

## Investment in road infrastructure and regional economic development

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**Abstract.** The paper deals with the impact of investment in regional road infrastructure on the regional economic development. The key trends and economic effects of investment in the regional road network are identified. Ensuring of sustainable development, improving of investment climate, increasing of competitiveness of the national economy, creating conditions for Kazakhstan's to transit to innovative development, stimulating of regional development is largely dependent on the availability and quality of infrastructure, road network being an important component here.

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### Introduction

Ensuring of sustainable development, improving of investment climate, increasing of competitiveness of the national economy, creating conditions for Kazakhstan's to transit to innovative development, stimulating of regional development is largely dependent on the availability and quality of infrastructure, road network being an important component here. Currently the road infrastructure is backward the needs of society, that resulted from unbalanced growth of autopark and financing of the industry.

The backwardness of road network in terms of intensification of foreign economic relations is a factor limiting the realization of transit potential of Kazakhstan as a logistics center between the European and Asia-Pacific global economic clusters. Construction and reconstruction of roads of international importance is a necessary condition for Kazakhstan to successfully integrate into the world economic space.

### Analysis of recent research and publications

According to national and international scientists and economists, the parameters of road infrastructure influence the development of industry, trade, agriculture, foreign trade and labor market. Moreover, that an empirical dependence between the density of the road network and the level of economic development is proved [1], [2], [3], [4], [5], [6]. However, the problems of interrelation between investment in road infrastructure and regional development (in particular for developing countries) are not properly covered, necessitating this study.

### Problem statement

This paper aims at improving the mechanism to finance the investment for the modernization and

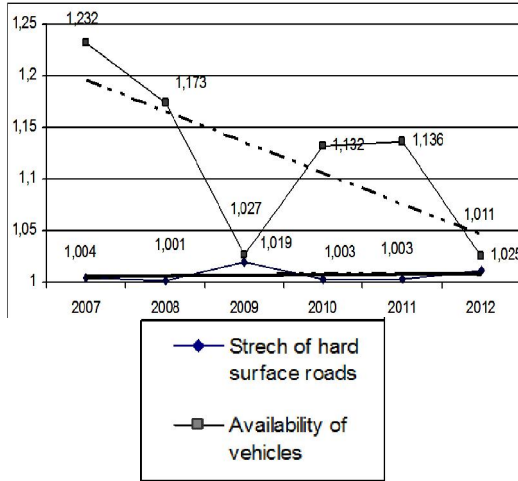
development of the regional road infrastructure (hereinafter - *RI*).

### Research findings

Over the last decade more than \$ 6.5 billion (995 billion) was assigned for the development of RI of Kazakhstan (including the local road network), for all that amount of financing has increased by almost 8 times. About 600 km of roads are repaired annually, while the demand is about 1 thousand km, since the average age of roads is 40-50 years old, and more than 80% (and for the East Kazakhstan region it's more than 90%) of RI does not meet international standards, causing the following problems [7], [8], [9], [10], [11]:

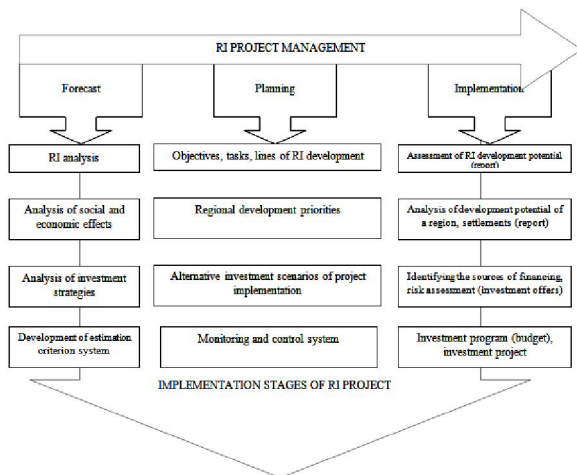
- 1) the pace of road construction are backward the needs of the economy and the growth rates of autopark (Figure 1);
- 2) low quality (technical specifications) of the road network, high level of risk of road haulage (the level of accidents and mortality on the roads);
- 3) low investment attractiveness of the industry, limiting the flow of private investment;
- 4) underdevelopment of internal RI (roads, facilities, service centers because of the lack of funding from local budgets: there are no access hard surface roads to 800 settlements);
- 5) technological backwardness, inadequate legislation, lack of experience in RI project management [2], [9], [10].

Most of the above problems are related in a way to the lack of funding, therefore, the main challenge for modernization of road infrastructure is to develop and apply modern mechanisms of investment, which will adjust RI in accordance with the needs of fast growing economy.



**Fig. 1. Comparative dynamics of autopark growth of and stretch of the road network in Kazakhstan in 2007-2012 (Ratios) [7], [12].**

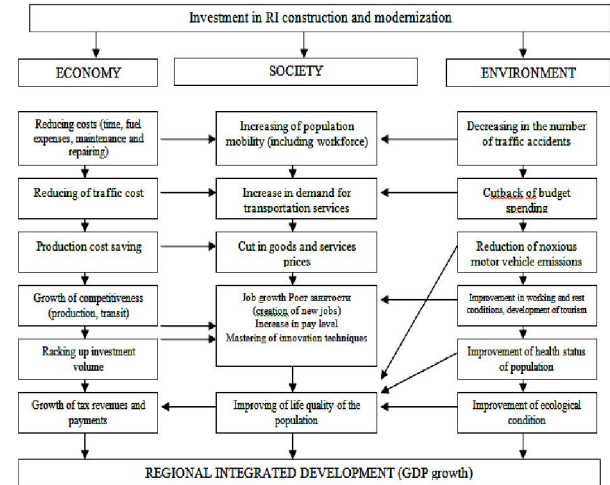
The need for substantial investment in the modernization and development of the road network regarding low investment attractiveness of the industry, high capital intensity and long payback period determines the reasonability to form common concept of development of RI investment projects in accordance with the methodological requirements of the systems approach (Figure 2):



**Fig. 2. Block diagram of the investment project development for RI of the region\***  
 \* Developed by the author based on [4], [6], [13], [14].

Investment in RI will provide a powerful stimulus to the development of the economy of East Kazakhstan region, being currently in dire need of improving communications systems for businesses and the public: fast, cheap and safe moving of cargo and passengers, increase the competitiveness of goods and services, creating jobs, introducing innovative

technologies and management methods (Fig. 3) [15], [16].



**Fig. 3. Impact of investment in RI on regional development \***

\* Developed by the author based on [4], [6].

Investment in RI rise two main types of effects: 1) direct ones connected with benefits for individuals and businesses using the roads: cost reduction of motor vehicles' maintenance, time reduction, risk reduction, improvement of the quality of transport and related services: 2) indirect ones, being a consequence of RI modernization: business activity stimulation, expansion of markets, creation of jobs, improvement of quality of life of the population, environment preservation.

The final impact of the implementation of RI investment programs of the development of the region can be calculated as an aggregate growth of gross regional product ( $\Delta GRP$ ) in the transport sector, the economy, households and the region as a whole, with regards to the effects associated with vehicles maintenance (speed, capacity, costs, rates) [17], [18].

Net effect of investment programs' implementation in the reporting period can be calculated as follows:

$$\Delta GRP = E = \sum E_i = E_B + E_M + E_T + E_C + E_N, (1)$$

where:  $E_B$  – effect of business activity stimulating;  $E_M$  – effect of reducing the costs of maintenance and operation of vehicles;  $E_T$  – economic effect of reducing moving time;  $E_R$  – economic effect of reducing transportation risks (accidents, loss);  $E_N$  – environmental effect.

Formulas to calculate key indicators are shown in Table 1.

Holistic concept, allowing developing an adequate model to evaluate investment efficiency as a factor of regional development and working out management decisions on its basis, should take into

account an integrated effect of investment in RI. Consequently, for overall evaluation of investment in public goods (RI) the use of such a macro-economic indicator as complex multiplier will be legitimate. The methodology of applying the multiplier is adequately represented in the works of J.M. Keynes, P. Samuelson and others [1], [19], [20].

**Table 1. Indicators of direct and indirect effect on investment in RI of the region**

Indicator	Formula	Legend, units
$E_B$	$R_{C_1} + R_{L_1} = (\Delta T \cdot \bar{R}_{C_1} \cdot r) / t +$ $+ [(\Delta \bar{R}_{L_1} + \Delta \bar{R}_{L_2} + \Delta \bar{R}_{L_3} + \Delta \bar{R}_{L_4}) r] / \Delta T'$	$\bar{R}_{C_1}$ – extra income on reducing the cost of cargo delivery; $\bar{R}_{L_1}$ – extra income on reduction of cargo loss (KZT); $\Delta T$ – time saving (hours per year); $\bar{R}_{C_2}$ – average cost per unit of cargo (KZT per kg, m <sup>3</sup> ); $r$ – market interest rate; $t$ – reporting period in hours ( $t_{\text{max}} = 8760$ hours); $\Delta \bar{R}_{L_1}$ – 1 – saving on losses of: 1 – loss of cargo, 2 – reducing of cargo quality 3 – reducing of vehicles' workload; 4 – penalties for cargo losses (KZT); $\Delta T'$ – time saving by reducing the idle time (hours per year)
$E_M$	$\sum \Delta C_i = \Delta C_0 + \Delta C_r + \Delta C_e + \Delta C_s$	$\sum C_i$ – cumulative sum of savings on: $\Delta C_0$ – fuel saving; $\Delta C_r$ – saving on repairs; $\Delta C_e$ – saving on overhead; $\Delta C_s$ – saving on maintenance (KZT)
$E_T$	$\Delta T \cdot K_p \cdot I \cdot \bar{S}$	$\Delta T$ – time saving (hours per year); $K_p$ – ratio of utilization of passenger transport (by shippers); $I$ – intensity of passenger (cargo) traffic (units per year); $\bar{S}$ – average costs of passenger (consumer) for the reporting period (KZT)
$E_C$	$\Delta C \cdot (\bar{S}_{C_1} + \bar{S}_{C_2} + \bar{S}_{C_3})$	$\Delta C$ – reducing of the number of accidents (units per year); $\bar{S}_{C_1}$ – average reduction of insurance premiums for vehicles; $\bar{S}_{C_2}$ – average reduction of the premium per unit of cargo; $\bar{S}_{C_3}$ – average reduction of insurance premium per passenger (KZT)
$E_N$	$\sum P_i (v_i^* - v_i^0) = \sum P_i \Delta v_i$	$P_i$ – charge (fees, fines, penalties) for the emission of environmentally harmful substances (KZT); $v_i^0, v_i^*$ – emission volumes of harmful substances before and after the RI modernization (units per year); $\Delta v_i$ – reducing of harmful emissions for the reporting period.

Considering a region as an integrated economic system, investment in RI can be divided into autonomous and induced. The former are the investment being a tool of macroeconomic regulation with a budget like a source. The latter are that part of investment of economic entities that are connected (directly or indirectly) with RI development [21].

The economic efficiency of both autonomous and induced investment shows itself at the macro-, meso- and microlevels, generates both direct (motor industry) and indirect (related sectors, the public sector, households) effects and, therefore, can be calculated by the formula below on the basis of the above concepts:

$$M_k = \frac{\Delta GRP}{\Delta I} = \frac{E}{\Delta I'_B + \Delta I'_P} = \frac{E}{\Delta I'_B \cdot (\Delta I_B / E_{TRN}) + \Delta I'_P \cdot (\Delta I_P / E_{BM})} \quad (2)$$

where:  $M_k$  – complex multiplier;  $\Delta I'_{B,P}$ ,  $\Delta I_{B,P}$  – growth of autonomous (budget) and induced (private) investment in view of (without) intersectoral cumulative effect;  $E$  – comprehensive economic effect equal to the increase in GRP ( $\Delta GRP$ );  $E_{TRN}$ ,  $E_{BN}$  – cumulative economic effect in the public (private) sectors of regional economy.

The given investment mechanism works as follows: 1) autonomous investment generate primary multiplier effect and result in GRP increase; 2) GRP growth, in its turn, becomes an additional source of public investment in future periods; 3) total GRP

growth generates additional income in the private sector being a source of private investment; 4) integrated multiplier effect stimulates the growth of corporate profits and GRP in future periods, thereby, creating opportunities for new investment, introducing of innovation, scale up production.

The studied mechanism of the impact of investments in RI on the regional economic development allows assessing the already implemented projects as well as projecting the effectiveness of public and private investment in the road network within the long-term socio-economic development programs.

**Conclusions**

Efficient infrastructure is a necessary condition for the development of Kazakhstan's economy, which wide geography of export-oriented production is combined with insufficient density of the transport network. Implementation of RI investment projects will also have a stimulating effect on regional economy, contributing to:

- 1) attracting of private investment, including foreign direct investment, and growth of investment attractiveness of the region;
- 2) appearing of complex multiplicative effects due to the implementation of investment projects in related industries and creation of added value by reducing the cost of transport services;
- 3) increase in business activity, increase in mobility of workforce and economic entities;
- 4) formation of new markets and industries related to the introduction of innovations in the road sector.

Thus, in terms of national and regional policies, the priorities are the following: 1) primary financing of the construction and modernization of the road network (including regional and local ones); 2) improving the efficiency of RI public administration and rational use of available budget; 3) improving long-term and operational planning based on analysis of the effectiveness of RI investment to activate attracting private capital.

Our study indicates that even under tight budget constraints investment in road transport infrastructure is a necessary component of public policy, as they contribute to the accelerated socio-economic development of the regions.

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