Geoinformation systems and technologies in agriculture logistics and transport

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Abstract. The article contains theoretical considerations on the application of information technology in the field of logistics and transport. In the process of performing mechanized work during construction or in land reclamation measures, technical and technical means are used to provide fuel and lubricants. Based on the analysis of modern information technologies are recommended that ensure a reduction in material and technical resources and an increase in the utilization rate of machines over time.

1 Introduction

One of the leading sectors of the economy of our country is agriculture. During the years of independence, a radical reform of this sphere began and special attention was paid to increasing its effectiveness. As an essential factor for this, sequential measures are being taken to improve the reclamation state of cultivated lands and the rational use of water resources. The prerequisites for this are that more than half of the republic's irrigated lands comprise lands of varying degrees, which threatens soil fertility and crop yields.

The decree "On measures to radically improve the system for improving the reclamation state of lands", issued on October 29, 2007, marked the beginning of a new cycle of reforms in this area. The logical continuation of reforms in this area was the decree "On measures to improve the reclamation status of irrigated lands and the rational use of water resources for 2013-2017" and "On the state program for the development of irrigation and improve the reclamation of irrigated lands for the period 2018-2019." These decisions defined specific tasks for the fruitful use of life-giving moisture by jointly conducting inextricably linked irrigation and land reclamation works, reconstruction, repair and restoration of facilities, as well as the introduction of water-saving technologies. A state leasing company UZMELIOMASHLIZING was established, as well as state unitary enterprises specializing in land reclamation and other water management works. Concrete measures have been taken to strengthen the material and technical base, as a result of which over the past time more than 2,000 units of high-performance reclamation equipment, including 781 excavators, 240 bulldozers and other machine mechanisms, were delivered on a leasing basis [1].

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In recent years, the expansion of localization, which is one of the main areas of economic development, has been the focus of the company. In particular, partnerships with domestic manufacturers are increasingly being strengthened. Thus, since 2014, the UzXCMG joint venture, which began operations in the Khorezm region, has been buying excavators and bulldozers, and the CNH joint venture has mini loaders, which are then delivered to lessees.

In order to provide modern after-sales service for leased equipment, an important role was played by the creation of a subsidiary MELIOMASHLIZINGSERVICE at the company. Since this enterprise is fully equipped with new diagnostic equipment, its branches created in each region provide prompt and high-quality service. In order to monitor the effective use of land reclamation equipment, a program was launched in 2015 to install electronic monitoring devices on them - GPS navigators. This installation makes it possible to systematically remotely receive information from technical means. To date, more than 1300 machines and mechanisms have been equipped with such devices. Further deepening of reforms, as well as structural changes, are one of the most important areas of economic programs that are planned not only for the current year, but also for the near future [4-5].

But not everything is harmonious in the system, since the annual operating mode of excavators averages 1720 machine hours, with a significant part of the time spent on transport services and the provision of after-sales service. For this, it is necessary to introduce logistics systems and information technologies to select a route and technical means for transportation.

2 Methods

The goal of transport logistics is determined by the goal of company logistics: the right cargo must be delivered at the right time to the right place in the right quantity in the right quality and at the lowest cost [6,7]. Transport logistics tasks also include:

- creation of transport systems, including the creation of transport corridors and transport chains;
- ensuring technological unity of the transport and storage process;
- joint planning of the transport process with warehouse and production;
- choice of type of vehicle;
- determination of rational delivery routes, etc.
- When organizing transportation of reclamation equipment from the base to the facility, the following actions are performed:
- vehicle selection
- route selection
- calculation of the system for overcoming ascents, maximum incline to descent, stability on a horizontal surface for overturning.

For calculations, methods for determining values have been developed taking into account the individual data of the transport composition (transport-cargo).

The greatest coal to overcome the rise, taking into account the traction force of the tractor or vehicle, as well as road conditions, is determined by the formula:

$$\alpha = \frac{1000[T-(Q_1 f_1+Q_2 f_2)]}{17(Q_1+Q_2)}, \quad (1)$$

where: T - is the traction force of the tractor or energy tool, kg;

Q_1 - is the mass of the cargo falling on the drive axles of the vehicle, kg;

Q_2 - mass of the transported car with a trailer or semi-trailer, kg;

f_1, f_2 - coefficients of resistance to movement of the tractor and trailer, taking into account road conditions.

The smallest descent coal, taking into account the driving conditions with the use of the brakes of the technical equipment, is determined by the formula:

$$\alpha = \frac{1000\phi Q_1}{17(Q_1+Q_2)+5Q_1}, \quad (2)$$

where: φ - is the gearing coefficient of the drive wheels of a tractor or energy vehicle, taking into account road conditions.

If there is a horizontal rise in the chosen route, then it becomes possible to overturn the composition, therefore, it is necessary to calculate the coal of the largest slope

$$tg\beta = 0{,}34\frac{b}{H}, \quad (3)$$

where: b - is the width of the trailer or semi-trailer, m;

H - the height of the center of gravity of the trailer (semi-trailer) and the transported machine, m

3 Results and discussion

At the present stage, to include transport in the logistics system, informatization of transport and provision of telecommunication technologies are required. For example, in vehicles, the use of operational indicators of traffic data, warning about traffic jams and accidents along the route, the introduction of a collision avoidance system, the use of a navigation system in cars, and transport control using satellite communications, which makes it possible to optimize the route of travel, and based on changes in market conditions redirect power to a more profitable direction.

Transport production has significant features, which is reflected in the structure of its material and technical base, the nature of production activities and management organization. A significant part of the means of production of transport (from 20 to 85%) is not stationary, but capable of moving (a fleet of machinery and equipment), and during the production process this active part, called rolling stock, operates in various modes and organizational forms. The transportation process has increased energy intensity. Transport management information systems include freight transportation information systems, passenger transport management systems, vehicle security and control systems, information and navigation systems, and programs for determining optimal transport routes.

The advent of relatively cheap GPS sensors and the rapid spread of cellular and satellite communications systems has led to the creation of a wide variety of computerized ground transportation control systems that allow dispatchers in real time to not only track on the monitor screens the true location of the vehicles they are interested in (cars and trucks, dump trucks, buses, etc.), but also monitor the current state of these machines (fuel level in the fuel tank, temperature in the cabin or in the cargo compartment refrigerator, and so on. d.) . At the same time, the servers on which data from the on-board systems flock can be located both in the control rooms themselves and in the clouds (private or public). Four technical methods are used to determine the location of vehicles: direct positioning, indirect positioning, satellite systems and ground-based transmitters. Of these, indirect positioning in combination with UPS (Global Positioning System), GLONASS or GALILEO navigation systems [7-8] has become the most common.

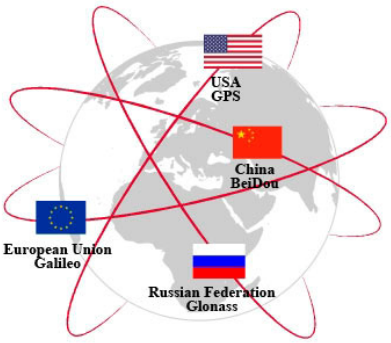

Fig. 1. Schematic movement of satellite systems by country.

Currently, about 170 types of tracking and dispatching systems are in operation in the world, more than half of which use GPS / GLONASS satellite navigation system sensors to determine the location of vehicles, which provides fairly accurate determination of the coordinates, course and speed of an object with an indication of the exact time practically anywhere in the world around the clock. To transmit the radio frequency signal, the technical and informational capabilities of the Inmarsat-C International Satellite System for Mobile Communication or the Euteltracs European Satellite System for Mobile Communication, GPS / GLONASS navigation system, GLOBALSTAR low-orbit system or ICO Global medium-orbit system are used. Satellite monitoring of transport is a satellite monitoring and control system for moving objects, based on the use of modern satellite navigation systems (GPS / GLONASS), communications equipment and technologies (GSM, GPRS), computer technology and digital maps. A typical GPS monitoring system consists of three links: terminals installed on cars, servers, and client workstations. The terminals are specialized GPS-trackers containing a module, the GPS itself and a cellular communication module (GSM, GPRS).

Fig. 2. Typical GPS monitoring system.

Satellite vehicle monitoring systems have significant differences among themselves. Some of them have those functions that others lack and vice-versa. Therefore, when choosing, it is recommended to rely on critically important aspects that need to be controlled.

Special equipment is guided by indicators of control of fueling and fuel drain. Carrier companies focus on mileage and vehicle direction.

The selection criterion is also the cost of the system. Low price is an indicator of low quality and the presence of defects. But high cost cannot guarantee high efficiency.

The benefits of using satellite GSM vehicle monitoring:

- increase the efficiency of transport;
- higher level of safety on the road;
- route optimization;
- prevention of misuse of machines;
- reducing the risk of being late in the delivery of goods;
- reduction in mileage by an average of 27%;
- reduction of telephone conversations between the driver and the dispatcher by 45%;
- reduction in downtime in the fleet by 9%;
- control of work performed;
- control of movement and stops;
- regular software updates;
- driving style control;
- display of the technical condition of the vehicle;
- keeping a journal of each trip;
- control of time for unloading cargo;
- report on disturbing events;
- display of all data on the map in real time.

Satellite monitoring of vehicles has become widespread due to the ability to optimize costs and increase the efficiency of vehicles. Tracking systems increase driver responsibility and discipline by reducing variable fuel costs.

There are a large number of transport management information systems that differ in the specifics of automobile, railway, water, and air transport. These include systems of the Transportation Management System (TMS) class, traffic management information systems that process huge amounts of information in real time. One of them is the Transportation Management System (TMS - Transport Management System) - a comprehensive solution that covers the entire transportation process from supporting strategic decision-making procedures, procurement planning and scheduling of transport to delivery and control of it, cost management and coordination with consumers-transport service providers [9-10]

TMS system solutions should have the following capabilities:

- strategic modeling and transport planning procurement of transport services, selection of suppliers;
- incoming, internal and outgoing logistics;
- tactical planning;
- operational planning and transportation optimization;
- optimization of the destination of carriers and the ability to manage interaction;
- execution of the transport plan, interaction and coordination with carriers;
- interaction with carriers, suppliers and customers;
- D-modeling of loading;
- calculation of transportation costs and tariff management;
- small shipments through postal operators;
- planning and execution of rail and intermodal transport;

- planning and execution of a route with several shoulders and modes of transport;
- scheduling and routing of own transport;
- reconciliation of bills for transportation services, payment and distribution of costs;
- management of the transport schedule and warehouse gates;
- tracking of transport orders, shipments and event management;
- analytics, performance management, scorecards and dashboards;
- the ability to apply local settings for different countries.

Technical architecture, system adaptation capabilities, flexibility, usability, deployment and scaling capabilities.

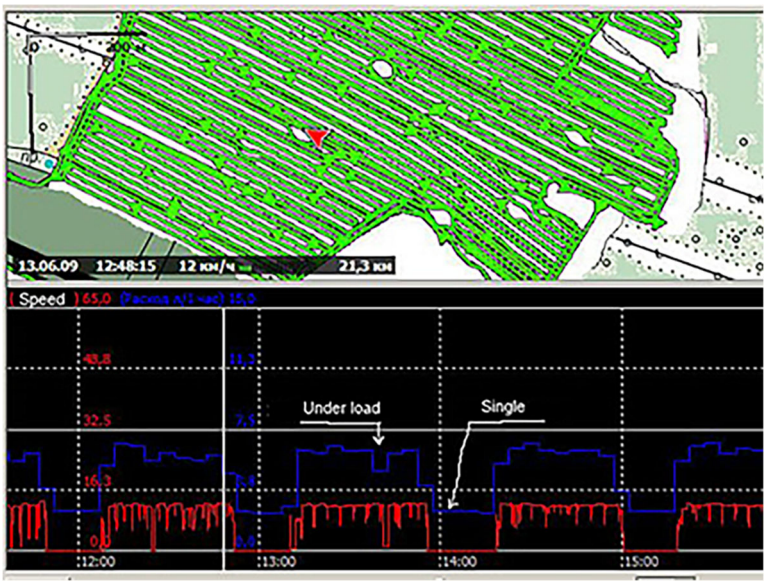

Fig. 3. Navigation control of the equipment.

The JDA Fleet Management transportation management system is part of the comprehensive Transportation & Logistics Management package, designed for transport and logistics companies and providing comprehensive multimodal transportation management. The tasks of the system include automation of transportation planning, asset management, route optimization and scheduling of deliveries. According to the developer, JDA Fleet Management, based on an analysis of various restrictions, is able to draw up detailed work plans for managing the company's fleet, taking into account the specified requirements for the delivery of goods. The system is aimed at reducing transportation costs, maximizing the use of transport resources, strict adherence to delivery schedules and increasing the level of service. The software product supports ESRI's ArcGIS Network Analyst geo-information system, which provides automated calculation of route distances and the formation of optimal routes, contributing to the creation of an efficient logistics network. In addition, the system allows you to simulate transportation routes, taking into account various restrictions (speed on a particular highway, the maximum height of the car with cargo, congestion at a specific time of day, etc.).

The use of geographic information systems, including ArcGIS software through the integration of electronic numerical maps and GPS navigators, makes it possible to control and monitor the technical condition of machines. ArcGIS visually depicts free movement and power utilization using bar graph information.

The “Network Analyst” panel will help you choose a rational route, trajectory and minimum distance to your destination.

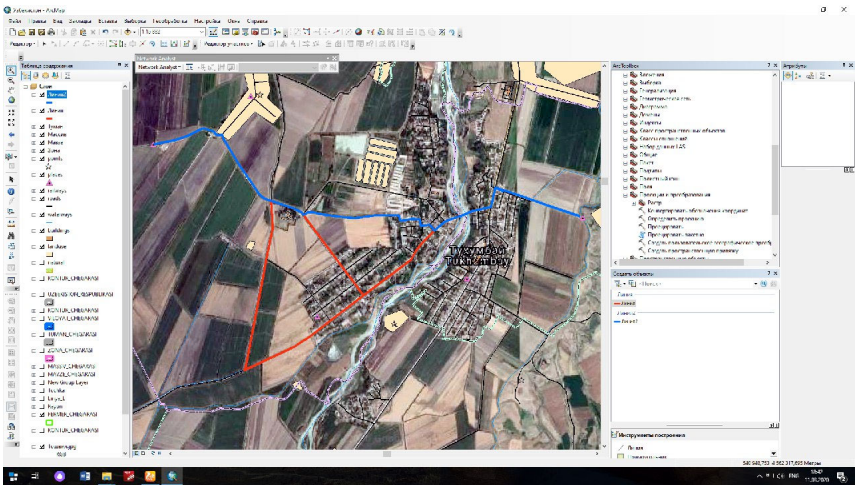

Fig. 4. Network Analyst Panel.

4 Conclusion

Based on the theoretical studies and software models, it shows the use of geographic information systems when choosing a transportation route and moving machines taking into account the stability and traction and speed characteristics of tractors, technical condition management and power management, as well as efficient use of working time. This reduces the cost of transportation, prevents machine downtime due to failures.

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