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HORIZONTAL INTEGRATION OF KNOWLEDGE

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ABSTRACT
In this paper, the problem of multi-criteria evaluation is addressed and the different ways of knowledge integration is discussed. Our decisions are becoming increasingly dependent on understanding of complex relations, deep context and dynamics of phenomena in the world around and geographic information system (GIS) technology is able to incorporate this new requirements. The contribution is focused on the possibilities of GIS in combination with expert knowledge to support the decisions in the field of agriculture production with regards to the prediction of diseases and pests. It is shown that the localized knowledge make possible to aggregate important aspects of defined phenomenon and evaluate them in context of different hypothesis.

KEY WORDS
Intelligent systems, horizontal knowledge integration, multi-criteria evaluation, decision support.

1. Introduction

Knowledge acquiring and integration tries to compensate:

The need of proved internal information verified in given conditions and exactly defined environment and the necessity of procedural knowledge that can be formalized and reached through internal information management systems.

Information requirement that is related to previously obtained results and theirs interpretation, type of context used and trends evaluation, project-related experiences and know-how [1], [2].

The loss of the middle management information, analysis and routing services through new solutions thanks of information technology development, influence of comparing studies and long period evaluation [3].

The area in Computer Science that is most influenced by the concept of knowledge is Artificial Intelligence (AI). In AI concepts such as Knowledge Based Systems (KBS), Knowledge Level, Knowledge Modelling and Knowledge Representation were invented and discussed [4].

In the early 1980s the development of a KBS was seen as a process of transferring human knowledge to an implemented knowledge base. This transfer was based on the assumption that the knowledge, which is required by the KBS, already exists and only has to be collected and implemented [5].

It was recognized that the assumption of the transfer approach that knowledge acquisition is the collection of already existing knowledge elements was not correct due to the important role of tacit knowledge for an expert's problem. Moreover, the specific introduction of the term knowledge creates a different point of view. It is no longer sufficient to deliver huge amounts of information instead to support them in doing their knowledge utilization.

New information technology of GIS in data processing and spatial analysis, together with modern decision analysis techniques promote new styles of knowledge communication and utilization. This requires complex communication and collaboration by many people with different educational backgrounds.

To improve spatial data processing the empirical evaluation models as well as the expert knowledge model based are used. However, statistical evaluation models are not usually based on adequate empirical study material, which is expensive and time-consuming to collect. Models are corrected statistically using the relationships between observed objects of spatial data. Together with expert knowledge structure incorporation the powerful tool is available.

GIS applications are frequently used in producing new information by combining information from different sources (multi-source data) and by spatial analysis of existing data. Spatial modelling is an integral part of spatial data processing approaches.

2. Knowledge Combination

Knowledge socialization involves capturing knowledge through physical proximity. The process of acquiring knowledge is largely supported through direct interaction with people.

Organizations around the world are using new information technology to be able to:

- Know where, when, why, and how to take action
- Share knowledge with others
- Help students understand real-world problems
- Share information across multiple disciplines and promote a holistic approach to learning.

The knowledge conversion involves the process of social processes to combine different bodies of explicit knowledge held by individuals. The reconfiguring of existing information through the sorting, adding, re-categorization and re-contextualization of explicit knowledge can lead to new knowledge. This process of creating explicit knowledge from another explicit knowledge can be referred to as combination.

2.1 GIS as a Tool for Knowledge Management

Geographic information system (GIS) technology is becoming an integral part of the information infrastructure in many organizations. The unique integration capabilities of a GIS allow disparate data sets to be brought together to create a complete picture of a situation.

GIS technology illustrates relationships, connections, and patterns that are not necessarily obvious in any one data set, enabling organizations to make better decisions based on all relevant factors. GIS technology is also being used via the Internet and Web services.

Forward thinking government agencies have found GIS essential to manage the business of government. GIS is demonstrating real business value—today numerous companies are using business intelligence systems to keep pace with customer expectations.

The business intelligence systems bring geographic information systems, marketing analysis tools, and demographic data products together to offer powerful ways to compete in today's business strategies.

GIS provides also essential marketing and customer intelligence solutions that lead to better business decisions. GIS offers the tools enable to analyse:

- Site selection and location analysis.
- Customer segmentation, profiling, and prospecting.
- Demographics and customer spending trends.
- Potential new markets.

GIS can help business save time and money, while improving access to information and realizing a tangible return on GIS investment.

By integrating GIS with the governmental processes it is possible to create an information base that shares information resources, reduces data redundancy and increases data accuracy, provides decision support and increases efficiency.

Geography is a framework for organizing our global knowledge and GIS is a technology for being able to create, manage, publish and disseminate knowledge for all of society. Using GIS is about sharing what you know and setting new courses that will sustain our world in the years to come.

2.2 Control GIS

Very roughly speaking, we can determine, considering the range of tasks [6], [7] three basic levels of GIS utilization: inventory GIS, analytical GIS and control GIS.

To the inventory GIS fit the imagination of the cadastre. Usually large and masterly managed database where it is possible to find and also provide all information for touched sides and we can make do with comparatively simple function tools and with context corresponding to the reasonable number of information layers. Main worry: to update and manage database.

For the analytical GIS it is typical, without accounting of the range of database, in some sense permanently growing and very changeable amount of information layers that cover the different extent of changeable area of interest and call for the application of sequences of whole scale of functions named before.

The top level of GIS usage it is control GIS, where as touch information layers hold true the same as in case of analytical GIS and the large ability is aided to implement knowledge models from different branches of scientific investigation of around world for wide context of evident as well as less evident connections, models of trends, objects and expected or predicted relations [10].

The integral part of control GIS is the modelling where the information layers from real, artificial and virtual world are composed together to select optimal scenario or verify given hypothesis or assumptions.

The contextual design of spatial data and further development of geo-information technologies, image processing techniques and the possibilities of object history modelling together with the geographical networks environment will provide quite new and considerably wider possibilities of using GIS.

GIS architecture is open to incorporate new requirements of knowledge-based analysis and modelling, namely in connection with web designed spatial databases and temporal oriented approaches. This type of geo-information processing it is the resource, tool and means. It is modelling in most common sense.

If we understand the standard geographical database as a digital model of the real world than control GIS can handle the DB, which is the result of temporal interface of standard DB with virtual and artificial models of real world.

2.3 Temporal context

The temporal context investigation, which can stay on different levels of application, it is very important source of new quality information concerned especially with the objects of type phenomena.

The natural process connected with time accounting is analysis of changes but great importance of time appears in connection with spread and movement of phenomenon and the dynamics of object in general.

Further development it is the question of accessible information, knowledge-based decision making and context sensitive analysis applying. The imagination of temporal object model is very exciting and it will bring quite new quality of evaluation processes, namely in the analysis of type WHAT IF, which is temporary oriented and compose the virtual and artificial components. The question is how to model effectively interrelations of the space and time.

Generally speaking, geographic information is a description of object with location, shape data and attribute data combined together. And each component can contain temporal information and can become the part of reproducible spatial-temporal processing of sequences of DB objects [8].

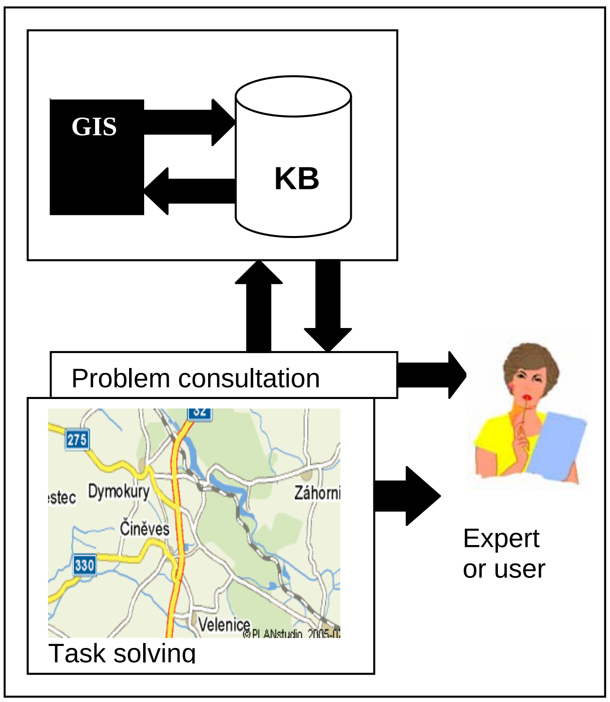

Figure 1. Scheme of application – combination of GIS and ES

We need to know the history to be able understand the trends and model our future. The management of any thing, including acceptation of the important decisions, it is not possible to do having the inventory information. To be successful in management of things it means to account the changes, understand the trends and effectively plan the changes if possible.

3. Knowledge integration

The access to the selected information (even in form of model) about exact place and location, in defined time, verified and coming from the credible source it is the main difficulty of decision support systems.

One possibility for dealing with this problem is to use expert knowledge when models based on objective information are not available or are not full-range, fig. 1.

This approach combines accessible information with information that is estimated on the basis of expert judgements instead of empirical measurement data. In order to enable the use of expert knowledge the methods for transforming expert knowledge into a numerical form, as well as appropriate tools for handling and producing data about stand conditions, are needed.

3.1 Parameters estimation

The use of modelling functions (see table 1.) strongly depend up exact definition of parameters as follows:

- specification of one or more target locations,
- specification of the neighbourhood that surrounds the targets,
- specification of the way spatial elements are interconnected,
- set of rules that specify the allowed movement along these interconnections,
- specification of a function to be performed on the "things" found surrounding the targets in the specified neighbourhoods,
- set of resources (such as a finished manufactured product),
- one or more locations where the resources reside (warehouse or factory location),
- objective to deliver the resources to a set of destinations (customers),
- set of constraints that places limits on how the objective can be met (speed of travel, time spent delivering the products, etc.).

The different requirements can be described by the set of factors and coefficients, but these factors are often connected to the critical characteristics coming from the selected area and surrounding objects that can influence the estimation quality.

Table 1
Expert knowledge supported functions

Modeling Tools of GIS	
neighbourhood function	connectivity function
contiguity function	network function
spread functions	seek or stream functions
inter-visibility functions	overlay function
and theirs combinations	

The great part of parameters can be successfully put more precisely with the aid of expert knowledge. GIS applications are frequently used in producing new information by combining information from different sources, by spatial analysis of existing data and by implementation of additional information coming from previously processing and analysis, expert knowledge, objects dynamics and trends.

Usually the objective in applications involving contextual modelling is to locate the area or areas where the given criteria apply and eventually calculate the measure of exposure to hazard in case of infections, diseases and pests, find the optimal routes and produce different complex scenarios. The powerful tool is the way of buffering where the expert knowledge can help us to set the ranges and find the areas with defined ways of protection.

3.2 Application

The use of expert system simultaneously with GIS approach enables to interconnect the possibilities of rule of type IF A THAN H [IF (features, conditions) THAN (consequential identification, methods, techniques)] with the analysis of type WHAT IF, accounting all advantages of spatial data analysis.

The final outcome of these applications is usually a map depicting areas simultaneously fulfilling all requested conditions and evaluated in context of related information layers.

Figure 2. Selected area with special recommendation

The evaluation procedure consists of the two steps: to set up parameters and determine their importance at first and provide the sensitivity analysis to demonstrate the effect of selected parameters and define weighting measures eventually.

4. Conclusion

In this paper, the problem of knowledge integration is addressed and the use of wide spatial and temporal context is discussed. The running development of information technologies, image processing techniques and knowledge-based databases, together with the geographical networks environment, will provide quite new and considerably wider possibilities of using GIS. Our decisions are becoming increasingly dependent on understanding of complex relations and phenomena in the world around and GIS technology is able to incorporate new requirements. The main goal has been to show selected aspects of this process and compare the increasing possibilities of the sources with the difficulties of data contextual structuring and the object dynamics implementation.

Knowledge : Tabulka

Number_rule	plot	illness	pest	conclusion
1	1111A	late blight	no	Give priority to grown of sugar beet
2	1111B	no	Colorado beetle	Minimaly 3 years not grown of potatoes
etc				

plot : Tabulka

Number_plot	acreage	perimetr	elevation_above_see-level
1111A	200	1130	230
1111B	260	14200	210
etc	0	0	0

Figure 3. Expert knowledge implication

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