

Digital Logistics as Institution for Improving Coordination of Flow Processes in Transport and Logistics System of the Smart City

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ABSTRACT

In today's world, in the context of digitalization, resources are diverted from traditional economic mechanisms, while information and communication technologies give impetus to new development institutions, which ensure transition to a new technological mode of economic development in the situation of decentralizing economic resources and contributing to a new quality of human life. The proposed institute of digital logistics provides interactions in the development of the transport and logistics system (TLS) of the smart city and is transformed through the formation of world-class infrastructure, providing the needs of its own software, equipment and personnel, replacing human functions with automated algorithms under the new system of economic management. In turn, its development today is an important and dominant factor that allows the control of transactions and transaction costs, as well as the enforcement of rules and regulations for a higher level of consistency in the interaction of economic agents in digitalized economy.

Keywords: *digital logistics, flow processes, adaptive coordination, TLS mutation, mechanisms of achieving criteria of transformation and development of urban transport and communication corridors, ecosystem*

1. INTRODUCTION

Today there is a tendency to move away from centralized management, and there is a transition from the C3 paradigm (management, calculation and communication) to the C5 paradigm (management, calculation, communication, lifecycle cost), which reduces transaction costs. Under these conditions, there is a need to control decentralized management systems through formation of new institutional environment. At present a more flexible approach that ensures the coordinated interaction of economic agents and reduces the systemic friction of the system itself, is in demand.

Development of a new management model of coordination of flow processes requires a deeper study of institutional changes, as well as the formation of new norms and rules of interaction of economic agents, which in modern realities is realized in the formation of a common information space in the development of appropriate infrastructure of the smart city TLS.

2. MATERIALS AND METHODS

Let us accept [1] that minimization of resource and material costs is insignificant for the transport and logistics system of a smart city, and those systems in which the level of transaction costs is minimal, dominate. Achievement of this indicator is possible only at coordinated functioning [2-4] and development of all economic agents. Thus, economy will act as a category of achievement of adaptive coordination as transition to new modern institutes of development [5].

We emphasize that search for information, costs of preparation and execution of the transaction, protection of specification and property rights, as well as opportunistic behavior with limited rationality act as criteria for evaluating transaction costs; they strive for a minimum value in the ideal flow model of the smart city TLS. The reason for this is that information asymmetry is insignificant due to full access to information in supply chains with open architecture and the value of opportunistic behavior is also minimized by existing restrictions - infrastructure, information space and rules of interaction between economic agents.

The difficulty in the development of TLS smart city in this situation is the quantitative indicator of economic agents and their intensive growth. Anyway, with the involvement of consumers in the management of flow processes, as well as the use of technology Web 2.0 and above, this indicator is reduced and leveled in the future. Today, current rules of interaction are expressed by institutional environment of the TLS smart city in the field of regulation, organization and provision [6-9], but do not allow to form a transport and logistics system of a new type [10], due to the lack of a systematic approach and the use of digital logistics tools [5, 11, 12], which in

combination contribute to adaptive coordination of flow processes. At the same time, transaction costs, as a basic category of institutional economics, are growing due to systemic frictions in the organization of the city flow processes.

3. RESULTS AND DISCUSSION

Development of interactions between economic agents in the TLS of the smart city should be carried out in the field of transportation process, related management

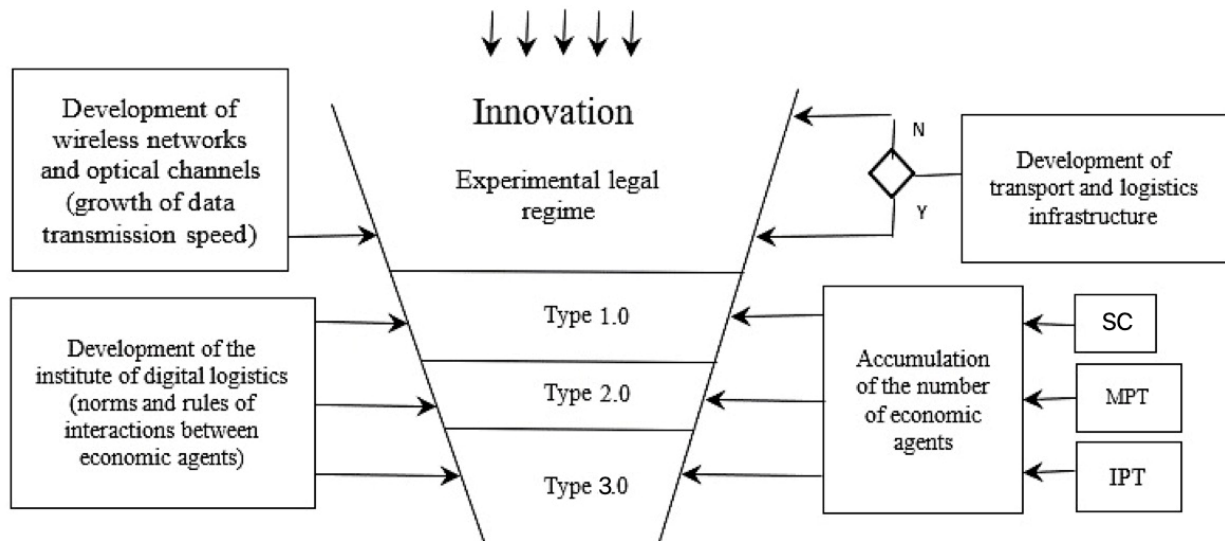


Figure 1. A mechanism for achieving the transformation criteria for the TLS of a smart city in the field of adaptive coordination.

Table 1. Directions for the development of mutations in the TLS of a smart city in the field of coordination

No.	Gene (Mutation)	1.0	2.0	3.0
G1	Replacement of routine operations in the field of interorganizational interaction between economic agents	ERP, TMS, RFID	ERP II	Cloud computing, semantic networks, predictive analytics
G2	Reliability, accuracy and security of transmitted digital information in real time	EDI	IOT, Big Data, Sensor technologies	Blockchain 2.0, Smart Contracts
G3	Involving consumers in managing streaming processes	CSRP in supply chains	CSRP households	CSRP of all flow processes
G4	Intelligent Automatics well-established decision-making algorithms	Enterprise information system	Corporate information system	Integrated control system
G5	Adaptive efficiency (control of transaction costs according to the established norms of interactions)	Intelligent transportation system	In supply chains (SC)	All flows
G6	Open architecture	Web 1.0	Web 2.0	Web 3.0
G7	Complexity of interaction	Participants of streaming processes: mass and individual passenger transport (MPT and IPT) and SC	All cyclical streaming processes in the TLS of a smart city	All flow processes of functioning and development
G8	The dynamic nature of infrastructure development	For SC	For MPT and IPT	Dynamic infrastructure of the transport and logistics system

processes, coordinated improvements on the basis of an appropriate evaluation system and its open architecture.

Let us highlight the mutations that need to be coherently and systematically developed and monitored in order to develop modern systems of management of city flow processes (Table 1). As a result, for each type institutions which determine the interaction between economic agents are partially formed; for a deeper integration, but to ensure adaptive coordination of flow processes new ones are needed. Their transformation has a direct structural relationship with the quantitative indicator or a set of economic agents with the growth of trust and cooperation, which is realized through the system of CSRP.

As a result, the formation of smart city TLS 3.0 provides control over organization of transportation in real time, as well as savings to the participants of the flow processes with a rational choice of mode of movement and the involvement of all consumers in the management.

The implementation of the gene transfer process is provided by the mechanism of achieving the criteria of smart city TLS transformation in the context of "regulatory sandboxes" (Figure 1).

In this situation transactional costs are influenced by accumulation and evolutionary selection of the number of economic agents with certain criteria of functioning, while there is formation of integrated genes of smart city TLS, which can be called "established majority" at a

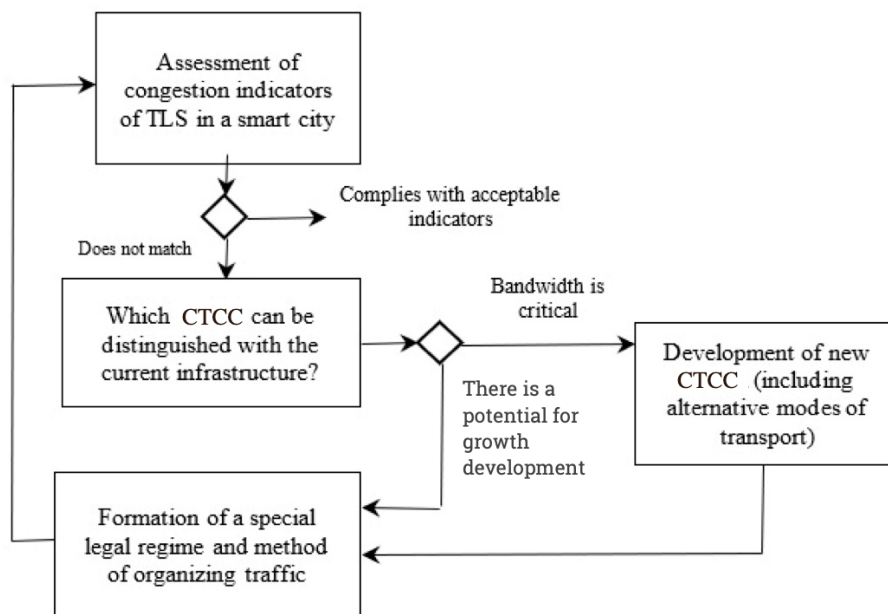


Figure 2. Mechanism for the development of urban transport and communication corridors TLS of the smart city.

Table 2. Development of the digital logistics institute in the field of adaptive coordination of streaming processes in the TLS of a smart city.

Direction	Explanation
Control	Ensures implementation of rules and regulations for the interaction of economic agents in the information space, fair distribution of risks, economic, information and cyber security; also organizes functioning of the system integrator and the achievement of savings for economic agents (minimization of transaction costs).
Service support	Provides dynamic nature of the sharing and development of infrastructure and vehicles, as well as training of the necessary personnel.
Transformations and interactions	Forms an information space operating on the principle of Smart contracts (self-executing algorithms) in the field of rational choice of a method of movement or transportation in the TLS of the smart city while organizing access and dynamic pricing in real time; also stimulates innovations in the field of improving coordination processes, increasing trust, cooperation and involvement of economic agents in management.
Transportation process	intelligently manages movement process and the process of adaptive coordination of flow processes; also provides a reduction in system friction in the field of movement control and organization.
Knowledge generation and implementation	Identifies current problems in the field of organizing movement at the request of consumers in real time, suggests ways to achieve them, shortens the time for approbation and implementation, taking into account "regulatory sandboxes".

certain point in time. This statement allows to judge the achievement of critical indicators, when we can talk about the achievement of an appropriate level of coordination and reducing the level of transaction costs.

At present, the role of conflicts between economic agents in the field of transactions in transportation, which are expressed by slowing down the flow processes or complete (partial) blockage, is high. With the purpose of leveling these risks, an alternative vector of development in relation to traditional approach in development of TLS of smart city is the development of city transport and communication corridors (CTCC) as corresponding transport and logistics infrastructure, which allows forming cooperative (autonomous) transport and logistics systems as prototype of hybrid systems that combine centralization, decentralization and self-organization of flow processes. Their development will allow to form a balance of management of flow processes with the use of multi-agent systems (MAS), which allow to make decisions independently within the boundaries of their competence with different variability of models.

Introduction of certain speed modes in the organization of transportation through the CTCC will ensure the coordination of flow processes and reduce investment in new infrastructure, as this indicator depends on the mechanism of their development (**Figure 2**).

As a result, in the development of the share and network economy, there is a need to isolate the institution of digital logistics in the field of adaptive coordination of flow processes, which will provide control, transformation and more effective interaction between participants of flow processes in information space, as well as will organize service support, transportation process, knowledge generation and implementation (**Table 2**).

The author's proposed approach focuses on the development of adaptive coordination of flow processes and is based on the prediction of future arrangement and generation of technology, and on targeted investment in cooperative smart city TLS with the allocation of CTCC as its component structure and the development of the institute of digital logistics.

As a result, an ecosystem of smart city TLC is formed [13, 14], which controls and organizes all transportation (movement) processes through a system integrator, as well as provides a rational choice of alternatives in hybrid functioning and social interaction.

4. CONCLUSION

Today replacement of routine operations in the field of interorganizational interaction between economic agents is not implemented in a comprehensive way. This requires clear and reasonable actions aimed at

intensification of efforts in conditions of understanding the necessary result in the field of coordination of flow processes.

Involvement of consumers in management allows to build a system including flow processes of resources attraction (crowdfunding, fundraising) under new ideas in the field of sustainable development, as well as their wishes. In this case, the more economic agents will have access to an integrated management system, the greater the pool of innovations, focused on improving the process of transportation in real time and the quality of life, will be [2, 6, 7, 9, 12, 15, 16], life.

We emphasize that no one cancels the "invisible hand of the market", which ensures the rational selection of both innovations and economic agents in supply chains, ensuring the transfer of allocated genes into transport and logistics systems of a new type. We believe that cooperation acts as an alternative and necessary stage of interaction to achieve a competitive advantage for joint development.

The state, influential groups, as well as institutional matrix restrain changes. Anyway, evolutionary processes provide transformations and transformational costs are now included in the list of costs of business, for which introduction of innovations to gain an advantage in the framework of schumpeterian competition is critical. Optimization of flow processes cannot be solved at its expense only, at present this process requires a comprehensive alternative approach, which considers all stakeholders and ensures economizing and planned development

Complex implementation of mutations for the majority of economic agents will provide an increase in the consistency of transactions, but will not fully solve the issue of cooperation and trust, which should be determined by the institution of digital logistics, which reduces the level of transaction costs and ensures the most effective adaptive coordination of flow processes in the TLS of the smart city.

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