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Organizational and Economic Mechanisms for Synchronizing the Construction of Educational Infrastructure within Comprehensive Territorial Development Projects

This article examines the imbalance between the pace of housing construction and the development of educational infrastructure within comprehensive territorial development (CTD) projects. The study aims to systematize and further develop organizational and economic mechanisms that ensure the synchronization of housing commissioning with the delivery of educational facilities. Based on an analysis of data from Rosstat and the Ministry of Education of the Russian Federation, the study shows that, despite the achievement of the targets set by the national project "Education", a substantial proportion of newly built educational institutions operate beyond their design capacity because educational infrastructure is delivered later than residential occupancy. The article identifies three basic financing models, including a budget-funded model, a developer-led model, and public-private partnership (PPP), and compares them in terms of implementation time, budgetary burden, and facility quality. International experience from the Gulf states and the European Union is also reviewed, demonstrating the effectiveness of statutory developer obligations and employing the issuance of infrastructure bonds. The article proposes a conceptual three-pillar model of the organizational and economic synchronization mechanism, comprising regulatory, financial-economic, and organizational-managerial components. Key risks for project participants are identified, together with mitigation measures, including the wider use of standard design documentation (SDD) and urban digital twins. The practical significance of the study lies in the applicability of the proposed measures for shifting from "catch-up" to anticipatory planning of social infrastructure in CTD projects.

Keywords: integrated territorial development, educational infrastructure, synchronization of construction, public-private partnership, organizational and economic mechanism, infrastructure bonds

The national development goals of the Russian Federation for the period up to 2030 envisage not only an increase in housing construction volumes but also the formation of a higher-quality urban environment [1]. Comprehensive territorial development (CTD) projects are a tool for achieving these goals, as they are intended to ensure the balanced development of residential, engineering, and social infrastructure. However, recent statistics consistently indicate a systemic imbalance: housing is commissioned significantly faster than schools and kindergartens. Despite the achievements of the national project "Education", the problems of second-shift schooling and overcrowded schools persist in many dynamically developing regions [2]. The causes of this gap are related not only to demographic fluctuations but also to shortcomings in the organizational and economic mechanisms regulating interaction among public authorities, developers, and investors.

The scale of these disproportions can be assessed using the following data. In 2025, Russia commissioned 108.1 million sq. m of housing, which was 0.4 % higher than in 2024 [1]. However, comparable dynamics in the commissioning of educational institutions were not observed. During the same period, no new kindergarten places were created in 51 regions of the country, and no new school places were created in 37 regions [3]. According to estimates by the Accounts Chamber of the Russian Federation, 53.6 % of schools built in 2019–2024 are already operating beyond their design capacity [4]. One of the main reasons for this situation is the mismatch between planning horizons. As shown

in Fig. 1, the investment and construction cycle for housing development typically lasts 3–5 years, whereas the full cycle for developing budget-financed educational infrastructure takes 5–7 years, largely due to lengthy procedures for inclusion in targeted investment programs. The resulting time lag of 2–4 years is a key source of the "infrastructure gap".

The uneven provision of social infrastructure is especially evident in comparisons across regions. Data on the availability of nearby schools and kindergartens in new residential developments (Table 1) show that, even in the leading constituent entities of the Russian Federation, only about half of new buildings are provided with educational infrastructure within walking distance, whereas in lagging regions this value remains below 20 %. This situation reduces quality of life, contributes to commuter flows, and has an adverse effect on housing prices.

It is noteworthy that the Domclick case mainly covers multi-apartment residential developments and may not fully convey the individual housing construction sector; nevertheless, the general trend is evident.

To overcome the current imbalance, it is important to identify which financing models are currently used and which of them can ensure synchronization. Russian and international practice distinguishes three main models: budget financing, developer financing, and mechanisms based on public-private partnerships (PPP). Their comparative characteristics are presented in Table 2. The budgetary model remains dominant in the vast majority of constituent

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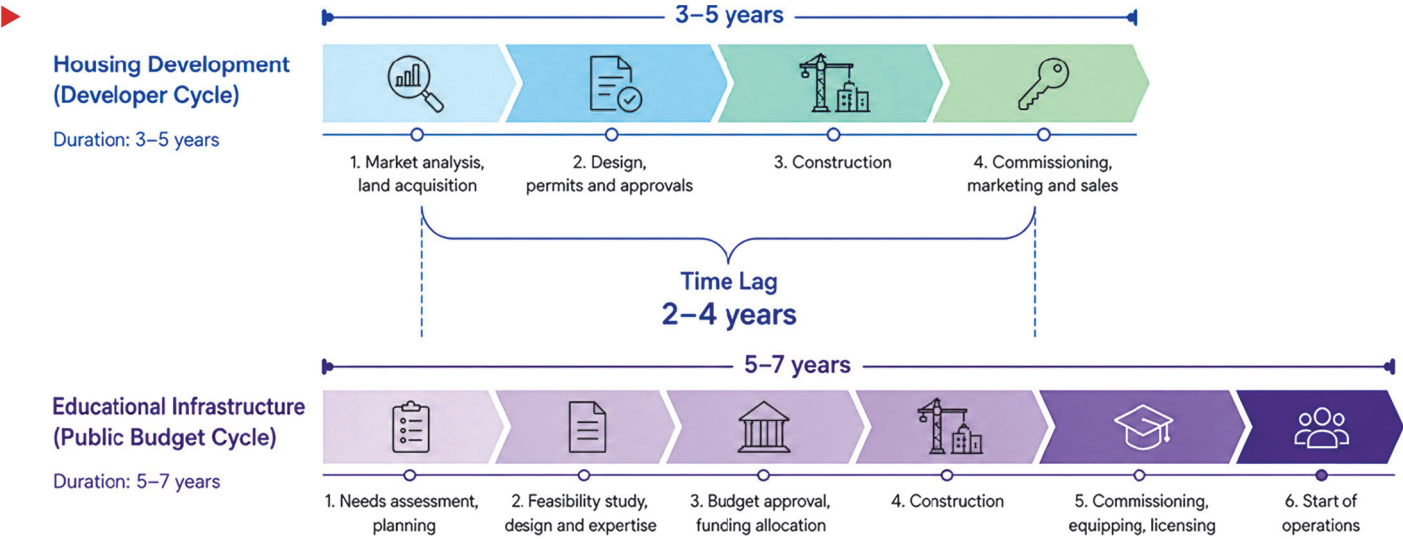


Fig. 1. Comparison of investment and construction cycles for housing and educational facilities (conceptual diagram)

Note: the figure shows the differences in cycle duration and stages that lead to the time lag. Stage durations are indicative and may vary depending on specific regional conditions.

Table 1. Provision of new residential buildings with nearby schools and kindergartens in selected constituent entities of the Russian Federation (2025)

Region	Provision with nearby schools, %	Provision with nearby kindergartens, %
Kaliningrad Region	53.2	50.6
Nizhny Novgorod Region	52.5	53.2
Republic of Tatarstan	49.3	55.8
Tyumen Region	47.9	45.1
Omsk Region	44.6	47.6
Omsk Region	14.2	14.2
Republic of Bashkortostan	14.9	14.9
Samara Region	18.8	20.1

Source: compiled by the authors based on Domclick data, 2025.

Table 2. Comparison of financing models for educational infrastructure

Model	Source of funds	Advantages	Disadvantages	Examples
Budgetary (classical)	Federal/regional budget, targeted investment programs	Direct quality control; compliance with standards	High budget burden; long lead times (5–7 years); risk of underfunding	Most regions of the Russian Federation
Developer-based (developer obligations under CTD contracts)	Developer's own funds	Synchronization with the housing commissioning schedule; reduced budget burden	Increase in housing cost; risk of transferring a low-quality facility to the municipality	Moscow (renovation), Rostov Oblast (since 2025)
PPP (concessions, infrastructure bonds)	Off-budget investment with returns through operation or the budget	Risk sharing; accelerated construction; introduction of innovations	Complex structuring; long-term budget obligations	Saint Petersburg (5 schools, 13.3 billion rubles), DOM.RF projects

Source: compiled by the authors based on data from [5–8].

entities of the Russian Federation; however, its potential is limited: according to the Ministry of Finance of Russia, more than 60 % of consolidated regional budgets are in deficit [5]. The developer-based model, developed in Moscow within the renovation program, has proved effective in terms of schedule synchronization, but it requires significant financial resources from developers and can increase the cost per square meter of housing by 8–12 % [6]. The PPP model, including the use of infrastructure bonds, is considered

the most promising in terms of balancing the interests of the parties. Bond issues of “SOPF DOM.RF” have a ruAAA credit rating, which confirms their reliability and makes them an attractive instrument for investors [7].

Valuable experience in synchronization has also been accumulated internationally. In the United Arab Emirates, the general plans of the emirates establish obligations for master developers to commission schools and kindergartens before completion of the first

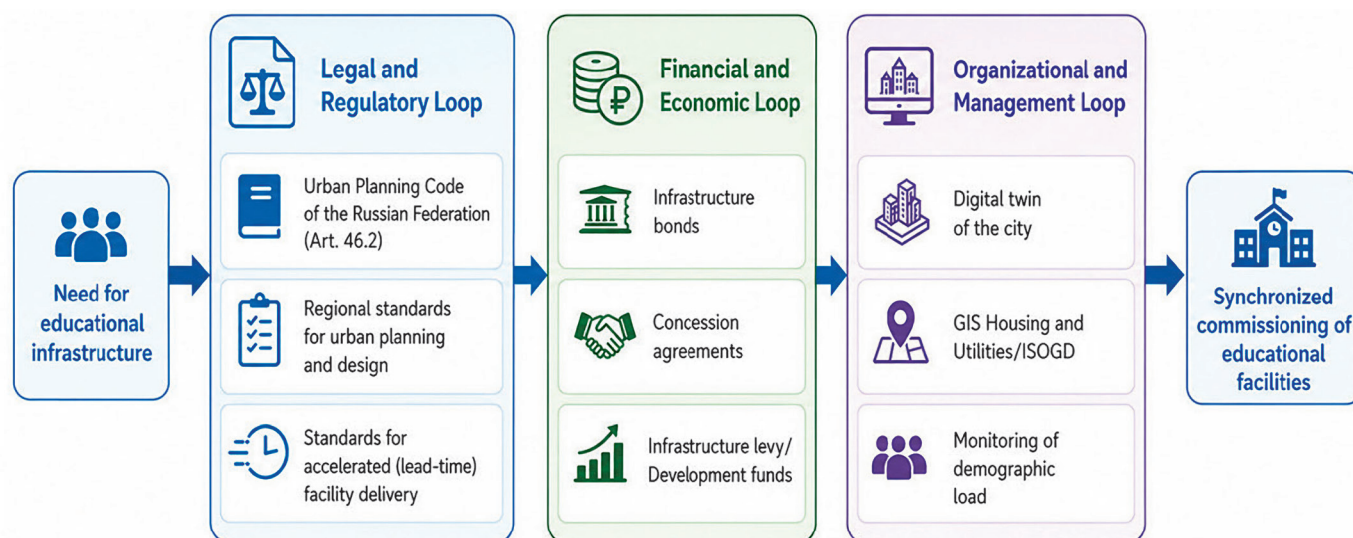


Fig. 2. Conceptual model of the organizational and economic mechanism for synchronizing educational infrastructure construction in CTD projects

phase of housing. Compliance is ensured through escrow account mechanisms and substantial penalties [9]. As a result, in Dubai in 2023–2024, an average of 87 % of educational facilities in new districts were commissioned synchronously with occupancy. In Saudi Arabia's NEOM megaproject, educational infrastructure is designed as an integral part of the smart city simultaneously with engineering networks and residential areas [10]. In European Union countries, approaches based on targeted fees from developers are common. In the United Kingdom, under Section 106 Agreements, developers transfer contributions to the municipal budget, which are then centrally allocated to the construction of schools within walking distance of new housing [11]. A similar mechanism is beginning to be implemented in Russian legislation through comprehensive territorial development agreements; however, in practice, payments for removing infrastructure constraints often do not cover the actual cost of constructing social facilities [12].

Taking into account these models and international experience, it is possible to propose a holistic structure that consolidates disparate tools into a single system. Fig. 2 presents a conceptual three-loop model of the organizational and economic synchronization mechanism. The first regulatory and legal loop involves introducing standards for anticipatory commissioning at the level of constituent entities of the Russian Federation; under these standards, housing cannot be commissioned without the availability of places in educational organizations within walking distance. This will require amendments to the Town Planning Code of the Russian Federation and to regional urban planning standards. The second financial and economic loop includes expanding the use of the "infrastructure menu" mechanism, subsidizing interest rates on loans to developers that undertake school construction, and creating regional social infrastructure development funds that accumulate targeted fees and budget transfers. The third organizational and managerial loop is based on the implementation of a city digital twin using the GIS Housing and Communal Services and the information system for ensuring urban development activities. This enables real-time forecasting of shortages of school places based on data on issued construction permits and demographic forecasts. All three loops should function within a unified logic, exchanging data and

ensuring end-to-end control from the planning stage to facility commissioning.

Implementation of the described model involves some risks that must be considered in practice. For developers, the main risk is an increase in project cost due to the need for simultaneous financing of residential and social construction. For the public partner, the risk lies in receiving a facility that does not meet educational standards or requires significant maintenance costs. One effective way to minimize these risks is to use standard design documentation (SDD). However, according to available data, only 21.7 % of new schools and 19.6 % of kindergartens are currently built using SDD [13]. Increasing this share can reduce design time by 30–40 % and construction costs by up to 15 % [14]. In addition, the development of turnkey concession agreements with predetermined technical and economic parameters is a promising direction, as it can simplify the entry of private investors into projects [15].

Thus, the analysis confirms that synchronization between housing construction and the commissioning of educational infrastructure is a key factor in forming a full-fledged urban environment in CTD projects. Existing financing models are limited in effectiveness; however, their combination, primarily on the basis of PPP and supported by regulatory requirements, can provide the necessary balance. The proposed three-loop conceptual model establishes a holistic framework for the practical transition from "catch-up" to "anticipatory" planning. Its implementation will require improvement of the regulatory framework, expansion of the practice of issuing infrastructure bonds, and large-scale digitalization of urban planning data. Further research by the authors will focus on developing a detailed methodology for assessing the economic efficiency of various forms of PPP for school construction within CTD projects.

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Организационно-экономические механизмы синхронизации строительства образовательной инфраструктуры в проектах комплексного развития территорий

В статье исследуется проблема дисбаланса между темпами жилищного строительства и созданием образовательной инфраструктуры в рамках проектов комплексного развития территорий (КРТ). Целью работы является систематизация и развитие организационно-экономических механизмов, обеспечивающих синхронизацию ввода жилья и объектов образования. На основе анализа данных Росстата и Минпросвещения РФ показано, что, несмотря на выполнение целевых ориентиров национального проекта «Образование», значительная часть новых учебных заведений работает с превышением проектной мощности из-за отставания их ввода от заселения микрорайонов. Выявлены три базовые модели финансирования: бюджетная, девелоперская и на основе государственно-частного партнерства (ГЧП), проведен их сравнительный анализ по критериям сроков, нагрузки на бюджет и качества объектов. Рассмотрен международный опыт стран Персидского залива и Европейского союза, демонстрирующий эффективность нормативного закрепления обязательств застройщиков и применения механизма инфраструктурных облигаций. Предложена концептуальная трехконтурная модель организационно-экономического механизма синхронизации, включающая нормативно-правовую, финансово-экономическую и организационно-управленческую блоки. Определены ключевые риски участников и пути их снижения, в том числе за счет расширения использования типовой проектной документации (ТПД) и цифровых двойников городов. Практическая значимость работы заключается в возможности применения предложенных мер для перехода от «догоняющего» к «опережающему» планированию социальной инфраструктуры в проектах КРТ.

Ключевые слова: комплексное развитие территорий, образовательная инфраструктура, синхронизация строительства, государственно-частное партнерство, организационно-экономический механизм, инфраструктурные облигации

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