AN INNOVATION DEVELOPMENT IN COMPLEX RAILWAY MANAGEMENT USING TRANSPORT DEEP LEARNING MODEL

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Abstract

At present, the railway administration is lagging behind in promoting innovative solutions to deal with complex transport systems. Nevertheless, passenger coverage is expanding here, for which electronic tickets are available. The principle of centralized development allows IT systems to operate in such difficult situations where critical processes such as online booking, ticket purchase are transitioning to deep learning. Model road system development and its centralized transformation as part of product development and further replication in the field are key to success and successful implementation. In this paper, an innovation development in complex railway management was proposed using transport deep learning model. The proposed system consists of numerous systems that manage various aspects of its operations, including passenger and freight transport management, planning transport and technical resources. All data from external systems are integrated into a single automated information system using developed interfaces. Modernization of communication and tele mechanics systems used in railway transport is one of the ways to significantly increase the intensity and safety of railway transport.

Keywords:

Railway, Innovative, Administration, Transport, Tickets, Deep Learning, Modernization

1. INTRODUCTION

Information becomes the basis for further development of transport and logistics systems. A significant number of companies are working in the field of developing new software tools that allow you to create more efficient systems [1]. Information technologies are increasingly being used to serve passengers in public transport. Railways consider the improvement of passenger information systems as an important factor in improving the quality of passenger service [2]. A network integrated information system has been developed to serve the passengers of public rail transport using the capabilities of a global system for determining the location of vehicles based on satellite communication (GPS) [3]. An important feature of the automated system is that it notifies passengers at train stations and followers. Intensive research and practical work is underway to develop an integrated automated information system for public transport passengers [4-5]. Such a system, once its development and pilot operation is complete, will be introduced in all countries [6]. Pilot operations have already been carried out in Belgium, Finland, Italy and Sweden. More than 100 industrial and transport companies are successfully operating automatic control systems for vehicles based on the software [7]. The modular construction of the software package allows you to effectively solve various problems of operational management of transport, including the optimization of transport routes [8]. A key feature of the package is that, along with applications of deterministic data and traditional two-valued logic, so-called non-traditional, rigorous logic can be used to solve probabilistic optimization problems [9].

2. RELATED WORKS

International competition for transport cargo flows has intensified, the world community has further tightened environmental and safety standards for transport, which creates a real threat for carriers to lose their positions in the international transport market [10]. These technologies for collecting and processing data from statistical monitoring of the operation. The transport complex and the creation of an integrated electronic document management system. Normative and technical documents for the communication of administrative systems of the campus and the concept of creating integrated information service systems for users of transport services and subjects of the transport market. However, the traffic is not fast enough to satisfy the market participants. Gradually, conditions are created for the widespread dissemination of information and communication technologies, ensuring the rights to freely search, receive, transmit, produce and disseminate information, expanding the training of information and qualified users, improving telecommunication infrastructure and creating connection points for open information systems. Many subjects of the transport market are taking steps to expand electronic commerce, electronic exchange of documents, including cross-border, and the introduction of standard contractual and freight-transport documents [11].

At the same time, efforts to ensure transparency of the information environment for investors and participants in the innovation process in transport have not yet yielded significant results. The development of a set of regulatory standards for an integrated system for monitoring such traffic has not been completed and the creation of logistics centers and information support activities for transport in international transport corridors. The development of integrated automated traffic management systems and the creation of public transport logistics centers in the country have been delayed.

3. PROPOSED MODEL

In foreign trade traffics are very complicated. So, for import transportation during transshipment in port-railway station system, 10 documents are required (manifest, bill of lading, cargo plan, hatch note, insurance policy, certificate of conformity, invoice, etc.), for export - 13 (railway bill, road list, wagon sheet, invoice, customs declaration etc.). It is necessary to provide 204 original documents to return 8 documents for goods imported from the system. For export shipments, 10 and 189 relevant documents are required. At the same time, no documents are transferred from one mode of transport to another along with the goods. This is because all modes of transport have different coding systems for packages, modes of transport, and goods within tariff groups. It is also impossible to use unified international documents for foreign trade transport in mixed transport, because the data coding system is different from the international one. The coding systems given in Industrial Billing and Customs Code are also different. In addition, the customs coding system is different from the international one. These circumstances point to the need to improve paper workflows, introduce electronic data processing, simplify the technical scheme of workflows, as well as process large-scale electronic exchange and information flows in logistics networks based on internationally recognized standards. This was shown in the Fig.1.

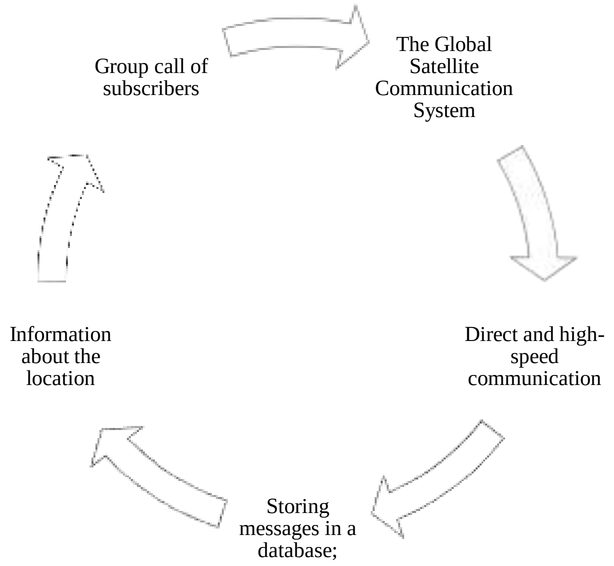

Fig.1. Requirements of proposed model

The Global Satellite Communication System provides:

- Direct and high-speed communication with the control room;
- Storing messages in a database;
- Ability to obtain information about the location and condition of the vehicle and cargo;
- Group call of subscribers;

One of the most common cargo and vehicle tracking systems is paperless information systems for tracking, communication and traffic dispatch based on satellite navigation and communication systems. Some of these systems have found application in our country. For example, the state-owned company It has developed a system based on GPS and Inmarsat-C satellite systems to automatically manage and monitor the location of vehicles and the status of cargo using a telecommunications network. The proposed model was shown in the Fig.2.

The main value of the software product is the rich database, which includes all roads accessible to trucks of a total length of 2 million km, divided into 4 quality categories and numbers, more than 54,000 cities and towns, about 1,500 border crossings and more than 44,000 road junctions. When using the program, it is possible to create practical routes (on the best roads, which reduces time and money for transportation), shortest routes (minimum distance, using all types of roads), as well as economical. It is best to go on trails, free roads. Practical routes are established by choosing shorter distances while maximizing the use of higher category roads. When laying the route, the following are taken into account: distance between route points, quality of roads, characteristics of territories, restrictions on weight, axle load, height, division of roads into urban and rural areas, roads closed for repairs and trucks, regulated detours, etc. In the construction of short routes, roads closed to traffic are excluded, ring bypass roads are chosen instead of roads through city centers. Setting the user to avoid using toll roads removes the selection of long stretches of such roads, but does not allow long-distance detours through toll tunnels and bridges. The route can have unlimited intermediate stops, which the program can arrange in an order that minimizes the total mileage on the route.

The program allows you to create routes of one of three specific types from a specific start point to end points, which is very useful for operators of combined transport. Various route options between two points are displayed on the screen, indicating the time and cost to analyze and select the preferred one. The program provides the ability to close the borders of states and sections of roads, to exclude the route of the route, to mark the sections of roads to be included in the route, to set the empty and estimated cost. Loaded kilometers, duration and cost of each stop, movement for the driver and stop for rest, average speed on different types of roads - and in each country, taking into account its rules and features.

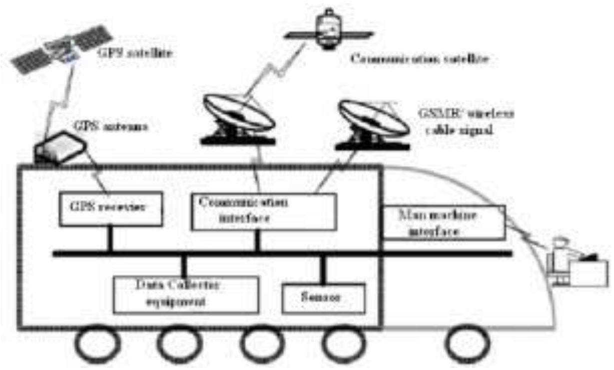

Fig.2. Proposed model

4. RESULTS AND DISCUSSION

The proposed transport deep learning model (TDLM) was compared with the existing deep learning approach towards railway safety (DLARS), Rapid transit systems (RTS), Machine learning for safety at railway stations (MLSRS), and Artificial intelligence in railway transport (AIRT)

Irrespective of the number of vehicles supplied, a specific package is required. At the same time, it is not necessary to buy all the equipment at once, it is possible to gradually increase the system capabilities (for example, first equip the control room with a dispatcher system, and then purchase traffic software). In addition, with the hourly positioning mode and 2 messages per day from the driver to the sender, the total cost of maintaining the system and paying the GSM operator for transportation, and these costs are not included. The comparison of Track Management was shown in the Table.1.

Table.1. Comparison of Track Management

Inputs	DLARS	RTS	MLSRS	AIRT	TDLM
100	38.55	60.83	58.95	45.41	93.26
200	37.84	59.90	57.84	44.08	92.02
300	36.54	58.90	57.14	43.21	91.91
400	35.63	57.95	56.17	42.03	91.05
500	34.63	56.98	55.26	40.93	90.37
600	33.62	56.02	54.36	39.83	89.70
700	32.62	55.05	53.45	38.73	89.02

At the same time, the IRS is structured to optimize traffic. The method of sending information about the location while the machine is running allows you to reduce the number of messages by 3 times, when the machine is idle or under repair; the dispatcher system can be disabled.

The information transmitted to the developer's computer continues to be a trade secret, so all information from the vehicle is sent directly to the dispatch center of the transport company. Information is sent only to the SMS center of the cellular operator independently selected by the computer customer. There are no intermediate places for storing information, all information flows to its owner, who decides the problem of its further distribution. The comparison of Transmission Management was shown in the Table.2.

Table.2. Comparison of Transmission Management

Inputs	DLARS	RTS	MLSRS	AIRT	TDLM
100	39.36	43.82	68.79	44.91	93.27
200	40.99	45.56	70.37	46.33	94.56
300	41.47	47.90	72.57	47.59	95.57
400	42.76	48.71	74.20	49.58	96.46
500	44.87	51.00	75.34	52.05	96.83
600	46.36	52.93	77.54	53.49	97.87
700	48.17	54.66	78.69	55.21	98.64

Unauthorized access by non-state structures to information compiled in communication channels is technically impossible, while state structures are difficult. In order to get the information, state officials need to know which telecom operator the information is being sent through, provide him with a warrant to listen, find the phone numbers the vehicle is equipped with, and then decode the packaging parameters. This is possible only in the case of legitimate state interest in the carrier. The comparison of Access Management was shown in the Table.3.

Table.3. Comparison of Access Management

Inputs	DLARS	RTS	MLSRS	AIRT	TDLM
100	48.15	45.22	86.95	41.49	94.09
200	49.81	51.08	80.11	46.90	93.99
300	50.26	49.94	78.82	48.39	93.92
400	45.68	51.08	76.68	51.63	93.87
500	46.73	53.44	72.61	55.08	93.78
600	46.04	55.08	69.40	58.27	93.71
700	45.34	56.73	66.19	61.46	93.64

This system is built on a different principle. All information comes to the server and accumulates in it. Connected clients receive information from the server at a specific frequency. That. The customer, by connecting to this system, entrusts his information to the employees of this system. Every legal entity providing information services is obliged by law to disclose all information by a public authority upon official request. And the developer of the IRS Dispatcher is not the owner, custodian or receiver of the information, customers' information flows do not pass through it, and it has nothing to give even if compelled by the authorities. The comparison of Information Management was shown in the Table.4.

Table.4. Comparison of Information Management

Inputs	DLARS	RTS	MLSRS	AIRT	TDLM
100	45.18	51.96	78.25	50.91	93.83
200	45.34	53.16	79.87	50.78	93.80
300	46.08	54.81	81.67	52.05	93.80
400	46.43	56.16	83.35	52.39	93.78
500	46.88	57.58	85.06	52.96	93.76
600	47.33	59.01	86.77	53.53	93.75
700	47.78	60.43	88.48	54.10	93.73

It has a wider function than this system. Because it is implemented based on the principle of direct information exchange between subscribers, the time to deliver a message to the sender is measured in seconds, and thanks to such efficiency, it is possible to create a vehicle schedule control system that responds to traffic failures. The system is still working in experimental versions; many problems have not yet been solved technically. At the same time, it plans to build an all-dispatch center, which complicates the system by an order of magnitude. The comparison of Dispatcher Management was shown in the Table.5.

Table.5. Comparison of Dispatcher Management

Inputs	DLARS	RTS	MLSRS	AIRT	TDLM
100	52.45	54.74	65.92	35.99	85.33
200	52.78	56.24	66.51	37.86	86.34
300	54.12	57.35	67.49	38.69	86.50
400	55.26	57.73	68.70	39.60	87.46
500	56.09	59.03	69.48	40.95	88.04
600	57.07	60.04	70.42	42.12	88.70
700	58.05	61.05	71.35	43.28	89.35

To obtain further information from TS, constant access to the website of this organization is required. This approach increases message delivery time and requires additional costs. The system does not focus on flights, in which it is impossible to create control of the vehicle schedule, so the inability to connect the transportation schedule, information about the time and place of arrival of goods to the customer and the time of release of vehicles arises. Such a deficiency significantly reduces the operational usefulness of the system for solving the problems of a large transport company or fuel and energy complex. The comparison of Delivery management was shown in the Table.6.

Table.6. Comparison of Delivery management

Inputs	DLARS	RTS	MLSRS	AIRT	TDLM
100	56.31	58.74	69.84	40.52	87.03
200	57.02	59.67	70.95	41.85	88.23
300	58.32	60.67	71.65	42.93	88.39
400	59.23	61.62	72.62	44.18	89.24
500	60.23	62.59	73.53	45.38	89.92
600	61.24	63.55	74.43	46.59	90.60
700	62.24	64.52	75.34	47.79	91.28

The construction of the IRS dispatcher is simple, it depends only on the work of the mobile operator, it works only for a single company and its burden is low. In this system, apart from the cellular operator, the server and the internet communication channel between the client and the server are also required to function. In this case, the server must serve dozens of customers and thousands of vehicles simultaneously. The comparison of Communication Management was shown in the Table.7.

Table.7. Comparison of Communication Management

Inputs	DLARS	RTS	MLSRS	AIRT	TDLM
100	53.41	50.33	74.77	47.83	83.33
200	53.74	51.83	75.36	49.70	84.37
300	55.08	52.94	76.34	50.53	84.50
400	56.22	53.32	77.55	51.44	85.46
500	57.27	54.33	78.69	52.36	85.03
600	57.98	55.26	79.80	53.69	86.27
700	59.28	56.26	80.50	54.56	86.38

When a server is down or a communication channel is interrupted, clients lose the ability to manage traffic fleets. Along with the obvious advantages, the IRS dispatcher has significantly lower costs for both mobile devices and dispatch center and subscriber services.

5. CONCLUSION

The Consumers have the opportunity to choose between a sufficient number of information and communication systems. However, the cost of equipping vehicles and control rooms with communication systems and computer equipment with specialized software is very significant. It is beyond the financial capability of most car owners. The automotive industry is characterized by high dispersion. Most transport companies do not have more than 30-40 vehicles. This concept is fully applicable to the international road transport sector. Satellite communication station with GPS, Logic MTA mobile terminal, including cable, installation and mounting kits for 10 vehicles connected to mobile satellite. However, considering the utility of information service in road infrastructure, there is an agreement between the two developers on docking dispatcher IRS with information sources.

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