JURIJ KOLENC D. Sc.
LIVIJ JAKOMIN, D. Sc.
IGOR TRUPAC, D. Sc.
MIRAN ZGONIK, D. Sc.
Fakulteta za pomorstvo in promet
Pot pomorščakov 4, Portorož

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EFFICIENCY OF THE TRANSPORT PROCESS FROM THE POINT OF VIEW OF SELECTED DRIVERS' ACTIVITIES

ABSTRACT

This paper presents the results of research in the transport process efficiency from the point of view of driver's activities in road goods transportation, by vehicles with payload up to 5 tons. Based on the expert assessment of 6233 transportation tasks and measuring the frequency of individual operations of the driver, an analysis has been performed on the results and their influence on the efficiency of the transport process. Among the numerous activities of the driver directly related to driving a motor vehicle, those relating to the vehicle and cargo before carriage, in the course of carriage and after it, this paper concentrates on the analysis of those activities related to loading and discharge, the specific manoeuvres and driving operations in a motor vehicle.

KEY WORDS

transport, driver's operations, motor vehicle

1. INTRODUCTION

Like any technological production process, the process of transportation represents numerous mutually related elements which appear in temporal and functional sequence and create a certain aggregate of services. In its basic nature, the transport process is the shifting of goods, but it also comprises the preparation of goods, take-over, loading, transport, unloading, and delivery of goods.

The basic technological elements in the transport process are: preparation, implementation and concluding the transportation.

The preparation of transport includes the following technological procedures:

- the preparation of *vehicle* for the carriage of goods ranges from the analysis on technical-exploitational and other features of a vehicle as regards technological and other characteristics of road traffic infrastructure, and may also call for other traffic branches if required, up to the establishing its roadworthiness (technical faultlessness), etc.;
- the preparative arrangements in *transport process* comprise the transport plan with respect to technical-exploitational characteristics, the cargo manipulation plan and mechanisation, the preparation of driver or crew resp., of transport documentation, and other preparatory tasks in the transport process;
- the preparatory work on the *organisation of transport* consists of the following steps: an optimal means of transport, transport route and technology are chosen, the required transportation time schedule is estimated, an analysis of organisational and traffic technological factors is made, the plan of loading, re-loading and unloading the cargo is worked out, the documentation on transport organisation is issued, and other organisational arrangements.
- the preparation of *implementation of transport* covers the following operations: the conclusion of contract on transportation, goods packing and marking, as well as weighing, sorting and warehousing, concluding cargo transport insurance, together with the preparative arrangements on quality and quantity control, customs examination and other instances of supervision of goods, and all other preparatory tasks in performing transportation.

The *implementation* of transport consists of three basic technological phases:

- Phase one ranges from an immediate inspection of a vehicle before use, the vehicle's arrival and positioning to the place of loading, the take-over of goods, the control of loading, stowing and securing (fixing) the goods, up to the control over vehicle's roadworthiness and the crew's competence, and any other control operation as required.
- Phase two comprises the transportation of goods from the place of loading to the place of discharge,

all the procedures in the course of the carriage (trip) related to the driver's or crew's operations with the vehicle and manipulation with goods, etc.;
- Phase three covers the vehicle's arrival and positioning to the place of discharge or re-loading, the actual handling (unloading or re-loading), the freight forwarding operations related to unloading, re-loading or delivering the cargo to receivers, or to further shipment, and concludes by issuing and providing the documentation related to goods, vehicle and crew.

The concluding stage in goods transport comprises:
- the return of vehicle to the truck base, or the base of the haulier's company, resp.;
- the control of vehicle after use, fuel and spares supply, washing and lubricating if required, possible minor repairs and all other preparative arrangements on the vehicle before next employment, and finally parking the vehicle at its designated place in the truck base or garage; in case of faulty vehicle, it should be delivered to the service workshop for repair;
- reporting, analysis and providing solutions to problems related to any traffic and customs offences and other transgressions, accidents or material damage caused or incurred in the course of transport process;
- accounting travel, handling and transport expenses, as well as other expenses; control and payment;
- quality and quantity control of goods carried, as per contract,
- resolving claims related to the contracts concluded on goods, vehicle, crew and other activities;
- the analysis on transport process factors from technical-exploitational, technological, organisational, economic and legal viewpoint.

The practical experience and preliminary research have proved that the activity of the vehicle's crew or drivers have a considerable influence on the efficiency of transport process.

In the framework of the project on establishing relevant parametres of transport process efficiency, numerous parametres of the transport process elements have been measured and analysed on 6233 different transportation tasks performed by young drivers (with up to two years of driving experience) with freight motor vehicles up to 5 t payload on the territory of the Republic of Croatia.

2. ANALYSIS OF SELECTED DRIVERS' ACTIVITIES IN TRANSPORT PROCESS

Due to ampleness, we have restricted ourselves in this paper to the selected activities of drivers in the course of performing transportation tasks, such as loading and unloading of goods, specific manoevres with motor vehicle, and the activities while driving motor vehicles in cities.

2.1. Analysis of driver's activities at the place of loading and discharge

In addition to the basic activities related to driving the vehicle, drivers perform certain activities at the places of loading and discharge of goods, the results obtained from the data are presented in Table 1.

The analysis of the distribution of frequency of drivers' activities at the places of loading and discharge of goods reveals as follows:
- drivers perform some 70% of loading-discharge of goods by themselves;
- some 24 % of activities refer to the supervision of loading and discharge of goods which are performed by a third party;
- activities in loading-discharge operations show approximately the same frequency, except with the manual discharge of goods performed by the drivers, which characteristically surpasses the frequency of that activity in loading operations.

All that supports the assumption that driver's activities at the place of loading, and discharging of goods from the vehicle can significantly influence the efficiency of the whole transport process, and all the more so since the driver gets physically tired, which may result in unreliable driving of the motor vehicle.

Table 1 - Distribution of frequency of drivers' activities at the places of loading and discharge of goods

No.	Activity type	Loading, %	Discharge, %
1	Driver loads-unloads by himself - manually	5.79	9.59
2	Driver loads-unloads by himself - by means of mechanisation	63.35	61.56
3	Driver assists in loading-discharge operations	4.88	3.11
4	Driver supervises the loading-discharge operations	24.29	23.10
5	Other activities	1.69	2.64
Total		100	100

Table 2 - Distribution of frequency of specific manoeuvres with the vehicle

No.	Specific movements of a motor vehicle	Frequency, %
1	Parking at right angle - entry backward	33.05
2	Parking at right angle - entry forward	46.73
3	Parking at an angle – entry forward	2.61
4	Parking at an angle – entry backward	15.18
5	Parking sideways – entry backward from the left	0.34
6	Parking sideways – entry backward from the right	0.43
7	Parking sideways – entry forward to the right	1.12
8	Front ramp or canal – entry backward	0.08
9	Front ramp or canal – entry forward	0.13
10	Passing ramp or canal - entry and exit forward	0.33
Total		100

Moreover, the drivers also have to perform specific manoeuvres with the vehicles at the place of loading and discharge of goods, as shown in Table 2.

The analysis of the distribution of frequency of specific manoeuvres with vehicle in the course of performing the transportation task within a transport process has shown as follows:

- the majority of manoevres refers to the parking manoeuvres at right angle - entry forward and exit backward which amounts to some 47 % of all the manoevres or 1.76 manoeuvre per each transportation task resp.;
- the variant of positioning the motor vehicle at the place of loading or discharge at right angle - entry backward and exit forward has only a 33 % share in all specific manoeuvres. or 1.25 manoeuvre per each transportation task resp.;
- Positioning the motor vehicle sideways - entry backward and exit forward occurs in some 15 % of all specific manoeuvres or 0.57 manoeuvre per each transportation task resp.;
- In the process of goods transportation the driver performs on average 3.78 specific manoeuvres by motor vehicle per each transportation task.

Although these results cannot be taken for granted for all transportation tasks we can employ them usefully for planning and resolving the current problems at the places of loading and unloading, as well as for the training of drivers of vehicles in goods transport.

2.2. Analysis of drivers' activities in driving motor vehicle

Depending on the type of transportation task in the transport, process the type and features of the vehicle, the characteristics of road infrastructure, the structure and conditions of traffic operation on natural and other conditions, the driver actually performs numerous operations with varied frequency in the course of driving.

The transport tasks analysed were performed in heavy city traffic (36 %), hence the analysis of drivers' activities in our case refers only to these conditions.

Table 3: The distribution of frequency of drivers' operations in driving the vehicle

No	Drivers operations	Frequency. %
1	Starting the vehicle (from the spot)	8.52
2	Stopping the vehicle	8.52
3	Engaging - Disengaging the coupling	21.57
4	Change of gears	9.98
5	Braking without engaging the coupling	12.86
6	Typical accelerating	19.64
7	Typical manoeuvring with steering wheel	10.76
8	Blinkers - switching on and off	8.15
Total		100

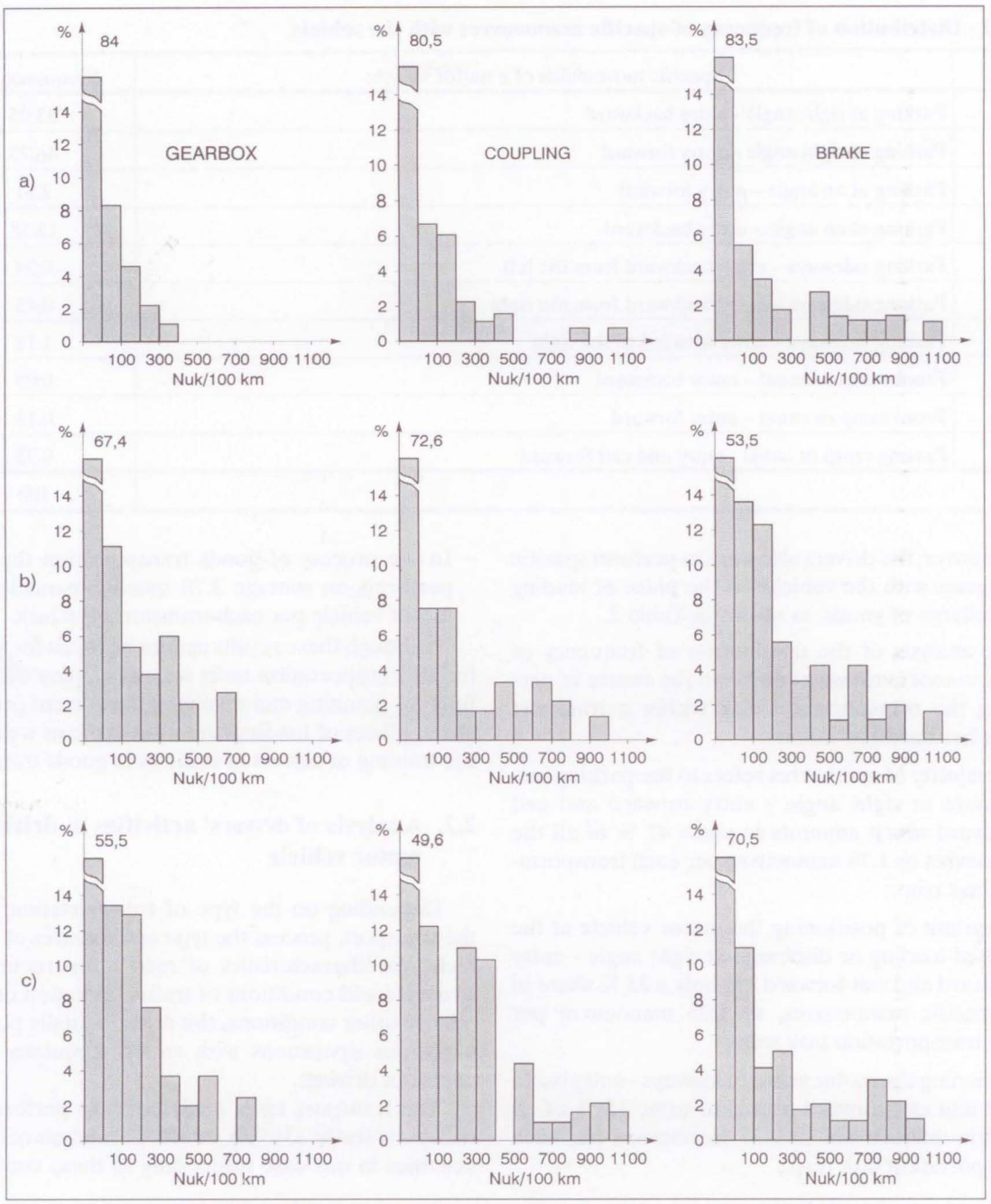

Figure 1 - The distribution of frequency of applying the gear, coupling pedal and working brake on a route in length of 100 km, in which the roadway is: a) asphalt-concrete roadway, b)gravelroadway, and c) earthen roadway

The distribution of frequency of drivers' operations in driving the vehicle, as shown in Table 3, relates to the itinerary comprising the total length of 100 km of the streets in the city of Zagreb.

The analysis of the drivers' activities of freight vehicles in performing transport tasks in heavy city traffic shows that in 100 km of driving, 5253 operations in driving the vehicle are performed on average, out of which the highest frequency refers to applying the coupling pedal (ca. 22 %), the accellerator pedal (ca. 20 %), and the brake pedal (ca. 12 %).

In addition to the factors influencing the vehicle analysed above, the frequency of operations performed by drivers in steering their vehicle is also affected by the characteristics of the roadway. This is presented in Figure 1 [3] based on the research by MADI Institute.

The results of these analyses are in compliance with other research on similar problems and can serve the vehicle designers and infrastructure project designers in road traffic to improve the working conditions for drivers, the technology and organisation

of work, and to add to the efficiency of transport process.

3. ANALYSIS OF ATTRIBUTIVE DESIGNATIONS OF THE WORK PERFORMED BY DRIVERS

In addition to the exact data referring to the selected activities of the drivers of motor vehicles, as collected and analysed, also descriptive information related to the assessment of efficiency of transport process have been collected and analysed for all transport tasks. They are presented in Table 4.

Expert assessment in Table 4 is presented in proportion to the distribution frequencies. The analysis of these assessments shows as follows:

- from the driver's point of view, approximately 70% of all transport tasks are being performed efficiently, as a whole;
- inadequate organisation of loading and discharge of goods has a characteristic impact on the fall in efficiency of the transport process, amounting to 13 %.
- the characteristics of traffic flows, the infrastructure of road traffic, and atmospheric conditions of driving influence the efficiency of the transport process by ca. 5 %;
- the impacts of the drivers' lack of experience and skills in performing specific operations related to a set transport task in the transport process are not negligible, totalling to ca. 8%.

Although the expert assessments can count as representative for the transport tasks analysed, with respect to the number, they only represent relative and subjective assessments and shall be taken as such

4. CONCLUSION

The analyisis of transport process efficiency from the point of view of the motor vehicle drivers' activities shows that there is a characteristic interdependence between the efficiency level of the transport process and the activities of the driver

The realization of transport process carrying varied cargo with different motor vehicles in various traffic, exploitation, natural and other conditions, includes also most different activities of drivers.

In this case, the activities related to loading and discharging the goods, and the positioning of vehicle at the place of loading or discharge, as well as the driver's operations in the course of driving the vehicle in city driving and on roads with different characteristics of roadway have been chosen as the most characteristic activities

Table 4: The distribution of frequency of expert assessment on the efficiency of work in drivers of motor vehicles

No	Attributive designations of the efficiency in performing a transport task	Frequency. %
1	Transportation task is performed in due time, safely, economically, reliably and efficiently, as a whole	69.80
2	Time loss due to lack of organisation in the discharge of goods	7.40
3	Time loss due to lack of organisation in the loading of goods	5.26
4	Impact of the characteristics of traffic flows, infrastructure of road traffic, and atmospheric conditions of driving	4.43
5	Driver's lack of skill in positioning the vehicle to the place of loading or discharge	2.00
6	Loss of time due to inadequate organisation and regulation of traffic	1.65
7	Driver's unreliability in performing specific transportation tasks	1.48
8	Lack of experience in driving in a queue with the foreseen dynamics	1.36
9	Non-observance of traffic regulations, and general indiscipline	1.30
10	Lack of experience in driving with a foreseen trailer	1.22
11	Driver's unreliability due to insufficient experience in performing transportation tasks	1.17
12	Driver's unreliability due to frequent change	0.95
13	Lack of experince in driving off the road	0.75
14	Unreliability (deficiency) of a motor vehicle	0.67
15	Other	0.56
Total		100

The results of the analyses of 6233 transportation tasks according to the loading and discharge of goods reveal a characteristic frequency of the driver's personal involvement in loading or discharge operation, which affects the decrease in efficiency of the whole transport process.

The results of the analysis referring to the frequency of specific manoevres with motor vehicle show a characteristic influence of the drivers' skill and qualifications on efficient performing of such manoeuvres, which is confirmed also in the expert assessment in Table 4.

The results of the analysis referring to the frequency of drivers' operations in driving the motor vehicle in cities and on roads with different roadway characteristics can be useful to the designers of road traffic infrastructure and constructors of motor vehicles to improve the working conditions for drivers, exploitation conditions of the movement of vehicles, advanced technology and organisation of work, and thus contribute to the efficiency of transport process.

POVZETEK

UČINKOVITOST TRANSPORTNEGA PROCESA S STALIŠČA IZBRANIH DELATNOSTI VOZNIKOV

V članku so predstavljeni rezultati učinkovitosti transportnega procesa s stališča delatnosti voznika pri prevozu tovora s cetnim tovornim vozilom, nosilnosti do 5 t. Na temelju ekspertne ocene 6233 transportnih nalog in merjenja frekvence posameznih aktivnosti voznikov je opravljena analiza rezultatov in njihov vpliv na učinkovitost transportnega procesa. Od številnih aktivnosti voznika, kot je neposredno upravljanje motornega vozila, tistih, ki so v zvezi z vozilom in tovorjem pred vožnjo, za časa vožnje in po končani vožnji, so v tem članku posebej analizirane samo tiste, ki so v zvezi z nakladanjem in razkladanjem, specifičnimi manevri in operacijami pri upravljanju z motornim vozilom.

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