DEVELOPMENT OF A DIGITAL COOPERATION PLATFORM FOR INDUSTRIAL STRUCTURES UNDER REGIONAL DIGITALIZATION CONDITIONS

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Abstract: *Regional digitalization changes the way industrial enterprises search for partners, share production capacity, coordinate orders and manage inter-firm cooperation. In many regions, industrial structures still exchange information through fragmented channels, which leads to duplicated procurement, weak subcontracting links, low transparency of available capacity and delayed managerial decisions. This paper proposes the development of a digital cooperation platform for industrial structures under regional digitalization conditions. The platform integrates an enterprise registry, production-capacity profiles, procurement needs, logistics information, digital agreements, partner-matching algorithms and analytical dashboards into a unified information environment. The scientific novelty of the study is the formulation of industrial cooperation as a data-driven regional platform model rather than a set of separate enterprise interactions. A transparent matching score is introduced to evaluate compatibility between demand and capacity, technological specialization, reliability, logistics accessibility and cooperation risk. Scenario-based analytical results show that the proposed platform can improve partner selection, increase contract traceability and support evidence-based regional industrial policy.*

Keywords: *regional digitalization, industrial cooperation, digital platform, enterprise matching, supply chain coordination, Industry 4.0, information system.*

1. Introduction

Regional economic development increasingly depends on the ability of industrial enterprises to cooperate quickly, transparently and efficiently. A single enterprise is rarely able to produce a complete high-value product without external suppliers, subcontractors, logistics operators, service companies and technology partners. Therefore, industrial cooperation becomes a strategic mechanism for increasing productivity, reducing

production costs, accelerating innovation and strengthening local value chains.

In the context of regional digitalization, cooperation should not remain limited to personal contacts, paper-based requests or irregular negotiations. Digital tools can transform fragmented industrial relations into an organized information ecosystem. Such an ecosystem makes it possible to identify unused production capacity, connect enterprises with complementary needs, monitor contract execution and provide government bodies with reliable indicators for industrial policy.

However, many regional industrial systems face several practical problems: incomplete information about enterprises, weak visibility of available equipment and capacity, slow partner search, non-transparent subcontracting processes, duplicated procurement and limited analytical support. As a result, enterprises may import components that could be produced locally, while other firms may operate below their capacity because potential partners do not know about their capabilities.

This paper proposes a digital cooperation platform for industrial structures under regional digitalization conditions. The aim is to design an information system that supports the full cooperation cycle: registration of industrial participants, data standardization, demand and capacity matching, contract workflow, logistics coordination, risk assessment and analytical monitoring.

2. Related Work and Research Gap

The literature on Industry 4.0, digital transformation and platform ecosystems emphasizes the role of data integration, interoperability and network-based value creation. Digital platforms are considered an important organizational form because they connect many participants, create common rules and enable data-driven coordination. In industrial systems, platforms can support supplier selection, production planning, quality control, maintenance services and logistics management.

Existing enterprise systems such as ERP, CRM and SCM mainly serve the internal needs of individual firms. They are useful for planning resources and managing operations, but they do not fully solve the problem of regional cooperation between independent enterprises. Online directories and business catalogues provide basic information, but they usually lack dynamic capacity data, compatibility scoring, contract monitoring and risk analytics.

The research gap is the absence of a compact and practically implementable platform model that treats regional industrial cooperation as an integrated digital process. The proposed approach addresses this gap by combining enterprise profiles, production capacity, procurement needs, logistics indicators and reliability evidence into a transparent cooperation-matching mechanism. The platform is not only a database; it is a decision-support environment for enterprises, cluster managers and regional authorities.

3. Proposed Platform Architecture and Algorithm

The proposed platform consists of six main functional modules. The first module is the digital enterprise registry, where each participant creates a verified profile containing sector, specialization, location, certificates, equipment, production capacity and contact data. The second module is the demand-and-capacity repository. Enterprises can publish procurement needs, outsourcing requests, spare capacity, available services and technological offers.

The third module is the partner-matching engine. It compares the requirements of one enterprise with the capacity and specialization of other enterprises. The fourth module is the digital contract workflow, which records cooperation requests, negotiations, accepted offers, execution stages and delivery documents. The fifth module is the analytics dashboard, which visualizes active cooperation links, cluster density, bottlenecks, capacity utilization and regional industrial indicators. The sixth module is the governance layer, which includes data security, access rights, audit trails, interoperability standards and user feedback.

The algorithm of the platform can be described as follows. First, industrial participants submit standardized data about their resources, products and needs. Second, the system validates the data and converts it into comparable features. Third, the matching engine calculates a cooperation suitability score for each potential pair of enterprises. Fourth, enterprises receive ranked partner recommendations. Fifth, selected partners launch a digital cooperation workflow. Sixth, the platform monitors execution and updates reliability indicators based on completion time, quality feedback and document consistency.

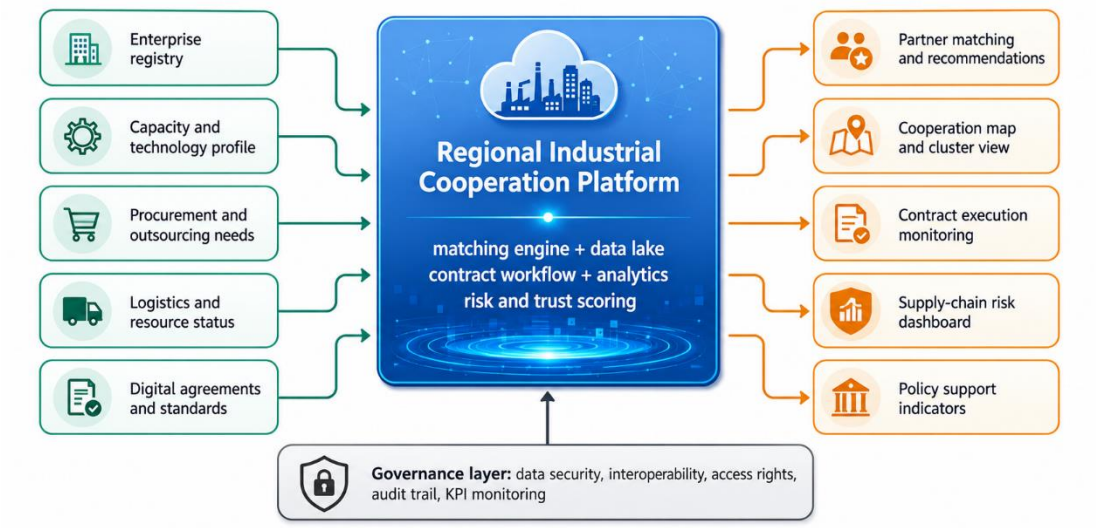

Figure 1. Digital cooperation platform architecture for industrial structures.

4. Mathematical Model

The platform uses interpretable variables to evaluate whether two industrial enterprises can form an effective cooperation link. Let enterprise i represent a potential customer or coordinator, and enterprise j represent a potential supplier, subcontractor or service provider. The main variables are K_ij for technological compatibility, Q_ij for capacity-demand balance, S_ij for sector complementarity, R_j for reliability, L_ij for logistics friction, U_ij for uncertainty of data and G_ij for compliance with standards or certification requirements.

The latent cooperation potential between two enterprises is calculated as follows:

$$z_{ij} = \alpha_0 + \alpha_1 K_{ij} + \alpha_2 Q_{ij} + \alpha_3 S_{ij} + \alpha_4 R_j + \alpha_5 G_{ij} - \alpha_6 L_{ij} - \alpha_7 U_{ij} \quad (1)$$

The normalized cooperation suitability score is obtained through the logistic transformation:

$$P_{ij} = 1 / (1 + \exp(-z_{ij})) \quad (2)$$

A higher value of P_{ij} means that the platform recommends enterprise j as a more suitable partner for enterprise i. To avoid unstable recommendations based on one-time data changes, the model uses a temporal smoothing mechanism:

$$M_{ij}(t) = \lambda P_{ij}(t) + (1 - \lambda) M_{ij}(t-1), \quad 0 < \lambda \leq 1 \quad (3)$$

The general platform value index for a region can be expressed as:

$$V_t = w_1 N_t + w_2 C_t + w_3 A_t + w_4 T_t - w_5 B_t \quad (4)$$

where N_t is the number of active cooperation links, C_t is the average capacity utilization improvement, A_t is the share of contracts completed through the platform, T_t is traceability of cooperation processes, and B_t represents identified bottlenecks or unresolved risks. This index can be used by regional authorities to monitor whether digitalization creates real cooperation benefits.

5. Results and Analytical Discussion

A scenario-based analytical evaluation was prepared to compare the proposed platform with traditional cooperation mechanisms. Four approaches were considered: manual partner search, a simple online enterprise directory, isolated ERP-based coordination and the proposed digital cooperation platform. The comparison focuses on partner-matching quality, time required to find a partner, traceability of contracts and the ability to detect cooperation risks.

Table 1. *Analytical comparison of industrial cooperation mechanisms.*

Method	**Partner matching**	**Time index**	**Contract traceability**	**Risk visibility**
Manual search through personal contacts	0.58	1.00	0.31	0.42
Simple online enterprise directory	0.67	0.78	0.44	0.50
Isolated ERP-based coordination	0.71	0.69	0.60	0.62
Proposed digital cooperation platform	0.89	0.43	0.84	0.81

The table shows that manual cooperation is strongly dependent on personal networks. It may work in small business communities, but it does not

provide systematic visibility of regional capacity. A simple online directory improves access to contact information, yet it does not evaluate whether an enterprise has the required technology, free capacity or reliable performance history. An ERP-based solution is stronger inside one enterprise, but it is usually closed to external partners and cannot function as a regional cooperation environment.

The proposed platform provides the highest analytical matching score because it combines several types of evidence: technological profile, available capacity, sector complementarity, logistics friction and reliability indicators. The time index is lower because ranked recommendations reduce the need for long manual negotiations. Contract traceability increases because each cooperation stage is recorded in the digital workflow. Risk visibility improves because delays, repeated quality complaints, data incompleteness and logistics bottlenecks can be detected at an early stage.

The platform can also support regional management decisions. For example, if many enterprises search for the same component outside the region while local producers have underused capacity, the system can recommend import-substitution cooperation. If logistics friction is high between two industrial zones, the dashboard can justify infrastructure improvements. If several firms lack certification needed for larger contracts, authorities can design targeted support programs.

6. Scientific Novelty and Practical Value

The scientific novelty of the study is that industrial cooperation in a region is formulated as a digital platform process based on data integration, compatibility scoring and continuous monitoring. Unlike ordinary enterprise catalogues, the proposed model evaluates cooperation suitability through measurable variables and provides ranked recommendations.

The second novelty is the use of a transparent mathematical model for partner selection. Each recommendation can be explained by specific factors: technological compatibility, capacity balance, reliability, logistics accessibility or certification compliance. This increases trust among platform users and makes the system suitable for practical industrial management.

The practical value of the platform is reflected in four directions. First, enterprises can find local partners faster and reduce transaction costs. Second, industrial clusters can improve coordination between manufacturers, suppliers and service providers. Third, regional authorities

can obtain real-time indicators of cooperation intensity, bottlenecks and capacity utilization. Fourth, digital traceability can increase transparency of contracts and support more reliable supply-chain management.

7. Conclusion

This paper presented the development concept of a digital cooperation platform for industrial structures under regional digitalization conditions. The platform integrates enterprise profiles, production capacity, procurement needs, logistics data, digital contracts and analytics into a unified information environment. The proposed matching model makes it possible to evaluate cooperation suitability between enterprises using interpretable variables.

Scenario-based analytical results show that the platform can improve partner selection, reduce search time, increase contract traceability and strengthen risk visibility compared with manual search, simple directories and isolated internal systems. Future work should focus on pilot implementation in a selected region, integration with existing enterprise systems, development of data governance regulations and empirical validation using real industrial cooperation cases.

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