINESS functional entity contains business processes of real system in the field of environmental protection, land reclamation and spatial arrangement, in relation to tenders, investments, cost monitoring, procurement, income achieved etc.;
- INFORMATION functional entity deals with broadcasting information to wider audience, competent ministries, governmental agencies and local community institutions;
- TECHNICAL functional entity deals with exploitation maintenance of the SIL (databases, telemetry, hardware, software, communication, security) in order to achieve full readiness for working process.

4. DATA CLASSES

Having in mind that the SIL is a specialized integrated information system of three EPIS entities, thematically oriented toward problems of environmental protection, land reclamation and spatial arrangement of areas created as the consequence of mining works at the coal open pit mines, the SIL has all the properties of spatial, i.e. geo information system, which means that it uses two classes of data, relational and geo (short of geographical) data, from which spatial i.e. geo information are extracted by processing. This model of data class identification is broadband and it is not suitable for accurate thematic classification of data.

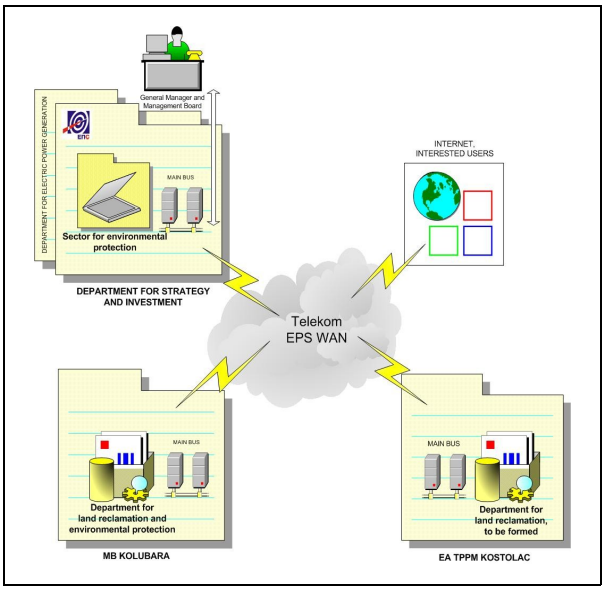

Fig. 2. Principle outline of logic topology and SIL integration

The analysis of the real system, analysis of functional demands of the information logistics, analysis of user queries and applications generate information resources of SIL into classes of data: mining works, data on area and influences, spatial information platforms, land reclamation and spatial arrangement, management and business flows, standards and laws, library. Figure 1 shows the structure of data classes. It is characterized by branching of themes and dispersion of the contents.

5. SYSTEM ARCHITECTURE

The three entities of the information logistics system, the Sector for Environmental protection of the Department of Strategy and Investment in Belgrade, Service for land reclamation and environmental protection of Kolubara and a Service with similar tasks that should be formed in Kostolac, are dislocated on the area with radius of approximately 80(km). With respect to organization, functions, information and staff, the entities are mutually autonomous. The information connection of entities into the system of information logistics has several common goals:

1. Informational arrangement of the process of environmental protection, land reclamation and spatial arrangement of areas created by mining activities at EPIS;
2. More efficient transfer of innovations, continuity in development and innovation research in order to enhance and improve operational, functional and informational performances of the system;
3. Harmonization of historical data conversion into digital database;
4. Rationality, lower cost of construction and system exploitation, faster functional animation of system;
5. More efficient and more effective management of information and logistic flows in the subject area.

The suggested solution for the architecture of the System of Information Logistics should simultaneously enable autonomous – entity and coupled – common functioning. In order to satisfy these non contradictory conditions, the logic in solving the system architecture points to the utilization of a concept “each one alone and all together”. By accepting this approach and by having in mind the uniqueness of the entities, a conclusion is imposed that the architectures of information logistic systems at the level of group “B” entities (Kolubara and Kostolac) are equivalent, and that they are somewhat different from the entities of group “A”. The differences are predominantly in segments for acquisition, mobile operations, measurements and management.

The architectures of the information subsystems of the SIL (entities) are determined functionally, according to the level of the Study, and certain exceptions can be made due to changes in local information demands, changes in information, ambient or other real system conditions. Figure 2 presents the principle outline of SIL entities integration, and figures 3 and 4. Principle outlines of the functional architecture of the SIL entities, groups “A” and “B”.

Architecture of group “A” (figure 3): The subsystem of information logistics of the Sector of Environmental Protection of the Department of Strategy and Investment in Belgrade is

integrated in network of five workstations – computers with PC

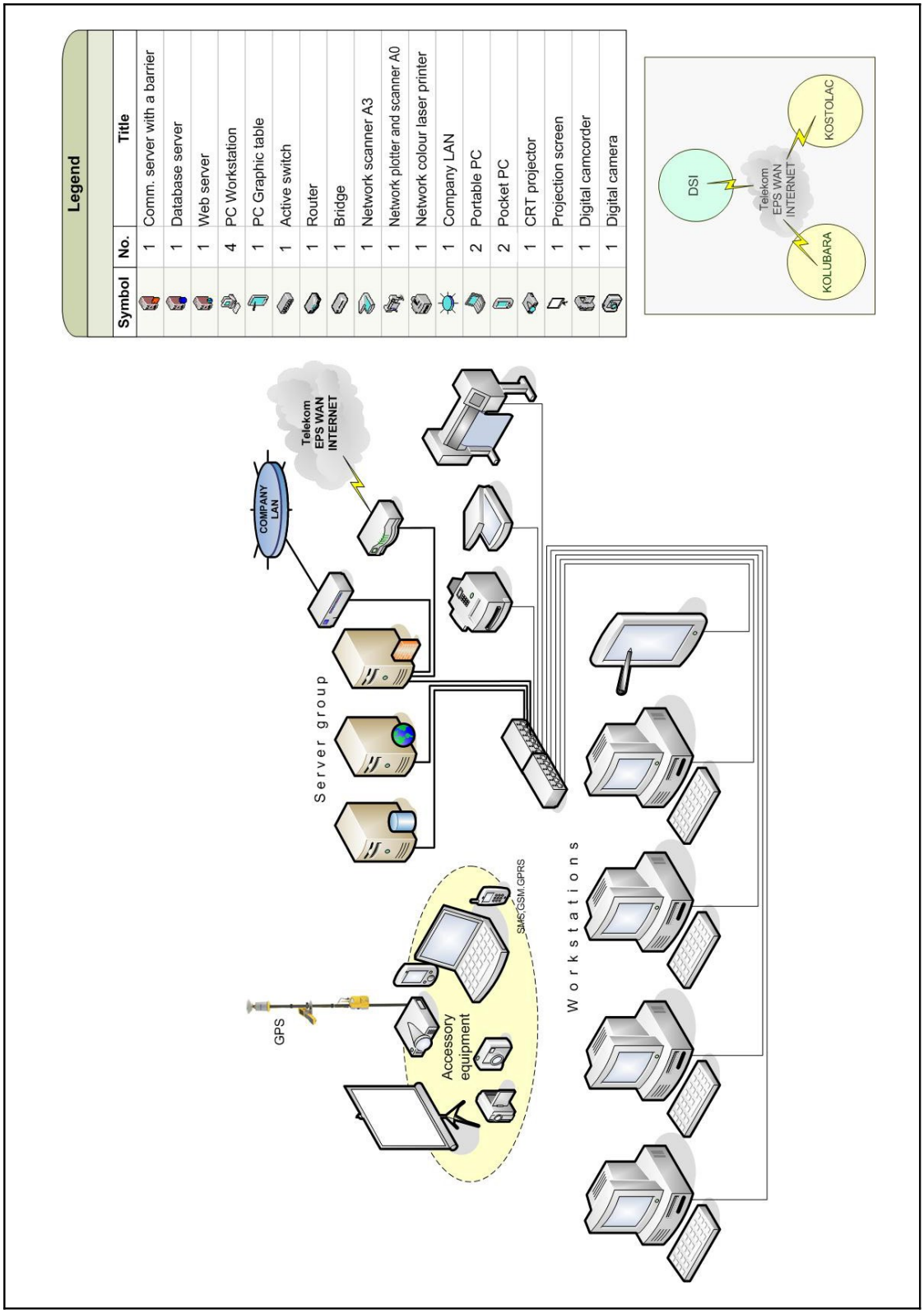

Fig. 3. Principle outline of the SIL subsystem functional architecture at DSI

platforms (an assessment is made that four standard PC's and a PC graphics board should satisfy the needs of the SIL during the inception and the subsequent development phase), the two-functional network plotter and scanner of A0 size and a network colour laser printer. A local client/server network with three dedicated servers: communication, database and Web server is suggested.

The universal Fast Ethernet standard is suggested for data exchange within the network. This standard is already used in the computer network of EPIS. The LAN of the Sector of Environmental Protection of the Department of Strategy and Investment is connected to the EPIS network and Telekom WAN network via bridge and a switch.

Due to uniqueness of the tasks and the functional needs, for the system architecture, auxiliary equipment is also suggested: two laptops, two pocket PC's, a video camera, a digital camera, video beam and a GPS set.

Architecture of group "B" (figure 4): Due to similar needs and functions of the SIL subsystem, belonging to the Kolubara and Kostolac, the same architecture is suggested for both entities, integrating five workstations (four PC's and PC graphics board) a plotter of A0 format, colour laser printer and a scanner of A3 format. Client/server networks of the entities in Kolubara and Kostolac will be supported by two servers: Communication and a database server. Their functions in the local networks of these entities are equivalent to the already described functions of the servers having the same name in the local network of the Sector for Environmental Protection. The suggested way of connecting the local networks of the entities onto the company local networks, WAN Telekom and Internet VPN is similar to the solution of LAN at the Sector for Environmental Protection at the Department of Strategy and Investment.

For the configuration of both entities, somewhat different auxiliary equipment from the Sector of Environmental Protection is suggested, according to the specifics of the tasks and functional needs. The suggested set comprise of: GPS survey set, two laptops, two pocket PC's, a digital camera and two probes for measuring the quality of water chemistry.

6. CONCLUSION

Apart from the actual practical goals, the SIL has the task to influence the creation of affirmative atmosphere and spreading of knowledge on the significance and the need of establishing the computer integrated information and information-management technologies into the coal open pit mining at EPIS.

All preconditions for SIL project realization. Knowledge on the necessity and inevitability of introduction and application of top computer and computer integrated information and surveillance technologies. For the successful realization of the SIL project, it is necessary to have a critical mass of qualified and prepared experts. The entities of the SIL, the Department of Strategy and Investment, Kolubara and Kostolac, possess highly qualified engineering staff, ready to accept the challenges of the project. The resources required to build the SIL are relatively small, amounting to approximately 300,000€. The architecture of the SIL enables staged development and less strain in investment dynamics. The analysis shows that the ratio of construction and exploitation of SIL costs and immediate and indirect benefits of information system is highly in favour of benefits. In general, by introduction of the SIL, a better and more efficient environmental protection would be achieved, better conditions for monitoring and surveillance of the status, for analytics, for creativity in solving the problems of land reclamation, revitalization and spatial arrangement of areas created by exploitation works in both basins.

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