

MAKING DECISIONS IN MONITORING BY USING DECISION-MAKING METHOD, KNOWLEDGE BASES AND NEW IT SOLUTIONS

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Abstract: In this paper we deal with decision-making processes in monitoring with the use of new technological solutions. This is an area where decision-makers in monitoring face a large number of different challenges and need appropriate specific knowledge. We give an example of a method for making complex decisions. Here we propose the application of the semantic web and knowledge bases that can provide decision-makers with a quick access to the necessary knowledge in the decision-making process. To update some of the knowledge we will use the Protégé editor, an open source platform. Our goal is not to update all the necessary knowledge needed by those who make decisions in monitoring, but only to propose a new concept to their faster fulfillment and more efficient use.

Keywords: monitoring, decision-making, knowledge base, efficient use of knowledge, methods, facilitation, business intelligence.

INTRODUCTION

Monitoring consists of continuous observations of certain activities carried out under a particular program or project, as well as report/reports accordingly. It is a process of continuous collection of information on all aspects of a particular project. The task of monitoring is to check the progress of project activities. In essence, it is a set of systematic and purposeful observations. Monitoring provides very important feedback to project donors/funders, as well as to project implementers and beneficiaries. Monitoring serves financiers to respond in a timely manner if something proves to jeopardize the desired result of the project; reporting to management benefits in the decision-making process to improve the performance of project activities; while through monitoring the final users we are trying to provide the desired level of quality of the outcome of the project to which they are entitled.

A project is a set of activities (investments) whose goal is to solve a certain problem(s) in a predicted time frame and a defined space/location. Investments include: time, money, human and material resources. Achieving the set goal, i.e. goals implies that

the project will go through several clearly defined and specified phases.

Monitoring should be carried out by all individuals and institutions that have an interest in the project itself (i.e. participants). In order for the project to be implemented effectively, the persons involved in planning and implementation should plan each of the phases in advance and predict their course in as much detail as possible.

The ultimate philosophy of project implementation in the EU goes so far that the ultimate goal is no longer the successful implementation of projects as such, but ultimately "criticism" is directed to the course of the implementation process, or answering the question - how much is the process implementation selected and implemented in the most optimal way? This thinking is based on the desire to better understand the entire implementation process, more than the implementation itself, and to analyze the use, management and "maintenance/correction" of the same. Thus, the question "how well do we reach the desired goal?" makes it clear that according to the EU PCM methodology, the application of the phrase "goal justifies the means" has no place.

Monitoring is important both for the planning/design phase of the project and for the implementation phase itself. Monitoring could be allegorically compared to recreational skiing. It is like when we ski, and we look ahead to stay in the desired direction, not deviating from the trail, and possibly avoid various obstacles, bumps and other things that could happen to us on the trail [9].

Decisions are a common part in monitoring, and they strongly influence the final outcome of project implementation and depend on the position of the decision-maker. Understanding the decision-making process can help avoid bad decisions and stimulate good ones. However, there are many factors that influence decisions, and not every one of them is known, nor the ways in which they are related. At the same time, decision-making processes, due to their complexity, are approached from different points of view, even within a certain science.

If we look at decision-making as such, during monitoring, we can see that it includes the management of a higher number of related components, such as the dynamics of project implementation, unexpected events, resource allocation, reprogramming of activities and the like. The uncertainty associated with each of these components, as well as the changing relationships that exist between them, in terms of time and space, form the very core of project management complexity. Clarifying each of these complex components is essential to responding effectively to unforeseen situations and examining how useful alternative strategies are in decision-making. However, it is very difficult to predict the consequences of such complex behavior, because they often occur within a dynamic context.

Good leadership, competent and trained to make the right decisions is essential if management wants to achieve top results and improve productivity. Monitoring, especially in the field of construction projects, is by nature a multidisciplinary area, where the successful implementation of projects requires the commitment of all parties, including monitoring, designers, contractors, investors, supervisory authorities and institutions. All of them must initiate requests, cooperate with each other, consider and understand everyday problems, as well as make decisions to solve them.

Monitoring benefits from the employment of

individuals who possess developed interpersonal skills that facilitate the process of collaboration with a multitude of different stakeholders at different levels. The use and even the abuse of these skills during the implementation of projects can positively, but also negatively affect the final outcome.

The term “monitor” is a person who is responsible for monitoring the implementation of the project. It represents a person-expert who has many years of experience in monitoring the implementation of projects and who is familiar with legal regulations and procedures for the implementation of the project, who has many years of expert experience in construction projects (discussed in this paper) and number of other characteristics that give him the opportunity to identify all obstacles and complications that may arise in the implementation of the project.

The key associate of the monitor is the “project manager”, a person who is responsible for project management and refers to project leaders, but is also used in the broadest possible sense, without a generally accepted definition due to the uniqueness of each project and system for its implementation.

In order to be able to observe a different approach to monitoring and implementation of the new ideas in faster acquisition of knowledge in the decision-making process, we will introduce some more terms that we need here. These are primarily the semantic web and knowledge bases.

The concept of the Semantic Web was introduced by Tim Berners Lee (2001) as a clear structure for the content of a Web page. It arose as a need to more efficiently find certain information and knowledge. It is based on the idea of information on the web making readable to the machine. Instead of documents linked by hyperlinks, it should use interconnected data (information) that have a specified structure and meaning [10].

For having the idea of the Semantic Web to be able to operate, computers would have to have access to collections of information. It must provide rules for reasoning about data, and enable the presentation of data and information.

In this paper, we use the Protégé editor [11], an open source platform for knowledge update that allows knowledge to be read and stored. Protégé editor provides a rich set of modeling structures and

activities that support the creation, visualization and manipulation of data and information represented in different formats.

What is often overlooked is that modern processes from monitoring in construction and construction works requires knowledge of complex financial issues and demands interpersonal skills as well, which means that monitors know all activities such as tender documents, price analysis, price control, construction contracting works, planning of works, etc. Unlike from the managerial position e.g. in sales, monitors have to deal with a large number of different tasks and processes for each construction project.

The key contributor to the project monitor is the project manager, as he not only oversees all actors in the project implementation, but he also makes decisions about their engagement and must provide: purpose, direction and motivation to both contractors and subcontractors who work for them, who do not necessarily have the same or similar structure of their organization and working processes.

Each discipline requires from its managers to perform similar duties, although the true nature of these duties depends on the project. For example, a designer or engineer typically manages processes related to the design and construction of specialized facilities or structures. In the construction industry, although some of the responsibilities are duplicated, given the category of work, each of the managerial positions deals with different participants in terms of supporting the construction project and the goals of the construction organization. Therefore, managers must possess specialized interpersonal and leadership skills, especially when it comes to decision-making in various managerial positions. Solving problems and making appropriate decisions is an interpersonal process. Behavior during the decision-making process is directly related to the achievements of the individual on each construction project, as well as the achievements during his career in performing the assigned tasks.

The quality of decision-making within activities and success of monitoring depends to a large extent on those who make decisions, what skills and abilities they possess, what their management style is, and what techniques and methods they use in decision-making [1]. Therefore, it is not only the ap-

plication of appropriate techniques and methods in decision-making that is important, but also the professional skills, education and experience that monitors have.

All individuals, involved in the implementation of a construction project, are exposed to situations where a decision must be made. Their decision-making process involves many aspects and is influenced by several connections and factors. Here will be presented, the decision-making process with using the semantic web and knowledge bases, so that the necessary knowledge can be obtained faster and the decision-making process itself can be better understood.

Using the Protégé editor, an open source platform, we will update only some basic knowledge related to the decision-making process: decisions are part of everyday life and affect the lives of individuals (help to avoid bad decisions; stimulate good ones).

Some factors that influence decisions in monitoring are: labor productivity; unexpected events; resource allocation and reprogramming of activities (uncertainty associated with each of the components; variable connections that exist between them (time, space).

Good leadership: is competent; trained to make the right decisions; supervises associates; provides purpose, direction and motivation; must possess leadership skills; ensures the success of monitoring, is of appropriate education and appropriate experience (Figures 1 and 1a).

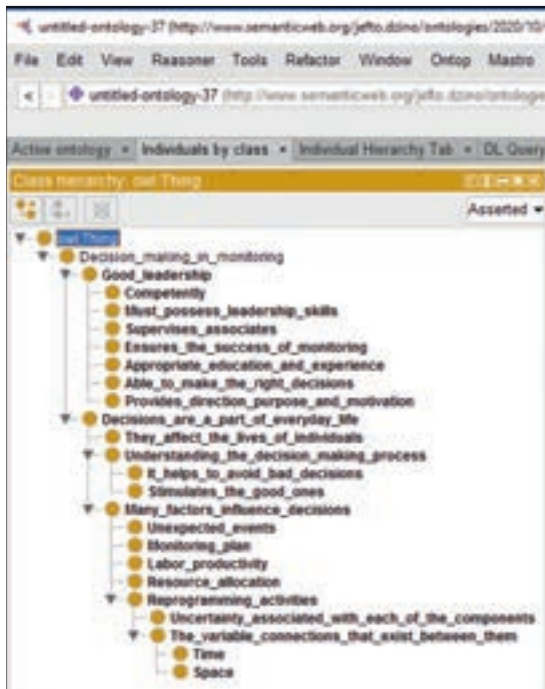


Figure 1. Basic concepts related to the decision-making process

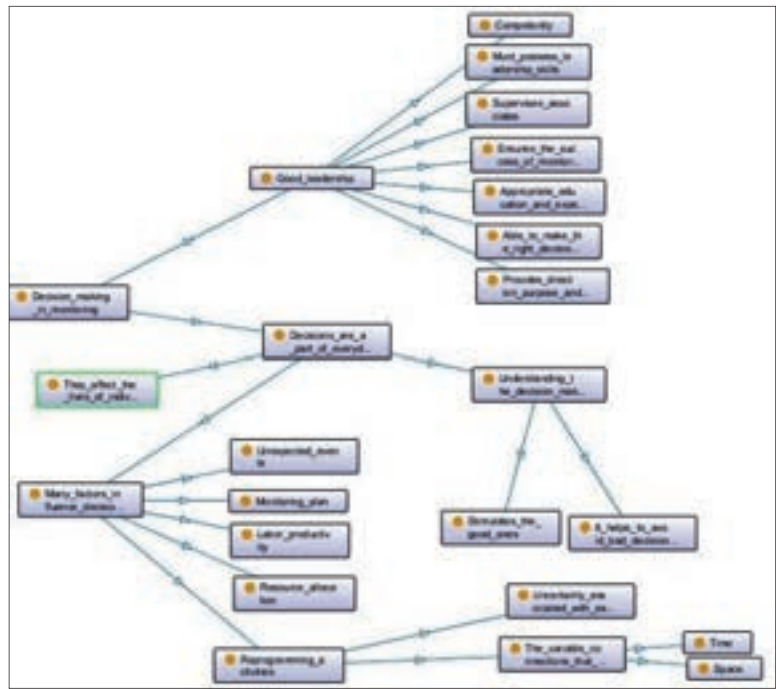


Figure 1a. OntoGraf - Basic concepts related to the decision-making process

DECISION-MAKING IN MONITORING

In monitoring, decisions are made every day, both small, everyday decisions, and those related to the project implementation strategy. There are many significant factors that influence decision-making, and they can be seen as the final outcome of the process, apropos the choice between different options [6]. The decision-making process can be viewed as a unity of the following phases: the “before-decision” phase, the “decision-making” phase and the “after-decision” phase.

In the decision-making process in monitoring, the main goal is to implement the project without any other alternatives existing. There are two basic approaches in the decision-making process, the goal-oriented approach and the procedure-oriented approach [8]. A goal-oriented approach implies the possibility of predicting the outcome, and a procedure-oriented approach is one in which the process is in the center of attention.

According to Turban, (2011) there are several stages in the decision-making process [9]:

Information gathering phase: The information gathering phase is a process in which the decision-maker examines reality, in order to identify and define the problem. The decision-maker searches for

conditions that require a particular decision.

Design phase: This phase refers to attempts to find, develop and analyze all possible courses of action for the rest of the process. The design phase implies creativity, which means that decision-makers are looking for alternative solutions, which they then analyze in more detail.

Election phase: In the election phase, a real decision has already been made and a certain course of action is being followed. The decision-maker compares the best solutions available and then chooses the best ones.

Implementation phase: In the final phase, the decision implementation phase, the selected solution is applied.

One should always have in mind that after realization, this process does not stop. Continuous monitoring of the decision-making process in monitoring is crucial, in order to achieve the best results and ensure the implementation of the project.

Using the Protégé editor, we will update the basic terms related to the decision-making stages. Stages in the decision-making process: Gathering information - (decision-maker examines reality, searches for conditions); Design phase - (finding and analyzing possible courses of action); Selection phase - (a real

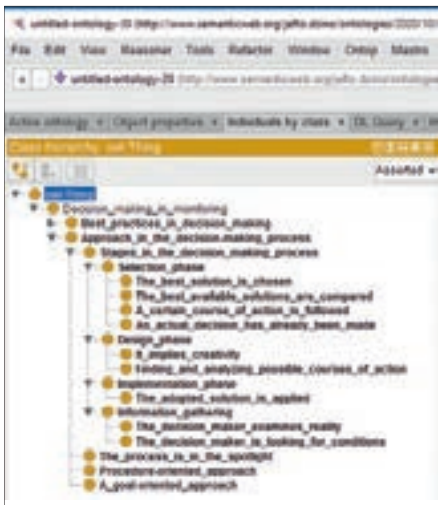


Figure 2. Decision-making phases

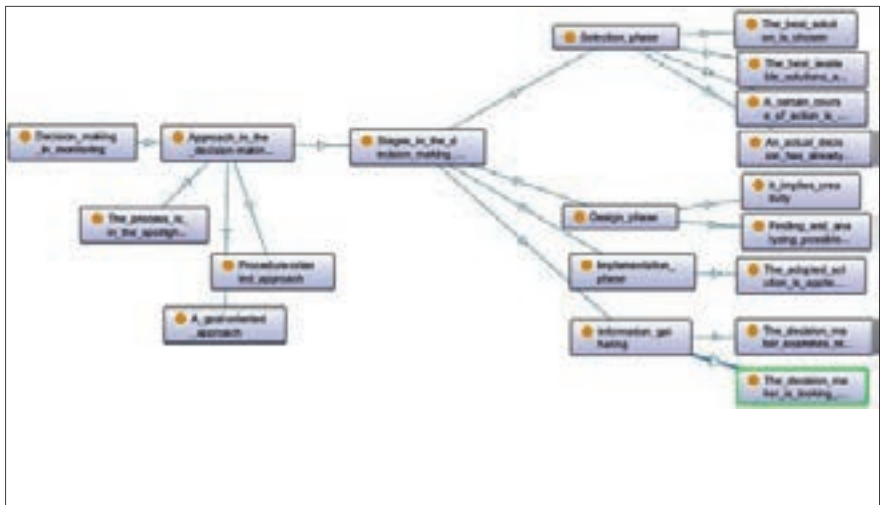


Figure 2a. OntoGraf - Phases of decision-making

decision has already been made, a certain course of action is followed, the best available solutions are compared, the best solution is chosen); Implementation phase - (the adopted solution is applied), (Figures 2 and 2a).

BEST PRACTICES IN DECISION-MAKING

Often monitors rely on common managerial approaches that work well in some conditions but not in others [5]. Why do these approaches fail, even when logic says they should prevail? The answer lies in the basic premise of organizational theory and practice: that a certain level of predictability and order exists in the world. This assumption, based on Newton’s science that forms the basis of scientific management, encourages simplifications that are useful in regulated circumstances. Circumstances change, however, as they become more complex, simplifications may fail.

Monitors in their decision-making can encounter: simple situations, complicated situations, complex situations and chaotic situations.

Simple situations: The domain of good practice

Simple situations are characterized by stability and a clear cause-and-effect relationship that any monitor can easily spot. The right answer is often obvious and indisputable. In this area, the decisions are undisputed because all parties share the understanding. Simple situations, properly evaluated, require direct management and supervision. Here,

monitors recognize, categorize, and respond. They assess the facts of the situation, categorize them and then base their response on established practice.

Since both project monitors and implementers have access to the information necessary to deal with the situation in this area, the command and control style for establishing parameters works best. Recommendations are specific, decisions can be easily delegated, and roles can be automated. Exhaustive communication between the monitor and the project implementer is usually not required, as there is rarely disagreement about what needs to be done.

Complicated situations: The domain of experts

Complicated situations, unlike simple ones, can contain more correct answers, although there is a clear connection between cause and effect, not everyone can see it. While monitors in a simple situation must recognize, categorize and respond to the situation, monitors in a complicated situation must recognize, analyze and respond. This approach is not easy and often requires expertise. Making decisions in complicated areas can often be time consuming, and there is always hesitation - a lot of time from finding the right answer to making a decision. When the right answer is unattainable and when the decision must be based on incomplete data, the situation is more complex than complicated.

Complex situation: Occurrence domain

Most situations and decisions in project implementation are complex, due to some major change - bad weather conditions, bad quarter, changes in monitoring, changes in project implementation procedures, etc. which represent unpredictability. In this area, only in retrospect can one understand why things are unfolding in a certain way. Instructional patterns, however, can arise if the monitor performs experiments that certainly fail. Therefore, instead of trying to impose a course of action, the monitor must patiently allow the way forward to be shown. They must first examine, then see, and then answer.

Chaotic situations: The domain of quick reaction

In chaotic situations, looking for the right answer would be pointless: The connection between cause and effect is impossible to determine, because they are constantly changing and there are no suitable patterns - just turbulence. This is an area of inaccessibility.

Business schools and organizations prepare managers to operate in regulated domains (simple and complicated), but the monitor usually has to rely on its natural abilities when operating in a disordered environment (complex or chaotic). When faced with greater complexity today, however, intuition, intellect and charisma are no longer enough. Monitors need resources and approaches to monitor projects through lesser known waters. In the complex en-

vironment of today’s business world, monitors are often asked to act contrary to their instincts. They will have to know when to share power, and when to keep it to themselves, when to turn to the wisdom of the group, and when to consult on their own. A deep understanding of the situation, the ability to accept complexity and paradox, and the will to flexibly change the managerial style, will be necessary for monitors who want to allow things to unfold at a time when uncertainty is growing.

Using the Protégé editor, an open source platform, we will update only some basic knowledge related to best practices in decision-making: Simple situations - the domain of good practice (characterized by stability and clear connections (monitors recognize, categorize, respond)). Complicated situations - the domain of experts (clear link between cause and effect; Monitors see, analyze and respond -) (requires expertise, requires a lot of time), Complex situation - the domain of occurrence (the monitor must examine, see and answer); Chaotic situations - the domain of rapid response (the relationship between cause and effect is difficult to determine (deep understanding of the situation, ability to accept complexity, ability to accept paradox, willingness to change managerial style)), (Figures 3 and 3a).



Figure 3. Best practices in decision-making

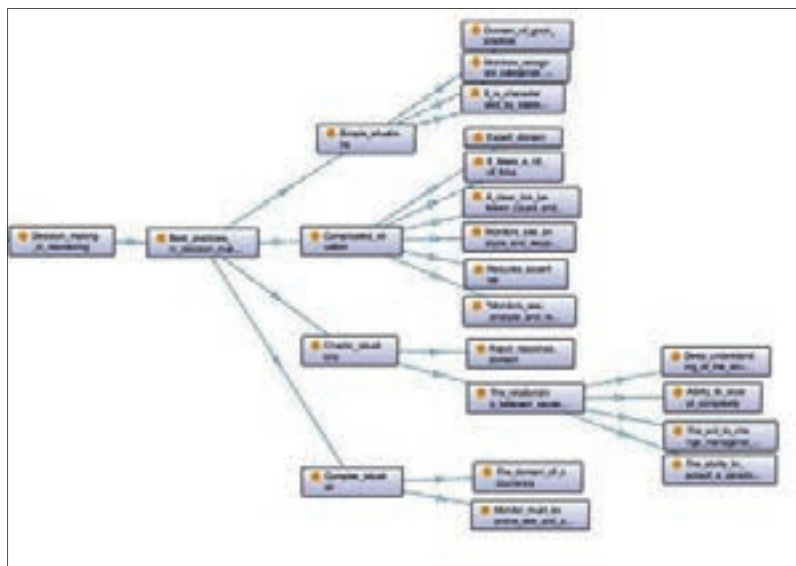


Figure 3a. OntoGraf - Best practices in decision-making

Nowadays, the time of modern business, modern way of doing business, those who make decisions need new technological solutions to quickly get the necessary knowledge. Quality monitors must have the appropriate knowledge, skills and experience in the field of construction management. This is necessary because the decisions that are made are of different complexity in different areas.

In modern business conditions, monitors must find the best way that means project implementation, harmonization of profitability levels, meeting the needs of investors, efficient use of resources, and key elements of progress and responsibility. A good knowledge base can certainly help them in this.

DIGITAL DATA EXPLOSION

Digitization ensures that huge amounts of data are easily accessed. Data on suppliers, deadlines, subcontractors, occupancy of construction machinery, their efficiency and many others can be obtained almost in real time. Most construction companies are ready to share all types of information with monitors, project managers, subcontractors and suppliers online.

Almost since the invention, IT systems have helped automate the process. Now monitoring has a practical way to standardize the processes they have perfected and sell them to others. Any process that is the best, but not crucial to the competitive advantage of monitoring, can be turned into a profitable business. Cloud computing makes such capabilities more accessible, as it allows easy software distribution, simplified software version control, and the like [7].

Lately, information technologies have been deviating from their traditional role of automation and reducing business and process management costs. IT will continue with this function but will increasingly provide new business opportunities. The faster they progress, the more opportunities open up [2].

Technical and analytical progress in the analysis of large amounts of data is crucial for the development of business intelligence. By processing, storing and transmitting data at extremely low prices - digitization has the capacity to change almost every form of human labor. Digitization and analysis of large amounts of data will open up new possibilities, and this will lead to new challenges. Remote

teams are available, and the traditional hierarchical structure is disappearing and transforming into an increasingly flexible, internal and networked structure.

Well-established business models based on digitalization and processing of large amounts of data, aim to optimize existing processes, and increase the efficiency of monitoring and thus the construction and quality of products and services. Digitization reduces transaction costs for information gathering, communication, and control activities.

Using the Protégé editor, we will update the basic concepts related to what digitization provides, which are: a large amount of data; easy access to data; getting data in real-time; analysis of large amount of data; opening up new opportunities and reducing transaction costs.

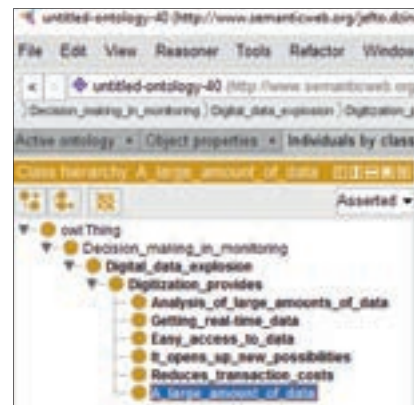


Figure 4. Digitization

METHOD FOR DECISION-MAKING

During the work, unforeseen circumstances can jeopardize the implementation, and decision-making is a key factor in the implementation of projects. How to choose the right decision and how to act is a question that we all ask ourselves, this comes to the fore especially when a decision, which needs to be made, includes several participants and is neither easy nor simple to make. In circumstances when the implementation of the project is in question, it is necessary to gather all actors and choose a decision.

We can say that making a decision seems simple, because in everyday life we make a number of decisions, but in complex decisions we need to consult, to explore, to consider several solutions that can be made as a decision, to choose one solution - a decision, to discuss the same and to consult whether it

is correct and then say that we have chosen is the right decision.

In practice, making a decision is one initial step, followed by the responsibility of who will implement it, which is also a challenge, because by making a decision we have done nothing if we do not have a person in charge of it.

What is a challenge in making decisions is that they do not just stay on paper or in the air, we have a decision, we have a person who is in charge of that decision, but it is necessary to implement that decision in practice, so we need a person who is in charge to implement it. In practice, for decisions that are not complex and it is related to just one person, but for complex decisions these may be different people.

Guided by these facts, our recommendation is to use the facilitation [4] and method called "final decision" that we have created for these needs in these cases.

The French writer Antoine de Saint-Exupery [12] said, "Force (the enemies) to build a castle together and you will turn them into brothers."

The purpose of the "final decision" method is to reach a solution to the problem, how to implement the solution and take responsibility in the implementation plan to ensure the implementation of the solution. The method uses external experts for help - people who are recognized experts for a given problem. The complexity of the method is reflected in the fact that it not only provides a solution, but also brings a way to implement the solution in order to ensure the implementation of the solution.

For the purpose of preparation, the topic-problem should be clearly defined. Experts prepare lectures-case studies in accordance with the topic-problem. All participants in the meeting should be introduced to the topic, forward all professional literature and available documents.

MODE OF OPERATION

Preparation: After scheduling a meeting or workshop, facilitators collect material (expert and scientific literature as well as available documents) from experts, contractors and the participants themselves in order to prepare and send it to all participants.

This is a very important and responsible job that needs to be done as best as possible.

The facilitators, in consultation with the participants, determine the time required for the materials

to be read and for the participants to be prepared until the beginning of the workshop.

The exchange of materials between the participants is desirable - it should be stimulated.

In preparation, participants are divided into groups of 3 to 8 members.

For the purpose of the process of the method to be presented, suppose that we wil work in three groups.

The method consists of three working parts:

1. The first part refers to decision-making - solution
2. The second part refers to the manner of implementation of the decision-solution
3. The third part refers to taking over responsibility for the implementation of the decision-solution



Figure 5. Flow of the method

PROCESS OF THE METHOD

Part I - Adoption of the final decision

1. Adoption of principles - total duration 45 minutes
 - a. Explanation of the mode of operation
 - b. Work in groups - lasting 20 minutes
 - c. Group presentations - a total of 15 minutes (e.g. if we have three: 3x5)
 - d. Adoption of the principle - lasting 10 minutes
2. Expert opinion on the topic-problem - total duration of 45 minutes
 - a. Introduction to the problem - lasting 10 minutes

- b. Explain the problem - in 10 minutes
- c. Best practices - lasting 10 minutes
- d. Questions - lasting 15 minutes

3. Discussion - total duration 45 minutes

- a. Work in groups - lasting 20 minutes
- b. Presentation of the solution - lasting 15 (3x5) minutes
- c. Adoption of possible solutions in three to 10 minutes

4. Expert opinion on solutions - total duration 45 minutes

- a. Expert presentation - for a total duration of 15 (e.g. if we have three 3x5) minutes
- b. Questions - lasting 10 minutes
- c. Work in groups - lasting 10 minutes

5. Adoption of the decision - solution - for 10 minutes (the method that can be used here is voting or by everyone writing their name on the stick and sticking to the solution they consider the best)

Part II - How to implement the final decision - solution

- 1. Way of implementation of the final decision - solution - total duration 75 minutes
 - a. Work in groups - lasting 20 minutes
 - b. Presentations - lasting 15 minutes

- c. Expert opinions - lasting 10 minutes
- d. Questions-discussion - lasting 10 minutes
- e. Adoption of the final plan - lasting 10 minutes
- f. Deadlines - lasting 10 minutes

Part III - Taking responsibility - total duration 15 minutes

- a. Taking responsibility - 15 minutes

CONCLUSION

The success of project implementation is significantly influenced by decision-makers, what skills and abilities they have, what is their management style, what techniques and methods they use in decision-making. It is not only the technique in decision-making that is important, but also the professional opportunities and experience that managers have, and especially their education.

Good leadership is essential if monitoring is to achieve quality project implementation. Monitoring in the field of construction projects is by nature a multidisciplinary field, where successful project implementation requires the engagement of everyone, including monitors, project managers, designers, contractors, designers, users and institutions. All of them must initiate requests and cooperate with each other.

As complex decision-making is a challenge, here is a method with precisely stated processes that

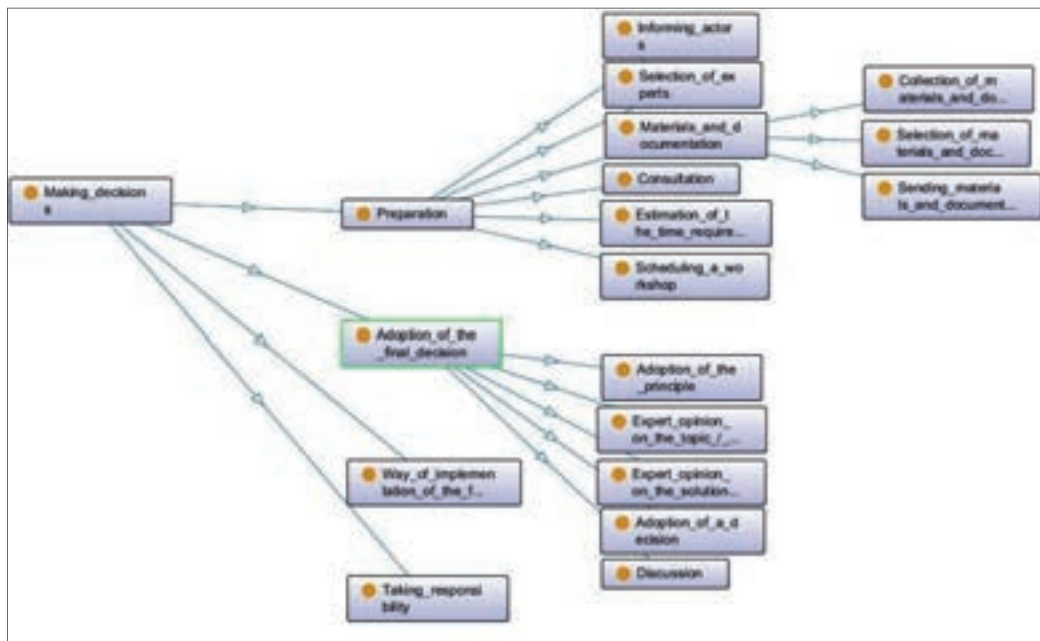


Figure 6. OntoGraf - final decision method

can be used in making such decisions. Modern processes of monitoring construction projects include complex issues and demanding interpersonal skills, which means that monitors are engaged in activities such as monitoring the progress of project implementation, price bidding, price control, tenders, project planning, etc. Project managers have to deal with a multitude of tasks and processes for each construction project or completely different types of projects. They must possess specialized interpersonal and leadership skills, especially when it comes to decision-making in various managerial positions.

There are several important factors that influence decision-making, and the decision can be seen as the final outcome of the process, i.e. the choice between different options. Lack of information is usually considered an important constraint for decision-making, along with constraints on decision-maker in terms of attention, memory, understanding and communication. Within these limitations, the basic assumption remains that the decision-maker strives to be rational.

The information available to decision-makers contributes to their ability to understand whether they are for or against a decision, to measure the usefulness, and to assess the possibility of an outcome. Quality information increases a decision-maker's ability to make good decisions.

Business intelligence significantly improves the business decision-making process, as it can provide knowledge to the decision-maker. Knowledge is more valuable than data and information because it is closer to action and can be used to make more correct decisions. Intelligence represents knowledge about the environment and serves as a basis for making quality decisions. Business intelligence directs attention to spotting important directions and patterns as well as the connection between project implementation and its environment. Therefore, it can be said that business intelligence is active knowledge about the application of information content.

The application of business intelligence significantly improves the business decision-making process, because its use makes knowledge more valuable than data and information. Intelligence represents knowledge about the environment and serves as a basis for making quality decisions. Business

intelligence directs attention to spotting important directions and patterns as well as the connection between project implementation and its environment. Therefore, we are of the opinion that business intelligence is active knowledge about the application of information content. Business intelligence includes a series of activities, guided by the specific information needs of those in charge of decision-making, with the goal of achieving a competitive advantage. Through business intelligence processes, monitoring can collect, analyze, store and share accurate and useful information, necessary for monitoring and decision-making. The paper is part of research and solutions for the purpose of using information and knowledge from databases and for the purpose of decision-making.

Here we have shown how the decision-making process in monitoring can be carried out using knowledge bases and the semantic web. Decision-makers can also use a specially created method when making complex decisions. Those who make decisions face different challenges and it is necessary for them to be able to get the necessary knowledge quickly, and knowledge bases can help them in that.

The purpose is to propose a new approach in the use of knowledge to those who make decisions in monitoring, with the aim of making decisions easier, faster and more efficient.

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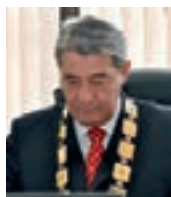


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FOR CITATION

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