A COMPARATIVE STUDY OF SERVICE QUALITY IN DELIVERING SELF-UNLOADING CONTAINERS

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ABSTRACT

Containers offer cost-cutting opportunities in cargo transportation, loading/unloading operations, improving the efficiency of machinery and equipment utilization. This leads to continued growth in the volume of containerized cargo transportation; however, this growth is held back by the limited number of container terminals where containers are transferred to automotive transport that delivers them to the end receiver. To address this problem, the authors have developed a technology to deliver containers without the use of container terminals (cf.: World of Transport and Transportation, Vol. 14, 2016, Iss. 4). This article assesses the quality of transportation services provided by the old conventional technology in comparison with the suggested one that relies on the use of the self-unloading container.

Keywords: *automotive transport, transportable container, transportation technology, jack posts, container terminals, container yards, service quality assessment.*

Background. *Our last year's article in the World of Transport of Transportation summarized the trial of a new container delivery technology that involved the use of no container terminals or container yards. That technology relies on a new design, the self-unloading container [1]. The proposed configuration included jack posts with electric drives that, using the power supplied by either the batteries of the train or the power grid of the station, lift the container over the flatbed railcar and then put it down on an automotive flatbed trailer for delivery to the final destination.*

On the loading/unloading pad at the final destination, the container's jack posts, with no additional equipment required, lift the container off the flatbed trailer and position it at a height that is convenient for the loading or unloading of the goods, or even place the container on the ground so that other lifting equipment can be used. Loading of the container onto a flatbed railcar is performed in a similar manner [1–3].

Table 1 compares the existing and proposed technologies of container delivery by the equipment and vehicles used.

Table 1 shows that the new container delivery technology requires less equipment while making it possible to use non-specialized vehicles.

Objective. *As new container delivery technology requires less equipement, we could provide a comparative assessment of transportation service quality offered by the existing and proposed container delivery technologies. The comparison needs to consider, among other factors, that the need to improve the quality of container handling at container transfer sites remains a concern for both shippers and receivers, as insufficient quality of these operations has a negative effect on the overall efficiency of the process of transportation.*

Methods. *The authors use mostly economic comparative analysis methods.*

Results.

Let us review the factors that define the quality of container service (Pic. 2).

The 'reliability' integrated indicator includes guaranteed execution of the operations, their correct succession and timeliness:

$$S_{reliab.} = \frac{y_{executed}}{y_{requested}}, \quad (1)$$

where $y_{executed}$, $y_{requested}$ are the number of operations that are executed with a sufficient degree of reliability, and the total number of service requests, respectively [5].

The indicator that characterizes the reliability of operations being executed 'just on time' is determined by the formula:

$$S_{reliab.t} = \frac{t_{nom}}{t_{actual}}, \quad (2)$$

where t_{nom}, t_{actual} are the nominal and actual times, respectively, of the operation's execution.

The nominal time needed to execute an operation is assumed based on the regulatory requirements adjusted for the conditions of the container terminal's operation and requests from the clients [5].

Table 1

Comparison of container delivery technologies

№	Operation	Equipment and vehicles required	
		Existing technology	Proposed technology
1	Loading of cargo into container	Common loaders (e.g. forklifts)	
2	Loading of container on the vehicle	Specialized loading equipment (e.g. front or side container loaders)	–
3	Transportation of container to the receiver or to a container terminal	Specialized container semitrailers	Specialized container semitrailers, universal cargo flatbeds
4	Unloading of container from the vehicle	Specialized unloading equipment (e.g. gantry cranes)	–
5	Unloading of cargo from container	Manual unloading using pallet dollies or similar load-handling equipment	

Table 2

Expert evaluation of transportation service quality in container delivery with the existing and proposed technologies

No.	Factors	Expert valuation		Changes	
		Existing technology	Proposed technology	Absolute value	Improvement rate,%
1	Reliability and quality of operations	7	11	4	57.1
2	Technological level of available equipment	9	12	3	33.3
3	Waiting time before transloading	12	1	-11	-91.7
4	Convenience of approach and departure	8	10	2	25.0
5	Availability of parking lots and free parking spaces	7	12	5	71.4
6	Compliance with sanitation requirements	11	12	1	9.1
7	Extra services	7	9	2	28.6
8	Availability of waiting areas before operations	6	11	5	83.3
9	Information support	10	10	0	0
10	Personnel competence and professionalism	11	11	0	0
11	Level of service culture	8	9	1	12.5
12	Affordable prices	5	10	5	100.0

The safety criterion primarily characterizes the degree of traffic safety in locations where transportation complexes are situated:

$$S_{saf.}=\frac{1}{k}\left(\frac{F_{norm.appr.}}{F_{appr.}}+\frac{F_{compliant}}{F_{total}}+(1-D_{def.})\right), \qquad (3)$$

where $F_{appr.}$, $F_{norm.appr.}$ are the actual and normative numbers of approaches to transfer sites for container-carrying vehicles; F_{total}, $F_{compliant}$ are the total number of container terminal complexes and the number of terminal complexes equipped in compliance with regulations; $D_{def.}$ is a partial coefficient of defectivity defined by the availability and technical compliance of equipment and equipment maintenance at terminals (at $D_{def.}$ = 0); k is the number of partial safety criteria factored in the equation such as safety of approach, container transloading, and vehicle departure [5].

The comfort criterion is a set of parameters assessing the environment and conditions in which the service is provided from the perspective of convenience for the consumer. The values involved in this criterion are determined with sociological surveys.

Based on our analysis of the effects of various factors influencing the quality of container service in transport companies, the results of interim studies, and the requirements contained in GOST R9001–2008 and GOST R51004–96 national standards, the following 12 partial criteria were selected for assessing the quality of service:

1) Reliability and quality of operations.
2) Technological level of available equipment.
3) Length of the waiting period before transloading.
4) Convenience of approach and departure.
5) Availability of parking lots and parking spaces.
6) Compliance with sanitation regulations.
7) Extra services.
8) Availability of waiting areas before operations.
9) Information support.
10) Competence and professionalism of the personnel.

Pic. 1. A container placed on the ground for unloading.

11) Level of service culture.
12) Affordable prices.

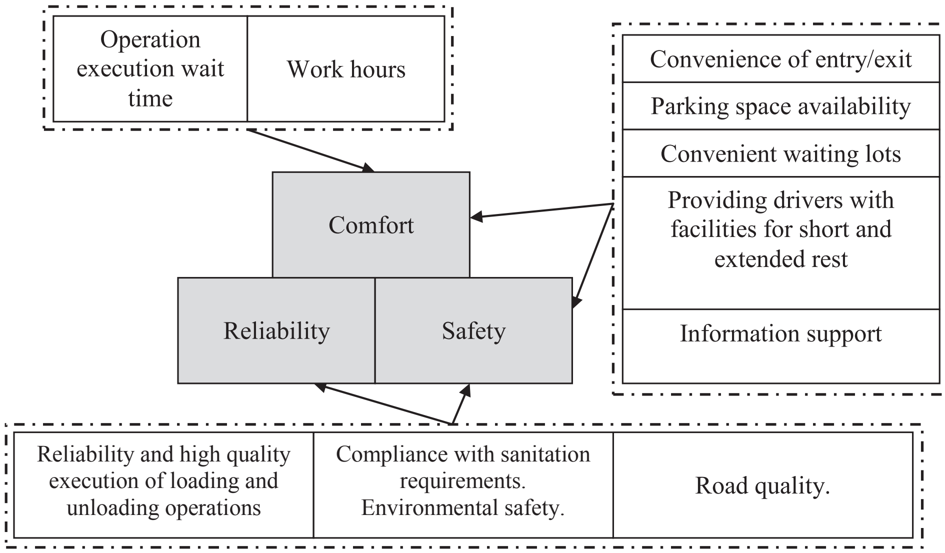
These indicators cover the reliability, comfort level, speed and timeliness of operations; socio-economic aspects, safety and information support.

To obtain quantitative values of the partial criteria and arrive at an integral indicator of the quality of container service offered by transportation companies, a methodology was selected that was based on the application of registration techniques and methods of sociology (opinion polls, questionnaires, scale rating) to collect raw data that was subsequently processed with methods of mathematical statistics and computational methods.

Table 2 summarizes transport service quality assessment for the existing and proposed technologies of container delivery based on expert opinions and a 12-point scale (1 being the lowest and 11 the highest value of the indicator). The absolute change in the quality indicators was computed by the formula:

$$\Delta_{abs\,j}=A_{proposed.j}-A_{existing.j}, \qquad (4)$$

where j is the factor's consecutive number; $A_{existing.j}$, $A_{proposed.j}$ are the points given to the jth factor by an



Pic. 2. Factors that define container service quality.

expert with regard to the existing or proposed container delivery technology.

The quality indicators' improvement rate was determined by the formula:

$$T_{IR} = \frac{\Delta_{\text{abs.j}}}{A_{existing.j}} \cdot 100\% . \qquad (5)$$

Expert valuations of transportation service quality demonstrated that delivery technologies involving self-unloading containers allows the following improvements:

– improve price affordability twofold;

– minimize the waiting time before transloading;

– increase the number of waiting areas, parking lots, and free parking spaces before transloading;

– improve the reliability and quality of operations.

Thus, the proposed technology creates opportunities to realize real aggregate social, informational, and economic benefits.

REFERENCES

1. Ryabov, I. M., Gorina, V. V. Technology of Container Transportation Using Lifting Pillars. *World of Transport and Transportation*, Vol. 14, 2016, Iss. 4, pp. 52–61.

2. Utility model patent No. 168036, Russian Federation, MPK B65D90/14, B60P1/64. Loading/unloading device for a transportable container. I. M. Ryabov, V. V. Gorina; Volgograd State University of Engineering, 2017.

3. Gorina, V. V. Expanding the applications of transportable containers through improvements in their design [*Rashirenie vozmozhnostey ispolzovaniya transportabelnyh konteinerov za schet sovershenstvovaniya ih konstruktsii*]. Competitive exhibition of student research, design, and technology papers at Volgograd State University of Engineering (Volgograd, 10–13 May 2016).– Volgograd, 2016, pp. 120–121.

4. Velmozhin, A. V., Gudkov, V. A., Mirotin, L. B., Kulikov, A. V. Automotive freight transportation. Textbook [*Gruzovye avtomobilnye perevozki: Uchebnik*]. Moscow, Goryachaya Liniya-Telecom publ., 2006, 560 pages.

5. Serova, E. Y. Providing high-quality roadside services to drivers and passengers through effective organization of service businesses operation [*Obespechenie kachestvennogo pridorozhnogo obsluzhivaniya voditeley i passazhirov na osnove effektivnoy organizatsii systemy predpriyatiy servisa*]. Author's abstract of Ph. D. thesis (Engineering), Volgograd, 2011, 16 p.

6. Containerized transportation [*Konteinerizatsiya perevozok*]. [Electronic resource]: http://www.alternativa.in/container/konteynernye-perevozki-prirastayut-za-schet-khimicheskikh-i-nalivnykh-gruzov.html. Last accessed 25.04.2017.

7. Eliasson, L., Eriksson, A., Mohtashami, S. Analysis of factors affecting productivity and costs for a high-performance chip supply system. *Applied Energy*, Vol. 185, 2017, pp. 497–505.

8. Garcia J. M., Lozano, S., Canca, D. Coordinated scheduling of production and delivery from multiple plants. *Robotics and Computer-Integrated Manufacturing,* 2004, Vol. 20, Iss. 3, pp. 191–198.

9. Giuffre, O., Grana, A., Tumminello, M.L., Sferlazza, A. Estimation of Passenger Car Equivalents for single-lane roundabouts using a microsimulation-based procedure. *Expert Systems with Applications*, 2017, Vol. 79, pp. 333–347.

10. Lobo Antonio, Jane Vivec. Port users perspective of the container transshipment business. Proceedings of the International Conference on Port and Maritime R&D and technology, Singapore, 2001, pp. 87–94.

11. Vuyeykova, O., Sladkowski, A., Stolpovskikh, I., Akhmetova, M. Rationalization of road transport park for the carriage of mining rocks in the open mines. *Transport Problems*, 2016, Vol. 11, Iss. 1, pp. 79–85.

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