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Article

Periods of Formation of Highway Construction Entrepreneurship, Theoretical Issues of Efficiency and Technological Innovation

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Abstract: Background: Highway construction entrepreneurship has evolved through distinct historical phases shaped by socio-economic, political, and technological changes. From early state-controlled infrastructure development to the modern rise of private sector-led initiatives, this sector has experienced significant transformations. These shifts reflect broader economic reforms and the increasing importance of innovation and efficiency in the global construction industry. **Objective:** This study aims to analyze the chronological development of highway construction entrepreneurship, investigate the theoretical underpinnings of operational efficiency, and explore the role of technological innovation in enhancing competitiveness and performance. Special attention is paid to identifying the core challenges and success factors across different developmental periods. **Methods:** A qualitative research methodology was employed, incorporating historical analysis, literature review, and case studies of major highway construction projects from various economic periods. Theoretical frameworks on entrepreneurial development, construction efficiency, and innovation diffusion were used to interpret findings and structure the analysis. **Results:** The findings reveal three major periods in the formation of highway construction entrepreneurship: (1) the foundational phase marked by state dominance and limited private initiative, (2) the transition phase with the introduction of market-based reforms and public-private partnerships, and (3) the innovation-driven phase characterized by digital tools, sustainable practices, and smart infrastructure. Technological advancements—such as Building Information Modeling (BIM), GPS-enabled machinery, and prefabrication—have significantly improved efficiency and reduced construction costs. Moreover, successful enterprises demonstrated a strong alignment between strategic management, regulatory compliance, and innovation uptake. **Conclusion:** The development of highway construction entrepreneurship is a cumulative process influenced by historical context, economic policy, and technological progress. Enhancing efficiency in this sector requires a balanced integration of theoretical knowledge, innovation capabilities, and practical project execution. The study underscores the need for continued investment in technology, adaptive business models, and capacity-building to sustain entrepreneurial success in the competitive highway construction industry.

Keywords: automobile, road construction, enterprise, cost, efficiency, cost, entrepreneurship, evolution, consumer, strategy, innovation, investment, state, private, infrastructure.

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1. Introduction

The formation of alternative transport corridors on a global scale, the creation of sustainable highway chains, the opening of new routes on transit routes, the transition to effective "competitive cooperation (competition)" in efforts to access the world ocean, the creation of necessary highway infrastructures for domestic and international external

freight transportation, such as modern clusters, based on the natural and geographical location of the countries, the improvement of tariff and customs systems, the increase in the investment attractiveness of highway construction service entities, the determination of the prospects for these entrepreneurial services are among the important tasks of strategic importance [1].

From this point of view, in order to measure the efficiency of a highway construction enterprise, it is necessary to implement indicators, change them, introduce new ones, temporarily abandon some of them. These indicators should be constantly monitored. Because they are based on only one of the methods for assessing the efficiency of a highway construction enterprise. The two methods used to assess efficiency mentioned above are different from each other and at the same time interrelated. A serious problem that arises in determining and assessing the efficiency of a road construction enterprise using these methods is that some of the indicators used in these methods require that they be expressed both quantitatively and qualitatively. This makes it difficult to express them through a single common parameter. To avoid such problems, the following 4 main indicators should be analyzed when assessing efficiency:

1. Total costs. Indicators that group each cost and indicate its share in the total cost.
2. The duration of the road construction cycle. Indicators that indicate the time it takes to complete one order.
3. Quality of road construction service. This is an indicator that is summarized by answering questions on several criteria based on feedback from customers.
4. Road construction efficiency. An indicator that represents the profit generated by distributing it across each road construction cycle stage.

Analysis of literature on the topic

Due to the lack of access to the open sea in Uzbekistan, the path chosen for the development of construction business services based on railway, air and road systems for the import and export of domestic and foreign goods has been chosen. In the adopted "Uzbekistan - 2030" Strategy, in special paragraph 53 entitled "Deepening the integration of the Republic of Uzbekistan into global transport and logistics networks and increasing the potential of the national transport system", priority goals and tasks for the modernization and reform of the transport systems of our republic are set. Research aimed at solving these goals and tasks, ways and prospects for the development of road construction business services, and factors for increasing their efficiency was conducted by our foreign and domestic scientists [2].

Decrees of the President of the Republic of Uzbekistan No. PF-60 dated January 28, 2022 "On the Development Strategy of the New Uzbekistan for 2022-2026", No. PF-158 dated September 11, 2023 "On the Strategy of Uzbekistan-2030", No. PF-158 dated December 2, 2017 The issues of road construction entrepreneurship are reflected in the resolutions No. PQ-3422 "On measures to improve transport infrastructure and diversify foreign trade routes of freight transportation in 2018-2022" and No. PQ-246 dated May 18, 2022 "On measures to ensure the harmony of scientific potential and practical activities in working with international ratings and indices" [3].

Currently, when talking about the efficiency of road construction entrepreneurship, it is necessary to refer to the term KPI (key performance index), that is, key performance indicators. This term was proposed by Peter Drucker in the 1960s, who explained the need for this system with his phrase "strategy without measurements is just a desire". This system began to be widely used after the 2000s. KPI is mainly used by enterprises and in organizations, it is considered a tool for assessing employee performance, increasing profits, and achieving goals. Today, KPI is widely used mainly to determine the share of employees in the overall result, set bonuses, and provide motivation. When determining the main performance indicators in transport and logistics enterprises, it is necessary to

study them not only in the activities of dispatchers, but also at each stage of the processes [4].

There is no universal classification of KPIs in the field of road construction entrepreneurship. According to Y. Melnikov, the main performance indicators can be divided into two groups: (1) service and (2) financial indicators. Here, service indicators mean services related to logistics operations [5].

The service KPIs of road construction entrepreneurship include: perfect order, timeliness of shipment, timely return of documents. Financial KPIs include the ratio of delivery cost to sales volume, average cost of shipments, and the ratio of transported cargo to vehicle capacity (utilization rate).

These indicators can be calculated independently by enterprises. The enterprise can also include other indicators that it considers to affect efficiency in these indicators. In general, the enterprise itself determines how many indicators the enterprise should consider as the main ones [6].

R.S. Kaplan and D.P. Norton believed that the number of such indicators should not exceed 20, and J. Hope and R. Fraser - no more than 10. Based on the experience of enterprises, the "10/80/10" rule was considered the most appropriate choice. According to this rule, an enterprise or organization should have 10 indicators representing the main final result, up to 80 production indicators and 10 main efficiency indicators [7].

However, in the conducted research, it was found that in exchange for increasing the efficiency of road construction entrepreneurship, it is necessary to develop the industry, ensure its proportionality by regions, and The analysis of factors affecting the economic development of the country, the identification of strategic directions for development, the introduction of innovations into the global road construction industry have not been sufficiently studied, and accordingly, the literature devoted to this problem has been published in small quantities, which has led to the need to provide a scientific solution to this issue in this study [8].

2. Materials and Methods

The study analyzed the periods of formation of the highway construction entrepreneurship, the specific features of the theoretical issues of efficiency and technological innovations.

In order to deeply analyze the problems within the framework of the topic, develop scientifically based conclusions and recommendations, the method of comparative analysis was used based on the data obtained through the study and analysis of foreign and domestic scientific research.

3. Results

From the time of its emergence to the present day, the road construction industry has gone through several stages of development. This has happened differently all over the world and in individual countries. Based on our scientific research, we have tried to present in tables how the evolution of the road construction industry has happened in the world and in Uzbekistan. The evolution of road construction in the world is divided into 4 stages. These stages are expressed in terms of years and have their own characteristics (**Stages of evolution of road construction entrepreneurship and their specific aspects**).

Table 1. Stages of evolution of road construction entrepreneurship and their specific aspects

Stage name and period	The function of the road construction business	Types of flow	Control concept
1920-1950s Fragmentation stage	1. logistics 2. packaging, transportation an storage 3. delivery	Material	TMB management, material goods management

1950-1970s Formation stage	1. logistics 2. packaging, transportation an storage 3. delivery 4. distribution management 5. marketing	Material	Material managemer distribution
1970-1990s Development stage	1. logistics 2. distribution management 3. delivery 4. production process management 5. packaging, transportation an storage organization 6. marketing 7. transportation quality management	Material, information	Road construction business
1990-2010s Integration stag	1. material flow management as a whole system 2. information flow management 3. financial flow management 4. complex logistics service	Material, information financial, services	Road construction entrepreneurship, supply chain management
2010 to present Development stage of modern highway construction entrepreneursh ip	1. expansion of the range of logistics services 2. outsourcing 3. environmentally friendly organization of transportation processes 4. transport management using digital technologies	Material, information financial, services	Road construction entrepreneurship, supply chain management, Environmental protection

Having studied the existing stages and researching current trends, we propose to introduce the 5th stage "Development of modern road construction entrepreneurship". Because since 1990, there have been significant changes in the field of road construction. It can be said that the globalization of the world economy and the development strategy of Uzbekistan's development have made a significant contribution to the development of road construction. It cannot be said that these stages occurred in all countries exactly between these years. Various factors influenced this, such as the form of government, wars, economy, geographical location, etc. In Uzbekistan, based on the study of available information, we have presented the following diagram in the form of a diagram (**Evolution of road construction entrepreneurship in Uzbekistan**).

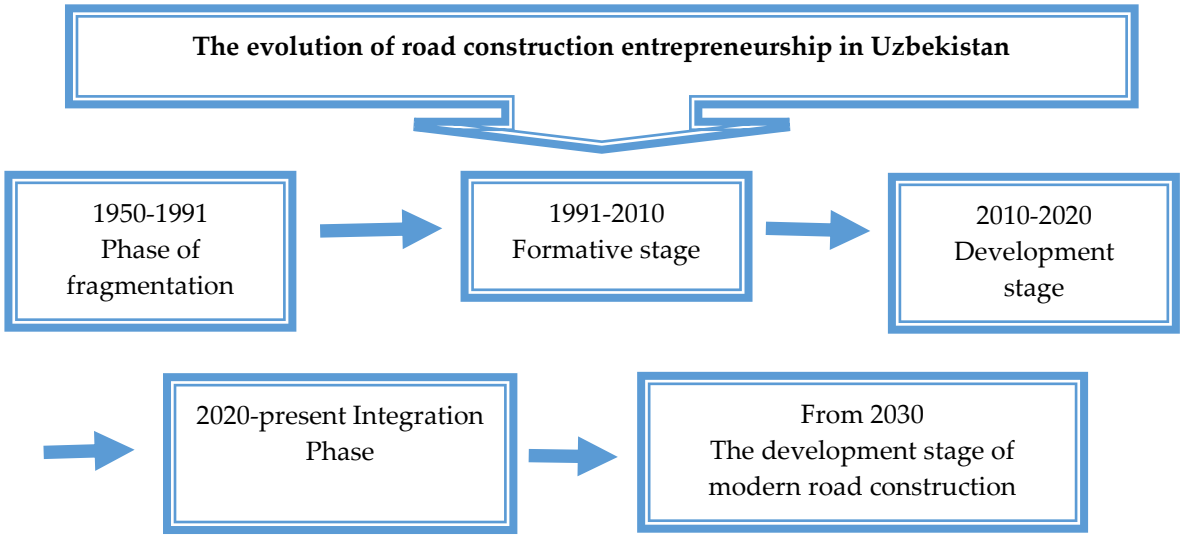


Figure 1. Evolution of road construction entrepreneurship in Uzbekistan

It is precisely during these years that the continuation of the stages is based on the recording of information about this activity in official sources. In our opinion, we are still trying to find our place in the global road construction entrepreneurship market and firmly occupy it. Therefore, we cannot say that we have yet passed to the 5th stage. We believe that we will achieve this as a result of the implementation of the development strategy planned until 2030 [9].

The specific features of road construction entrepreneurship in our country at these stages can be expressed as follows:

The table outlines the evolutionary stages of road construction entrepreneurship in Uzbekistan, detailing transitions from fragmented operations to integrated, technology-driven systems. It highlights key developments, such as privatization, digitalization, and internationalization, alongside controlled flows material, information, financial, and service reflecting growing complexity and strategic alignment with global logistics standards (**Characteristics of road construction entrepreneurship in Uzbekistan during the evolutionary periods**).

Table 2. Characteristics of road construction entrepreneurship in Uzbekistan during the evolutionary periods

Stage	Symbol	Controlled Flows
1950-1991 Phase of fragmentation	1. the use of existing means in road construction, the presence of delays and idle parts 2. the lack of separate statistics 3. the long transportation time;	Material
1991-2010 Formative stage	1. formation of transport modes and road infrastructure after independence 2. emergence of the private sector 3. creation of the legislative framework	Material
2010-2020 Development stage	1. keeping statistics on transportation and storage activities necessary for road construction 2. continuous cargo turnover and transportation	Material, Information, Financial

	3. the creation of central, higher organizations 4. the emergence of road construction centers 5. the use of digital technologies and platforms 6. the creation of new transit routes for international road construction cargo transportation 7. efforts to transport cargo by water transport in the world ocean;	
2020-present Integration phase	1. increased participation in international transportation 2. strengthening its position in international rankings 3. availability of competitive strategies	Material, Information, Financial Services
From 2030 The developmer stage of modern logistics	1. to gain a place in all international rankings 2. to become a member of regional and global organizations that organize cargo transportation activities 3. to popularize the use of digital technologies 4. to carry out transportation using remote, unmanned vehicles;	Material, Information, Financial Services

It is also possible to see that the stages of development and integration occurred in a continuous manner in some areas. However, in general, they can be considered to have occurred between these years [10].

Efficiency is one of the economic concepts that does not have a single, generally accepted definition. According to researchers, the essence of efficiency may vary depending on the content of the object, activity and operation being studied, its specific characteristics, the purpose of measuring efficiency, and the measurement methods [11].

Below we will consider several definitions of efficiency:

Efficiency - achieving a certain result with the minimum possible costs or producing a product in the largest possible volume from available resources [12].

Efficiency - 1. As an economic and mathematical term, it is studied in the context of concepts such as efficiency point, efficiency limit, and is understood as achieving a certain goal, realizing potential opportunities, and performing a task. 2. Utility.[6] Efficiency - from a financial point of view, an indicator expressing the volume of goods produced or services provided, corresponding to a unit of cost, a unit of capital invested, or the total cost of all production factors [13].

Efficiency - in its economic sense, is understood as the ratio between the final result of production and the resources, funds, or expenses advanced to it [14].

A common aspect in all of the above terms is the relationship between this result and the efforts made to achieve it. When paying attention to the definition of the concept of efficiency in many economic literature, it can be seen that the discussion is about economic efficiency. It can also be seen that the definitions of efficiency in economic and technical terms, and the definitions of efficiency in production and resource allocation always coexist and are used to complement each other [15].

4. Discussion

Based on the above, we give the following definition, which describes the situation in the service sector.

Efficiency in the field of road construction is the ability of the road builder to complete the construction of the road with minimal cost and meet the needs of the consumer.

In this definition, efficiency in the field of road construction can be expressed as the ratio of the result achieved and the costs incurred, as in the production process. However, the specificity of the consumer's assimilation of the final results of material production and intangible production is ignored. That is, the consumer's satisfaction with the specified road construction should also be taken into account when expressing efficiency. For example, if the consumer is not satisfied with the construction provided by a road construction company, he can purchase the construction through another company. In this case, the consumer continues to receive the goods from the manufacturer, but chooses to use a different delivery service. When the service is considered by the road construction company or center that performed the service, the service is performed. The ratio of payment received for road construction to the cost incurred is good, but the customer's choice is no longer this company [16].

Determining and measuring efficiency, in turn, is necessary for people related to the road construction enterprise. They can be divided into the following groups:

Group I - those who work directly in the road construction enterprise. These include the head of the enterprise, heads of departments, managers and workers.

Group II - those who do not work in the road construction enterprise, but are directly interested in the activities of the enterprise. These include founders, investors (who have invested in the enterprise and are now planning to invest), suppliers.

Group III - those who benefit from the final result of the work carried out at the road construction enterprise. This group includes the final consumers of the goods produced or services provided by the enterprise, state organizations (tax, finance, statistics, customs) that require and control reports.

Efficiency is important not only for a single enterprise, but also for a specific sector of the country's economy, a specific region. Efficiency can be interpreted differently depending on the point of view of the interested party. In this study, the efficiency category was approached from the perspective of the activities of road construction enterprises. These enterprises are mainly engaged in road construction and their consumers. In general, it can be considered that there are 3 parties in the process. All three parties strive to achieve efficiency for their own benefit. This, in turn, implies reducing their costs. The most important and interesting aspect is that the cost of one party is considered income for the other. We propose to define this aspect as the "Efficiency Corner" of road construction entrepreneurship. It can be explained in detail using the following diagram.

From the perspective of manufacturers of tangible goods, transportation costs are included in the cost. Manufacturers are usually interested in reducing the cost of the product and increasing efficiency. However, minimizing transportation costs can lead to changes in delivery times and consumer characteristics of the product. In addition, the logistics company engaged in delivery sets tariff rates for its services. The manufacturer's costs are the supplier's income. The consumer receives the goods either directly from the manufacturer or by concluding a contract with an intermediary logistics company. In both cases, it is interested in the fact that transportation costs are minimal or absent in the price of the goods [17].

That is, it seeks to satisfy its needs through the consumption of quality products at low cost and has a certain profit. In this case, increasing the efficiency of one party requires that the efficiency of the other party be reduced. Each party wants to reduce its costs. The other party is interested in not reducing these costs. All three parties have their place in society, are profitable entities. The state cannot accept the choice of taking the side of one party and making it profitable. All three of them are participants in an inseparable, interdependent process. In this trilemma, each party participates to the maximum possible limit of costs, while exceeding its efficiency to a certain extent. If they cannot reach a

common level of losses and efficiency, they will participate in the same process with other partners. In this case, there will be no single party that achieves full efficiency.

5. Conclusion

In this study, the periods of formation of the road construction entrepreneurship, the state of theoretical issues of efficiency and technological innovations were studied. The requirements for them were analyzed. Based on the need to pay special attention to the efficiency and technological innovations of the road construction entrepreneurship, the following proposals and recommendations were prepared:

1. Determining efficiency in road construction enterprises is carried out on the basis of the principle of effectiveness;
2. Based on our research, the purpose of determining efficiency in road construction enterprises is to study exactly what part each participant participating in this construction performs in total;
3. Economic efficiency in road construction is understood as reducing the volume of road construction costs by involving innovations, increasing the company's profits by reducing the cost and time spent on road construction.

It can be seen that the proposed definition also reflects the general part of the definition of efficiency, that is, the ratio of the result obtained to the costs incurred. If we explain this definition in detail, the profit received is considered the final net profit of the firm. The construction of the road in a short time is expressed in the concept of "just in time" at the exact time of road construction.

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