Problems and solutions for digitalization of transport corridors in CAREC countries

T.A. Babayev[1*], V. Virkovski[2]

[1]Institute of Control Systems, Baku, Azerbaijan
[2]eTrade & Logistics Consultancy, Baku, Azerbaijan

ARTICLE INFO	ABSTRACT
	Problems and trends for digitalization of international supply chains are analysed. The practical approaches for transport corridors digitalization in CAREC countries are considered and proposed on the base of the best international practices as well as technological solutions developed in the EU and Asia-Pacific regions. The concept of the national e-Logistics systems and platforms is introduced as the core solution for interoperability and seamless integration of the national segments of digital transport corridors. On this basis, functional schemes are developed for digitalization of Transcaspian International Transport Route and the newly announced transport corridor between China, Kirgizstan and Uzbekistan. A twin project on the road map development for digitalization of transport and logistics sectors in Azerbaijan and Uzbekistan is introduced.

1. Introduction

Eurasian transport corridors are considered to be the important components of building transport and trade bridges between Europe and Asia. They play a significant role in shaping the main transcontinental supply chains, which are currently undergoing a major transformation. For this transformation to be smooth and efficient, it is necessary to develop synergetic new elements of transport and digital infrastructures that ensure connectivity and seamless integration of national segments of the Eurasian network of transport corridors.

Approaches and solutions for the digitalization of the transport and logistics sector of the world market have been actively developed by the international expert community since 2015-2016. In 2015, EU countries created the Digital Transport and Logistics Forum (DTLF) [1]. Within the framework of the DTLF, a special expert group was formed to develop interoperable information systems for the TEN-T network of the EU transport corridors. The conceptual development of projects for the digitalization of the logistics sector and transport corridors in the Eastern Partnership (EaP) countries also began in 2015, when the topic of e-Logistics and digital transport corridors (DTC) was recognized as a priority and included in the EU and EaP Ministerial Declaration on the digital economy [2].

In 2016, the United Nations Economic Commission for Asia and the Pacific (UNESCAP) published the results of its research project "Using Logistics Information Systems to Improve

---

*Corresponding author.

E-mail addresses: tofig.babayev@gmail.com (T.A. Babayev), v.virkovski@gmail.com (V. Virkovski).

Efficiency and Efficiency"[3]. The main objectives of the UNESCAP study were to review the technical aspects of existing national and transnational logistics information systems in the countries of the EU, Asia and the Pacific region, as well as to identify best practices and provide recommendations on regional technical standards for the creation and use of logistics information systems. In accordance with the UNESCAP recommendations, it is advisable to use national e-Logistics systems (NELS) for the digitalization of business processes in all modes of transport and the provision of multimodal services. In 2017-2019, the EAEU member states declared digital transport corridors as one of their strategic priorities on the EAEU digital agenda with the implementation of a relevant research project to develop the concept of the DTC ecosystem and subsequent projects to create digital infrastructure elements and priority services.

As a result of the above-mentioned R&D, all the main countries of the EU, the EAEU and the Asia-Pacific region are implementing and planning large-scale projects since 2020 to digitalize their logistics sectors, as well as national and international transport corridors: FENIX and FEDERATED in the EU, digitalization of the Trans-Caspian transport corridor with the participation of Kazakhstan, Azerbaijan and Georgia, the DTC ecosystem of the EAEU countries, the national logistics information platform LOGINK in China, integrated into the NEAL-NET network with the platforms of Japan and Korea, the UNESCAP project on digitalization of railway and multimodal transport in the countries of North and Central Asia. All this proves the need for active development and construction of appropriate digital platforms and technological solutions in CAREC countries that will significantly affect the market efficiency and attractiveness of various transport corridors and, as a result, may lead to a serious reconfiguration of international supply chains on the Eurasian continent.

2. Modern trends and problems in digitalization of international supply chains

In 2020-2022, experts from the interregional Working Group on e-Logistics and Digital Transport Corridors (DTC) analyzed current trends in the digitalization of international supply chains and proposed innovative approaches to the digitalization of transport corridors. Supply chain digitalization is the transformation of analogue and paper-based logistics processes into digital ones by creating special blocks of structured data that integrate information across the entire international supply chain and transport corridor, as well as information from some external sources of transport and logistics systems. The experts of this Working Group also performed an analysis of current trends in the digitalization of supply chains, which was carried out on the basis of the latest research by the Gartner group and reports from the Big Four consulting companies - McKinsey, PWC and IBM [4]. As a result, the following main trends in the digitalization of operational models of international supply chains were identified:
- By 2024, supply chains and their platforms will be transformed/redesigned based on the principle of modularity, using innovative digital business models;
- By 2026, large organizations and supply chain operators will compete as regional or corporate digital ecosystems rather than as individual firms/enterprises;
- By 2026, more than half of supply chain organizations will use artificial intelligence (AI) and machine learning (ML) to empower decision making.

The main problems in practical implementation of the above trends are related to the harmonized development of the transport, logistics and digital infrastructures of the international transport corridors used for the main supply chains of Eurasian continent. In this respect it's important to distinguish the areas of transport and electronic logistics:
- <u>Transport logistics</u> deals with the transportation of material goods, as well as the analysis, optimization and management of cargo flows created in supply chains with the provision of appropriate logistics services;
- <u>Electronic logistics</u> (eLogistics) is engaged in the analysis, optimization and management of

information flows created in supply chains with the formation and provision of digital services on this basis.

The main functions of eLogistics systems are considered to be as follows:

- Collection and analysis of data in supply chains for their subsequent collective usage and exchange in order to increase the efficiency of interaction and synergistic cooperation of all participants in logistics processes, as well as decision-making management;
- Ensuring interoperability of processes and systems used by different modes of transport (multimodality);
- Unification of logistics data exchange standards based on structured electronic messages and/or documents with minimal human involvement in the exchange process.

On the base of eLogistics approach the following requirements for digitalization of transport corridors can be formulated:

- Digital transport corridor (DTC) can be created by integrating national e-Logistics systems (NELS) that are capable of serving multi-modal transportation of goods by sea, rail, road and air transport.
- DTC shall provide control over cargo transportation and monitoring on its way from consignor to consignee;
- During DTC creation it is necessary to form a single trusted information space for the particular transport corridor;
- DTC construction requires solving the problems of reengineering and digitalization of end-to-end business processes in transport corridors, including transit and export-import transportation;
- To develop and optimize DTC elements, digital models of infrastructure facilities and vehicles should be used and created on the basis of relevant data transmitted from the technological transport systems of the national DTC segments;
- When building DTC, the principle of compatibility (interoperability) of digital platforms and national systems shall be provided which requires solving the problems of regulatory, organizational, semantic (documentary) and technical interoperability. In each country, the national platform is to act as an integrator of information flows and a system that processes data from the main participants and controllers of multimodal transport in order to convert them into standardized formats of international electronic documents. Thus, interoperable NELS platforms, the same type of cargo control and monitoring modules, standardized formats of data and electronic documents used by participants in supply chains will help ensure the interoperability of the DTC national segments as a federated and scalable information and service system.

DTC shall create conditions for the provision of a developed package of value-added digital services to key participants of international supply chains.

3. Approaches and solutions for digitalization of transport corridors in CAREC countries

To meet the above requirements, the following principles for transport corridors digitalization were formulated:

a. The principle of preserving the digital sovereignty of DTC member countries, implemented by creating its national segments that can be integrated into international transport corridors of various configurations.

b. The principle of interoperability of national segments, information systems and digital platforms of DTC participants.

c. The principle of a federal approach to the formation of a supranational DTC integration platform.

d. The principle of multimodality, which involves the creation of systems and digital platforms that serve transportation by all major modes of transport.

e. The principle of visualization – monitoring and traceability of cargo transportation.

f. The principle of digital trust and information security based on the creation of a trustful information space in the DTC, modern methods of identifying its participants and objects, as well as ensuring a high level of information security when exchanging data and electronic documents.

g. The principle of fair market competition in the provision of digital services, which assumes that new systems and platforms that will be created during the DTC construction will offer new value-added service packages to the market without ousting existing service providers from the digital market.

A practical example of the harmonized solution and implementation of the above principles is considered to be the concept of digitalization of international transport corridors, developed by the expert community of the Eastern Partnership countries [5]. This concept is based on the creation of a federative ecosystem of platforms that unites the information resources of the participants in the international transport corridor by creating a data pipeline for multimodal cargo transportation and providing various services for business and the state. To implement such a concept, the DTC should consist of national multimodal e-Logistics systems (NELS) built on a basic integration platform capable of serving multimodal transportation of goods by sea, rail, road and air in the participating countries. Such platform is considered to be the "building block" of digital infrastructure which can be used for the formation of international DTC by combining interoperable NELS of participating countries in the transit chain. In each country NELS is to integrate information flows and technological systems that process data from the main participants of DTC and operators of multimodal transportation at the local level, as well as converts them into standardized formats of international electronic documents and structured data to handle cross-border transactions. NELS architecture recommended by UNESCAP is shown in Fig.1.
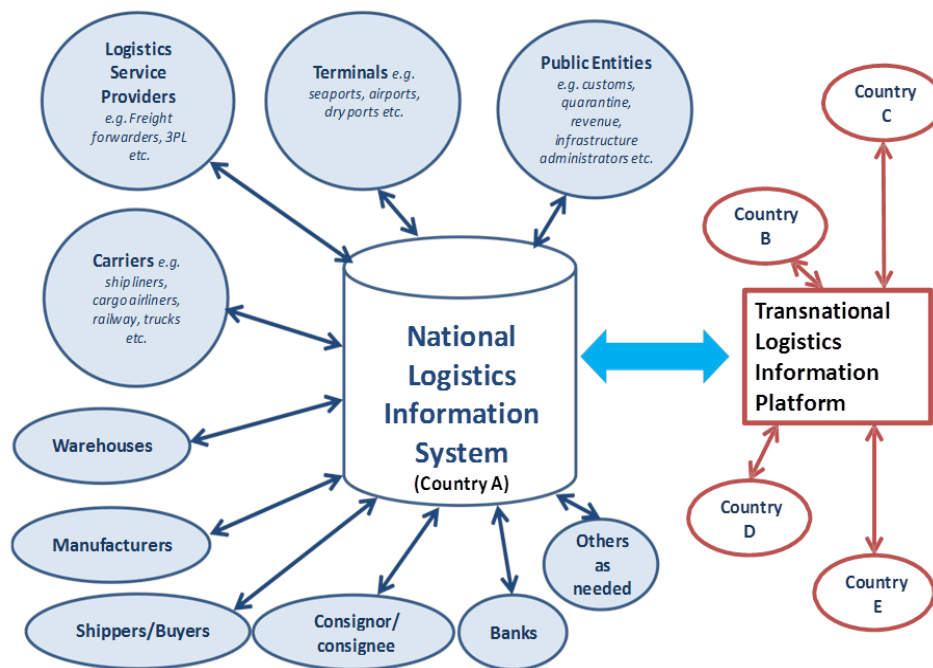
Source: UNESCAP

Fig. 1. Recommended NELS architecture

In the course of research and development undertaken in the framework of EU4Digital program in the Eastern Partnership countries, a core solution for the NELS integration platform has been developed [6]. The functional diagram of such a platform is shown on (Fig. 2).
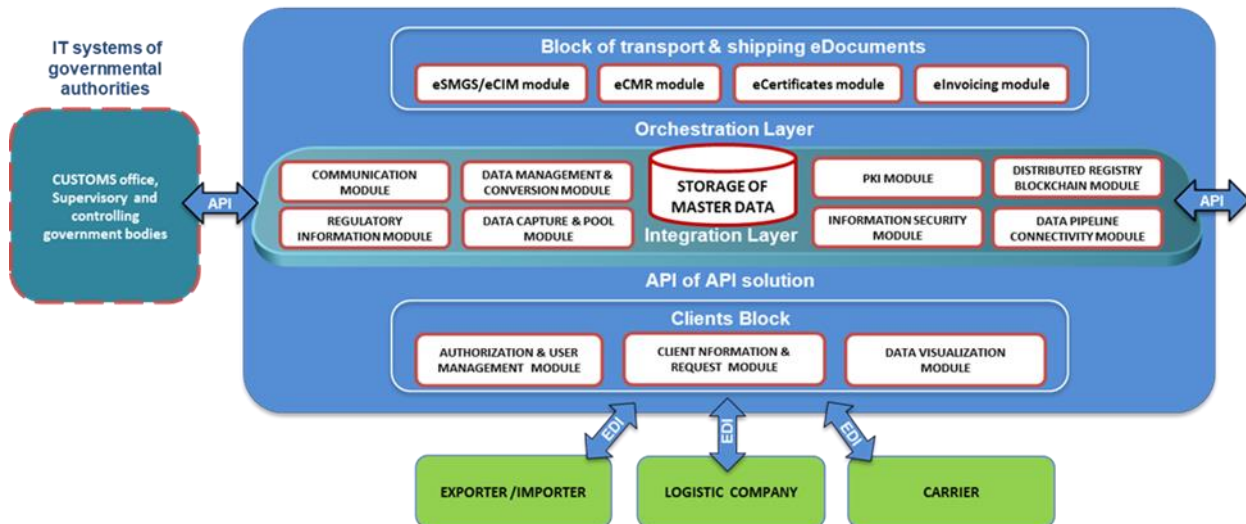

Fig. 2. Functional architecture of NELS platform

As result DTCs are considered to become the effective tools for international supply chain digitalization and allow integrating information systems and resources of their participants into the collaborative digital ecosystem with a single information space to increase the efficiency of end-to-end business processes in multimodal transportation at the two levels:

- Participants of international DTC are to share data, establish common processes and have a supranational technology platform to integrate DTC national segments
- Core NELS platforms at the national level are to ensure connectivity, interoperability and seamless integration of the DTC national segments.

The proposed approach and DTC concept are considered to be largely consistent with the digitalization strategy of the CAREC countries in the field of e-Logistics [7]. According to such strategy adopted in 2022 the following e-Logistics activities are planned to be implemented in the region in the period up to 2030:

- Creation of a regional hub for the transit of goods from Asia to Europe through the transformation of logistics and transport;
- An integrated transit and transport system should be developed as a real tool to increase cross-border transit capacity and ensure freer movement of goods and services;
- Development of a cross-border e-Logistics platform to support the exchange of information that underpins cross-border and transnational supply chains.

Particular attention in the CAREC region will be given to the integration of logistics, customs, finance and insurance functions on unified platforms. The development of such platforms for the region can reduce transaction costs, increase transparency and accountability, and reduce delays and other associated risks for transit traffic.

In view of the recent changes in transcontinental transit cargo flows from China to Europe the special attention of participants in international supply chains is paid to the Middle Transport Corridor and its Transcaspian International Transport Route (TITR) passing Kazakhstan, Azerbaijan and Georgia. Experts from the interregional Working Group on eLogistics and DTC have developed the complete approach to the TITR digitalization in the CAREC countries involved with the functional scheme of the proposed solution shown in Fig. 3.

In September 2022, at the Samarkand summit of the SCO countries, a strategic agreement was signed on the Uzbekistan-Kyrgyzstan-China railway project [8]. This agreement envisages that the development of a feasibility study for the construction of a new section of the railway through the territory of Kyrgyzstan should be completed in the first half of 2023. The PRC is primarily interested in transit opportunities in this project, since in the future the new railway should connect China with the countries the Persian Gulf and the Middle East, providing access to the EU countries as one of the main markets for Chinese consumer goods. The China-Kyrgyzstan-Uzbekistan railway corridor extended through Turkmenistan to the countries of the Middle East is designed to expand the transport capabilities of the PRC, the functional diagram of the technological solution for the digitalization of this transport corridor is shown in Fig. 4.
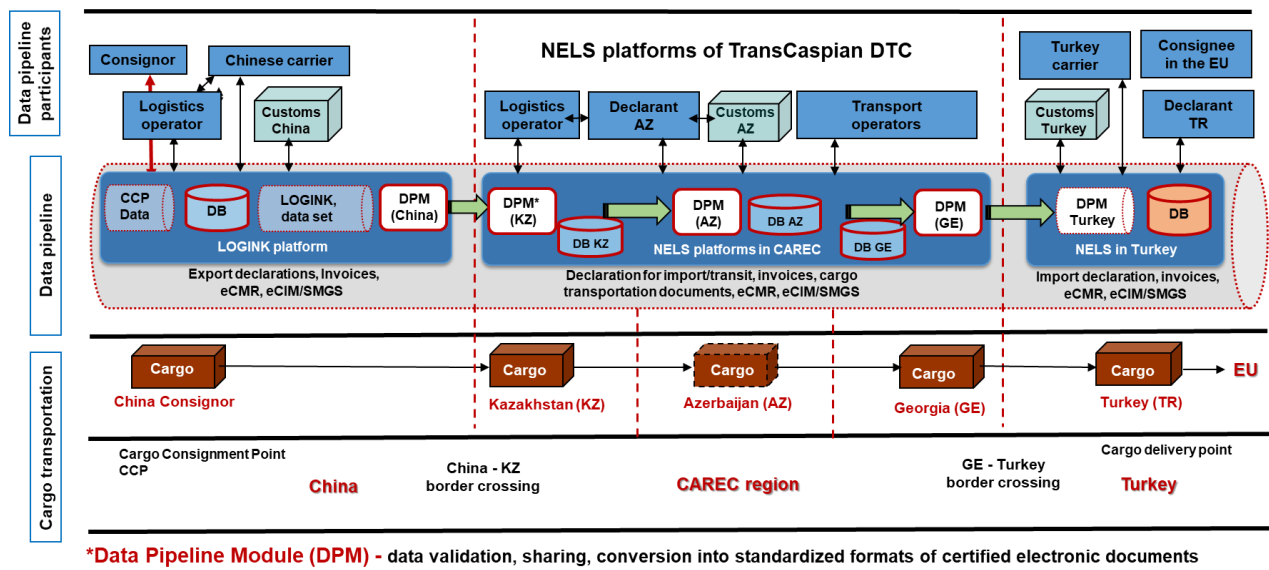

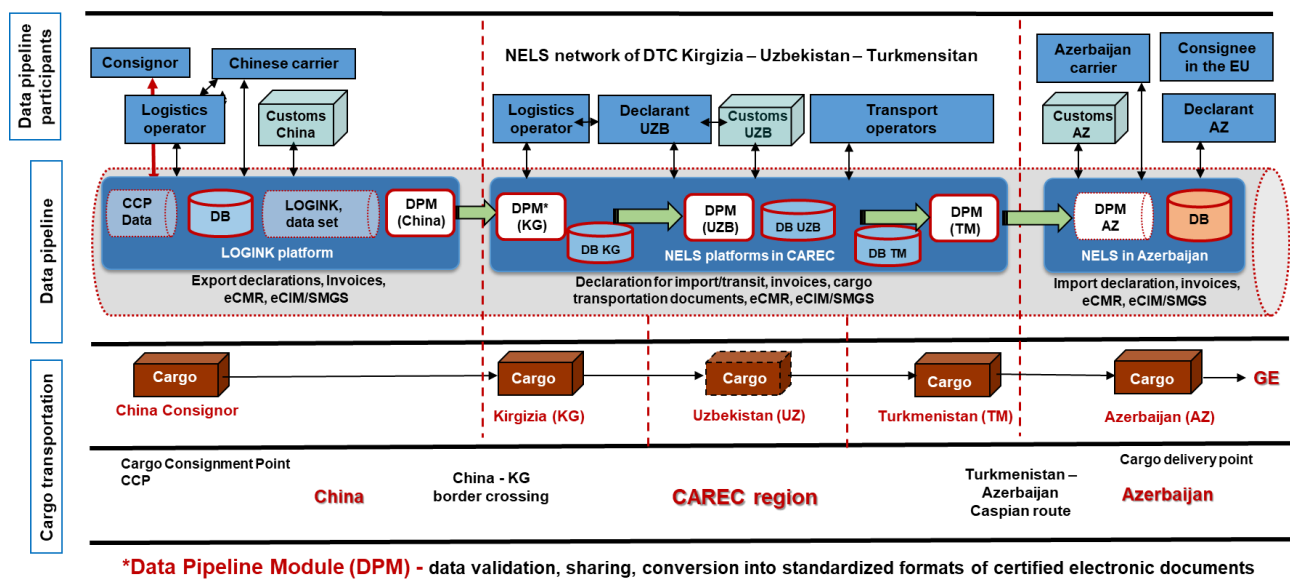**Fig. 3.** Functional diagram for digitalization of Transcaspian International Transport Route

Fig. 4. Functional diagram for DTC between PRC-Kirgizia-Uzbekistan-Turkmenistan-Azerbaijan

4. Conclusions

For the preparation of relevant projects, it is very important to develop national road maps in CAREC countries in order to analyze in detail the levels of digitalization of the transport and logistics sectors and prepare detailed plans for the implementation of projects to create national e-Logistics systems (NELS). Thus, in 2022, the expert teams from the Institute of Control Systems of the Ministry of Innovation and Science of Azerbaijan and the Tashkent State Transport University of Uzbekistan prepared a joint project to develop technological foundations and road maps for the digitalization of the logistics sectors of Uzbekistan and Azerbaijan in order to create digital transport corridors and to ensure the efficiency of cargo flows from East Asia to Europe. Within the framework of this project, it is planned to develop a plan of preparatory measures for the digitalization of national segments of the main international transport corridors passing through the territory of Uzbekistan and Azerbaijan in the East-West direction.

The scope and the work plan of the typical road map project includes:

Work package 1. Analysis of the digitalization level of the transport and logistics sector (TLS) in the particular CAREC countries

Work package 2. Analysis of business processes and information exchange in TLS

Work package 3. Overview of the national ICT infrastructures in TLS

Work package 4. Analysis of the main directions for TLS digitalization in the country

Work package 5. Development of the main components of the NELS model

Work package 6. Development of digital services portfolio to be provided by NELS

Work package 7. Implementation Plan of the project to create NELS

Work package 8. Analysis of Public-Private Partnership (PPP) options

Work package 9. Road map for the implementation of NELS project and cost estimation

As far as the methodology for such projects in CAREC countries is concerned the proposed analysis methods are derived from a systematic Business Process Reengineering (BPR) approach that is centered on business processes digital transformation in TLS and information systems redesign to produce a comprehensive roadmap to NELS development. The BPR methodology builds on incumbent systems, local realities, global standards and best practices to produce an optimized blueprint of the new NELS and a comprehensive roadmap to the new redesigned processes and system implementation. The proposed analysis approach includes three main phases:

Current Status and Analysis Phase is about the assessment of the current level of TLS digitalization of CAREC countries with the field research conducted. This phase corresponds to an in-depth analysis of existing IT-systems and current business processes in TLS. Additionally, this phase reviews the current world best practices and international reference models such as the UN CEFACT, UNESCAP and EU/EaP standardized solutions. At this phase a thorough understanding of how the particular country conducts transport & logistics activities, the details of logistics processes and the systems and infrastructure supporting those processes should be the basis to producing an accurate As-Is analysis.

At BPR level, the analysis includes the understanding of the current business processes and implemented ICT systems that support those processes. This phase conducts a requirement analysis through surveys and interviews with various stakeholders. Additionally, at this stage ICT systems architecture, existing systems designs and systems integrations are analyzed. Field research phase also examines the current regulatory framework, organization, governance, business models and capacity. Finally, the gap analysis component compares the current analysis of the existing systems to the world standards and best practices in order to identify areas of innovation and optimization.

System Architecture and Functional Specification phase corresponds to the NELS architecture and specification phase, where new processes are redesigned to reflect all major

improvements identified through gap analysis processes. Detailed functional specifications can be developed and in addition to that the NELS governance and operational model proposed with the new service provision and revenue models. Besides, financing arrangements for NELS implementation and PPP options can be analyzed to identify the potential sources of funding.

Implementation Planning Phase is about the development of implementation plan that sets up roadmap to the new NELS creation in CAREC countries. The project expert team will propose a comprehensive and realistic phased roadmap that will guide the incremental implementation of the new NELS with the proper organizational and governance structure to support its success. This final phase will also develop implementation cost estimation and detailed scheduling with the overall cost estimation of such project in the country.

Digitalization of transport & logistics sectors and as well as transport corridors in CAREC countries will facilitate:

- Acceleration and cost reduction of transportation, including transit, through the use of digital technologies for information interaction between participants in the national segment of international transport corridors and cross-border information exchange, as well as provide participants with a developed package of digital services;
- Reduction of transport costs by optimizing the movement of goods on the national segment of international transport corridors;
- Digitalization and reengineering of business processes in the transport and logistics sector, which will increase the performance discipline and quality of management decisions.

References

[1]   https://transport.ec.europa.eu/transport-themes/digital-transport-and-logistics-forum-dtlf_en

[2]   https://digital-strategy.ec.europa.eu/en/news/first-eastern-partnership-ministerial-meeting-digital-economy

[3]   https://www.unescap.org/resources/regional-study-use-logistics-information-systems-increased-efficiency-and-effectiveness

[4]   https://www.gartner.com/en/articles/the-rise-of-the-ecosystem-and-4-more-supply-chain-predictions

[5]   HIQSTEP project "Study on the Harmonisation of the Digital Markets in the Eastern Partnership: eTrade, eLogistics and Digital Transport Corridors" – Study report, final version, May 2018.
https://eufordigital.eu/library/study-on-the-harmonisation-of-the-digital-markets-in-the-eastern-partnership-etrade-elogistics-digital-transport-corridors/

[6]   Preparatory Actions to pilot a Digital Multi-modal Transport Corridor between the Baltic Sea and the Black Sea - https://eufordigital.eu/wp-content/uploads/2020/06/DTC-report-draft.pdf

[7]   CAREC Digital Strategy 2030 – https://www.carecprogram.org/uploads/MC-2021-Docs-2-CAREC-Digital-Strategy-2030-20211711-EN.pdf

[8]   https://rus.ozodi.org/a/32420042.html