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DSS AND GIS IN KNOWLEDGE TRANSFORMATION PROCESS

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Abstract

Knowledge is an important resource for successful decision-making process in the whole society today. The special procedures of control and management of knowledge therefore have to be used. In the area of knowledge management and knowledge engineering basic terms of these disciplines are data, information, knowledge and knowledge transformation.

The knowledge can be defined as a dynamic human process of justifying personal beliefs. Knowledge is a product of successful decision-making process.

Knowledge transformation is a spiralling process of interactions between explicit and tacit knowledge that leads to the new knowledge. Nonaka and al (2000) show, that the combination of these two categories makes possible to conceptualise four conversion steps: Socialisation, Externalisation, Combination and Internalisation (SECI model). Another model of knowledge creation is the Knowledge Transformation Continuum (BCI Knowledge Group) that begins with the articulation of a specific instruction representing the best way that a specific task, or series of tasks, should be performed.

Knowledge modelling and knowledge representation is an important field of research also in Computer Science and Artificial Intelligence. The definition of knowledge in Artificial Intelligence is a noticeable different, because Artificial Intelligence is typically dealing with formalized knowledge (e.g. ontology). The development of knowledge-based systems was seen as a process of transferring human knowledge to an implemented knowledge base.

Decision Support Systems (DSS), Geographical Information Systems (GIS) and Operations Research/Management Science (OR/MS) modelling process support decision-making process, therefore they also produce a new knowledge. A Decision Support Systems are an interactive computer-based systems helping decision makers complete decision process. Geographic Information Systems provide essential marketing and customer intelligence solutions that lead to better business decisions. Operational Research and Management Science (OR/MS) is methodology based on system theory and theory of modelling. The OR/MS models serve for better quantification and precision of decision-making process.

In this contribution the role of DSS, GIS and OR/MS models in the process of knowledge creation will be explained. The tacit or explicit character of this knowledge and the process of its creation will be explained and discussed.

Key Words

Tacit and explicit knowledge, SECI model, Operations Research and Management Science Models, Decision Support Systems, Geographical Information Systems, Models

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Introduction

Knowledge as a meaningful resource of decision-making process has changed the society and economy, today. The nature of knowledge in contemporary society is so specific that special procedures of control and management have to be used. In the area of knowledge management and knowledge engineering basic terms of these disciplines are data, information, knowledge and knowledge transformation.

Data can be explained as the product of research or the raw material of information. A single piece of data has no meaning unless the context is understood. Data need to be transformed to information that is a flow of messages. The relationship in the data is pointed out and discussed.

Knowledge is a multifaceted concept with multi-layered meaning. The traditional epistemology adopts a definition of knowledge as "Justified True Belief". In the theory of knowledge creation, knowledge is seen as a dynamic human process of justifying personal beliefs as part of an aspiration for the "truth". Knowledge is often not explicitly describable, not easy to explain and to formulate and formalize. Therefore the knowledge is recognized as *explicit* or *tacit.*

Machlup and Mansfield (1983) see information as a flow of messages of meanings that might add to, restructure or change knowledge.

Dretske (1981) offers more useful definitions. He said that, "Information is that commodity capable of yielding knowledge, and what information a signal carries is what we can learn from it."

Knowledge management today recognizes the need to exploit intellectual capital, but many practices fall short by only concentrating on individual knowledge components. Integrated knowledge has structure (it's process centric), links (it integrates parts into a dynamic, cohesive whole), relevance (it's meaningful to execution of the task at hand), and is accurately delivered in a critical time and critical environment. An integrated solution is more effective from a process improvement, decision support, training, and risk management perspective than a focus on just storing and accessing information from a central repository.

Knowledge Management can substitute the loss of stable procedural knowledge by explication and formalization through internal information management systems and to solve customer-related or project-related experiences and know-how by establishing best-practice or lessons-learned databases (van Heijst et al, 1997, 1998). Also the middle management information analysis and routing services through new IT solutions, e.g., DSS, GIS, intranets, data mining, or data warehouses (O'Leary, 1998a) can be advantage.

Together with the globalisation of businesses, an enormous market pressure enforces ever-shorter product life cycles. On the other hand, modern information technologies allow to create worldwide geographically dispersed development teams, virtual enterprises (Ribiere and Matta, 1998) and close cooperation with suppliers, customer companies, and outsourced service providers. All these factors require complex communication and coordination flows, complex both in technical and in conceptual terms. The role of IT is to support the information and document distribution, to enable worldwide communication and synchronization.

Further more, new customer-oriented management, quality principles and new information technologies promote new styles of communication and decision-making in company departments.

This requires complex communication and collaboration by many people with different educational backgrounds, skills, personal goals and perspectives. It also requires a combination of document types, data and information flows, and decision-making processes or changes in previously separated groups of people.

All these business phenomena produce knowledge-related activities comprising (Abecker et al, 1997, Leibold et al, 2001):

- Better exploitation of already available but insufficiently used documents,
- Formalization of business rules in workflows,
- Better usage of human skills and knowledge, application of new information technologies and competency databases and
- Explication of experience and know-how in best-practice databases, and much more.

Most of these activities can also be supported by information technology, and are in fact already partly supported by conventional information systems (Davenport, 1996, Bullinger et al, 1997, Tiwan, 2002).

However, the specific introduction to the term knowledge creates a different viewpoint: it is no longer sufficient to deliver huge amounts of information to users, instead it is important to support them in doing their knowledge work.

Knowledge Management is a holistic approach, which can be analysed from different viewpoints. For this reason, it is difficult to give an exact definition. Nonaka and Takeuchi (1995) and Bernbom (2001) stress the importance of the distinction between tacit and explicit knowledge in their definition: *Knowledge Management is the tacit and explicit knowledge framework for a dynamic human process of justifying personal belief toward the truth.*

Explicit knowledge is knowledge that is already extracted and consumable in books or other media. Tacit knowledge is not present in explicit form, and cannot often be articulated by a person who possesses the knowledge.

Davenport and Prusak (1988) stress the importance of the process and supply chain:

Knowledge Management is a formal, structured initiative to improve the creation, distribution, or use of knowledge in an organization. It is a formal process of turning corporate knowledge into corporate value. Sveiby and others also emphasize the corporate value (Probst et al, 1999, Sveiby and Lloyd, 1990):

Knowledge Management is the art of making Money out of immaterial assets.

What is very important - how the knowledge can be captured and processed, what technology areas can help us to realize a Knowledge Management strategy, and what kind of knowledge is managed in fact.

Material and Methods

Knowledge Creation or Transformation - SECI Model

Knowledge creation is a spiralling process of interactions between explicit and tacit knowledge (Nonaka, 1995, 2000). The interactions between the explicit and tacit knowledge lead to the creation of new knowledge. The combination of these two categories makes possible to conceptualise four conversion steps (Figure 1):

- Socialisation
- Externalisation
- Combination
- Internalisation

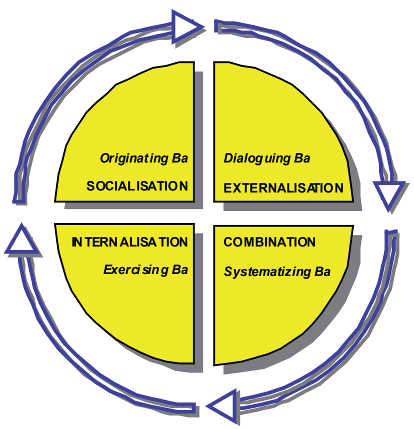

Figure 1: SECI model (source: Nonaka et al, 1995, 1998)

Socialisation enables the conversion of tacit knowledge through interaction between individuals. One important point to note here is that an individual can acquire tacit knowledge without language. Apprentices work with their mentors and learn craftsmanship not through language but by observation, imitation and practice. In a business setting, on job training uses the same principle. The key to acquiring tacit knowledge is experience. Without some form of shared experience, it is extremely difficult for people to share each other's thinking process.

The tacit knowledge is exchanged through join activities – such as being together, spending time and living in the same environment – rather than through written or verbal instructions.

Externalisation requires the expression of tacit knowledge and its translation into comprehensible forms that can be understood by others. In philosophical terms, the individual transcends the inner and outer boundaries of the self. During the externalisation stage of the knowledge-creation process, an individual commits to the group and thus becomes one with the group. The sum of the individuals' intentions and ideas fuse and become integrated with the group's mental world.

Combination involves the conversion of explicit knowledge into more complex sets of explicit knowledge. In this stage, the key issues are communication and diffusion processes and the systemization of knowledge. Here, new knowledge generated in the externalisation stage transcends the ground in analogues or digital signals.

The **internalisation** of newly created knowledge is the conversion of explicit knowledge into the organization's tacit knowledge. This requires the individual to identify the knowledge relevant for oneself within the organizational knowledge. That again requires finding oneself in a larger entity. Learning by doing, training and exercises allow the individual to access the knowledge realm of the group and the entire organization.

Nonaka and Konno (1998) also adapt the concept of Ba and suggest different Ba's which facilitate the knowledge conversion for his SECI knowledge creation model. Ba can be considered as a shared space that serves as a foundation for knowledge creation. Ba can be thought of as a shared space for emerging relationships. This space can be physical (e.g. office, dispersed business space), virtual (e.g., email, teleconference), mental (e.g. shared experiences, ideas, ideals) or any combination of them. Ba provides a platform for advancing individual and/or collective knowledge.

There are four types of Ba that correspond to the four stages of the SECI model (Table 1). Each category describes a Ba especially suited to each of the four knowledge conversion modes. These Ba offer platforms for specific steps in the knowledge spiral process. Each Ba supports a particular conversion process and then each Ba speeds up the process of knowledge creation. The four Ba's proposed (Nonaka and Konno, 1998) are as below:

- **The Originating *Ba***: a locale where individuals can share feelings, emotions, experiences and perceptual models.
- **The Dialoguing *Ba***: a space where tacit knowledge is transferred and documented to explicit form. Two key methods factors are through dialogue and metaphor creation.
- **The Systematizing *Ba***: a virtual space, where information technology facilitates the recombination of existing explicit knowledge to form new explicit knowledge and;
- **The Exercising *Ba***: a space where explicit knowledge is converted into tacit knowledge.

SECI Element	*Key Elements*
Socialisation and Originating Ba	Focus on potential barriers to personal knowledge exchanges, Employ face-to-face systems across organisations.
Externalisation and Dialoguing Ba	Creative development of systems to aggregate tacit knowledge
Combination and Systematising Ba	Develop multi-organisational outines Solidify shared commitments and mental models
Internalisation and Exercising Ba	Creation of shared expertise and routines Mentoring across organisational boundaries

Table 1: Summary of SECI Implementation Across Organisations (source: Nonaka and Konno, 1998)

Knowledge Transformation Continuum

The Knowledge Transformation Continuum (KTC) is seen as a continuum that begins with the articulation of a specific instruction representing the best (or optimal) way that a specific task, or series of tasks, should be performed within the context of a business process (BCI Knowledge Group) An explanation of each of the components in the cycle and their relevance to the whole is as follows: This specific instruction in reality represents the implicit knowledge resident in the minds of the members of an organization converted to explicit knowledge. This process can be explained by five phases:

- Instruction
- Action
- Measurement
- Collaboration
- Transformation

The articulation of an **instruction** is the first critical step in the transformation of implicit knowledge and experience to explicit knowledge, which can be mined and shared across an organization in the form of process based best practices. Implicit knowledge is defined as the accumulated experience and values of an individual. As such, it resides with the individual and it is of little value to the organization, except as reflected by the action of the individual possessing the specific knowledge. However, once transformed into explicit knowledge by means of an instruction, that knowledge is available to the organization as a whole and will remain an asset of the organization even after the original individual is no longer involved in the process or has departed the organization.

The purpose of a preceding instruction is to provide the basis for a future **action** and to guide an individual performing a specific task on how best to complete the task. Tasks are organized within the tool following the four-tier architecture. Beginning with the overall process, the tool recognizes the sub-process, task and sub-task levels in an effort to provide the flexibility necessary to achieve a significant degree of information granularity so that people can get answers to questions without searching through a series of key word hits, web pages and documents. These answers are based upon the most up-to-date and approved knowledge. In addition to being used as decision support, these actionable instructions are also leveraged as tactical training for the purpose of job certification.

Each action should have a predefined result associated with it. It is by **measuring** the result of an action that an organization is in a position to evaluate its performance, either against a pier group or internal thresholds set by management. Quantification and qualification of results is a critical part of the continuum. The marriage of process centric knowledge and measurement ultimately enables the organization to proactively drive the decision making process towards implementing the highest potential improvements.

The collaboration represents the collective participation of the members of the organization with the specific intent of improving and achieving best possible results from the application of people and technical systems involved in critical business processes. Providing visibility and access to a process centric body of instructions and an elaboration of the measurements and what they mean to the welfare of the organization has, in our experience, resulted in a significant amount of participation by the staff in a continuous improvement process. When proper incentives are tied to the collaboration effort, the results have been spectacular.

Transformation is the last phase. Through collaboration a new way of doing things emerges. Process components are improved and a new best practice is set in place. It does not stop here, it continues and develops its own momentum reaching levels previously unimaginable.

Table 2 shows parallels between SECI and KTC processes.

SECI Element	KTC Elements
Socialisation	Instruction, Action
Externalisation	Measurement
Combination	Collaboration
Internalisation	Transformation

Table 2: Parallels between SECI and KTC processes (source: autors)

Knowledge in Computer Science and in Artificial Intelligence

The area in Computer Science that is most influenced by the concept of knowledge is Artificial Intelligence (AI). Figure 2 derived from Aamodt and Nygard (1995) serves as a basis for understanding the use of knowledge in Computer Science. There is no fundamental difference in the representation of data, information and knowledge: everything is based on symbols.

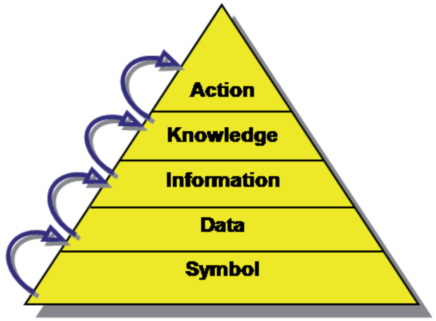

Figure 2: Knowledge pyramid (source: Aamodt and Nygard (1995))

In AI concepts such as Knowledge Based Systems (KBS), knowledge level, knowledge modelling, and knowledge representation were invented and discussed (Studer et al, 1999, 2000). 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 (Musen, 1993). It is interesting to note that research in AI indeed used the early definitions of knowledge in philosophy. It followed the ideas of Plato that knowledge is something inherently true.

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.

- Some observations can be made about modelling view of the building process of a KBS.
- The model is only an approximation of reality.
- The modelling process is a cyclic process. The model may guide further acquisition of knowledge. New observations may lead to a refinement, modification, or completion of the already constructed model.
- The modelling process is dependent on the subjective interpretation of the knowledge engineer. Therefore this process can be faulty and an evaluation of the model with respect to reality is indispensable for the creation of an adequate model.

Since this control knowledge is specified independently from the application domain, reuse of this strategically knowledge is enabled for different domains and applications. Besides knowledge modelling also knowledge representation is an important field of research in computer science and AI.

McCarthy (1989) explains an interesting idea:

Expressing information in declarative sentences is far more modular than expressing it in segments of computer programs or in tables. Sentences can be true in a much wider context than specific programs can be used. The supplier of a fact does not have to understand much about how the receiver functions or how or whether the receiver will use it. The same fact can be used for many purposes, because the logical consequences of collections of facts can be available.

More we can see about knowledge representation in Erdmann (2001), Erdmann and Studer et al (2001), Fensel (2000), Staab and Schnurr (2000) and Sure et al (2000), about information retrieval and information articulation in Mitra et al (2000), about Web catalogues in Labrou and Finin (1999), and about meta-data based search engines in Heflin (2001).

According to Nichols and Twidale (1999) computer supported cooperative work is a research area that examines issues relating to the design of computer systems to support people working together. The type of knowledge managed by computer supported cooperative work systems is usually informal and document centred.

Thus, it is requested to design systems that allow users to collaborate more effectively. Such systems can open up opportunities for collaboration and knowledge sharing that has previously been impossible. People can collaborate in the same place (co-located) or in different places (remote) but also collaborate at the same time (synchronous) or separated in time (asynchronous) (Nichols and Twidale, 1999).

The definition of knowledge in AI is a noticeable different, because AI is typically dealing with formalized knowledge (e.g. ontology, business rules represented in logic, etc.) (Decker et al, 1999, Decker, 2002, O'Leary, 1998b). In a computer supported cooperative work context, knowledge formalization is very difficult and costly, so the formalization of knowledge contained for example in documents is usually not done. In order to enable the usability of AI techniques in computer supported cooperative work this difference will need to be overcome. One possible way is to develop cost-effective techniques that help to formalize knowledge especially knowledge contained in documents (Fensel et al 1998a, Fensel et al 1998b).

Effective management of knowledge requires hybrid solutions of people and technology. Some task human better does, others are better done by technology. Using knowledge to make a decision is usually more successful effected by humans. On the other hand transformation and storage of information is effective done by an appropriate technology.

Results

Decision Support Systems, Geographical Information Systems and OR/MS Models

A Decision Support System (DSS), Geographic Information System (GIS) and Operations Research/Management Science models (OR/MS models) play really important role in knowledge transformation process. We study, explain and discus these facts in our previous work (Brožová and Šubrt, 2006, Klimešová and Brožová, 2006, Klimešová and Vostrovský, 2008, Šubrt and Brožová, 2007) and we synthesise our result in this section.

A Decision Support System (DSS) is an interactive computer-based system or subsystem intended to help decision makers use communications technologies, data, documents, knowledge and/or models to identify and solve problems, complete decision process tasks, and make decisions (Power, 2002). Also, DSS refers to an academic field of research that involves designing and studying DSS in their context of use. In general, DSS are a class of computerized information systems that support decision-making activities. Five more specific DSS types include:

- Communications-driven DSS
- Data-driven DSS
- Document-driven DSS
- Knowledge-driven DSS
- Model-driven DSS.

The DSS and their construction are based on the models. These models are an approximation of reality and are dependent on the subjective interpretation of the knowledge. It means that new observations may lead to a refinement, modification, or completion of the already constructed model. On the other hand, the models may guide further acquisition of knowledge and the knowledge is the base for decision support. Moreover, besides knowledge modelling also knowledge representation is very important field of DSS.

A large group of these models is a group of Operations Research/ Management Science models (OR/MS models). These models are obviously mathematical, so each model can be represented as an equation, inequality, or system of equations or inequalities, which describe certain aspects of the modelled physical system. Models of this type are used extensively in the physical sciences, engineering, business, and economics.

Geographic information system (GIS), as the second group of mentioned systems, provides essential marketing and customer intelligence solutions that lead to better business decisions. Geography is a framework for organizing our global knowledge and GIS are a technology for being able to create, manage, publish and disseminate this knowledge for whole society. GIS strengthen the welfare of a nation's citizens. With GIS, it is possible to analyse:

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

GIS allow visualizing and interpreting data in ways simply not possible in the rows and columns of spreadsheets. GIS can help your business saving time and money, while improving access to information and realizing a tangible return on your GIS investment.

OR/MS methodology is based on system theory and theory of modelling. The basis of OR/MS approach is to build a model for the problem being studied. Practical problems are often unstructured and the definition and clarification of problems, as well as the building of models, is an important part of the OR/MS methodology. Most people discover that the understanding created by building a model is a very valuable part of the OR/MS projects. Once a model is built, algorithms often have to be used to solve it. An algorithm is a series of steps that will accomplish a certain task. The study, understanding and invention of such algorithms is also an important part of OR/MS modelling for decision-making. The decision maker might incorporate some other perspectives of the problem such as cultural, psychological, etc., into the management scientist's recommendations. Finally, communicative and political skills are needed in implementing the results of an OR/MS model in a real-life situation. OR/MS models are aimed at assisting the decision-maker in his/her decision-making process.

OR/MS modelling process helps to improve operations in business and government through the use of scientific methods and the development of specialised techniques. Operations Research is not "research"; it is the cyclic process of re-searching for an optimal (or desirable) strategic solution to the existing decision problem/situation. OR/MS modelling process provides systematic and general approaches to problem solving for decision-making, regardless of the nature of the system, product, or service. The approaches and tools used in OR/MS models are based on analytical methods, simulation and qualitative or logical reasoning. Many of these tools and approaches depend on computer-based methodologies.

Models in Phase of Knowledge Socialization

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

OR/MS models, particularly mathematical models are important part of organisational decision making systems. Development and spread of model applications and organisational information systems were called into existence of DSS. These systems represent a large portfolio of models, which represent tacit knowledge. With database and communication module DSS are worked up to help the organisations to make the rational decisions on different management levels.

Using GIS is about sharing what you know and setting new courses that will sustain our world in the years to come. Standards and interoperability are extensively important elements in our overall software development and support efforts. GIS technology provides essential information tools for many levels of society. As developers, you need to be able to

- Develop applications using the language of your choice
- Deploy applications on a variety of platforms
- Access and manipulate GIS data in multiple formats

To use DSS and GIS needs not only technical skills (explicit knowledge) but also especially good experience and craftsmanship (tacit knowledge). The best way of its application needs to start by apprentice work and practice, because sharing of this tacit knowledge involves joint activity and direct interaction with experienced people. DSS and GIS give the tools to be able to:

- Make informed decisions
- Know where, when, why, and how to take action
- Share knowledge with others
- Help better understand real-world problems using data analysis
- Share information across multiple disciplines and promote a holistic approach to learning

Models in Phase of Knowledge Externalisation

Knowledge externalisation is based on the articulation of tacit knowledge.

The conversion of tacit knowledge into explicit knowledge involves techniques that help to express one's ideas or images as words, concepts, figurative language (such as metaphors, analogies or narratives) and visuals. Dialogues, "listening and contributing to the benefit of all participants" strongly support externalisation. Translating the tacit knowledge of people into readily understandable forms may require deductive/inductive reasoning or creative inference (abduction).

The DSS and OR/MS models are applications that help business data analysis and presentation so that users can make decisions more easily. It is an "informational and knowledge application" to distinguish it from an "operational application" that collects the data in the course of normal business operation.

The model and the way of its application as well as results interpretation may be used for solving many similar problems and this will be a typical pattern of decision-making. The selected model and its application to problem solving represent explicit knowledge that is created as the best practice and can be understood beyond its linguistic, organisational and cultural context.

Also GIS plays a significant part in the way in which the information is distributed to other agencies and organizations and how it is disseminated to the public. Across government and agencies GIS software solutions are integrated into decision-making processes. By integrating into government or organisations processes, GIS can:

- Create an information base that shares information resources, reduces data redundancy, and increases data accuracy
- Perform joint project analysis and provide decision support
- Streamline processes to increase efficiency, automate tasks and save time and money

With the development of the Web services architecture GIS are becoming more open, robust and interoperable. Web has a unique ability to integrate diverse data through shared location and specially GIS Web services offer real potential for meeting the demands of users and will bring significant benefit to knowledge-based society. Web provides universal and rapid access to information at a scale that has never been seen before and GIS technology has become easier to use and more accessible and make possible to think about large context of processed data.

Models in Phase of Knowledge Combination

The next step of knowledge conversion involves the social process to combine different bodies of explicit knowledge held by individuals. The reconfiguring of existing information through the sorting, adding, re-categorising and re-contextualising of explicit knowledge can lead to new knowledge. This process of creating explicit knowledge from explicit knowledge is referred to as combination. The knowledge combination phase relies on three processes.

First, capturing and integrating new explicit knowledge is essential. This might involve collecting externalised knowledge (e.g. public data) from inside or outside the company and the combining such data.

Second, the dissemination of explicit knowledge is based on the process of transferring this form of knowledge directly by using presentations or meeting. Here new knowledge is spread among the organizational members.

Third, the editing or processing of explicit knowledge makes it more usable (e.g. documents such as plans, reports, market data).

In the combination process, justification – the basis for agreement – takes place and allows the organization to take practical concrete steps. DSS and GIS allow disparate data, information and explicit knowledge to be brought together to create a complete picture of a situation, because GIS and DSS technology have the specialized tools focused on:

- Knowledge identification
- Knowledge sharing/ dissemination
- Knowledge acquisition
- Knowledge preservation
- Knowledge development
- Knowledge utilization.

The focus on single process steps allows the structuring of the management process. Detection of problems in this process and detection of problems, which interfere with the overall knowledge management process, is simplified. Explicit knowledge about future development of solved problems in case of different initial situations is obtained at the end of this stage.

Models in Phase of Knowledge Internalisation

In practice, internalisation relies on two dimensions:

First, explicit knowledge has to be embodied in action and practice. Thus, the process of internalising explicit knowledge actualises concepts or methods about strategy, tactics, innovation or improvement. For example, training programs in larger organizations help the trainees to understand the organization and themselves in the whole.

Second, there is a process of embodying the explicit knowledge by using simulations or experiments to trigger learning by doing processes. New concepts or methods can thus be learned in virtual situation.

Adaptive mechanism of DSS can served as a training tool in organisational systems of training and education. These systems are also used as a simulation tool for experiments with possible decisions and their consequences.

The internalisation capabilities of GIS allow including the new data, information and knowledge into organisational knowledge system. GIS provides essential information tools for many levels of society. IT professionals need those tools to be able to:

- Coordinate and communicate key concepts between departments within an organization
- Share crucial information across organizational boundaries
- Manage and maintain a central spatial data infrastructure, often within a service-oriented architecture (SOA)

The process of exploitation of OR/MS models, GIS and DSS is included into organisational knowledge base as a new specific process and can be used by other members of staff in similar decision situations as a standard. Because these specific processes can be shared mainly by experience, by cooperative action of people, the standards become a set of tacit knowledge.

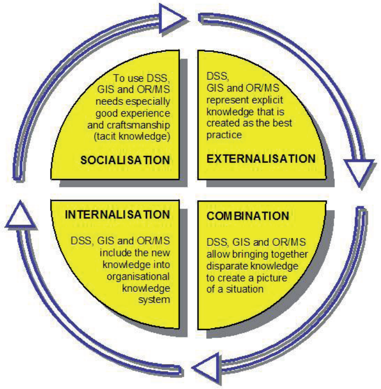

Figure 3: DSS, GIS and OR/MS in SECI spiral (source: autors)

Conclusion

In this contribution the role of DSS, GIS and OR/MS models in the process of knowledge creation and tacit or explicit character of this knowledge were explained and discussed. In the frame of the SECI model it is possible to conclude that

- To use DSS, GIS and OR/MS needs especially good experience and craftsmanship (tacit knowledge), it means knowledge socialisation.
- DSS, GIS and OR/MS represent explicit knowledge that is created as the best practice that is knowledge externalisation.
- DSS, GIS and OR/MS allow bringing together disparate data, information and explicit knowledge to create a complex understanding of a situation (problems and so on), which is knowledge combination.
- DSS, GIS and OR/MS include the new knowledge into organisational knowledge system as a tacit knowledge; it is a process of knowledge internalisation.

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