SMART Intelligence Models for Managing Innovation Projects

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Abstract

Existing SMART Intelligence Models for managing innovative projects and programs have been explored. The competency-based approach is considered the basis for building a SMART Intelligence Model for managing innovative projects and programs. Proposed five groups of Competencies SMART Intelligence Model for Managing Innovation Projects. The SMART intelligence model has five groups of interrelated competencies: emotional, social, cognitive, business and technical. Each group of competencies of the SMART Intelligence Model are defined. To assess the competence level of the project team, the Organization competence-based model IPMA Delta model was used. As an example of the application, the SMART Intelligence Model to the implementation of the double degree project of the Kyiv National University of Civil Engineering and Architecture and the Dortmund University of Applied Sciences within the framework of the implementation of European Union DAAD VIMACS and ERASMUS+ WORK4CE projects is presented.

Keywords

Innovation project, Competencies, SMART Intelligence model, Emotional, Social, Cognitive, Business, Technical, Managing projects

1. Introduction

Intelligence today is generally understood as the ability to understand and adapt to the environment by using inherited abilities and learned knowledge.

The theory of multiple intelligences was developed in 1987 by Dr. Howard Gardner. This theory suggests that the traditional notion of intelligence is far too limited. Dr. Gardner proposes eight different bits of intelligence to account for a broader range of human potential. This intelligence are [1]:

2. Linguistic intelligence (“word smart”);
3. Logical-mathematical intelligence (“number/reasoning smart”);
4. Spatial intelligence (“picture smart”);
5. Bodily-Kinesthetic intelligence (“body smart”);
6. Musical intelligence (“music smart”);
7. Interpersonal intelligence (“people smart”);
8. Intrapersonal intelligence (“self-smart”);
9. Naturalist intelligence (“nature smart”).

It was the beginning SMARTification of intelligence systems.

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The dynamic development of standards and methodologies in project management is associated with the shortage life cycles of projects and project products. As the result, projects management practice used hybrid approaches and methodologies, elements of entropy and genetic models of projects. Ideas and concepts for creating projects based on analogues. The updating of knowledge and concepts of project management in world practice confirms the significant interest in this field of activity [2].

The rapid development of project management in world practice is associated with its impact on the sustainable dynamic development of countries in the context of the formation of an electronic economy. The conscious synergy of project management as a tool for the development and promotion of SMARTification, E-business, E-commerce, E-economy, E-employment based on open Internet technologies determines the main trends in the development of information technology, the development of new methods and tools for project management [3].

Under these conditions, the key trends in the development of project management are associated with the following areas:

- Globalization of knowledge and project management technologies;
- Business practice;
- Information technologies;
- Social importance;
- Development of human resources involved in projects;
- General development of science and technology;
- Development of SMART markets and market mechanisms.

As intelligence mechanisms, we are understood as modern concepts – SMART information modeling, integrated project implementation and big data, with their methods, tools and modern hardware and software [4]. Integrated use of intelligence mechanisms allows to obtain, process, store and use of the knowledge generated in the project, as well as able to increase the effectiveness of the project, achieve planned goals and increase the likelihood of its successful completion [5].

2. Analysis of recent research and publication

Cognitive models are used with two different objectives:

- a cognitive model aims to formally describe the cognitive processes underlying the observed behavior in a specific task and explain specific experimental effects observed within this task;
- the parameters of a cognitive model estimated from the observed behavior in a task are used as measures for differences across individuals or experimental conditions.

One of the directions of cognitive analysis is explanatory cognitive models that provide an effective tool for comparing prediction theories, models of the future, and experimental assessments of the adequacy of knowledge. The complexity of cognitive analysis models and the lack of methods for evaluating the results of knowledge accumulation makes it difficult to use them in research. The results of explanatory cognitive models can provide a theoretical basis for deciding the pros or cons against a particular model of cognitive analysis. Measures of quantitative analysis determine how project managers or their operating conditions differ concerning a particular process of the cognitive model. In the field of cognitive modeling, models define the cognitive process. Cognitive models of the second direction are called models of cognitive evaluation. Any cognitive model can be both an explanatory and an evaluative cognitive model, depending on the circumstances of its use. The cognitive models that are used to explain the observed behavior of systems within specific projects differ from the cognitive models that are used to quantify differences in their parameters [6].

One of the biggest challenges in intelligence research is the identification of the cognitive processes underlying cognitive competencies and the competencies of assessing the parameters of the knowledge acquisition process.

Modern theories of general intelligence suggest that intelligent behavior is the result of individual differences in the various independent cognitive competencies of the project manager and that there is a hierarchical structure of cognitive competencies with a common set of competencies that determine individual differences in the cognitive abilities of project managers [7].

According to the triarchic theory, intelligence has three groups of competencies: analytical, creative, and practical.

Analytical intelligence is called basic intelligence and refers to the intelligence that is applied to analyze or evaluate problems and find solutions.

Creative intelligence is defined as the ability to go beyond standard areas of knowledge to create innovative ideas. This type of intelligence is defined by imagination, innovation and problem-solving.

Practical intelligence is seen as the competencies that project managers use to solve the problems they face in everyday life. In this case, the project manager finds the best match between the requirements of the project and the requirements of the environment. Adaptation to the requirements of the environment includes the use of knowledge gained from experience to purposefully change following the state of the environment (adaptive competencies), change the environment by the goals of the project (formative competencies) and search for a new environment for development (competencies of selection of alternatives) [8, 9].

Emotional Intelligence is the ability to keep under control stakeholders' emotions, discriminate between different emotions, and use emotional information to guide thinking and behavior.

Let's look at intelligence assessment. Intelligence assessment also reveals strong construct validity, meaning that they are measuring intelligence rather than something else.

There are issues with intelligence tests beyond looking at them in a vacuum. These tests were created by western psychologists who created such tools to measure euro-centric values.

Stereotype threat is a phenomenon in which people feel at risk of conforming to stereotypes about their social group. Negative stereotypes can also create anxiety that results in lower scores.

Stereotype threat is closely related to the concept of a self-fulfilling prophecy in which an individual's expectations about another person can result in the other person acting in ways that conform to that very expectation.

To convey an idea of the benefits of the application of cognitive modeling in intelligence research, we will discuss three examples of cognitive models in the following sections. Let selected different models describing cognitive processes of particular interest to intelligence research, such as decision making, working memory and cognitive control. This is demonstrating how they may be used to quantify project managers' differences in their respective cognitive processes. The three models described below differ in their breadth of application and their former use as assessment or measurement models.

Projects are born in a certain environment and very often in the same agony as all living things. The environment of the project "feeds" it with various ideas, approaches, tools, resources (including money) and means of solving the problems of the project - it forms the environment of the project. As for a person, clothing, housing, habitat and communication, etc. form an environment [10,11, 12, 13].

The specifics of managing innovation projects and the problems of dynamic leadership lies in the particular innovation of the tasks that project managers constantly have to solve, and the low level of performance culture among project participants: customer, investor, financing organizations, project managers, project performers, surrounding organization, control services (technical, financial, tax, etc.).

In this case, project management is considered a universal language of communication between project stakeholders. From the unambiguous and professionally correct understanding of the language of project management, the result of the implementation of an innovation project largely depends on the selected criteria (time, cost, quality, etc.).

The main problems of managing innovation projects are formed around the following factors [14, 15]:

– customer requirements for the project and increasing their competence. At the same time, the principle "appetite comes with eating" works;

– the innovation of the resulting products or projects. This innovation is considered an objective property of the system, which requires the decentralization of management functions and the use of hierarchy as a means of dealing with the innovation of management tasks. Typically, in such a management scheme, a significant number of conflicts arise when decisions are made by managers of the same level. Every manager tries to "pull the blanket over himself";

– relationship and mutual influence with the external environment of projects (economic, political, environmental, social, cultural environment). Such connections quite often negatively affect the progress of the project.

– degree of uncertainty and risk. In innovation projects, the degree of risk is always much higher, as it is balanced by the effect of project implementation. Here the folk wisdom “you have to pay for everything” works [16];

– organizational restructuring. Such restructuring is inevitable since the project management system must reflect changes in the control object, which consist of changes in the structure of the reorganization. This is an objective property of any innovation project, and the absence of changes in an innovation project during its implementation is "not the rule, but the exception" [17];

– frequency of technology change. This property is determined by the significant duration of the project, on the one hand, and the desire of the customer to obtain a result that corresponds to the latest technological advances, on the other. The inevitability of replacing technical and technological solutions makes it possible to meet the customer’s expectations of the type “I want this, but I don’t know what” [18];

– planning and pricing errors. These errors are an essential attribute of any innovation project. In this case, project managers are always under the "crossfire" of the designers, the customer and the contractors. This triangle is the source of most of the problems that arise in the process of project monitoring.

3. Competencies intelligent model for managing SMART innovation projects

In real practice project managers apply a conceptual model with five domains of competencies:

1. Emotional Intelligence (EI) competencies of Result Orientation, Initiative, Flexibility, and Self-Confidence;
2. Social Intelligence (SI) competencies of Empathy, Influence, Networking, and Distributed Team Leadership. They also showed significantly more cognitive competencies in Systems Thinking and Pattern Recognition;
3. Cognitive Intelligence (CI) competencies being key to effectiveness in Acquisitions of knowledge, Creativity and Innovation, Artificial Intelligence and Modeling in an organization [19];
4. Business intelligence (BI) competencies like Strategy, Culture and Values, Planning and Control, Opportunity and Risk Management [20];
5. Technical intelligence (TI) competencies: vision of the product and result, technical, technological and organizational solutions in the implementation of the project, work in conditions of uncertainty and innovation, clear definition of boundaries and work with the context [21].

The SMART Intelligence model of Competencies for managing Innovation Projects is shown in Fig. 1.

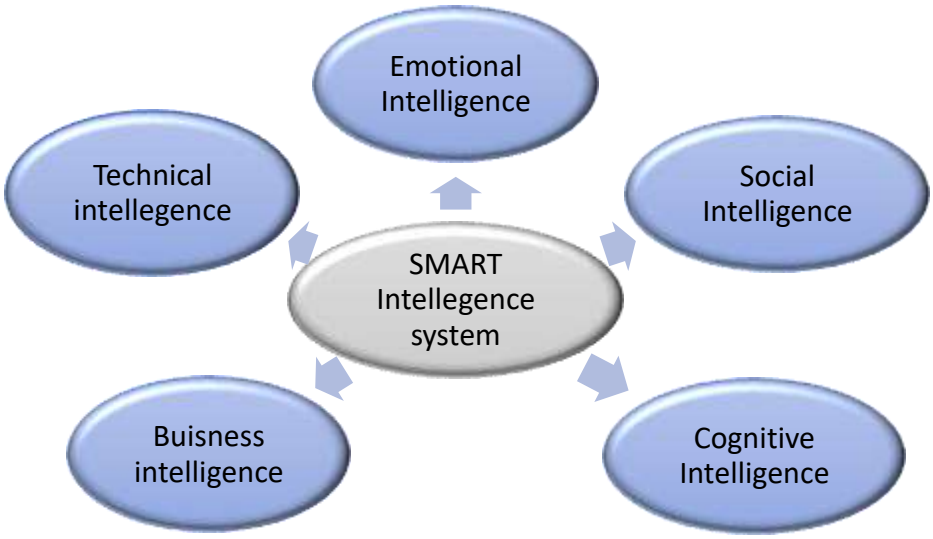

Figure1: The SMART intelligence model

The approach to achieving a particular goal depends on the situation. The guiding intelligence principles are the elements of the prospective competency as well as the technology solution used to build the solution. This choice starts with what the best practice is already available and then what needs to be built on top of that. This will be the technological and functional architecture [22, 23].

Project managers face complexity and uncertainty, which means that every situation requires a different approach. Therefore, the various Agile approaches are commonly referred to as "Frameworks", they are the starting point from which the approach must gradually evolve. When you start a project, you study the lessons learned, choose a certain structure, and realize that this choice is an assumption that has not yet been proven to be correct.

Work empirically when testing this assumption or hypothesis through an experiment. Such a hypothesis must be formulated in such a way that it can be falsified. We often adjust in small steps and sometimes you need to radically change the way of working. A clear, inspiring and supportive vision for the product or result to be delivered gives meaning to the higher goals the organization wants to achieve. It provides direction and sets boundaries. When there are many uncertainties and a changing context, it is often impossible to specify goals and requirements for the result. Therefore, the command continues to communicate with the user. The focus and boundaries of the product vision allow us to constantly improve it with the help of sub-goals. We then work in a plan-do-check-act mode until we achieve results [24].

Consider the mechanisms of intellectual support for models based on their Smartification [25, 26].

Emotional intelligence is supported by the SMARTification mechanism based on flexibility, self-management, emotional contagion, and result orientation competencies.

SMARTification of the socio-intelligence mechanism is determined based on the active use of social networks, distributed teams, and empathy.

SMARTification of cognitive intelligence is based on knowledge acquisition, creativity and open innovation, artificial intelligence and modeling in an organization.

SMARTification Business intelligence mechanisms are based on competencies strategy, culture and values, planning and control, opportunity and risk management.

SMARTification of Technical intelligence mechanisms based on the competencies vision of the product, output and outcome, technical, technological and organizational solutions in the project implementation, action in conditions of uncertainty and open innovation, clear definition of scope and project context.

For the assessment of competence for the proposed model Key Intelligence Indicators have been developed for each competency [27].

In the case of the proposed intelligence competence model study according to the application of the proposed conceptual model. It had been developed by an assessment Double degree Master's program in preparation for Project Managers at Kyiv National University of Construction and Architecture. At the end of this program group of 20 students had been assessed according to five domain conceptual models of innovation competencies.

The project team's competence was assessed using the IPMA OCB and IPMA ICB 4 models [1,2].

Table 1.

Results of assessment competencies level according to Benchmark of project success

Competencies by domain	Assessment level	Benchmark
Cognitive Intelligence		
Acquisitions of knowledge	9	7
Creativity and Innovation	8	7
Artificial Intelligence	8	7
Modeling by vision	9	7
Social Intelligence		
Empathy	9	7
Influence	8	7
Networking	8	7
Team Leadership	6	7

Emotional Intelligence		
Result Orientation	8	7
Initiative	8	7
Flexibility	7	7
Self-Confidence	8	7
Business intelligence		
Strategy	8	7
Culture and Values	8	7
Planning and Control	7	7
Opportunity and Risk	8	7
Technical intelligence		
The vision of the product and result,	8	7
Technical, technological and organizational solutions in the implementation of the project,	7	7
Work in conditions of uncertainty and innovation,	8	7
Clear definition of boundaries and work with the context	7	7

As the result of analyses, there are two competencies, where the assessment level is low than Benchmark.

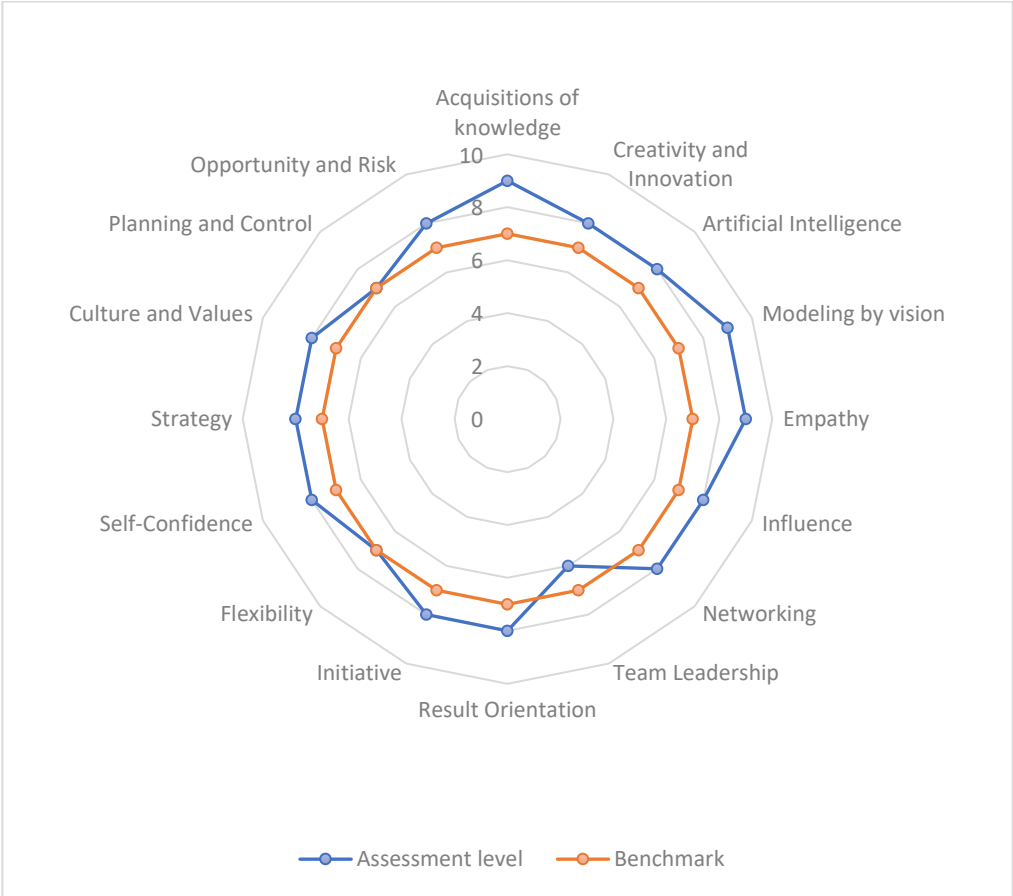

Figure 2: Results of the case study of assessment by SMART Intelligence model of competencies for Innovation Projects success

As the result of analyses, there is competence, where the assessment level is lower than Benchmark. It is Team Leadership competence. To be successful project team need to improve this competence.

The project manager decided on the initial step to organize 3 pieces of training for the project team. The first training was devoted to the development of the initiative of the innovation project team. The

second concerned leadership. The third training improves Artificial Intelligence competence. As a result, the assessment of the team's competence has changed significantly and is given in Table 2.

Table 2.
Results of assessment competencies level according to Benchmark of project success

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Artificial Intelligence	8	6
Modeling by vision	7	6
Social Intelligence		
Empathy	7	6
Influence	8	6
Networking	8	6
Team Leadership	9	6
Emotional Intelligence		
Result Orientation	7	6
Initiative	7	6
Flexibility	7	6
Self-Confidence	8	6
Business intelligence		
Strategy	8	6
Culture and Values	7	6
Planning and Control	7	6
Opportunity and Risk	8	6
Technical intelligence		
The vision of the product and result,	8	6
Technical, technological and organizational solutions in the implementation of the project,	7	6
Work in conditions of uncertainty and innovation,	7	6
Clear definition of boundaries and work with the context	8	6

The results of the evaluation of Innovation competencies compared to the benchmark are shown in Figure 3.

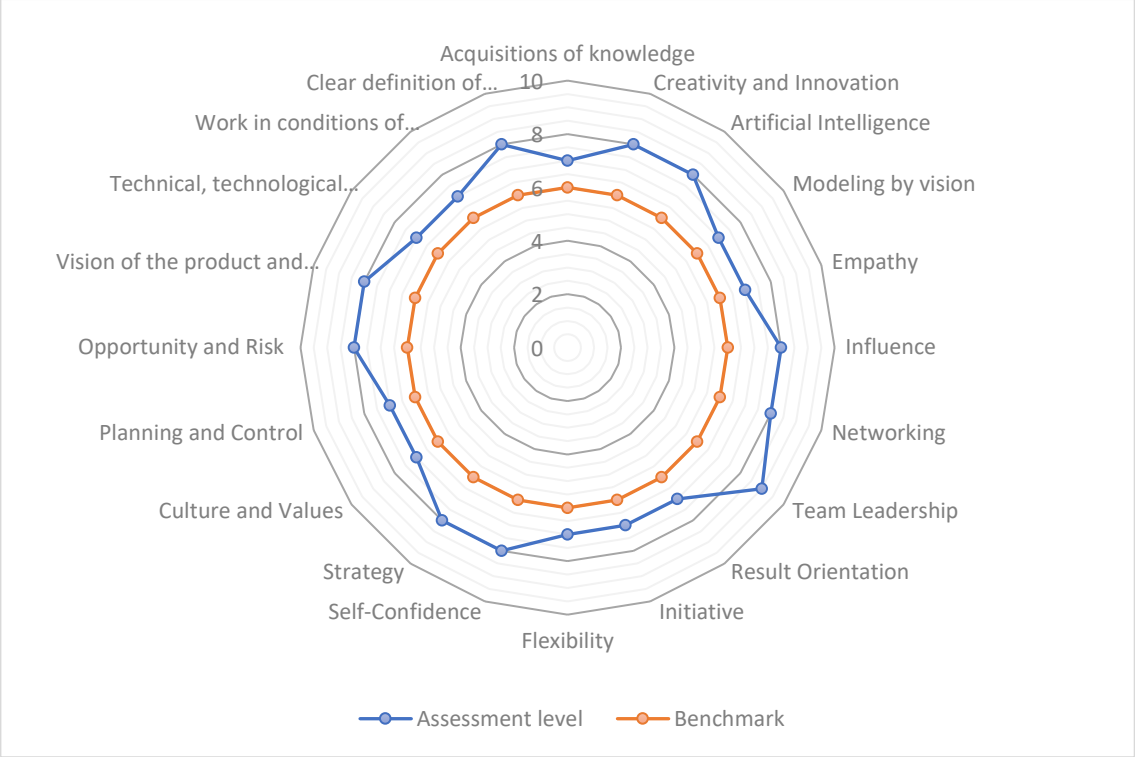

Figure 3: Results of the case study of assessment by SMART Intelligence model of competencies for Innovation Projects success

As the result of the training of the project team, the assessments of innovation competencies in almost all cases exceeded the level of the benchmark. This indicates the readiness of the project team for its successful implementation.

4. Intelligence didactic and competencies model

Three structural parts of the intelligence didactic model are:

- the teaching information includes module and type, topic, theme, corresponding module, corresponding subjects, and health objectives;
- the contents refer to the structure of the teaching example which includes different steps and tasks;
- the steps describe the main phases of the teaching example. Moreover, these steps are divided into different tasks which correspond to the objectives of the teaching example;
- the warm-up and cool-down phases are only described when they are part of the main subject;
- additional information includes the references and offers links and other information.

Didactic concept based on the set of competencies. The structural elements of learning and outcomes are teaching, understanding, generalization and use. The logic of the learning process, therefore, is to move from the presentation of the material through explanation to understanding and generalization. It is easy to see in this scheme most of the lessons today.

Let's discuss the application of the didactic concept.

Contemporary concepts applications are including:

- programming of the educational process;
- problem learning;
- developmental training;
- cognitive technology;
- cooperation pedagogy;

– cybernetic learning concept.

Let's look at the set of competencies for the master's degree Education Program "Cognitive technology" which was implemented at Kyiv National University of Construction and Architecture. There are three groups of competencies. Assessment of the level of competencies for two groups done by IPMA OCB model [2] in the group of 15 students in 2021.

The first group of SMART competencies:

– degree of clarity: selection of information, its understanding and in-depth study;
– degree of association: the connection of new information with existing knowledge;
– degree of the system: formulation of concepts, conclusions, laws;
– degree of the method: understanding the theory, using it in new conditions, phenomena and situations.

Assessment of competencies by SMART Intelligence model for the first group of competencies is shown in fig 4.

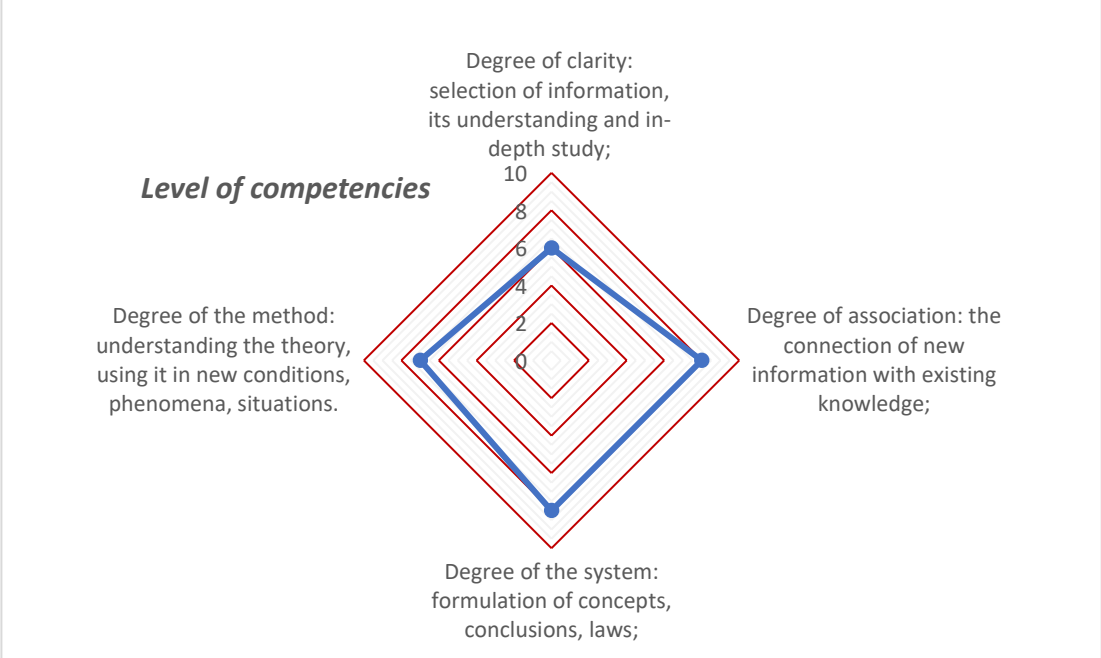

Figure 4: Assessment of competencies by SMART Intelligence model for the first group of competencies

Second group SMART competencies:

– ability to abstract thinking, analysis and synthesis;
– ability to communicate in a foreign language;
– ability to conduct research at the appropriate level;
– ability to learn and master modern knowledge.

Third group SMART competencies:

– ability to search, process and analyze information from various sources;
– ability to generate new ideas (creativity);
– ability to identify, pose and solve problems;
– ability to make informed decisions.

Assessment of competencies by SMART Intelligence model for the third group of competencies is shown in fig 5.

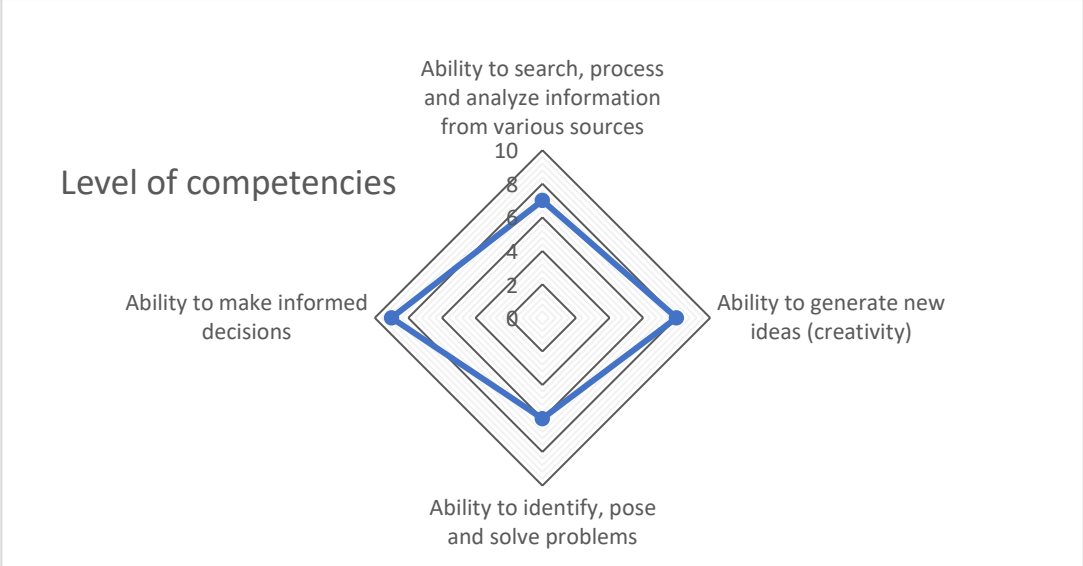

Figure 5: Assessment of competencies by SMART Intelligence model for the third group of competencies

Program outcomes consist of the following educational results:

- to know and be able to apply in practice the methods of system analysis, methods of mathematical and information modeling for the construction and study of models of objects and processes of informatization;
- know the methods of forecasting the dynamics of processes of different nature, be able to develop forecasting functions;
- know and be able to apply risk measures, assess them and use them in the analysis of multifactorial risks of accidents and catastrophes;
- to know and be able to apply methods of evolutionary modeling and genetic methods of optimization, methods of inductive modeling and mathematical apparatus of fuzzy logic, neural networks, game theory and distributed artificial intelligence, etc.

5. Conclusion

The proposed SMART Intelligence Competencies model for managing Innovation Projects includes five domains of competencies. These domains are the cognitive, emotional, social, business and technical competencies. Each domain has a set of competencies.

SMARTification process gives the possibility to develop Intelligence mechanisms for the SMART model.

To support of the success an innovation project, a benchmark level of competencies assessment is used. It allows to identify the low level of some competencies and, at the stage of project initiation, plan the necessary corrective actions to develop insufficient project competencies.

The example of the program for the preparation of masters with double diplomas confirmed the effectiveness of the proposed model.

The given step by step process model allows to successfully carry out innovation projects.

The following issues should be highlighted as areas for future research:

- SMARTification of competence domain by intelligence mechanisms for managing innovation projects;
- SMATR mechanism of managing the uncertainty in the value creation process of innovation project;

- creation of effective competence assessment models and tools for each domain of competence.

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