

## IMPLEMENTATION OF INNOVATIVE TECHNOLOGY FOR EVALUATING HIGH-SPEED RAIL PASSENGER TRANSPORTATION

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### Abstract

The size and content of consumer value (CV) of the service for the transportation of passengers by the railways of Ukraine in long-distance communication by nighttime and daytime trains is determined. A comparison is made of the results of two approaches to researching the attitude of customers to the service – traditional (point-based) and new, taking into account the specific requirements of the total management of the customer value of the service. The directions of the managerial impact of CV on the passenger transportation in long-distance communication by the railways of Ukraine based on the attitude of customers to the disadvantages and advantages of this service are determined.

In three focus groups, discussions were held about travel by Ukrainian railways by daytime and nighttime trains. Based on the results, a list of the disadvantages and advantages that form the consumer value of such a transport service is formed. The list of 19 positive and negative statements reflected all stages of the trip by rail. Behind it, the Likert scale and the corresponding form for conducting an interview were developed. The number of respondents is 823. The sample is random.

The results of the polls confidently prove that the prejudiced attitude of passengers towards daytime transportation has been overcome. The ratio of passengers of the railways of Ukraine in daytime transportation in long-distance traffic is better than in nighttime.

Only one fifth of those traveling daytime and nighttime are fully satisfied with the level of advantages and disadvantages, which is not enough for most customers to make repeat purchases. However, such a hypothesis needs to be verified in future studies.

The feeling of satisfaction among passengers of daytime trains with a positive value of consumer value does not arise in 29 %, which is a threat to the railway operator company. Women are generally worse off on transportation services than men.

Personal experience using the train in general does not affect the attitude. However, the experience of using a nighttime train significantly reduces the consumer value of the transport service.

The main conclusion is that when several customer segments are served simultaneously in a common space, the total management of the customer value of the service and the corresponding research methods are productive.

**Keywords:** system analysis, innovative services, railway transport, segmentation, consumer value, Likert scale.

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## 1. Introduction

In 2012, an innovative service was founded on the railways of Ukraine – daily high-speed passenger transportation. Before that, specialist scientists conducted preliminary studies, developed an economic one, and provided railroad experts with recommendations for a range of new services. But despite this, a significant part of the advice of scientists was ignored by the leadership of the railway transport. As a result, this led to errors in arranging the car spaces of new trains, incorrect allocation of seats by class, false steps in pricing and pricing policies, problems in creating amplifier services. Together, this entailed a negative attitude to daytime high-speed traffic on the part of society. Its reflection was numerous negative media reports, jokes and jokes.

Has today changed the attitude of passengers to daytime high-speed traffic? What is the comparison with traditional nighttime travel? What is the structure and value of consumer value (CV) of such a transport service? What should be the controlling effect today for the sake of increasing CV? According to what parameters should the passenger segments of daytime and nighttime trains be distinguished? Does the attitude to the service differ from those who traveled by daytime trains from those who do not yet have such experience? Attempts to find answers to these questions were in vain.

In CV of services, let's understand the difference between the advantages and disadvantages of the client. Such a concept is widespread and is disclosed in [1, 2]. The composition of the CV elements in different services has differences. In [3], a variant of the CV content of passenger transportation by rail in long-distance traffic is shown. Further, let's proceed from the fact that the customer's attitude to the service is a product of its customer value.

By the beginning of the daytime high-speed traffic movement, the State Research Center for Railway Transport of Ukraine enterprise [4] prepared a feasibility study for the project by specialists. The operator of these transportations was the Ukrainian Railway High-Speed Company. The market measurement of its activities is still without due attention of scientists. Therefore, the answers to the questions could not be found.

## 2. Material and methods of research

### 2. 1. The specification of previously unresolved parts of a common problem

There is an opinion among railway workers that the search for these answers is not important: trains run, people travel, the target financial and economic indicators of the operator company are achieved, and only certain elements of the innovative transport CV need improvement.

Let's explain the fallacy of this position. With this approach, the improvements are point. They are likely to increase CV of the services for which segments of passengers. However, to the optimal content and size of the CV management will approach the touch.

Further, it will be shown that a reasonable conclusion about the need to improve one or several CV elements can be made only after segmenting customers by areas of their search for service values [4]. That is, to ensure a positive impact on the CV, taking into account the interests of all segments of passengers, it is possible only subject to the principles and methodology of total management [5].

Such an approach – total CV management of nighttime and daytime high-speed rail transportation of passengers – requires input data that must be necessary. It is possible to get such primary information as a result of marketing research conducted by special techniques.

The main aim of research in the work is the introduction of innovative technology for evaluating high-speed rail passenger traffic by improving the total management of the CV of service.

To achieve this aim, the following tasks are proposed:

- determine the size and content of consumer value of the service for the transportation of passengers by rail of Ukraine in long-distance communication by nighttime and daytime trains;
- compare the results of two approaches to research, the attitude of customers to the service – traditional (critical comments on which are given above) and new (taking into account the specific requirements of the total CV management);
- determine the direction of the managerial impact on the CV of the transportation of passengers in long-distance communication by the railways of Ukraine based on the attitude of customers to the disadvantages and advantages of this service;
- value of passenger segments in the directions they search for the CV of the transport service (daytime and nighttime transportation);
- differences in the attitude of men and women to transport services in general and by its elements;
- difference in the attitude of respondents who used the service and those who have not traveled by daytime or nighttime trains;
- differences in the attitude of customers to the elements of the disadvantages and advantages of nighttime and daytime trips.

### 3. Methodology of studies of the quality of railway passenger transportation

At the first stage of research, discussions were held in three focus groups on trips on Ukrainian railways by daytime and nighttime trains. As a result, a list of the disadvantages and advantages that form the CV of the transport service was formed. Behind it was developed the Likert scale [6] and the corresponding form for conducting interviews.

The degree of agreement with the statements was assessed by selecting answers from the list of “disagree”, “rather disagree”, “neutral”, “rather agree”, “agree”.

Surveys were conducted at the second stage of work. The total number of respondents is 823 people. The proportion of men among the respondents was 41 %, women – 59 %.

Not all respondents used both daytime and nighttime trains (**Table 1**).

**Table 1**  
Share of respondents who used trains, %

Sign	Share, %
Used daytime	61
Did not use daytime	39
Used the nighttime	89
Did not use nighttime	11

The study was completed in 2018. The CV calculation of the transport service and customer segmentation was carried out according to the methods given in [4].

### 4. Implementation of innovative technology for assessing the quality of passenger rail transport

By the client’s attitude to the service let’s mean its attitude – the psychological state of a person, in a certain situation inclines her to a certain activity. It is measured, for example, on the G. Likert scale – in the amount of the sum of the digitized answers according to the degree of the respondent’s agreement with the statements [7].

But the CV is an attitude that arises as a result of the interaction of the client and the service provider. It is calculated as the arithmetic difference between the sums of digitized answers according to the degree of agreement with statements that correspond to the preferences and disadvantages of the client [7]. Here let’s proceed from the position that the advantages “compensate” for the disadvantages of the client. That is, the CV of a certain size and content becomes an attraction,

which leads the client to use the service. If the client has never used the service, it is possible to talk about its attitude to the premises of the CV created by the service provider.

In this study, the zero difference between the sum of shortcomings and the sum of customer preferences determined the conditional zero of the CV. Due to the excess of the number of statements corresponding to preferences (by one), estimates of the attitude of passengers to transport services are optimistic.

The distribution of respondents by the CV of the nighttime and daytime transportation services is shown in Fig. 1. From Fig. 1 it can be seen that the proportion of respondents whose interaction with the carrier forms a positive CV of service is significantly higher in daytime transportation. Also, the CV of daily traffic reaches large values.

The average CV value of rail transportation for nighttime transport was 1.0, and daily 8.3 units, as per the Likert scale.

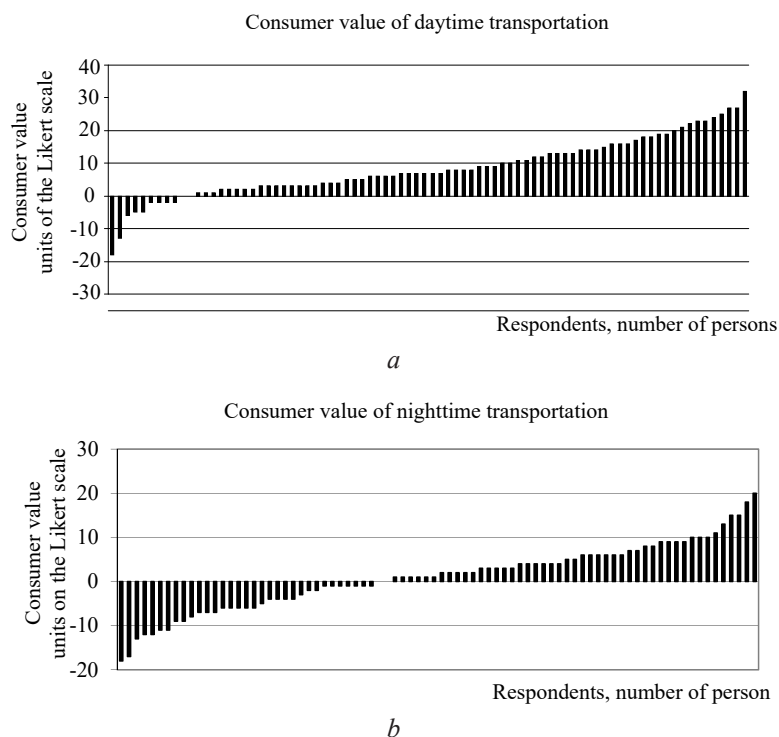
The histograms in Fig. 1 best show the attitude of passengers to the transport service as a whole, but do not provide all the necessary information regarding the direction of its improvement. To do this, customers were segmented by their search directions for CV of transport services.

The decision on whether the respondent is satisfied with the size of the disadvantages (or advantages) was made by comparing it with the median of the array of disadvantages (advantages), Table 2 [4]. Let's note that the conditional zero of the scale can also be a value or an average value. The segmentation results are summarized in Table 3.

**Table 2**

Medians of the array of advantages and disadvantages of nighttime and daytime transportation, units of the Likert scale

Type of transportation	Median of disadvantages, units of the Likert scale	Median of advantages, units of the Likert scale
nighttime	33	35
daytime	31	40



**Fig. 1.** Distribution of respondents by CV:  
*a* – daytime transportation services; *b* – nighttime transportation services

**Table 3**

Segments of respondents by their search directions for CV of transportation services, % of the total

Consumer value	Disadvantages	Advantages	Nighttime transportation, %	Daytime transportation, %
CV<0	not satisfied	satisfied	1	0
	satisfied	not satisfied	11	1
	satisfied	satisfied	1	0
	not satisfied	not satisfied	29	11
	Total for CV<0		<b>42</b>	<b>12</b>
CV>0	not satisfied	satisfied	13	21
	satisfied	not satisfied	16	15
	satisfied	satisfied	20	23
	not satisfied	not satisfied	9	29
	Total for CV>0		<b>58</b>	<b>88</b>

In the **Table 3**, it is necessary to pay attention to the fact that situations when the client is satisfied with the disadvantages and advantages, but  $CV < 0$ , does not arise due to an error, but is a consequence of the research design – the conditional zeros on the developed scale are defined this way. The number of such seemingly illogical relationships can be reduced by establishing points of conditional zeros of the scale according to other rules. In this study, the proportion of such “inconsistencies” was insignificant.

Data analysis of **Table 3** on the segmentation of clients of daytime and nighttime transportation should begin with the understanding by the researcher of the general idea of the management of the service provider for improvements.

If it consists in the desire to reduce the proportion of customers, the interaction with which leads to the emergence of  $CV < 0$ , and this reduces the likelihood of a repeat purchase [3, 4], analyze the upper part of the **Table 2**.

The ratio of only 12 % of passengers to traveling by daytime trains is negative, which is not a threat that requires a response from the carrier. However, in nighttime transportation it is already 42 %, and most of them (three quarters – 29 %) are those customers who are not satisfied with both the disadvantages and the advantages. The obvious conclusion is that it is necessary to simultaneously correct the elements of both the shortcomings and the advantages of the nighttime transportation service.

The next step of management should be to analyze the content of the disadvantages and advantages of nighttime transportation to identify the main points of impact.

If the management of the service provider is engaged in improvement for those customers whom the service as a whole satisfies ( $CV > 0$ ), they work with the bottom of the table. It is possible that the proportion of passengers who are satisfied with the disadvantages and advantages is almost the same for nighttime (20 %) and daytime (23 %) traffic. The shares capable of accepting the disadvantages, but dissatisfied with the advantages, are also the same – 16 % (nighttime) and 15 % (daytime). The difference between the shares of those who are not satisfied with both disadvantages and advantages is significant – 9 % (nighttime) versus 29 % (daytime). The combination of “disadvantages do not satisfied - advantages satisfied” is inherent in 13 % of travelers by nighttime and 21 % by daytime trains. Thus, the logical direction of managerial impact is the simultaneous work with the disadvantages and advantages of daytime transportation and the increase in the advantages of nighttime trips. Then discover those elements of the content of disadvantages and advantages that need correction.

In the traditional approach to research, CV of services considers the situation as a whole. Let's show how this usually happens. To do this, let's collapse the **Table 3** and present the data in **Table 4**.

**Table 4**  
Structure customer attitude to the disadvantages and advantages nighttime of and daytime transportation

Attitude to the disadvantages and advantages	Nighttime transportation, %	Daytime transportation, %
<i>D+</i> , <i>A+</i>	21	23
<i>D-</i> , <i>A+</i>	14	21
<i>D-</i> , <i>A-</i>	38	40
<i>D+</i> , <i>A-</i>	27	16

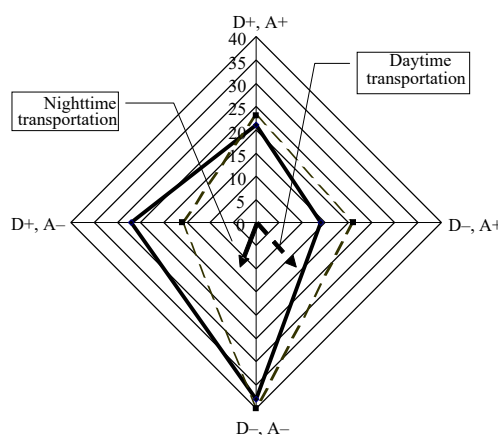
Note: “*D*” – disadvantages, “*A*” – advantages, “+” – satisfied, “-” – not satisfied

Based on the data of **Table 4** let’s show a useful improvement: let’s build a petal diagram of the customer relationship structure (on its axes – percentages) and define the general vector of the CV of service as the sum of the vectors related to disadvantages and advantages (**Fig. 2**).

From **Fig. 2** it follows that the ratio of passengers of the Ukrainian railways to long-distance transportation services is generally negative (in the direction of the vectors). In nighttime transport, customers do not see advantages and are more condescending to disadvantages, and in daytime, on the contrary.

Let’s conclude that the application of the traditional approach does not provide information for working with each of the passenger segments. Productive in this sense is management decision-making based on segmentation in the direction of passengers searching for CV of services, as was done when analyzing the data in **Table 3**.

Next, let’s move on to measuring differences in attitudes between men and women, **Table 5**.



**Fig. 2.** The petal diagram of the structure of the attitude of railway customers to the disadvantages and advantages of nighttime and daytime transportation; general vector of transport service CV

**Table 5**  
The value of the average CM of the transport service depending on the gender of customers, units of the Likert scale

Transportation type	Gender	
	Men	Women
Nighttime	1.4	0.7
Daytime	9.6	7.6

**Table 5** shows that women generally feel worse about the service. The striking difference between the CV of daytime and nighttime traffic for both genders is also striking. For women, it is smaller (0.7–7.6), that is, men experience a greater increase in the CV of daytime transportation compared to nighttime (1.4–9.6).

Since the studies involved both those who traveled and respondents who did not use these modes of transportation, the difference in the ratio should be estimated (**Table 6**).

**Table 6**

The value of the average consumer value of the transportation service, depending on whether the client used the service, units of the Likert scale

Transportation type	Used or not	
	Yes	No
Nighttime	0.8	2.2
Daytime	8.1	8.8

In fact, the **Table 6** compares the CV that arose as a result of the interaction between the client and the provider, and its relation to the CV premises (expected by the service center) created by the transportation operator.

If in daytime transportation the ratio is practically independent of the experience of use, then nighttime trains are rated much better than those who did not travel. This measurement result allows to refute the popular belief that the population still has a biased attitude towards daytime high-speed traffic.

The expected conclusion is that those who did not travel on nighttime trains are much better: the acquisition of personal experience significantly reduces the CV of such transportation.

In the **Table 7** let's find out what disadvantages and advantages passengers of the railways of Ukraine consider the most (least). Here, the division into nighttime and daytime transportation does not count [8].

**Table 7**

The magnitude of the average disadvantages and advantages of long-distance passenger transportation services by Ukraine's railways (nighttime and daytime together), units of the Likert scale

The content of the disadvantages and advantages	Units of the Likert scale
The train schedule is designed so that it is convenient	3.7
Train ticket price high	3.5
There is an opportunity to conveniently buy a ticket on the Internet	4.4
Due to the inconvenient schedule, additional costs arise (taxi, hotel)	3.3
During the trip, the passenger's personal safety is ensured	3.5
There is a risk of theft of passenger luggage and personal items	3.9
The work of the staff in the car fully satisfies the passenger	3.5
During the trip, the car smells unpleasant	3.5
The air temperature in the car is comfortable	2.9
There are no drafts in the car during the trip	3.0
During the trip, the toilet had hygiene products (water, soap, toilet paper)	3.2
The toilet in the car is dirty	3.4
Passenger seats and floor are clean	3.8
The price of food and drinks in the car is high	3.9
Passenger's seat (couch or seat) is convenient	3.8
Passenger gets tired during the trip	3.4
The interior of the car is cozy	3.5
As a result of the train ride, there is a risk of getting sick (runny nose, headache)	3.6
The train arrives on time	3.9

*Note: the magnitude of the elements of disadvantages and advantages can't be compared with each other (different number of statements, different nature of the elements)*

Most favored passengers consider the opportunity to buy a ticket using the Internet, adhering to the schedule and its convenience. But they are worried about the price of additional and reinforcing services, the microclimate in cars, the lack of hygiene products in latrines.

However, a cross-analysis of nighttime and daytime transportation reveals significant differences in the attitude of passengers to disadvantages and advantages (Table 8).

Passengers believe that the price of daytime trips is higher than nighttime ones. However, railroad customers see relatively large additional cash costs in nighttime trips.

In daytime trains, the personal safety of the passenger is greater, and the risk of loss of property and the onset of illness as a result of the trip is less. The staff also interacts better with daytime train passengers. Nighttime trips here lose [8].

**Table 8**

Comparison of the average disadvantages and advantages of long-distance passenger transportation services by Ukrainian railways by nighttime and daytime trains, units of the Likert scale

The content of the disadvantages and advantages	The average value of the disadvantages and advantages, units of the Likert scale	
	Nighttime	Daytime
The train schedule is designed so that it is convenient	3.7	3.6
Train ticket price high	3.3	3.8
There is an opportunity to conveniently buy a ticket on the Internet	4.3	4.4
Due to the inconvenient schedule, additional costs arise (taxi, hotel)	3.6	3.0
During the trip, the passenger's personal safety is ensured	3.0	3.9
There is a risk of theft of passenger luggage and personal items	4.3	3.5
The work of the staff in the car fully satisfies the passenger	3.2	3.9
During the trip, the car smells unpleasant	4.2	2.8
The air temperature in the car is comfortable	2.4	3.4
There are no drafts in the car during the trip	2.5	3.5
During the trip, the toilet had hygiene products (water, soap, toilet paper)	2.6	3.8
The toilet in the car is dirty	3.9	2.8
Passenger seats and floor are clean	3.5	4.1
The price of food and drinks in the car is high	3.7	4.1
Passenger's seat (couch or seat) is convenient	3.8	3.8
Passenger gets tired during the trip	3.2	3.6
The interior of the car is cozy	3.2	3.9
As a result of the train ride, there is a risk of getting sick (runny nose, headache)	3.8	3.4
The train arrives on time	3.8	4.1

*Note: the magnitude of the elements of disadvantages and advantages can't be compared with each other (different number of statements, different nature of the elements). However, it is possible to compare the magnitude of the disadvantages of daytime transportation with the magnitude of the disadvantages of the nighttime. The same goes for advantages*

The microclimate is the worst in cars of nighttime trains, and the sanitary condition is the same. Despite the fact that the interior of the salons of the train daytime is cozy and the seats are comfortable, customers get tired more in it. The explanation for this attitude is simple – comfortable car seats for rides of 4 hours are installed in the cars, and almost all daytime trips in Ukraine



last longer. In addition, the arrangement of the three seats together creates significant ergonomic inconveniences for a person, and her personal space is violated [9].

When analyzing the data of **Tables 7, 8**, the ratio of the entire set of railroad customers included in the sample is investigated. However, the processing of data within an individual segment to determine the elements of disadvantages and advantages that need to be corrected will not differ. To do this, it is necessary to identify the segment of respondents that the researcher is interested in by the direction of their search for the CV of services (**Table 3**).

The determination of the  $p$ -level by the  $\chi^2$  test of the structure of respondents' answers according to their choice of the degree of agreement with the statement on the Likert scale (according to the list of "disagree", "rather disagree", "neutral", "rather agree", "agree"), shows that the same can be considered the structure of the ratio of passengers of nighttime and daytime trains ( $p=0.95$  and higher) only to the convenience of the schedule and the arrangement of passenger seats [10, 11].

This conclusion is another argument in favor of an in-depth study of the properties of each individual segment, highlighted in the direction the client searches for CV of services. The average disadvantages (advantages) for the two segments can be the same, and the structure of the distribution of responses on the Likert scale can be different. Such a check should be carried out at important points of correction of CV elements.

## 5. Conclusions

The results of the polls confidently prove that the prejudiced attitude of passengers towards daytime transportation has been overcome. The ratio of passengers of the railways of Ukraine in daytime transportation in long-distance traffic is better than in nighttime.

Only one fifth of those traveling daytime and nighttime are fully satisfied with the level of advantages and disadvantages. Based on the indicators of other services, such a share is unlikely to become a reliable basis for repeat purchases by most customers. However, this hypothesis needs to be verified in future studies.

The feeling of satisfaction among passengers of daytime trains with  $CV > 0$  does not arise in 29 %, which is also a threat to the railway operator company.

Women are generally worse off on transportation services than men.

Personal experience using the train in general does not affect the attitude. However, the experience of using a nighttime train significantly reduces the CV of transport service.

The use of CV histograms of services (**Fig. 1**) provides an understanding of the market situation as a whole. The sequence of analysis of the aspirations of the segments allows to determine the directions and parameters of managerial impact, the creation of the prerequisites for the CV of services of a certain level and content (**Table 3**).

The main conclusion from the conducted studies, which has found practical confirmation, is the traditional approach to the management of CV of services, which consists in the gradual point impact on the elements of disadvantages and advantages in the hope of finding the optimum attitude of the entire customer community, is false. When several customer segments are served simultaneously in a common space, the total CV management and the corresponding research methods are productive.

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