# Integrated Intelligence Model for Managing IT Projects

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**Abstract**

An analysis of existing models for the formation, evaluation and development of IT project management competencies has shown the practical absence of research in this area of knowledge. A conceptual model of IT competencies in the management of innovative projects and programs is presented. The model is based on four interconnected areas of IT competencies - Emotional Intelligence, Social Intelligence, Cognitive Intelligence, Managerial Intelligence and technical. Within each area, sets of competencies that support the implementation of IT projects are defined. A case of applying this model to the implementation driven by Agile methodology of the double degree project of the Kyiv National University of Construction 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**

Managing IT projects, Integrated intelligence model, Competencies, Innovation

## 1. Introduction

Modern approaches to the development of competencies in the context of innovative approaches and the implementation of IT projects and programs do not demonstrate effectiveness, form several gaps in the required competencies and do not have intellectual support for models. It follows from this that a new approach is needed to model the systems of competencies of innovative projects and programs that implement IT technologies. IT projects have significant specifics and require special competencies aimed at emotional, social, cognitive and managerial areas in the form of a holistic model. Such a model should ensure the success of IT projects based on the balance of these competencies. At the same time, the created values of IT projects should actively migrate among the stakeholders. The acquired new knowledge creates the foundation for new IT projects.

The creative activity of man, which transforms nature, as a consequence, hinders and inhibits the creative activity of the cause, i.e. nature, which seeks to improve man. A hypothetical way to solve this problem is to clarify the fundamental difference between the level of innovative technology used by nature and which so far man has been able to master. The cognitive process, evolving and improving in itself, aimed at simply expanding needs, may need to be adjusted concerning the unknown motives of nature's behaviour. The emergence of information systems promises to provide a means of flexible expansion of innovative resources in the construction industry, which can point the way to the transition to such innovative technologies that do not conflict with existing regulations and standards. These conclusions should be considered at the level of hypotheses. The time has come for the development of society when it is necessary to flexibly adapt their innovative technologies to natural ones to prevent and avoid global troubles.



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The vast majority of man-made technologies are based on the imitation and copying of various natural processes and phenomena. Agile technologies are no exception, they try to model the creative behaviour of the manager and are based on deep historical traditions of different cultures. Previously, the main object of various innovative technologies in construction was an individual or group, the task was to accumulate knowledge, and organize new behaviour in adverse external conditions. The traditions of these schools cover various aspects of activity: philosophy, preaching, commerce, intelligence, diplomacy, and politics. Now, in connection with the rapid development of information technology, a new association has emerged, consisting of the deeper use of computer systems and networks in innovation: artificial intelligence systems, and expert systems. The trend of such penetration is significantly growing and expanding, so there is a need for a new organization of construction activities with the wide involvement of information technology.

## 2. Analysis of recent research and publication

Management of the formation of IT competencies is systematic processes, creation, preservation, and distribution, which are used as elements of intellectual capital necessary for the success of the organization in competition. At the same time, special importance is attached to the strategy of effective use of intellectual assets to increase productivity, and efficiency and create new values. As a basic model of competencies, the authors propose to use the standards, IPMA OCB [1] and IPMA ICB 4.0 [2], P2M [9], and Agile [15].

The intelligence models and methods for managing IT projects are tools for creating an effective system of competencies for project management teams [10]. Intellectual competencies form the core of project management in general. In the process of managing IT projects, such a core plays a decisive role in their success. In [4] the following products are defined: analytical, search, knowledge products and systems products [3]. Each type of product of intellectual activity makes it possible to form potential IT competencies in the management of innovative projects [11, 12].

Analytic products include results analysis, research area structure analysis, IT technology market profile, network analysis, risk and opportunity analysis, goal profile, and rapid assessment of the state and prospects of projects [4, 13].

The search products are associated with the uncertainty, variety and quality of information [5,6].

Knowledge products serve as a basis for further development of the model itself and quality maintenance and balancing socio-cognitive space [7].

The system products are designed to ensure that the appropriate IT models are available for its efficient operation and to minimize inefficient practices such as the use of multiple information systems platforms [8,14].

The proposed model identifies the following groups of competencies:

1. Leadership and commitment;
2. Setting goals and coordinating teams;
3. Standardization and creativity;
4. Intelligent analytics.

The intelligence assessment of the competencies of IT projects would allow sharing between stakeholders to be done more easily, benefiting all parties.

Consider the key principles of Agile transformation in the organization:

1. Ignoring immunity to change

Transformation in an organization occurs only when the people in it change.

But people do not change, even if they want to. Remember your New Year's promises. Many do not even make plans, because they remember how bitter it was to realize that for a year and did not activate the season ticket to the gym or not take up their English. People do not change, even if they are threatened with death. It turned out that when cardiologists warn patients that they will die if they do not change their lifestyle (do not go on a diet, do not exercise, do not quit smoking), only one in seven patients changes their lives.

We have immunity to change: we reject the new, the unknown and cling to habitual beliefs. Immunity protects against fears.

2. Fear of becoming unnecessary to the company. Fear of losing authority and status. Fear of losing yourself.

When we try to change the thinking, behaviour, and culture in the organization, we are faced with this immunity, and therefore any change is difficult, painful and long.

We do the simple, we don't do the important

Where will cross-functional teams come from if we have 1-2 independent professionals and an army of assistants in each region?

Where will self-organization come from, if in fact, we have strict subordination?

Where will teamwork come from if motivation and reward are individual?

How will employees suddenly become happy if we do not give them resources, do not remove bureaucratic obstacles in their work, but only add more control, rallies and Agile - coaches?

We put aside complex and key things, those that meet a lot of resistance and make it interesting and enjoyable. It is much more interesting to organize pieces of training, stick stickers, and hold demo days and team sessions, rather than rebuild motivation and hiring systems.

Cognitive analysis and modelling are used in studies of organizational systems development as tools. The purpose of cognitive modelling is to generate and test a model of the observed situation in the system to obtain a system model that can explain its behaviour in the observed situation and development. It is the presence of the human factor, for various manifestations of which it is almost impossible to build accurate mathematical models, that allows us to consider the following system poorly structured system.

Dissatisfaction with the level of trust in the organization is often perceived by management, but ideas about the causes and possible ways to change the situation in the system are vague and contradictory. If we manage to formalize these ideas, it is possible to develop models and methods of decision-making in poorly structured situations of trust formation.

It is sometimes said that management is a successful experience. But the experience of management is well accumulated under two conditions:

- the problem situation has a verbal description, a formalized idea;
- there are many cases of confirmation of experience to deduce patterns.

Cognitive maps, allowing you to display subjective perceptions of the studied situation, are ways to formalize the idea of the studied situation of trust in the system. Instead of spatial relations in it, as a rule, the relations of influence, causality, and passing of events are allocated.

Research and reflection on changes in the situation over time (compiling a sequence of cognitive models allows you to gain experience in analyzing and managing the situation).

Most often, the cognitive map is presented in the form of a weighted graph, in which the vertices are compared factors, and the edges - are the weight of a school.

$$G = [V, E],$$

where $V$ is the set of vertices (concepts);

the vertices $Vi$ belong to the set $V$,

$i = 1, 2, ..., k$ are elements of the system under study;

$E$ - many arcs, arcs reflect the relationship between the vertices. Arcs are weighted by indicators of trust and communications.

Vertices $V$ most often indicate a qualitative representation of the system element.

Among the identified five types of cognitive maps by the type of relationships used to study the problems of trust formation and study the causes of conflicts, it is advisable to use cognitive maps that represent the impact, causality and system dynamics (causal cognitive maps).

The study of the interaction of factors allows us to assess the spread of influence on the cognitive map and changes in their state (value). Analysis of cognitive maps allows to identify the structures of the problem (system), find the most significant factors influencing it, to assess the influence of factors on each other. The task of analyzing situations based on cognitive maps can be divided into

Given the specifics of modern organizations, it should be borne in mind that, due to increasing globalization, small groups can be virtual teams, i.e. representatives of small groups can be removed territorially and may exist in different national cultures. The possible territorial remoteness of team

members requires increased attention to the mechanisms of coordination of actions of members of territorially distributed teams.

Representatives of different centres of influence can be distributed in the company territorially (ie belong to different elements of the OBS). That is, a team working together is not necessarily a team whose members work together. That is, the interaction of members of such teams can often be built only verbally. Modern information technology allows you to create virtual teams for employees of geographically distributed offices to jointly participate in the implementation of organizational development programs [17].

The task of building trust in virtual teams is quite new for many modern companies. In such conditions, when building trust, much attention is paid to creating a single database for decision-making, knowledge bases necessary for building community and understanding the value of diversity. Virtual cooperation largely depends on the level of trust and the shared vision and the provision of publicly available principles of business. One of the approaches to building trust can be, in particular, additional efforts to adapt methods of doing business depending on the uniqueness of national cultures, ethical principles, the legal framework of specific countries, differences in levels of economic development and, consequently, methods of remuneration.

Lack of informal communication, language barriers, and differences in national cultural traditions, including differences in ethical norms and laws of countries can often serve as barriers to establishing trust. Methods of building trust for virtual teams have their specifics. Arrangements for joint work are formalized first, there should be no situations where the rules of interaction are determined intuitively. Proposing, discussing and accepting a set of rules and regulations by virtual team members that allow and limit the actions of team members can provide a higher level of trust.

For the elements of the system identified in the model - small groups of stakeholders, homogeneity is formed, formed on a professional basis or is related to the specifics of the tasks. Therefore, it is necessary to take into account the differences in the subcultures of groups related to their professional activities. It makes sense to measure the professional homogeneity of the group, the index of professional cohesion, and the sociometric professional status of group members. At least one feature must be recognized and significant for team members, it was homogeneous.

The professional homogeneity index of the group is defined as the ratio of positive, negative and neutral (zero) interpersonal assessments obtained during group testing. The group can be characterized by low, medium or high professionalism.

The mathematical record of the formula for calculating the index ($I_{hom}$) looks like this:

$$I_{hom} = [(A_{FP} - O_{bo}) / [N_{rp} * (N_{rp} - 1))] * 100\%,$$

where $A_{FP}$ is the number of mutually positive evaluations;

$O_{bo}$ the number of mutually negative evaluations;

$N_{rp}$ - the number of members of the test group.

The sociogram constructed based on results of testing in the group will allow visualizing a condition of the group from the point of view of its homogeneity. Since the team must be homogeneous on at least one basis, recognized and important to team members, it is possible to study its homogeneity not only on a professional basis but also on any other basis, for example, it may be an indicator of creative homogeneity.

Similarly, the degree of trust of group members in each other can be examined.

Typical mistakes of managers when creating a team:

Experts have identified some common mistakes made by managers when creating a team:

1. Selection of the team on the principle of "psychological compatibility". It is much more important to unite the team based on a common goal and joint activities.
2. Reformation of formed groups on the principle of potential "psychological compatibility". "It destroys the foundations of the team - the experience of interaction and the experience of strengthening each other." In the new team, the resistance of the conscious and the unconscious will be great. It is much more effective to use the experience of interaction in new conditions.
3. Underestimation of the value of diversity. Groups made up of dissimilar individuals are more effective than groups with similar views. Understanding the value of diversity helps to improve relationships between team members and, consequently, strengthens trust in a small group.

Group cohesion is a measure of the mutual attraction of group members to each other and the group. Cohesion is expressed in the desire to stay in the group, in the desire to cooperate in solving common problems and to preserve the group. The more cohesive the group, the tighter group control over the views and actions of its members. An atmosphere of attentiveness and mutual support is created in a close-knit group. The downside of excessive cohesion is the reluctance of its members to think critically and make serious decisions due to the development of the group's unanimity. This tendency arises due to the tendency to conformism. (Optional: On conformism: a person with a higher intellectual level is less conformist than a person with a low intellectual level. An educated person is also usually confident in the accuracy of his statement and does not feel the need for support from the group).

When a group becomes too cohesive and has common expectations, the following flaws arise in the decision-making process:

1. Group decisions have a small number of options, opportunities outside this range are rejected or not considered at all.
2. Initially set goals are not reviewed or challenged.
3. Newly identified risks shall not be taken into account so as not to call into question the course of action initially chosen.
4. The courses of action rejected by the group from the beginning are not considered again in the light of new information.
5. Experience and knowledge of external experts are not involved.
6. When new information is discovered, the group gives priority to information that supports its initial hypotheses and ignores conflicting information.
7. The group does not think about how bureaucratic inertia or resistance of the organization can hinder the implementation of the chosen political line.

## 3. Integrated intelligent model for managing IT projects

In real practice project managers apply a conceptual model with four 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;
4. Business intelligence (BI) competencies like Strategy, Culture and Values, Planning and Control, Opportunity and Risk Management;
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.

The five-domain conceptual model of competencies for IT Projects is shown in Fig. 1.

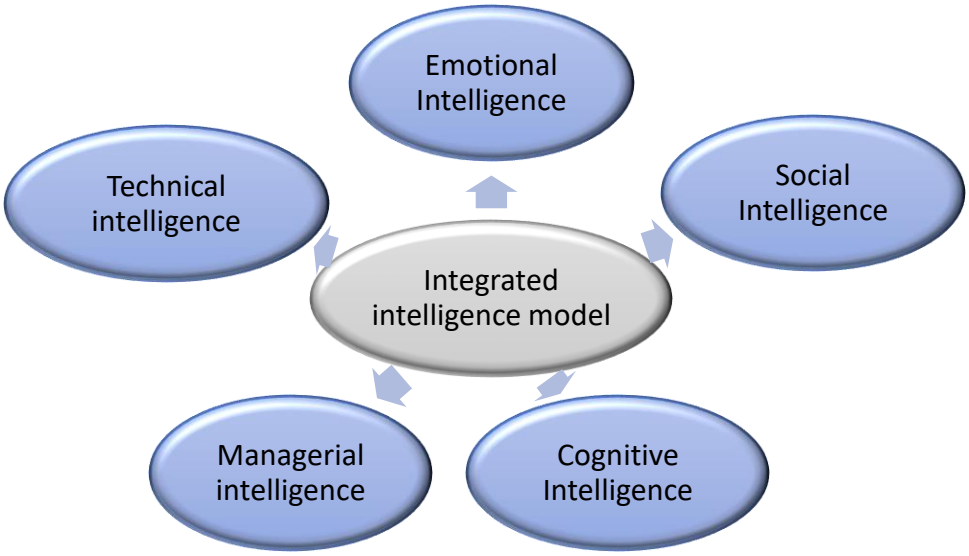


**Figure1:** The Integrated intelligence model five-domain for managing IT Projects

The transformation of the Integrated intelligence model to the competence dimensions show on the fig. 2. In the middle, if this model is Agile methodology as the integrator of all competencies.

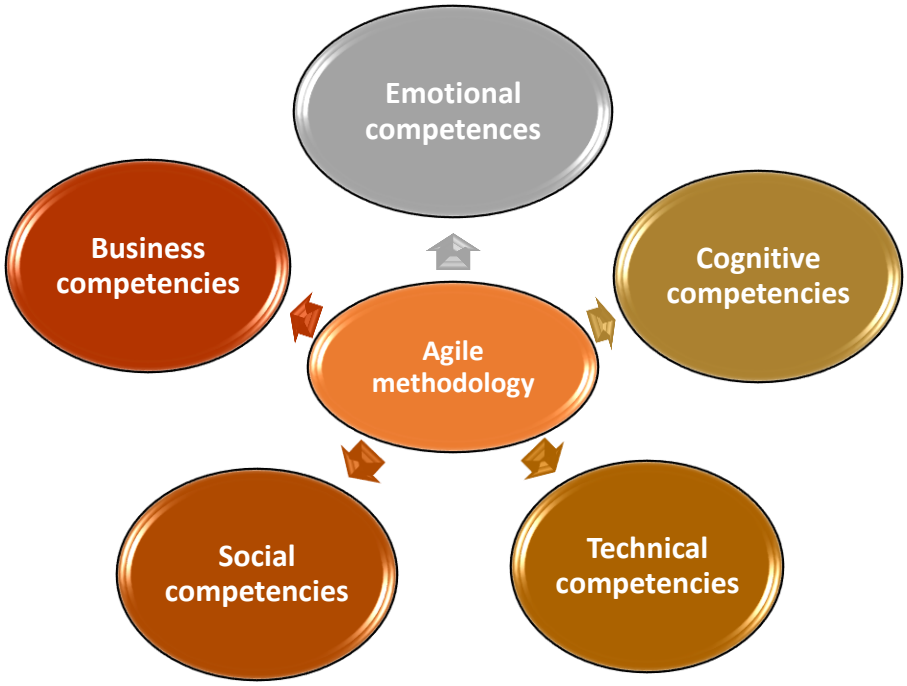


**Figure2:** The Competencies of the Integrated intelligence model for managing IT Projects

Let's define the formula for the success of projects based on IT competencies and the proposed concept.

Use the concept of "Emotional energy" based on the EI of the project manager and the project team.

Let us single out two emotional states of the project manager and the team “As is” before emotional infection and “As will be” after emotional infection. At the same time, the team develops such competencies as leadership, self-confidence, and result orientation.

The second component of the model is "Entrepreneurial potential" as one of the resources influencing the SI.

The third component of the model is the level of IT (innovative) maturity of the project team based on Cognitive readiness.

The fourth component defines Managerial competence (MI) and plays the role of integrator of all grope of competencies in IT projects [16].

Let's look at the case 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 grope of 20 students had been assessed according to the five domain conceptual model of IT 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 |
|---|---|---|
| **Emotional Intelligence** | | |
| Result Orientation | 7 | 6 |
| Initiative | 6 | 6 |
| Flexibility | 7 | 6 |
| Self-Confidence | 8 | 6 |
| **Social Intelligence** | | |
| Empathy | 8 | 6 |
| Influence | 9 | 6 |
| Networking | 7 | 6 |
| Team Leadership | 7 | 6 |
| **Cognitive Intelligence** | | |
| Acquisitions of knowledge | 6 | 6 |
| Creativity and Innovation | 5 | 6 |
| Artificial Intelligence | 8 | 6 |
| Modelling by vision | 7 | 6 |
| **Business intelligence** | | |
| Strategy | 7 | 6 |
| Culture and Values | 6 | 6 |
| Planning and Control | 8 | 6 |
| Opportunity and Risk | 9 | 6 |
| **Technical intelligence** | | |
| The vision of the product and result, | 7 | 6 |
| Technical, technological and organizational solutions in the implementation of the project, | 8 | 6 |
| Work in conditions of uncertainty and innovation, | 7 | 6 |
| Clear definition of boundaries and work with the context | 5 | 6 |

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


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

As the result of analyses, there are 2 competencies, where the assessment level is low the Benchmark. These are Creativity and Innovation and a Clear definition of boundaries and work with the context. To be successful project team need to improve these three competencies.

The project manager decided on the initial step to organize 2 pieces of training for the project team. The first training was devoted to the development of the creativity and innovation project team. The second concerned definition of boundaries and work with the context. The third training improves Technical 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

| Competencies by domain | Assessment level | Benchmark |
|---|---|---|
| **Emotional Intelligence** | | |
| Result Orientation | 7 | 6 |
| Initiative | 6 | 6 |
| Flexibility | 7 | 6 |
| Self-Confidence | 8 | 6 |
| **Social Intelligence** | | |
| Empathy | 8 | 6 |
| Influence | 9 | 6 |
| Networking | 7 | 6 |
| Team Leadership | 7 | 6 |
| **Cognitive Intelligence** | | |
| Acquisitions of knowledge | 6 | 6 |

| | | |
|---|---|---|
| Creativity and Innovation | 8 | 6 |
| Artificial Intelligence | 8 | 6 |
| Modelling by vision | 7 | 6 |
| **Business intelligence** | | |
| Strategy | 7 | 6 |
| Culture and Values | 6 | 6 |
| Planning and Control | 8 | 6 |
| Opportunity and Risk | 9 | 6 |
| **Technical intelligence** | | |
| The vision of the product and result, | 7 | 6 |
| Technical, technological and organizational solutions in the implementation of the project, | 8 | 6 |
| Work in conditions of uncertainty and innovation, | 7 | 6 |
| Clear definition of boundaries and work with the context | 7 | 6 |

The results of the evaluation of Innovation competencies compared to the benchmark are shown in Figure 4.


**Figure 4:** Results of the case study of assessment by Integrated Intelligence model of competencies for Innovation Projects success

As a 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. The general process of application Integrated intelligence model for managing IT Projects

Let's discuss step by step process for the application proposed conceptual model of competencies for IT Projects' success.

*Work break down the structure* of the IT Projects

**Step 1. Initiation**
1.1. Definition of the Mission, vision and expected result of an IT project. Profiling project goals
1.2. Installing a benchmark by directions
1.3. Generation of alternative directions for IT projects
1.4. Entropy estimation for each direction
1.5. Breakout Direction Choice
1.6. Assessment of the competence of each member of the project team and the team as a whole

**Step 2. Implementation**
2.1. Competence gap analysis of the team and the benchmark
2.2. Formation of an operational training program for an IT project team
2.3. Using the conceptual model of IT competencies for the successful implementation of the project
2.4. If the goals are not achieved, the next alternative is selected and Step 1 is repeated.

**Step 3. Closing down**
3.1. Results assessment
3.2. Lesson learns
3.3. Good practice

After achieving the goal of an IT project, a report is generated and an analysis of the level of competence of the project team is carried out.

## 5. Conclusion

The proposed conceptual model of competencies for IT Projects' success covers four interrelated competencies. These areas are guided by the emotional state of the project team, social status, and cognitive and managerial capabilities.

To analyze the success of an IT project, a benchmark assessment is used, which allows you to identify problematic competencies and, at the stage of project initiation, plan the necessary corrective actions to develop insufficient project competencies.

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

The typical work structure given in the article allows you to successfully carry out IT projects.

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

- generation of alternative directions for IT projects;
- building an entropy model for managing the uncertainty of an IT project;
- substantiation of the level of benchmarks in different areas of competence.

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