UDC 330.322:658
DOI: 10.15587/1729-4061.2018.151863

FORMALIZATION OF SELECTION OF CONTRACT-ORGANIZATIONAL PROJECT DELIVERY STRATEGY

O. Bugrov
PhD, Associate Professor
Department of project management
Kyiv National University of Construction and Architecture
Povitroflotsky ave., 31, Kyiv, Ukraine, 03037
E-mail: bugrov.oleksandr@gmail.com

O. Bugrova
PhD, Associate Professor
Department of Economic Theory
National University of Kyiv-Mohyla Academy
Skovorody str., 2, Kyiv, Ukraine, 04070
E-mail: bugrova.olena@gmail.com

Розроблено формалізовану систему вибору стратегії здійснення проекту капітального будівництва. Це важливо, тому що помилка при прийнятті стратегічного рішення (інтуїтивним, не формалізованим шляхом) критично впливає на подальший перебіг подій по проекту і зазвичай не може бути виправленою зусиллями тактичного і оперативного управління. В рамках всього спектра стратегій було визначено низку тих, які мають характерні ознаки, і через це специфічно впливають на результати проектів. Дискретність поля альтернатив дає можливість уникати «розмитості» при прийнятті рішення про найбільш доцільну стратегію. Система набула уніфікованості шляхом виокремлення в ній двох елементів: (1) змінного (рухомого) контексту, який розпізнає особливості певної бізнес-ситуації та специфіку аналізованого проекту, (2) постійного (нерухомого), який відображає властивості кожної з альтернативних стратегій. Бізнес-процес порівняльного аналізу побудований у три етапи: оцінка зрілості організації, ідентифікація рівня розвиненості ринку, визначення пріоритетів по проекту та відповідності комплексу пріоритетів профілям ключових організаційно-контрактних моделей. Перший етап дає відповідь на питання: «Чи слідувати багатоваріантній організаційній схемі проектного менеджменту?», другий – «Чи доцільно у відповідній ситуації запроваджувати IPD?», третій – «Якій з організаційно-контрактних моделей аналізованому проекту варто слідувати?» В такий спосіб концептуальна модель віддзеркалює всі наявні альтернативи характерних стратегій, які застосовуються міжнародними кращими практиками. Загальна кількість ключових, базових організаційно-контрактних альтернатив становить 26 стратегій. Як проектний простір, так і поле стратегічних альтернатив, концептуальною моделлю відображено в єдиній системі координат "час-витрати-цінність-ризик". Формалізований інструментарій сформував систему оцінювання проектних договірно-організаційних моделей COMPAS. Формалізована система дозволяє приймати однозначні обґрунтовані рішення щодо стратегій виконання проектів, що на практиці призводитиме до кращих проектних результатів

Ключові слова: інжиніринг бізнес-процесів, багатокритеріальний аналіз, прийняття стратегічних рішень, моделі виконання проектів

1. Introduction

Management covers strategic, tactical, and operative control. In this case, the "foggiest" area is strategic management. Strategic decisions concern the most essential crucial tasks, are the first to be made for a long period and in advance when the degree of uncertainty is high. The theory and practice of management are arranged so that the higher you climb the pyramid of solution aggregation from operative control to the determined strategy, the less is the possibility to apply numerical methods. Strategic decision-making often relies more on intuition (and requires a certain art of company management) than on the rational model with the application of the mathematical apparatus.

At the same time, an error when making strategic decision critically influences the further course of project events and usually cannot be corrected by any efforts of the tactical and operative management.

The delivery of investment construction project can be carried out with the use of different types of contract-organizational strategies. Its outcome in the 4-dimensional space "time–costs–value–risk" depends on which model of project delivery will be chosen. Thus, the relevant scientific issue is formalization (mathematical algorithmizing) of the process of making well-grounded decisions in the field of selection of the most appropriate strategic project delivery model (for specific circumstances).

2. Literature review and problem statement

Strategic analysis is typically associated with such attributes as the identification and evaluation of the data concerning the strategy formulation, identification of the external and internal business environment factors, and application of an appropriate analytical method [1]. These components must compose the basis of the system for selecting the most appropriate strategy of delivery of an investment construction project.

In paper [2], it is stated that the key drivers, on which any construction project is concentrated, are time, costs, and quality. In addition, it was emphasized that a reasonable procurement strategy has intentionally meet the appropriate specific balance of these factors in the context of the requirements of a customer for a specific project. Thus, in this work, the factor of risks is not taken into consideration and the problem of the strategy choice is limited to only three dimensions of analysis. This may be caused by following the established approaches in this field.

In paper [3], it is noted that the additional tools were developed to decide on the recommended project delivery

© O. Bugrov, O. Bugrova, 2018

model (strategy), however, now there is no general methodological approach. These tools are based on determining the requirements and several criteria specific to a particular project and the estimation of contract-organizational models according to these criteria [3]. Thus, the problem is that these tools imply the development of the own evaluation models on every specific project, and a universal conceptual model has not been developed yet. Given the above, it is possible to put forward the hypothesis that the appropriate approach could involve determining a number (a matrix) of *mainly universal* criteria and the development of a flexible procedure to assess on their basis the compliance of each of the basic strategies with the purposes of a specific (unique) project. It should be also added that this approach can be effective only if analytical-evaluation system in general comprehensively takes into consideration the features of a project, its owner (construction initiator) and surrounding conditions of its implementation (the market state).

Each construction initiator needs to make an early and important decision about the strategy, according to which the site will be designed and built, that is, he must choose a project delivery method. In recent years, with the emergence of new contract-organizational methods, the initiators benefited from great flexibility of design priorities, however, it became more difficult to make a really correct decision. This solution can turn out both true and false. Each method has its advantages and disadvantages, it is easy enough to be confused in the course the comparative analysis of strategies [4]. Therefore, the models of analysis existing today do not give an opportunity to clearly determine the best contract-organizational alternative.

The models of evaluation of maturity of organizations (such as P3M3), among the others, make it possible to analyze currently existing opportunities of corporations on project implementation [5]. Since the factor of organizational maturity must be taken into consideration when deciding on a project delivery strategy, it is advisable to make the approach in these standards an element of the created conceptual model.

In procedure [6], it is proposed to select the most appropriate contract- organizational strategy of erecting a capital building by using three tools: estimation of capabilities of an initiator, market analysis and comparison of the project delivery models. However, the through interconnected algorithm and proper mathematical apparatus of decision making remained unidentified.

Most of very important decisions are taken at the initial stage of a project. This stage is characterized by high potential of selecting the right way, which, on the one hand, reduces the likelihood of negative influences, on the other hand, creates the preconditions for the project success [7]. This selection is potentially affected by a whole number of diverse factors.

In study [8], the multicriteria decision making model was found to include:

– identification of possible alternatives;

– determining a number of criteria for the evaluation of options;

– formation of the system of ratings of separate alternatives for each of these criteria;

– establishment of comparative importance (rank) of each of the criteria;

– formalization of determining the best of the alternatives;

– as well as, desirably, the appropriate analytical computer tool. It is advisable to form the model of selection of the best strategy of a construction project delivery on the specified basis.

Multi-Criteria Decision Making (MCDM), is one of the research areas, which attracted the attention of scholars and practitioners. This problem is relevant because it concerns a difficult question of selection based of conflicting criteria; the application of new models often leads to other conclusions [9]. Thus, the improvement and appropriate formalization of the decision-making model (in this case regarding the selection of the most appropriate project delivery strategy) will help improve the results of investment construction projects.

The project delivery strategies (systems), PDSs, are the key means of creating favorable conditions for the success of capital construction projects. Several relevant recommendations on the problems of rational implementation of alternative strategies were created [10]. However, these achievements do not give proper formalization of the numerical comparative analysis of application of different PDSs in terms of management maturity, the market state, and the properties of the respective procurement strategies. Therefore, this scientific-practical field requires further research and improvement.

In paper [11], the advantages of integrated project delivery methods (strategies) are highlighted. It is also noted there that these strategies emerged because the traditional methods demonstrated their lack of effectiveness. This position, however, is somewhat simplified because the traditional methods for some of the specific projects and the relevant circumstances are most effective. It was proved in practice. At the same time, the task of each initiator of the construction is to determine the most appropriate project delivery strategy for a specific project, which causes the relevance and importance of the development of advanced toolset of decision-making on this issue.

The research into publications on the enumeration of the criteria for selecting the most appropriate project delivery model, presented in [12], can make one think that this list must be individual for every single project. The reasons determining such a point of view, specifically, can include such factors as uniqueness of each project, complexity of interrelations between different criteria, ambiguity of determining the properties of separate project delivery models, etc. However, this position appears logical only if the insufficiently clear and comprehensive methods/procedures for making decisions on relevant issues are used. Moreover, the given approach itself is a certain artificial obstacle in the efforts to create a unified flexible conceptual model of selecting the best strategy (almost for any individual project). It should also be noted that although all the projects certainly are different, all of them are implemented in the same coordinate system of conditions, characteristics, and goals. The scientific objective is to determine such a well-grounded coordinate system and the elaboration of the algorithm for choosing in it the strategic path that predictably will be the most advisable for achieving success in a specific project.

The study [13] offers a comparison of performance of common project delivery systems and analysis of the factors that affect the application of the integrated project strategy (IPD). Along with this, no quantitative assessment was given to the specified comparative characteristics and factors.

The project success strategically depends not only on the type of model of its implementation, as well as on a number of other factors. Specifically, the results are influenced by the application of different approaches of the early contractor involvement – ECI [14], the mechanisms for determining the contract price and the amounts to be paid to the contractor, etc. We should also note that none of the pricing mechanisms is specific to any project delivery method [4]. Along with this, it should be emphasized that too branched range of possible different alternatives can make a formalized model (system) for appropriate decision making impractical. Therefore, the created conceptual model must be aimed at the analysis of only a deliberately limited number of alternatives.

In paper [15], it is noted that the system (model) of construction project implementation often is selected based on the established traditions and own experience of individuals who make this strategic decision. This contributes to the fact that usual, chronic problems can subsequently by repeated in the following projects. This makes it possible to argue that the formalized, standardized, and flexible toolkit of selection of the best contract-organizational alternatives could help improve the situation.

The above literature review shows that despite the existence of such research results as the procedure of analysis of alternatives and auxiliary tools of making appropriate decisions on specific projects, there is no uniform, comprehensively formalized conceptual model of selection of a project delivery strategy.

3. The aim and objectives of the study

The aim of this work is to develop a unified system for the selection of the project delivery model, which would ensure making well-grounded decisions based on a completely formalized process.

To accomplish the aim, the following tasks have been set:

– to identify the attributes of the unified template-system of selection of a project delivery model;

– to propose an improved structure for the process of comparative analysis of strategic alternatives taking into consideration the external and internal business and project environment;

– to develop an appropriate formalized toolset and test it on a business case.

4. The attributes of a unified comprehensive system for selecting a project delivery strategy

The project delivery strategies (models) are alternative institutional mechanisms of achieving desired project results. Establishing a certain procedure of involvement of project executors with a typical distribution of functions between them and the initiator of a construction site, each of these strategies takes on its characteristic properties. The selection of the most appropriate alternative strategies for the implementation of each specific project makes it possible to organize a project cycle in the way that has the greatest potential for completing the project with the maximum success. Thus, the selection system should adequately reflect the best practices and be integral, logical, convenient, open, visualized, and flexible.

In the case of supplementing the three-dimensional space "time–costs–quality" with the fourth dimension – a factor of project risks, a formalized system of determining the most appropriate project delivery strategy becomes more focused (that is, analysis and evaluation allow reaching more grounded and unambiguous decision). At the same time, if the specified system is "enriched" by even greater number of project dimensions, the model loses visibility, sustainability, appropriate simplicity and practical algorithmizing. Therefore, it is advisable to construct the analytical system so that the number of its measurements should coincide with the corresponding Universe number, where the dimension of time (which forms spatial-temporal continuum) is added to three dimensions of space. Full compliance of the created system with the range of best practices, applied in the field, can be achieved thanks to other two links of the decision making – regarding analysis of the initiator (internal state) and the market (external environment).

A conceptual model (template system) of selecting the most appropriate project delivery strategy should have the following attributes (feature components):

– a classification (typology) of the basic project delivery models/strategies (including the multi-option profiles of IPD and project management) with determining the features of each of them;

– selection of criteria (both for each analysis stage, and in the 4-dimensional space "time–costs–value–risk");

– a general through algorithm of making appropriate decision (which includes assessment of the degree of maturity of a company, the level of market development and dimensions of project space);

– a comparative metrics of properties of alternative models/strategies (in numerical measurements);

– a formalized procedure for making a reasonable strategic decision based on numerical evaluation of the ranks of criteria and rankings of alternatives;

– a computer template-tool, corresponding to the above points, which can be used for almost any specific project.

Gestalt (integrative structure, completed scheme) of a conceptual model should contribute to substantiation and reliability of the correct choice by realistic display of the features of different mechanisms of interaction between the project stakeholders in the context of liability, risk, and reward distribution.

5. Structure of the process for analysis of alternatives (the architecture of a conceptual model)

The process of engineering and implementation of a capital construction project is quite lengthy and comprehensive. One of the factors that determine it is an objective complexity of organization of relations between stakeholders of a project. The distribution of risks, liabilities and powers, the degree of responsibility and reward (benefit) of each stakeholder depend on the way these relations are built. In addition, a project delivery strategy determines the moment of involvement of appropriate stakeholders, the degree and nature of coordination and cooperation of the work of an initiator, contractors, a designer, suppliers, etc. The above exerts an irreversible effect on the project results in terms of deadlines, costs, and quality (value).

Thus, the structure of the conceptual model of selection of a project delivery strategy should be based on the typology of such strategies. On the other hand, an important prerequisite of construction of a proper model is the following statement. Life Cycle Engineering (LCE) is the concept that focuses on markets, consumers, and supply chains [8]. In the context of the aim of this study, it should be emphasized that the mentioned elements of LCE focus clearly correspond to three areas of analysis "state of risk–maturity of an initiator–performance scheme" during making a strategic decision on the most appropriate project delivery strategy.

In other words, when structuring the corresponding conceptual model, the following should be taken into consideration. Achievement of the appropriate level of functioning of business depends on understanding the internal capabilities of an organization and its external environment, as well as on the appropriate marketing strategy [17]. Similarly, the success of a capital construction project depends on the rational consideration of maturity of the client company, the existing market conditions, and the applied contract-organizational strategy (which is focused on the identified project priorities).

The proposed classification, based on the arguments given in [18], singles out 6+1 "characteristic" types of the project delivery systems:

– *The system of involvement of several contractors*. In this system, working documents are developed by separate packages of works (package by package), and immediately after its readiness for a certain package of works, an appropriate specialized contractor is involved in project delivery (and so on, in turn, until all packages of work are completed).

– *The model of involvement of a contractor in construction management and subcontractors to perform certain complexes of work*. This profile implies signing a contract with the managing contractor, which is involved in preparation of working documents and establishes a system of planning, organizing, and controlling the work of subcontractors. Subcontract bids are carried out one by one, as soon as the documents on the correspondent complexes of work are ready.

– The system of involvement of a contractor in construction management with liability for risks, often called Construction Management At Risk (CMAR). This strategy is very similar to the previous one by procedure, however, the management organization also becomes the main contractor, which from a certain moment bears a significant portion of risks on the project.

– *The traditional system*. This model implies the involvement of the general contractor for the execution of all construction work on the site, partly, by the forces of organizations-subcontractors. Bid documentation on the whole list of construction works here is prepared in a single package, which presupposes the existence of all drawings and specifications before the announcement of the tender, due to which this system is often called Design-Bid-Build – DBB.

– *Design-Build (DB)*. In this scheme, a contractor is involved in design and construction. And in the "turn key" variant, he bears the responsibility both for engineering, for equipment, for erection of a site, so for all kinds of work starting from signing the contract until the introduction of a building in operation.

– *System of step-by-step development*. In this model, the project team step by step (within five consecutive stages) finds the optimal solution in the triangle of goals "time–costs–value", and a contractor on the tender gives a price proposal not only on the entire complex of construction works, but also on the revision of the working documentation.

– *Project management strategy*. The multi-variant approach involves the appointment of a project manager who coordinates the work of experts on determining and assessment of alternatives, forms a project team, based on the project mission and project tasks, recommends the initiator one or another contract- organizational profile. Next, the procedure goes according to one of the above systems. Thus, this model has six key varieties.

The above strategies are institutional mechanisms of the rational organization of market relations of an initiator, a designer, and a contractor (supplier), each of which takes care primarily of their own interests. In order to strengthen cooperation between these stakeholders and to focus stakeholders' consolidated attention on the project mission itself, the world practice proposed approaches of the integrated (or alliance) project delivery. These methods can be applied both in a "pure form", and within any of the above market systems [19].

In paper [20], it is stated project alliancing and integrated project delivery (IPD) are two types of relational project delivery arrangements (RPDA). However, for the purpose of rational simplification of the formalized model, it is advisable to foresee only one such option in it.

Based on the above, we form the structure of the conceptual model of selection of project delivery strategies (Fig. 1).

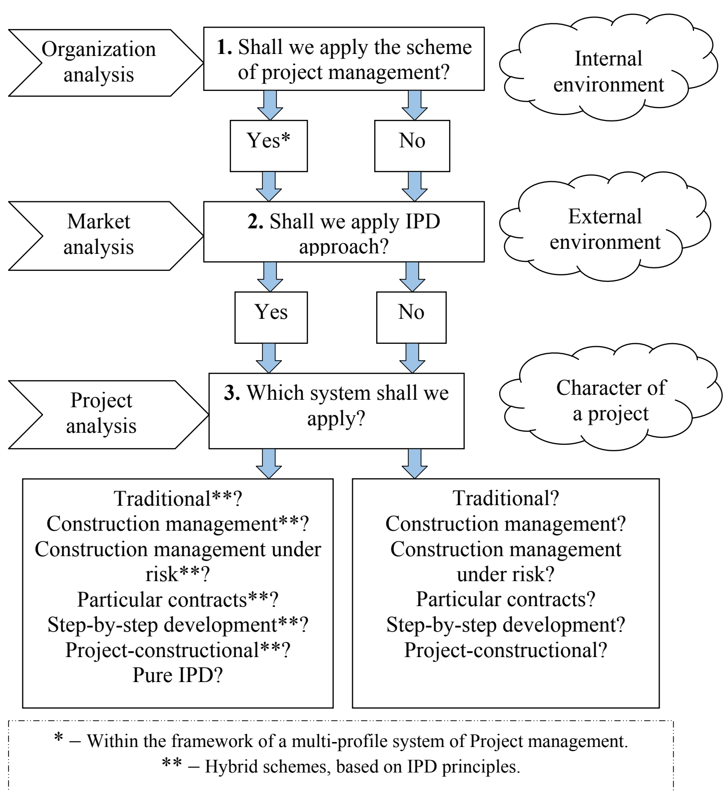

Fig. 1. Structure of the conceptual model of decision making on application of certain project delivery strategies (methods)

Thus, the proposed conceptual model includes three consecutive steps (links):

– first, based of analysis of information on the internal environment of an organization-initiator, a recommendation on appropriateness of involving in a project of an independent project manager is made. This step must be the first, as an independent project manager, in the case of his involvement, will together with the Initiator of a project complete the business-procedure of the selection of a project delivery strategy;

– then, based on the assessment of the market state (external environment of an organization and of a project), the recommendation concerning the appropriateness of the application of integrated approaches to project delivery is formed. This step should be the second since it is directly linked to the problem of early involvement of contractors in the project;

– finally, based on the nature of a project and its priorities, a recommendation about a certain strategy that is most appropriate in a specific project for specific existing and anticipated circumstances is formulated. Determining priorities is associated with the type and the scale of a project and expected sources of its funding.

The total number of key basic alternatives includes 26 strategies (that is: 6 – without integration approaches, 7 – with integration approaches and, accordingly, 6+7 – within the framework of a multi-variant project management system).

Here, we also note that for the sake of concentration and certainty, the proposed conceptual model does not cover such issues as:

– alternative mechanisms of pricing (reimbursement), payment according to the measurable amount of work (measurement), generally determined price (lump-sum), etc.) [4, 19];

– various auxiliary methods for early involvement of a contractor (information meetings), idea competition, competitive dialogue, etc. [14].

6. Mathematical toolset and system verification

6. 1. Formalized content of the conceptual model for selecting a project strategy

Based on the above determined structure, the Contract-Organizational Models for Projects: Assessment System (COMPAS) was created. According to this conceptual model, the first stage of the analysis aims to answer the question: "Is it worth applying the scheme of Project management?" The search for a proper decision at this stage is based on the following rule: the less developed the organization in the context of project management, the more reasonable the involvement of an independent project management.

Therefore, relying mostly on PMBOK [21], a set of estimates of corresponding maturity of an organization, which acts as an initiator or a customer of a construction project, was formed:

$$\{m_i\} = M, \tag{1}$$

where m_i is the point estimates of maturity of an organization in the area of project management (i=1, n), specifically, for management: m_1 – of the project integration; m_2 – of the project content; m_3 – of the project terms (deadlines); m_4 – of the project costs; m_5 – of the project quality; m_6 – of the project personnel; m_7 – of project communications; m_8 – of the project risks; m_9 – of the project procurement; m_{10} – of the project value; m_{11} – of the project stakeholders.

Each of the specified estimates depending on the degree of maturity of an organization on a correspondent issue can acquire numerical values from 1 to 6, specifically: Elementary – 1; Basic – 2; Intermediate – 3; Upper Intermediate – 4; Lofty – 5; Advanced – 6.

To make a decision (about the expediency of application of a multi-variant scheme of project management), a set of estimates of maturity of an organization is matched (compared) with the regulatory, basic set of maturity, which can be represented as:

$$\{m_i^b\} = M^b, \tag{2}$$

where m_i^b is the regulatory point estimate (appropriate) of maturity of an organization in the above spheres of project management.

If corresponding

$$m_i < m_i^b, \tag{3}$$

(at least mainly), therefore

$$\sum_{i=1}^{n} m_i < \sum_{i=1}^{n} m_i^b, \tag{4}$$

the involvement of an independent project manager is appropriate.

If

$$\sum_{i=1}^{n} m_i \cong \sum_{i=1}^{n} m_i^b, \tag{5}$$

then such expediency remains, but it is insignificant. In other cases, the application of a multi-variant project management strategy may seem excessive.

At the second stage, the conceptual COMPAS model gives an answer to the question: "Is it worth applying the IPD approach?" The search for the solution here is methodologically based on the rule: the weaker the integration of the market, the less the possibility to benefit from applying IPD (and it will be more difficult to implement this approach).

Based on the New Zealand and British recommendations [6], we will note that there are three groups of the construction market features (as for the degree of its integration). The first group characterizes the market as "weakly integrated", and, consequently, inappropriate for IPD application. Based on it, we form a set of such characteristics of the market environment:

$$\{w_f\} = W, \tag{6}$$

where w_f is the estimate of construction marker in the context of the factors of its weak integration (f=1, n), specifically, by the following features: w_1 – the market is made up of many separate organizations (contractors, designers, suppliers), who work for various clients (initiators); w_2 – one of the contract parties has a tendency to dictate relationships (either initiator, or contractor dominates); w_3 – the contract is usually made with a contractor, who offered the lowest price (without taking into account other aspects of a project); w_4 – weak interaction between the general contractor, the designer, the sub-contractors and suppliers that is prior to signing the contract; w_5 – absence of the common (collective, general) understanding of the capability of the market to ensure the appropriate project delivery; w_6 – contractors/designers do not understand the business of a client and because of it can not propose the appropriate business-oriented projects decisions; w_7 – roles and liabilities within the supply change (project delivery) are hierarchical and every sub-contractor level is dictated by the result of the corresponding bid; w_8 – designing the project documentation is, as a rule, a separate problem, which must be completed by the moment of invitation of sub-contractors/suppliers for the bid.

The second group of market features characterizes it as "sufficiently integrated". They form a set of factors of such state of market environment, which is characterized by prevailing orientation of stakeholders to common values:

$$\{e_f\} = E, \tag{7}$$

where e_f is the estimate of construction market in the context of the factors of its high integration (f=1, n), specifically, by the following features: e_1 – market participants closely cooperate with each other along the entire length of the supply chain (project delivery); e_2 – initiators strategically direct the contractors (suppliers), however, encourage interaction and cooperation of the executives themselves; e_3 – stakeholders focus on ensuring the achievements of the project targets; e_4 – sub-contractors/suppliers understand the business of an initiator and propose appropriate business-oriented decisions (for mutual benefit), which enable more effective motivation; e_5 – the team of the initiator is oriented to the integrated work with some key sub-contractors/suppliers; e_6 – designing is an iterative process, which involves the parties on ensuring installation (mounting), operation activity and exploitation of a construction site (the principle of a complete life cycle of a project); e_7 – market participants interact with the aim of achieving large project benefits without increasing costs, thus increasing the project value; e_8 – contractors and suppliers form common project teams or consortiums for separate projects.

The third group of organizational-functional features characterizes the market as "significantly integrated". These features make up a set of factors that are very convenient for the application of IPD model:

$$\{h_f\} = H, \tag{8}$$

where h_f is the estimate of the market state in the context of the factors of its significantly high integration (f=1, n), including by the following features: h_1 – the whole construction industry is interconnected and such relations are conscious and maximally supported; h_2 – contractors (suppliers) prefer the partners of the supply chain, who, in contractors' opinion, are able to bring the best value for successful delivery of a certain project; h_3 – organizations regularly practice the approach, within which many participants at all levels together transfer from one project to the other/ from one initiator to another; h_4 – organizations understand the importance of following the principle that all participants of the supply chain act in the best interests of the mission and aims of the project; h_5 – the structure and organization of the project activity are coordinated by all participants on the integration basis; h_6 – the market focuses on making excessive, doubling costs impossible (to improve the project value); h_7 – long-term investments in development of market possibilities are realized (in research, engineering networks, infrastructure, etc.); h_8 – created companied are oriented to (adapted for) the implementation of integrated decisions.

Each of the factors, presented in formulas (6)–(8), can acquire numeric values of the natural series from 1 to 3, specifically, if the answer is: "Yes" – 1; "It is difficult to say (both Yes, and No) – 2; "No" – 3.

To make a decision about the appropriateness of IPD application, the sets of estimates of the market maturity (6)–(8) are matched (compared) with one another. If the total number of points is maximal by unfavorable factors, and minimal – by very favorable factors:

$$\sum_{f=1}^{n} w_f > \sum_{f=1}^{n} e_f > \sum_{f=1}^{n} h_f, \tag{9}$$

the application of IPD is not appropriate. In this case, only the auxiliary methods of early involvement of a contractor can be recommended (the corresponding list is presented in [14]). Instead, if the total number of points is maximal by favorable factors, and minimal – by the unfavorable factors:

$$\sum_{f=1}^{n} w_f < \sum_{f=1}^{n} e_f < \sum_{f=1}^{n} h_f, \tag{10}$$

the application of IPD is very advisable, even in a "pure" form. If the sums of points for the corresponding categories of the market characteristics are approximately equal:

$$\sum_{f=1}^{n} w_f \cong \sum_{f=1}^{n} e_f \cong \sum_{f=1}^{n} h_f, \tag{11}$$

or, in another case, the maximum number of points is gained by the set of factors that indicate a medium level of market development:

$$\sum_{f=1}^{n} w_f < \sum_{f=1}^{n} e_f > \sum_{f=1}^{n} h_f, \tag{12}$$

there is appropriateness of application of the integrated approaches, but it is not so strongly pronounced and only in the framework of the "hybrid" schemes (Fig. 1).

At the third stage, the conceptual model of COMPAS gives an answer to the question: "What particular project delivery strategy should be applied?" The search for a solution here is based on the multi-criteria assessment of alternatives in the four-dimensional space "time–costs–value–risk".

Thus, in the set of ranks of the strategic priorities of initiator P^r, each of the elements is in the corresponding group:

$$\left\{ \begin{matrix} \{T_k^r\} \\ \{C_k^r\} \\ \{V_k^r\} \\ \{R_k^r\} \end{matrix} \right\} = P^r, \tag{13}$$

where $\{T_k^r\}$ is the sub-set of ranks of priorities of an initiator regarding the terms of project delivery; $\{C_k^r\}$ – regarding project costs; $\{V_k^r\}$– regarding project value (quality); $\{R_k^r\}$ – regarding project risks.

Relying particularly on the recommendations [22], we will note that the priorities of a client (an initiator of a project) can be identified by the means of obtaining his responses to a number of unified issues (Table 1). According to this table, each group (a subset) has four factors of determining project priorities ($k=\overline{1,4}$). Thus, for example, with respect to the terms of project delivery, the second question (k=2) clarifies the importance of an early start of execution of construction works at the site. For example, within the group, regarding the project value (quality), the first question (k=1) clarifies the expected degree of the technical/architectural complexity of the construction site and/or its saturation with operational equipment. An equal number of questions on each of the dimensions of the project space provides for a starting balance the analytical system – none of the vectors of the model is deliberately increased or decreased.

Each rank, presented in formula (13), for the element of any sub-set, can be equal to a natural number from 1 to 9 (depending on the priority of a certain question for an Initiator). The rank of the element with the lowest priority on the project is equal to 1, and with the highest – to 9.

In addition to the above-mentioned ranks, each element of the priorities analysis also has its rating. The second totality of parameters makes up a set of ratings of strategic priorities of an initiator:

$$\left.\begin{matrix}\{T_k^\rho\}\\ \{C_k^\rho\}\\ \{V_k^\rho\}\\ \{R_k^\rho\}\end{matrix}\right\} = P^\rho, \tag{14}$$

where $\{T_k^\rho\}$ is the sub-set of ratings of the priorities of an initiator regarding the terms of project delivery; $\{C_k^\rho\}$ – regarding the project costs; $\{V_k^\rho\}$ – regarding the project value (quality); $\{R_k^\rho\}$ – regarding the project risks.

Each of the ranks presented in formula (14) can be either equal to 1, or 2, or 3 (depending on the variant of the response of an Initiator to the corresponding question of Table 1). Specifically, if the response option is "A", the rating of a particular element is equal to 3, "B" – to 2, "C" – to 1. For example, if an Initiator answers "No" to the question "Is it important to lay a part of risks of inaccuracies in estimated amount of works on a contractor?", the rating of this elements is equal to 1.

Table 1

Conceptual model/matrix determining the basic priorities of the Client (Initiator of a project)

Groups (project space dimensions)	Question to assess options (project delivery models)	Variants of responses		
		A	B	C
Time (terms)	1. The accuracy of the determined term of construction: Is the timely project delivery a crucial factor for operation activities of a construction site?	Yes	It is difficult to answer	No
	2. What is the importance of the early beginning of construction of a site?	High	Medium	Insignificant
	3. What is the importance of a brief period of construction of a site?	High	Medium	Insignificant
	4. Is early construction completion more important than high quality?	Yes	Equal	No
Costs	1. Is it essential to have the most accurate prices for all works at the time of signing the contract agreements?	Yes	It is difficult to answer	No
	2. What is the importance of the price factor compared with the quality factor in the course of comparison of price proposals of contenders?	High	Medium	Insignificant
	3. Is a low price more important than early construction completion?	Yes	Equal	No
	4. What is the importance of compliance of the actual course of execution the works with the planned schedule of construction costs? *	High	Medium	Insignificant
Quality (project content, value)	1. The degree of technical/architectural complexity of the construction site and/or its saturation with operational equipment?	High	Medium	Insignificant
	2. What is the importance of the price factor compared with the quality factor in the course of comparison of contenders' offers?	High	Medium	Insignificant
	3. Is high quality/demanding characteristics (in terms of materials, structures, workforce, architectural concept) important?	Yes	It is difficult to answer	No
	4. Is high quality more important than a low price (minimized capital costs)?	Yes	Equal, it is difficult to answer	No
Risks	1. Is it important to lay a part of risks of inaccuracies in estimating amount of works on a contractor?	Yes	It is difficult to answer	No
	2. It is important to lay a part of risks of prices and rates fluctuations on a contractor?	Yes	It is difficult to answer	No
	3. Is the risk of selecting not the most appropriate design alternative significant? **	Yes	It is difficult to answer	No
	4. Are the changes of the course of construction possible and can project decisions be refined and improved?	Yes	It is difficult to answer	No

*Notes: * – depends on whether sources of funding are reliable enough to cover the needs of a project in funds every month; ** – is related to whether an Initiator is ready to take the risks of choosing the best design (engineering) alternative*

Multiplication of the mentioned above ranks by appropriate ratings gives the vector of each element of priorities, as well as the entire totality of project priorities:

$$\left\{\begin{bmatrix} \{T_k^r\}\cdot\{T_k^p\}\rightarrow\{\overrightarrow{T_k}\} \\ \{C_k^r\}\cdot\{C_k^p\}\rightarrow\{\overrightarrow{C_k}\} \\ \{V_k^r\}\cdot\{V_k^p\}\rightarrow\{\overrightarrow{V_k}\} \\ \{R_k^r\}\cdot\{R_k^p\}\rightarrow\{\overrightarrow{R_k}\} \end{bmatrix}\right\}=\vartheta, \quad (15)$$

where ϑ is the set of all vectors of priorities of an Initiator on a project; $\{\overrightarrow{T_k}\}$ is the sub-set of vectors of priorities regarding the terms of project delivery; $\{\overrightarrow{C_k}\}$ – regarding the project costs; $\{\overrightarrow{V_k}\}$ – regarding the project value (quality); $\{\overrightarrow{R_k}\}$ – regarding the project risks.

Once we have determined to which direction the COMPAS points more and to which less, it is necessary to find out what strategy most of all meets the comprehensive reference point. For this purpose, a set (matrix) of the features of key project delivery models is constructed in the coordinate system "time–costs–value–risk":

$$\left\{\begin{bmatrix} \{T_s\} \\ \{C_s\} \\ \{V_s\} \\ \{R_s\} \end{bmatrix}\right\}=Q, \quad (16)$$

where $\{T_s\}$ is the sub-set of ratings of features of project delivery strategies; $\{C_s\}$ – regarding project costs; $\{V_s\}$ – regarding the project value (quality); $\{R_s\}$ – regarding the project risks; s – number by order of a strategy from 1 to 7.

The numerical values of ratings of the properties of project delivery strategies are shown in Table 2. Here, we imply by property the convenience of a certain model to achieve the mission and goals of the corresponding project dimension.

As Table 2 shows, the sum of the ratings of properties for any project delivery model is 20. Equality of these sums reflects an unbiased attitude towards any of the strategies – none of them is a priori better or worse. Instead, a decision depends on the distribution of the total ranking of properties between the separate components of each of the strategies, on the one hand, and the vectors of an initiator for a particular project, on the other. Accordingly, it is determined which model is most appropriate to apply in a certain project.

Thus, the total of the points for each strategy is calculated based on the multiplication of ratings of the properties of models by vectors of project priorities:

$$T_s\cdot\sum_{k=1}^{4}\overrightarrow{T_k}+C_s\cdot\sum_{k=1}^{4}\overrightarrow{C_k}+V_s\cdot\sum_{k=1}^{4}\overrightarrow{V_k}+R_s\cdot\sum_{k=1}^{4}\overrightarrow{R_k}=B_s, \quad (17)$$

where $\sum_{k=1}^{4}\overrightarrow{T_k}$ is the sum of vectors of priorities of an Initiator regarding the terms of project delivery; $\sum_{k=1}^{4}\overrightarrow{C_k}$ – regarding the project costs; $\sum_{k=1}^{4}\overrightarrow{V_k}$ – regarding the project value (quality); $\sum_{k=1}^{4}\overrightarrow{R_k}$ – regarding the project risks.

The strategy, which will have a maximum number of points among the existing alternatives (Fig. 1), can be recommended for application in a project. A through example of choosing the strategy of a capital construction project is shown below.

6. 2. Results of approbation of the conceptual model for choosing a project strategy

Let us consider the use of the conceptual model COMPAS and the corresponding computerized tool on the example of a business case of the construction of a sports arena.

To make a decision about the most appropriate strategy, at first, it was determined whether it is worth involving an independent project manager and following the appropriate multi-variant scheme. To do this, we performed the assessment, the results of which are shown in Table 3 and in Fig. 2.

Table 2

Matrix of rankings of properties of project delivery strategies: convenience of models for achieving the mission by dimensions of the project space

Project dimension	Number by order of a strategy (s)*						
	1	2	3	4	5	6	7
Time	T_1=15	T_2=11	T_3=6	T_4=5	T_5=5	T_6=2	T_7=2
Costs	C_1=2	C_2=3	C_3=5	C_4=5	C_5=4	C_6=5	C_7=2
Value	V_1=2	V_2=3	V_3=3	V_4=5	V_5=5	V_6=7	V_7=9
Risks	R_1=1	R_2=3	R_3=6	R_4=5	R_5=6	R_6=6	R_7=7
Total	20	20	20	20	20	20	20

*Notes: * – strategy (model): 1 – involvement of several contractors; 2 – involvement of a contractor for construction management and subcontractors to perform certain complexes of works; 3 – involvement of a contractor for construction management with liability for risks (CMAR); 4 – traditional (DBB); 5 – design-build (DB), including "turn key"; 6 – step-by-step development; 7 – integrated projects delivery (IPD)*

Since in most of the areas of project delivery management, the existing level of maturity of a Customer is smaller than the norm (as well as in general – by the sums of the levels), it is recommended to involve an independent project manager. Therefore, it is advisable to choose a project delivery model among the alternatives of a multi-variant scheme of Project management.

Further, in accordance with the sequence of steps in the COMPAS system, it was determined if it was appropriate to apply IPD. For this purpose, the analytical assessment of market was performed (Table 4, Fig. 3).

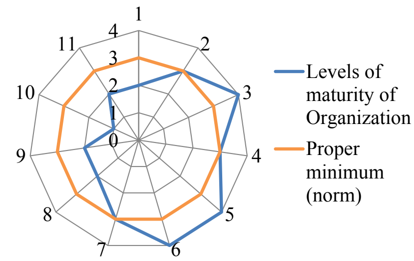

Fig. 2. Diagram of the levels of maturity of an Organization (Initiator) by eleven areas of project management

Table 3

Analysis of the level of maturity of an Initiator (assessment of internal environment)

Area of project management	Levels of maturity of Organization*	Proper minimum (norm)*	Difference**
1. Management of project integration	m_1=2	$m_1^b=3$	–1
2. Management of project content	m_2=3	$m_2^b=3$	0
3. Management of project terms	m_3=4	$m_3^b=3$	1
4. Management of project costs	m_4=3	$m_4^b=3$	0
5. Management of project quality	m_5=4	$m_5^b=3$	1
6. Management of project personnel	m_6=4	$m_6^b=3$	1
7. Management of project communications	m_7=3	$m_7^b=3$	0
8. Management of project risks	m_8=2	$m_8^b=3$	–1
9. Management of project procurement	m_9=2	$m_9^b=3$	–1
10. Management of project value	m_{10}=1	$m_{10}^b=3$	–2
11. Management of project participants	m_{11}=2	$m_{11}^b=3$	–1
Total	30	33	–3

*Notes: * – the numerical values of levels of existing maturity of a Customer (an Initiator of a project), as well as the normative values of levels of maturity were determined in accordance with the rules of a conceptual model, presented above in the comments to formulas (1) and (2); ** – calculated as the difference of existing levels of maturity of an Organization (column 2) and the norm (column 3). For example, for line 1 "Management of project integration":* $m_1 - m_1^b = 2 - 3 = -1$

Table 4

Analysis of market development level (assessment of external environment)

Characteristics of market environment	Market assessment*
1	2
Features of weak market integration:	
1. The market consists of many separate organizations (contractors, design engineers, suppliers), which work for different clients (initiators)	w_1=1
2. One of the contract party tends to dictate relations (either an initiator, or a contractor dominates)	w_2=1
3. The contract is usually concluded with the contractor who offered the lowest price (not taking into consideration the other aspects of a project)	w_3=3
4. Weak interaction between the contractor, designer, sub-contractors, and suppliers before signing the contract	w_4=3
5. The lack of common (collective, general) understanding about the capability of the market to ensure the proper project delivery	w_5=3
6. Contractors/designers/suppliers do not understand the client's business and because of this cannot offer adequate business-oriented project solutions	w_6=2
7. Roles and obligations within the supply chain (project delivery) are hierarchical and each sub-contractor level is dictated by the outcome of the corresponding bid	w_7=3
8. Designing the project documentation is usually a separate task that must be completed prior to the date of invitation of contractors/suppliers to the bid	w_8=3
Total	19
Features of sufficient market integration:	
1. Market participants closely cooperate along the whole length of a supply chain (project delivery)	e_1=1
2. Customers strategically direct contractors (suppliers), however, encourage interaction and cooperation of contractors	e_2=2

Continuation of Table 4

1	2
3. Key participants (stakeholders) focused on ensuring the achievement of project goals	e_3=3
4. Contractors/suppliers understand the initiator's business and offer appropriate business-oriented solutions (for mutual benefit) that provide opportunities for more effective motivation	e_4=2
5. The initiator's team is oriented to the integrated work with some of the key contractors/suppliers	e_5=2
6. Designing is an iterative process, which involves parties to ensure installation (mounting), operation activity and maintenance of a construction site (principle of a full project life cycle)	e_6=1
7. Market participants interact with the aim to achieve greater project benefits without increasing costs, thereby increasing the project value	e_7=1
8. Contractors and suppliers form joint project teams or consortiums for separate projects	e_8=2
Total	14
Features of high market integration:	
1. The entire construction industry is interconnected and such relations are deliberate and supported	h_1=1
2. Contractors (suppliers) prefer the supply chain partners, who, in the opinion of contractors, are able to bring the best value for the successful delivery of a specific project	h_2=1
3. Organizations regularly practice the approach, by which many participants at all levels together transfer from one project to another project/from one initiator to another initiator	h_3=2
4. Organizations understand the importance of following the principle that all members of a supply chain act in the best interests of the mission and objectives of a project	h_4=2
5. The structure and organization of the project activity is coordinated by the participants together on the integration basis	h_5=1
6. The market focuses on making impossible the excessive, duplicate costs (to improve the project values)	h_6=1
7. Long-term investments in the development of market capabilities (in research, engineering networks, infrastructure, etc.)	h_7=1
8. Created companies are focused on (adapted to) the application of integrated solutions	h_8=1
Total	10

*Note: * – numerical values of market assessment were determined in accordance with the conceptual model outlined above in the comments to the formulas (6)–(8)*

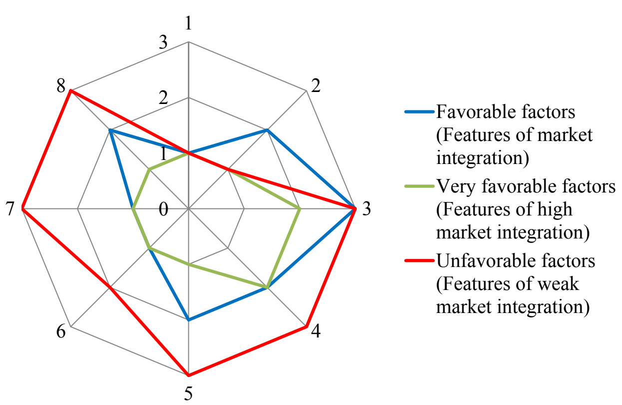

Fig. 3. Diagram of characteristics of market environment

*Note: * — determining each of the factors is shown in Table 4*

From the above data, the following conclusion can be made. Because the mentioned total amount of the points is the highest by the unfavorable factors, and the least – by very favorable, the IPD is not a recommended strategy. Instead, to enhance the productive convergence of stakeholders, it is appropriate to apply the auxiliary means of early involvement of a contractor, such as a competition of ideas or a competitive dialogue.

At the third stage of decision making, according to the conceptual model, it was determined which of the strategies is the most appropriate for the application in the project of the construction of a sports arena. To do this, the vectors of project priorities were calculated (Table 5).

Then, based on the vectors of project priorities (Table 5) and the matrix of properties of the models (Table 2), the correspondence of the strategies to the mission of the project of a sports arena construction is assessed in points (Table 6).

Table 5

Vectors of priorities of an Initiator on a project

Dimensions of project space	Number of questions to assess options*	Response variant*	Priority rank	Priority rating	Priority vector **
1	2	3	4	5	6
Time (terms)	1	A	$T_1^r=5$	$T_1^\rho=3$	$\vec{T}_1=15$
	2	A	$T_2^r=7$	$T_2^\rho=3$	$\vec{T}_2=21$
	3	B	$T_3^r=4$	$T_3^\rho=2$	$\vec{T}_3=8$
	4	C	$T_4^r=3$	$T_4^\rho=1$	$\vec{T}_4=3$
	Total	–	–	–	$\sum_{k=1}^{4}\vec{T}_k=47$

Continuation of Table 5

Costs	1	A	$C_1^r=5$	$C_1^p=3$	$\overrightarrow{C_1}=15$
	2	B	$C_2^r=4$	$C_2^p=2$	$\overrightarrow{C_2}=8$
	3	A	$C_3^r=3$	$C_3^p=3$	$\overrightarrow{C_3}=9$
	4	B	$C_4^r=9$	$C_4^p=2$	$\overrightarrow{C_4}=18$
	Total	–	–	–	$\sum_{k=1}^{4}\overrightarrow{C_k}=50$
Value (quality)	1	B	$V_1^r=8$	$V_1^p=2$	$\overrightarrow{V_1}=16$
	2	B	$V_2^r=4$	$V_2^p=2$	$\overrightarrow{V_2}=8$
	3	A	$V_3^r=5$	$V_3^p=3$	$\overrightarrow{V_3}=15$
	4	B	$V_4^r=3$	$V_4^p=2$	$\overrightarrow{V_4}=6$
	Total	–	–	–	$\sum_{k=1}^{4}\overrightarrow{V_k}=45$
Risks	1	A	$R_1^r=8$	$R_1^p=3$	$\overrightarrow{R_1}=24$
	2	A	$R_2^r=9$	$R_2^p=3$	$\overrightarrow{R_2}=27$
	3	B	$R_3^r=6$	$R_3^p=2$	$\overrightarrow{R_3}=12$
	4	B	$R_4^r=2$	$R_4^p=2$	$\overrightarrow{R_4}=4$
	Total	–	–	–	$\sum_{k=1}^{4}\overrightarrow{R_k}=67$

*Notes: * – questions and variants of responses to them according to Table 1; ** –according to formula (15)*

Table 6

Point evaluation of application of key strategies in a project

Project delivery strategy*	Estimate by measurement of project space: **				Total***
	Time	Costs	Value	Risks	
1. Involvement of a number of contractors	705	100	90	67	962
2. Involvement of a contractor in construction management and of subcontractors to perform certain complexes of works	517	150	135	201	1,003
3. Involvement of a contractor in construction management at risks (CMAR)	282	250	135	402	**1,069**
4. The traditional model: «design – bid – building» (DBB)	235	250	225	335	1,045
5. Design-build model (DB), including «turn key»	235	200	225	402	1,062
6. The model of step-by-step development	94	250	315	402	1,061

*Notes: * – as according to the result of the second stage of analysis, the application of the PID strategy in this project is not recommended, the corresponding option in the list of alternatives is absent; ** – calculated by multiplying the ratings of properties of strategies (Table 2) by total vectors of priorities according to dimensions of the project space "time–costs–value–risks" (Table 5). For example, for the strategy "Involvement of a number of contractors" according to the dimension "Time",* $T_1\cdot\sum_{k=1}^{4}\overrightarrow{T_k}=15\cdot 47=705$; **** – calculated from formula (17)*

According to Table 6, it is possible to draw the following conclusion. Since the CMAR strategy received the maximum number of points, it is recommended to be applied in this project.

Therefore, based on the results of analysis by the three stages of making a decision on the most appropriate strategy, it is possible to make the following recommendations:

– it is advisable to apply the profile of the Project management in the project of construction of a sports arena and to choose one of the possible alternative semi-strategies within this model;

– it is not recommended to apply IPD, however, it is advisable to conduct such activities as a competition of ideas or a competitive dialogue;

– CMAR strategy is the most oriented one to the priorities of a project Initiator among the market models.

7. Discussion of results of formalizing the choice of the most appropriate project delivery strategy

The proposed conceptual model is not abstract, but is rather constructed relying on the actual practice, the essence, and properties of various types of contract-organizational project delivery strategies. In the framework of the whole range of strategies, we identified a number of those that have distinct features and, therefore, specifically affect the project outcomes (the rest of the strategies is "transitional" or "hybrid"). Such discrete field of alternatives makes it possible to avoid uncertainty in making decisions about the most useful strategy. Only on this condition, the analytical system of selection of the project delivery strategy can be formalized and focused on the development of best practices.

In addition, the structure of the conceptual model reflects all key aspects of making the corresponding decision. The first aspect concerns analysis of the internal state of a Client (an Initiator of a project). If his organizational maturity turns out to be insufficient, it is recommended to conclude a contract with an independent project Manager and subsequently follow the appropriate multi-variant procedure. The second aspect of the model concerns market analysis. If the external environment is integrated enough, it is advisable to apply the IPD. Otherwise, it is often recommended to take supporting measures of convergence. The third aspect of the conceptual model concerns the choice of specific contract-organizational mechanism that best fits the mission of the project and the particular goals of its initiator. At this final stage, analysis goes on in the four-dimensional project space "time–costs–value–risk".

The formalization of the system of choosing a project strategy is generally based on the principles of multi-criteria decision. However, for each of the three above mentioned stages of analysis, a separate, the most practical approach was proposed. The key feature (difference) of the proposed system COMPAS is that the vectors of priorities for any specific project like a moving compass arrow point to the advisability of applying a certain strategy (as compared to other alternatives). At the same time, the properties of each of the key strategies are unified and play the role of the "fixed sides of the World of project delivery models". Or, in another associative plane, we can say that the COMPAS in the coordinate system "time–costs–value–risk" makes it possible to determine the correct contract-organizational path (model, strategic course), by which any specific project (specifically external and internal circumstances) should be followed.

The COMPAS system is a versatile methodological instrument – it is based on international best practices. It may happen that by the results of the performed analysis, a particular strategy is determined as the most appropriate, but it cannot be applied in a particular country of the world for regulatory and legislative reasons. In this situation, it is necessary to choose the project strategy that is second in the ranking of alternatives, and so on.

The limitations of the study are that the conceptual engineering of the business process of selection of the best project delivery strategy currently does not cover the scope of pricing in construction.

Regarding the discussion issues of the conducted research, it should be noted that analysis of the level of maturity of the project Initiator (the first link of the COMPAS system), as well as the assessment of market development (the second link), can also be carried out in other ways. Thus, the first stage of making an appropriate decision, specifically, can be implemented based on the approaches of IPMA Delta and Organizational IPMA Competence Baseline, the strengths of which are revealed in [23]. And the second stage, the assessment of readiness for application of IPD, can be carried out based of the analysis of the level of the information environment development in the field of capital construction that follows from [24].

The further research in the field of determining the strategy for a capital construction project could focus on:

– development of a formalized concept of making a decision on the application in the project of a certain model of the contract price;

– formation of a single interconnected complex from the blocks "Selection of organizational project delivery" and "Selection of the model of contract price";

– preparation of a series of formalized layouts of selection of a project delivery strategy for different types of construction sites (residential, power, for commerce and entertainment, industrial etc.).

8. Conclusions

1. The existence in the system of project delivery strategy selection of such attributes as the typology of strategies, evaluation criteria, the logical algorithm, the matrix of features of alternatives, the formalized apparatus and a computerized template-toolset provides the model with completeness and is a prerequisite for its validity and practical utility. The created conceptual system of making a corresponding decision takes on a methodological unification by separation two elements in it: (1) variable (movable) context, which recognizes the peculiarities of a particular business situation and the specificity of a particular project and (2) constant (unmovable), which displays the characteristic properties of each of the alternative strategies. Thus, the developed system can be applied for a maximally wide range of projects under any business activity conditions.

2. The process of comparative analysis involves three stages: (1) assessment of the maturity of an initiator of a project/ a client, (2) identification of the market development level, (3) determining project priorities and compliance of the project mission with profiles of key contract-organizational models. The first stage gives an answer to the question: "Should we follow the multi-dimensional business scheme of project management?", the second answers the question "Is it appropriate to introduce IPD in this situation?", the third responds to the question – "Which contract-organizational models should be followed in the analyzed project?". In this way, the conceptual model reflects all available alternatives to the typical strategies that are applied by the international best practices. The conceptual model reflects both the project space, and the field of strategic alternatives in a unified coordinate system "time –costs–value– risk". This three-stage decision making process and the 4-dimensionality of analysis make it possible to cover all possible key alternatives of strategic directions of a project.

3. The formalized toolkit formed the Contract-Organizational Models for Projects: Assessment System (COMPAS). The mathematical apparatus of the System is based on a set of estimates of maturity of an Organization; metrics of market features by three groups: weak, sufficient, and high integration; calculation of vectors of the project priorities that display the calculation result on the plane of the properties of particular strategies. The testing of the proposed conceptual model proves that it makes it possible to clearly identify the most appropriate strategy of delivery of a capital construction project. The proposed model is a protector against bias and imbalances in the field of selection of contract-organizational strategies.

References

1. Strategic Analysis Tools. Topic Gateway Series No. 34. CIMA. 2007. URL: https://www.cimaglobal.com/Documents/Imported-Documents/cid_tg_strategic_analysis_tools_nov07.pdf.pdf
2. Manual "procurement strategy in construction" // Leonardo da Vinci ToI project, Trane-to-cap. 2012. URL: https://ru.scribd.com/document/343390835/Book1-PROCUREMENT-MANUAL-TTC-ENG-pdf
3. Building and Construction Procurement Guide. Principles and Options // Austroads. 2014. URL: http://www.apcc.gov.au/ALLAPCC/Building%20and%20Construction%20Procurement%20Guide.pdf
4. An Owner's Guide to Project Delivery Methods // CMAA. 2012. URL: https://cmaanet.org/sites/default/files/inline-files/owners-guide-to-project-delivery-methods.pdf
5. Portfolio, Programme and Project Management Maturity Model (P3M3®). Introduction and Guide to P3M3® // OGC. 2010. URL: http://miroslawdabrowski.com/downloads/P3M3/OGC%20branded/P3M3_v2.1_Introduction_and_Guide.pdf
6. Planning Construction Procurement. A guide to developing your procurement strategy // New Zealand Government Procurement, Ministry of Business, Innovation and Employment. 2015. URL: https://www.procurement.govt.nz/assets/procurement-property/documents/guide-developing-your-procurement-strategy-construction-procurement.pdf
7. Haji-Kazemi S., Andersen B., Krane H. P. Identification of Early Warning Signs in Front-End Stage of Projects, an Aid to Effective Decision Making // Procedia – Social and Behavioral Sciences. 2013. Vol. 74. P. 212–222. doi: https://doi.org/10.1016/j.sbspro.2013.03.011
8. Erdogan S. A., Šaparauskas J., Turskis Z. Decision Making in Construction Management: AHP and Expert Choice Approach // Procedia Engineering. 2017. Vol. 172. P. 270–276. doi: https://doi.org/10.1016/j.proeng.2017.02.111
9. Applying decision-making techniques to Civil Engineering Projects / Abdel-malak F. F., Issa U. H., Miky Y. H., Osman E. A. // Beni-Suef University Journal of Basic and Applied Sciences. 2017. Vol. 6, Issue 4. P. 326–331. doi: https://doi.org/10.1016/j.bjbas.2017.05.004
10. Lahdenperä P. Project Delivery Systems in Finnish New Building Construction – A Review of the Last Quarter Century // Procedia Economics and Finance. 2015. Vol. 21. P. 162–169. doi: https://doi.org/10.1016/s2212-5671(15)00163-x
11. Mihic M., Sertic J., Zavrski I. Integrated Project Delivery as Integration between Solution Development and Solution Implementation // Procedia – Social and Behavioral Sciences. 2014. Vol. 119. P. 557–565. doi: https://doi.org/10.1016/j.sbspro.2014.03.062
12. Selection Criteria for Delivery Methods for Infrastructure Projects / Hosseini A., L dre O., Andersen B., Torp O., Olsson N., Lohne J. // Procedia – Social and Behavioral Sciences. 2016. Vol. 226. P. 260–268. doi: https://doi.org/10.1016/j.sbspro.2016.06.187
13. Azhar N., Kang Y., Ahmad I. U. Factors Influencing Integrated Project Delivery in Publicly Owned Construction Projects: An Information Modelling Perspective // Procedia Engineering. 2014. Vol. 77. P. 213–221. doi: https://doi.org/10.1016/j.proeng.2014.07.019
14. Project Delivery Methods in Large Public Road Projects – A Case Study of E6 Jaktøyen – Sentervegen / Haugen A., Wondimu P. A., Lohne J., Lædre O. // Procedia Engineering. 2017. Vol. 196. P. 391–398. doi: https://doi.org/10.1016/j.proeng.2017.07.215
15. Pöyhönen P., Sivunen M., Kajander J.-K. Developing a Project Delivery System for Construction Project – A Case Study // Procedia Engineering. 2017. Vol. 196. P. 520–526. doi: https://doi.org/10.1016/j.proeng.2017.07.233
16. Life Cycle Engineering and Management – Fostering the Management-orientation of Life Cycle Engineering Activities / Götze U., Peças P., Schmidt A., Symmank C., Henriques E., Ribeiro I., Schüller M. // Procedia CIRP. 2017. Vol. 61. P. 134–139. doi: https://doi.org/10.1016/j.procir.2016.11.240
17. Aghazadeh H. Strategic Marketing Management: Achieving Superior Business Performance through Intelligent Marketing Strategy // Procedia – Social and Behavioral Sciences. 2015. Vol. 207. P. 125–134. doi: https://doi.org/10.1016/j.sbspro.2015.10.161
18. Buhrov O. V., Buhrova O. O. Instytutsionalni mekhanizmy dosiahnennia tsilei budivelnykh proektiv // Upravlinnia rozvytkom skladnykh system. 2012. Issue 12. P. 30–34.
19. Bugrov O., Bugrova O. Formation of a cumulative model for managing the value of construction projects // Eastern-European Journal of Enterprise Technologies. 2017. Vol. 5, Issue 3 (89). P. 14–22. doi: https://doi.org/10.15587/1729-4061.2017.110112
20. Halttula H., Aapaoja A., Haapasalo H. The Contemporaneous use of Building Information Modeling and Relational Project Delivery Arrangements // Procedia Economics and Finance. 2015. Vol. 21. P. 532–539. doi: https://doi.org/10.1016/s2212-5671(15)00209-9
21. A guide to the project management body of knowledge (PMBOK guide). USA: Project Management Institute, 2013. 589 p.
22. Modelnyi kontrakt MTP dlia velykykh proektiv «pid kliuch». Kyiv: Asotsiatsiya «ZED», 2014. 184 p.
23. Bushuyev S. D., Wagner R. F. IPMA Delta and IPMA Organisational Competence Baseline (OCB) // International Journal of Managing Projects in Business. 2014. Vol. 7, Issue 2. P. 302–310. doi: https://doi.org/10.1108/ijmpb-10-2013-0049
24. Nikolaiev V. P., Nikolaieva T. V. Informatsiyne modeliuvannia budivel: imperatyvy optymizatsiyi budivelno-ekspluatatsiynoho protsesu // Budivelne vyrobnytstvo. 2015. Issue 59. P. 17–26.