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DETERMINATION OF THE URGENCY OF TIMBER TRANSPORTATION USING BASIC SCHEMES OF TRANSPORTATION PROCESS ORGANIZATION

The branched structure of timber consumption is typical for timber production assumes the formation of an effective plan of supply taking into account restrictions on delivery time. To solve this problem it has been proposed a method based on the use of the criterion of priority transport service for enterprises-consumers. This is the function of urgency of timber transportation. The results of theoretical investigations aimed to obtain analytical ratio of definition of urgency timber transportation on basic schemes of transportation process organization.

Introduction. In timber industry of the Republic of Belarus assortment logging timber is currently dominated. Harvested assortments are available for internal customers of the enterprise (own shops, boiler rooms, etc.) and outside customers (wood processing companies, transfer stations, trade organization of harvested timber, etc.). Many forestries of the Republic of Belarus are the primary wood processing plants (producing round logs, sawn wood, split wood, etc.), significant amounts of finished goods which are exported. In addition, use of wood raw material to obtain energy is currently of particular importance.

In such circumstances, producers and suppliers of wood raw material to consumers are to form plans for the delivery not only in terms of minimizing the total transportation cost, but strictly maintaining the delivery term stated by the customer.

When there is a limited number of the tractor-drawn harvesters, a branched system of “procurer” – “customer”, inconsistencies of calculated optimum forest roads density, which is characteristic of the timber industry of the Republic of Belarus, the organization of rhythmic and well-timed supply of timber to consumers is essential. To solve it, the previously proposed method for predicting the transport phase of the technological process of logging, which is based on the criterion of priority traffic – a function of the urgency of timber transportation (FUTT) [1, 2]. For effective practical use of this method it is useful to consider the method of calculation for different schemes FUTT organization of the transportation process of timber supply to consumers.

Main part. From the standpoint of the organization of the transportation process, during transportation of timber to consumers, there are three main schemes of work of the hauling rig depending on the type of linkage between the places of loading and unloading, “one to one”, “one to many” and “many to many” [3, 4].

For the scheme “one to one” when timber is supplied only one variant of the organization transportation route is used, it is called pendulum (Fig. 1). Under this option, a given volume of round timber from a loading point or transitional area is transported to one consumer.

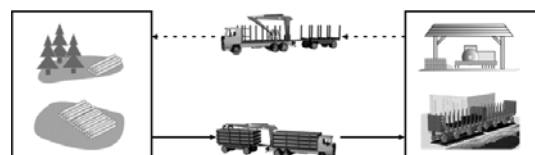


Fig. 1. Organization of supply by pendulum routes

For the scheme “one to many” two schemes of transport routes are used: radial and pendulum routes. In radial route (Fig. 2) timber from a loading point or a transitional area is successively transported to different unloading areas.

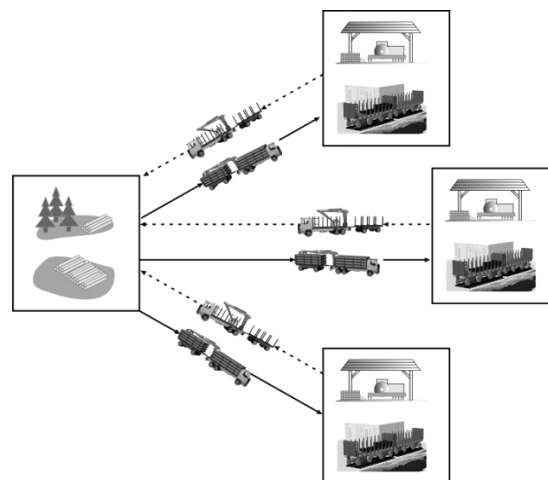


Fig. 2. Organization of supply by radial routes

When the pendulum method is used, timber is delivered from one loading point or a transitional area to several sites (Fig. 3).

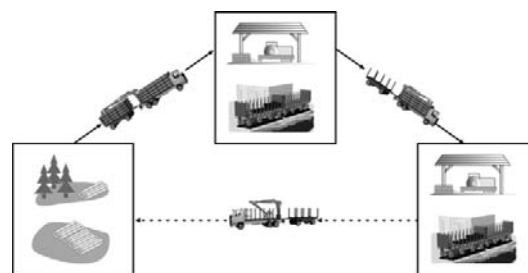


Fig.3. Organization of timber supply by pendulum routes

For schemes “many-to-many” four different organizations of supply routes are used: accumulative, delivered, accumulative and delivered, and cyclic. When working on accumulative route (Fig. 4), timber from several loading points or transitional points is delivered to one unloading area.

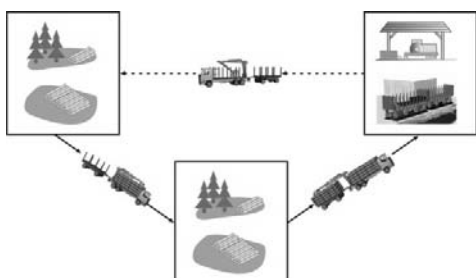


Fig. 4. Organization of supply by accumulative routes

When accumulative and delivered route (Fig. 5) is used timber from several loading areas is carried to some unloading areas.

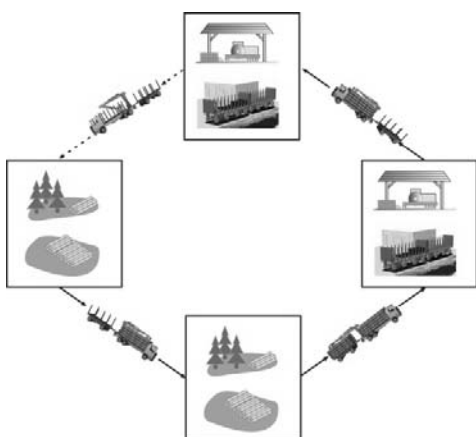


Fig. 5. Organization of supply by accumulative and delivered routes

When the cyclic route (Fig. 6) is used timber from different loading areas is consequently delivered to different unloading areas.

In the supply of timber to consumers in the regulatory interval of delivery the function of urgent timber transportation in general can be presented in the ratio (1) [1, 2, 5].

$$W(t) = Q(t) \cdot C \cdot \left(\frac{1}{T_d - t} \right), \quad (1)$$

where $Q(t)$ – the volume of harvested timber declared for carriage, m^3 ; C – total unit cost of $1 m^3$ of timber, BYR, thousands; T_d – determined time for delivery of the entire volume of timber; t – the total amount of time that passed from the time of application for delivery of timber and directly

time rate for supply of the stated volume of timber, including time to implement the transportation process, h.

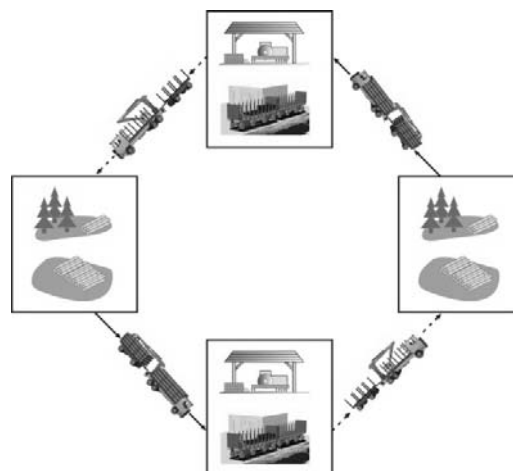


Fig. 6. Organization of supply by cyclic routes

Time to implement the transportation process can significantly affect the obtained value of FUTT and depends on the choice of wood supply schemes, the tractor-drawn harvesters used for work, qualitative and quantitative indicators of transportation network, which are used to develop the supply routes. To determine FUTT considering these factors, the structure of time spent on various shipping timber supply schemes has been analyzed. Thus, for the supply of wood by “one to one” scheme the duration of the delivery can be presented by a function (2).

$$t_d = t_{ir} + t_{dr} + t_{do} + t_{di} + t_{dm}, \quad (2)$$

where t_{ir} – duration of idle run route, h; t_{dr} – duration of run with load, h; t_{do} – duration of loading and unloading operations, h; t_{di} – duration of idle hours of hauling equipment (regulated and non-regulated), h; t_{dm} – duration maneuvering in loading and unloading areas, h.

Duration of delivery for the supply scheme “one to many” is presented in terms of dependence (3).

$$t_d = t_{ir} + t_{dr} + t_{c1} + t_{do} + t_{di} + t_{dm}, \quad (3)$$

where t_{c1} – duration of crossing for a full load of vehicles, h.

Duration of delivery for the supply scheme “many to many” is defined as a function (4).

$$t_d = t_{ir} + t_{dr} + t_{c1} + t_{c2} + t_{do} + t_{di} + t_{dm}, \quad (4)$$

where t_{c2} – duration of crossing for a full load of vehicles, h.

Let define T_l as the time from the moment of signing the contract for the supply. Taking into consideration the above obtained dependences, we get formulas for determining the function of

urgency of timber transportation used for timber production in Belarus schemes of organization of the transportation process of harvested timber:

– for the scheme “one to one”

$$W(t) = Q(t) \cdot C \times \left(\frac{1}{T_d - (T_t + t_{ir} + t_{dr} + t_{do} + t_{di} + t_{dm})} \right); \quad (5)$$

– for the scheme “one to many”

$$W(t) = Q(t) \cdot C \times \left(\frac{1}{T_d - (T_t + t_{ir} + t_{dr} + t_{cl} + t_{do} + t_{di} + t_{dm})} \right); \quad (6)$$

– for the scheme “many to many”

$$W(t) = Q(t) \cdot C \times \left(\frac{1}{T_d - (T_t + t_{ir} + t_{dr} + t_{cl} + t_{c2} + t_{do} + t_{di} + t_{dm})} \right). \quad (7)$$

To determine the constituents of time duration of the delivery it is recommended to use well-known methods and techniques.

Conclusion. Obtained dependences for the definition of FUTT allow to use more widely in practice, the method of forecasting the transport

phase of harvesting technology, which is based on the criterion of priority transport service of timber consumers – FUTT.

References

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