екта развития инфраструктуры для создания нового рынка перевозок и одновременного его обеспечения высококвалифицированными трудовыми ресурсами, необходимо учитывать эффективность строительства детских дошкольных учреждений и школ-интернатов. Это, несомненно, гарантирует результативность проекта как для компании, так и субъекта РФ, решая важнейшие социальные задачи и оптимизируя демографическую ситуацию в регионе создания новых перевозочных мощностей.

ЗАКЛЮЧЕНИЕ

Предложенная модель комплексно оценивает текущее состояние компании и ее стратегические направления работы, ресурсное и финансовое обеспечение проектов, риски возникновения неблагоприятных событий, а также постинвестиционные условия функционирования железнодорожной линии. Использование модели позволяет проводить всесторонний анализ инвестиционных проектов, выявлять возможности их выполнения, согласовывать планы реализации на разных уровнях управления, отбирать наиболее перспективные варианты в соответствии со стратегией развития. В конечном счете формализованная математическая модель создает предпосылки к координации целей компании и субъекта РФ, на территории которого находится инвестируемый объект, помогает на базе выверенных оценок и критериев формировать комплексный инвестиционный проект с учетом наиболее значимых показателей стратегической деятельности ОАО «РЖД».

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MODEL FOR SELECTION OF INVESTMENT PROJECTS

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ABSTRACT

The article is devoted to peculiarities of formation of the comprehensive investment project in accordance with the development strategy of «Russian Railways». The mathematical model of project selection is described, which comprehensively considers the current state of a company and future directions for its functioning, resource and financial support for the planned reforms and the risks of adverse events.

ENGLISH SUMMARY

Background.

The main priorities of the investment program of JSC «Russian Railways» for the current period are: the development of infrastructure to increase rail capacity; purchase and modernization of traction rolling stock; modernization of traffic control systems; development of commuter traffic; improvement of social services, including improvement training, education, discipline levels of railway men, support of corporate health service, etc.

With such a scenario, evaluation of the comprehensive investment project focusing not only on fixed assets for production purposes, but also non-productive fixed assets should be based on the criteria of economic and social efficiency. And prevailing parameters are net present value, payback period and ROI. Precondition is management of investment projects through the «prism» of functional strategies of «Russian Railways», because even profitable project with guaranteed results and a high degree of feasibility, can only provide short-term positive effect, and in future have a negative impact on some aspects of company's activities.

Comprehensive investment project of railway transport development should create for JSC «Russian Railways» a resource base, i. e. complex factors of production are necessary to create a new transport market. Comprehensive investment project is a reflection of targets and mission of the holding.

Objective.

The author aims at showing a new mathematical model for project's selection, which covers key aspects of any comprehensive investment project.

Mathods.

The author uses mathematical methods and economic analysis to support his proposal.

Results.

In practice of investment management, there is a system of indicators on base of which it is possible to make a project's selection from a variety of project alternatives. In particular, to evaluate its implementation in terms of profit maximization [1], cost-effectiveness [2], to determine the attractiveness of options, taking into account various parameters [3].

To assess the financial and economic efficiency of projects, criteria can be divided into two large groups depending on the fact to which extent they

take into account time factor [4]. Time factor is based on discounting, so methods and measurements of the first group are often called discount. The second group includes methods without discounting of costs distributed in time. Discount methods in modern foreign and domestic practice are predominant at medium and large enterprises.

Mainly four indicators based on discounting [5] are used: net present value (NPV); profitability index (PI); internal rate of return (IRR); discounted payback period (DPP).

However, in the form in which such methods are proposed in the literature, they can be used only to evaluate the cost-effectiveness of the project, analysis of the effectiveness of return or payback period. They handle financial flows, but do not take into account technological, technical and human resources of the company. It is not always possible to give correct results primarily in assessing the comprehensive investment project. Therefore, there is need for development of models and methods for the analysis of projects' implementation, taking into account not only the economic and financial parameters, but the possibilities of the company, its development strategy and availability of resources for the operation of input fixed assets.

It is possible to submit in a formalized manner a comprehensive investment project in accordance with the strategic directions of company's activity as a set of components:

$$P_i = \langle X_i, W_i, R_i, V_i \rangle,$$

where X_i – vector of initial characteristics of the i- project; W_i – vector of characteristics of attractiveness and feasibility of the project; R_i – overall risk; V_i – vector of post-investment characteristics of the project.

Vector of initial characteristics of the project can be represented in the following form

$$X_i = \langle C_i, Y_i, S_i, H_i, T_i, R_i, I_i \rangle,$$

where C_i – objectives of the project; Y_i – complex of works on the project; S_i – required financial investment; H_i – resource-intensiveness of the project; T_i – expected time of implementation; I_i – vector of mutual influence on other projects.

An important aspect of the analysis is the grouping of projects under consideration from the standpoint of objectives, finance, conditions (resources).

Indicators of attractiveness and feasibility are used for this purpose, which in a complex display the ability to perform a project, taking into account strategic directions of company's activity, resource, financial and time support

$$W_i = \langle SC_i, E_i, SR_i, HR_i \rangle,$$

where SC_i – index of compliance with strategic objectives and development of strategic capacity in project implementation; E_i – indicators to measure economic efficiency; SR_i – financial feasibility of the project; HR_i – resource feasibility.

Compliance with the strategic objectives of the organization Str_i is one of the critical factors of the project's success.

Strategy is defined by a set of indicators of financial and non-financial nature $\{K_j^{Str_i}\}$. Project objectives C_i are formulated as a set of indicators, with their values, which should be achieved by the project's implementation $\{K_j^{P_i}\}$. It is furthermore possible to carry out a comparison of the values of strategy indicators $\{K_j^{Str_i}\}$ with the corresponding parameters of the project $\{K_j^{P_i}\}$.

Index of compliance $SC_j^{Str_i}$ is considered for all strategic objectives in identified four perspectives. If in the project's description parameter $K_j^{Str_i}$ is absent, the indicator $SC_j^{Str_i}$ for a strategic objective Str_i is zero. Otherwise, there is a comparison of its target values in the project $K_t^{P_i}$ and strategies $K_t^{Str_i}$ with account of current value (at time t) of K_t^{Pres} indicator:

$$SC_t^{Str_i} = \frac{K_t^{Str_i} - K_t^{Pres}}{K_t^{P_i} - K_t^{Pres}}.$$

After determining compliance assessments for individual parameters, strategic compliance of a project can be calculated with respect to strategy Str_i by averaging estimates for individual indicators:

$$SC^{Str_i} = \frac{1}{N_{KPI}^{Str_i}} \sum_{t=1}^{N_{KPI}^{Str_i}} SC_t^{Str_i},$$

where $N_{KPI}^{Str_i}$ – number of indicators in description of strategy Str_i.

It is suitable, if each project has only one strategic goal. In reality, it is possible that a project has multiple strategic targets. In this case, after determining compliance assessments for each objective, strategic compliance of the project P_i can be calculated by averaging assessments SC^{Str_i} on individual indicators. In this case it is advisable to take into account the importance of strategic objectives by introducing weighting coefficients, which can be obtained by expertise using a method of analysis of hierarchies or paired comparisons. If each project is associated with N_i^{Str} of strategic goals, the compliance index is determined as follows:

$$SC_i = \frac{1}{N_i^{Str}} \sum_{k=1}^{N_i^{Str}} w^{Str_k} SC^{Str_k},$$

where w^{Str_k} – importance of a strategic objective.

The most desirable situation takes place, when the project of railway infrastructure development, associated with the creation of a new transport market, not only solves the strategic objectives of «Russian Railways», but also the strategic objectives of development of regions of the Russian Federation.

Thus, a compliance index for a project with the strategy SC_i is formed, whose values are interpreted, taking: $SC_i = 1$, if the project is consistent with the strategy; $SC_i = 0$, if the project does not comply with the strategy; $0 < SC_i < 1$, if the project is consistent with a strategy partially and thus is associated with the development of the strategic potential of the company.

Criteria for determining the cost-effectiveness of the project reflect:

$$E_i = \langle NPV_i, PI_i, PP_i, IRR_i \rangle,$$

where NPV_i – net present value; PI_i – profitability index; PP_i – payback period; IRR_i – internal rate of return.

Net present value of the project (NPVi):

$$NPV_i = -IC_i + \sum_{t=1}^{T} \frac{S_i(t) - R_i(t)}{(1+d_t)^t},$$

where $S_i(t)$, $R_i(t)$ – the receipt and expenditure of funds for the project i during the period $t = 1 \ldots T$; d_t – discount rate at time t; IC_i – investments for the project.

Obviously, the net present value is a random figure because it depends on the risk events. As required value NPV_i is considered NPV_i, obtained from the calculation of the favorable development of the project, i. e., excluding the risk associated with both technical, technological and resource constraints.

Profitability index (PI_i):

$$PI_i = \left[\sum_{t=1}^{T} \frac{S_i(t) - R_i(t)}{(1+d_t)^t}\right] : IC_i .$$

Internal rate of return (IRR_i) is calculated for $NPV_i = 0$.

The use of IRR_i helps assess «profitability reserve» of the project and loss risk when changing economic conditions for its implementation.

Financing of the projects can be carried out from various sources. Possible sources for JSC «Russian Railways» are: equity funds, bank loans, state and (or) municipal budget subsidies.

Each source is characterized by its value (rate of return), expressed as a percentage. In general, all sources of funding can be divided into equity and borrowed funds. Individual funding schedule is determined for each of them.

Financial feasibility of the project shows the possibility of the project's implementation under the conditions of specified investment dynamics, i. e. project is financially feasible, if at each step of the calculation period algebraic (with account of signs) sum of cash inflows and cash outflows is non-negative. Negative sum of the elements of real money flow at a certain step of the calculation period indicates financial non-feasibility of the project and shows that the company is unable to pay its obligations (debt), and measures should be taken to cover deficit.

Resource feasibility of the project illustrates the possibility of providing project with resources, including labor resources. Obviously, the return of the investment project is higher if labor potential employed in transportation is used more effective. Using, during implementation of the comprehensive investment project modern, effective methods of human resource management, taking into account the level of education, health, training and motivation will form high-performance labor potential of the company, which is especially important at the stage of innovation development.

The above mentioned provisions make it possible to formulate the problem of prioritization of the implemented projects based on the strategic development of the company.

If by solution of a task of forming an investment program only those projects are taken into account which are carried out in the interests of investors and require a profit, the most common criterion for the selection of such projects is the value NPV_i. Here as an optimal option will be considered a solution that provides the greatest total value NPV_i within defined limits:

$$\sum_{i \in P} NPV_i \to \max .$$

As a rule, in project's selection models there is also a requirement for a high profitability ($PI_i > 1$).

Projects undertaken for the strategic development of JSC «Russian Railways» (here it is necessary also to include projects concerning the social sphere) often do not involve profit earning and for their evaluation indicators, defined only by financial results, cannot be used. In this case, the project must to the most extent comply with the strategic goals of the company and have the best properties on the characteristics of attractiveness, feasibility and risk.

Possible limitations of the model are the following. Primarily they are related to the probability of the project:

– Limitation of providing adequate budget allocated for financing of investment costs;

– Limitations on the total consumption of resources.

Model should also contain a restriction on the expenditure of financial resources generated by summing the allocated and expended funds. Constraints on the estimated losses from risk can be introduced into the model.

Forming the performance criteria of the comprehensive investment project for infrastructure development to create a new transport market and provide it simultaneously with high-skilled labor resources, it is necessary to take into account the efficiency of the construction of kindergartens and boarding schools. This will undoubtedly ensure the effectiveness of the project for both the company and the region of the Russian Federation, solving critical social problems and optimizing the demographic situation in the region, where new transportation facilities are created.

Conclusion.

The proposed model comprehensively assesses the current state of the company and strategic directions of its activities, resource and financial support for projects, the risks of adverse events, as well as post-investment conditions for the functioning of the railway line. The use of the model makes it possible to carry out a comprehensive analysis of investment projects, to identify opportunities for their implementation, to coordinate the implementation of plans at different levels of government, to select the most promising options in accordance with the development strategy. Ultimately formalized mathematical model creates the preconditions for coordination of purposes of the company and region of the Russian Federation on the territory of which the invested object helps on the basis of adjusted estimates and criteria form the comprehensive investment project with account of the most significant indicators of the strategic activities of OJSC «Russian Railways».

Keywords: railway, integrated investment project, human resources, development strategy, net present value, profitability index, internal rate of return, payback period, selection model, financial feasibility, resource feasibility.

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