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THE USE OF MODERN TECHNOLOGIES TO PURCHASE TICKETS IN RAIL TRANSPORT (POLISH EXAMPLE)

Summary. The aim of the article is to learn about the behaviors of carriers and passengers in the use of modern technologies in rail transport aimed at selling tickets. This research examines whether passengers use modern technologies when purchasing tickets for rail passenger transport and how they evaluate them. Answers were also sought as to what actions carriers take to meet the requirements of passengers. This article presents the results of research on the supply side regarding the use of remote ticket distribution channels of the largest railway carrier and on the demand side, along with the results of survey research on passenger's preferences in the use and assessment of railway ticket distribution channels on a nationwide sample (2023, CAWI research, N= 722). As many as 78% of respondents indicated that they use modern technologies, and only 22% said they do not. However, only 42% of passengers purchased tickets using modern technologies. Women statistically significantly more often than men indicated that they never use applications to purchase electronic tickets (45.6% vs 34.9%). This response was also given significantly more often by people who were over 60 years old (58.3%) than by younger respondents. In the case of respondents aged 18–30, this percentage was 28.4%, and in the case of respondents aged between 31 and 60, it was 35.1 %.

1. INTRODUCTION

The digitization taking place in the modern world and generational changes have had a significant impact on the transportation services market, affecting both railway carriers and passengers. As a result, there have been significant changes in customer expectations, leading to the emergence of new preferences alongside traditional expectations. Passengers, forced to develop digital skills during the pandemic, have noticed the benefits and opportunities they offer [15].

In the field of transport services, technology, as well as customer relations [16, 20-21], the importance of innovation has also increased. Progressive technical and technological development creates many opportunities for the efficient functioning of rail transport. This promotes, among other things, a faster flow of information and facilitates the purchase of services, which may benefit passengers whose expectations are also growing. *Modern technologies* is a very broad concept that has

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been defined in various ways. It is most often associated with the Internet (passenger information, ticket sales), mobile applications, smart boards in vehicles, and at stops [14]. From the point of view of decisions made by passengers, ticketing systems are among the most important [25].

A modern passenger wants to purchase a ticket as quickly and efficiently as possible. Two segments of buyers are particularly important: Generation Z (i.e., today's 30-year-olds, who use and may even be addicted to mobile devices, are open to new technologies, are efficient in using them, and at the same time are impatient and impulsive) and seniors, who are often digitally excluded and use traditional solutions [2].

Therefore, carriers try to adapt both the product offer and the forms of distribution to these groups of buyers. It is therefore worth analyzing the activities of railway carriers in the field of ticket distribution, the results achieved both in quantitative terms (number of tickets sold through individual distribution channels) and in value terms (revenue and costs generated in individual ticket distribution channels) and new, strategic solutions [7]. Issues related to the use of remote ticket distribution channels were discussed using the example of the largest Polish railway carrier in passenger transport. The demand side was characterized based on survey results regarding travelers' preferences for using and evaluating railway ticket distribution channels.

The article aims to learn about passengers' behavior regarding the use of modern technologies when purchasing railway tickets. The main reason for undertaking this research is to determine whether passengers use modern technologies when purchasing tickets for rail transport and how they evaluate the available solutions offered by carriers. For this purpose, a survey of railway passengers in Poland was carried out using the CAWI method. Answers were also sought as to what actions railway carriers take to meet the requirements of passengers in terms of ticket distribution. The implications of the research are particularly important for carriers and rail transport organizers.

This article comprises an introduction, a review of the literature, a discussion of research methods and findings, as well as a discussion and conclusions.

2. LITERATURE REVIEW

Many factors, such as the COVID-19 pandemic and technological progress, have influenced changes in passenger rail transport. Such changes concern the aesthetics of vehicles, amenities for travelers, and digital innovations. Passengers' opinions confirm that passenger transport has undergone a major metamorphosis [8]. Due to their universality and public availability, railway transport should take into account the wide possibilities offered by information technologies. This applies to the entire passenger service process, from ticket purchase to arrival at commercial points of sale and the journey itself. An example is the ExtenSive project, which aims to develop both passenger applications and software for carriers that will ultimately enable the provision of transport services of the highest quality [22].

Public transport has to be more comfortable and attractive for passengers. Customers are influenced by many factors, including psychological factors, when choosing a mode of transport [5]. Understanding the psychosocial factors that influence public transportation usage behavior can provide important implications for transport policies aimed at managing passengers' mobility behavior [4]. Another important factor is access to relevant and timely information.

Contemporary authors have noticed changes in the behavior of passengers using passenger railway services and new directions in shaping their preferences [19]. As a consequence of the growing online availability of ticket purchases and information, the "digital passenger" has constantly growing requirements and expects personalized service [2, 18]. Whether the offer meets their expectations affects their satisfaction and the likelihood that they will purchase the product again [1, 25].

The development of modern technologies and their acceptance by passengers contributes to new forms of information and distribution [2, 3, 16]. Moreover, such innovative solutions are intended to encourage passengers to use group or collective forms of transport [7]. Mobile applications are the most widespread. Stopka [23] has addressed the requirements of users of a mobile application supporting door-to-door mobility in public transportation. These applications are often created by carriers to coordinate timetables and to synchronize arrival and departure times of various modes of transport,

ticket sales, and passenger information systems [6]. The evolution of passenger behavior in purchasing railway tickets was presented by Boltaikhanova, Bostanbekov, Nurseitov, and Begimbetov [28]; Zhou and Han [29]; and Pan, Lu, and Duan [30].

Many incompatible applications have been designed to find passenger information, and it is necessary to combine them to find all the relevant travel data needed by different modes of transport. Most of them enable the purchase of a ticket and also have additional functions, such as payment for parking in the city (MoBI LET, MPay, Skycash). Outside the scope of the selected applications, there are both local tools (e.g., mobiWAWA) and international tools (e.g., MPay). Because the situation during the journey may change (this may be due to traffic disruptions or traffic jams), the traveler should also have clear access to information about the trip when using the transport service, including voice messages. Additionally, the vehicles are equipped with various types of static and dynamic boards showing the current journey.

The analysis of available works and research, to the best of the author's knowledge, has shown that in Poland, there is generally no comprehensive research on changes in the use of digital information technologies for purchasing rail tickets by passengers. The only available results, in general terms and scope, are presented by the Office of Rail Transport [2]. This article aims to fill the resulting research gap.

3. THE SHARE OF REMOTE CHANNELS IN THE REVENUE AND COSTS OF TICKET DISTRIBUTION OF RAILWAY CARRIERS

This research concerns the supply side. First, the case method was used to assess the activities of the largest railway carrier regarding ticket distribution. For this purpose, information obtained directly from the largest railway carrier, POLREGIO, and the Office of Rail Transport was used.

The information shows that passengers are increasingly willing to buy tickets on mobile applications and the Internet. The percentage of such ticket purchases increased during the pandemic, but only in 2022 did this form of purchasing tickets become the most popular, overtaking traditional ticket offices for the first time in the history of statistics kept by the Office of Rail Transport. In 2022, 342.2 million people traveled by train, the highest number in 10 years. In 2022, railway passengers bought 35% of tickets via mobile applications and the Internet and 29.3% at ticket counters [11]. The share of online channels in the number of tickets sold increased by 7.1 percentage points year-over-year. Most often, single-use, long-distance tickets are purchased online and well in advance. Among ticket distribution channels, for several years, there has been a higher use of ticket machines at stations and stops as well as in vehicles. In 2021, 8.3% of travelers decided to buy a ticket at a stationary ticket machine, and 0.9% made purchases in vehicles. In 2022, these percentages were 8.4% and 1.1%, respectively (Table 1).

Table 1

Share of distribution channels by the number of tickets sold from 2019-2023

Distribution channel/number of tickets sold	2019 (%)	2020 (%)	2021 (%)	2022 (%)	2023 (%)
Stationary ticket offices	46.5	39.3	35.1	29.3	25.5
Applications and online sales systems	14.3	18.2	27.9	35.0	42.9
On-board service (conductor teams)	16.2	17.6	21.5	20.8	18.4
Stationary vending machines (at stations)	6.6	7.5	8.3	8.4	7.7
Mobile machines (in vehicles)	0.6	0.7	0.9	1.1	1.1
the remaining	15.8	16.7	6.2	5.3	4.5

Source: [11, 26]

The biggest declines in ticket distribution channels for years have been observed in stationary ticket offices. In 2018, their share was still over 50%, but in 2022, it was already below 30%. The demand for purchasing tickets from conductor teams has also decreased. In 2021, the share of such tickets in total sales was 21.5%, and in 2022 it dropped to 20.8%. Typically, this form of obtaining a ticket involves additional costs [11]. The number of railway tickets sold in 2022 increased by nearly 100 million compared to 2021. The largest proportion (49.5%) were single-use tickets. There were 50.4 million more of these tickets sold in 2022 than in 2021, which resulted in an increase in the share of single-use tickets in all tickets sold by 0.9 percentage points (from 48.6%). Season ticket sales also increased by 38.5 million compared to 2021, but the share of this category decreased by 0.6 percentage points (from 41.9% to 41.3%). Similarly, in the case of the "other tickets" category, 8200 more tickets were sold, but the share of this group was lower by 0.3 percentage points (from 9.5% to 9.2%) [11]. In 2022, the share of online ticket sales in overall ticket distribution revenue increased by 7.3 percentage points (from approximately 27% to 34.3%), while the share in revenue from tickets purchased at ticket offices decreased by 5.1 percentage points. Most often, long-term tickets are sold at ticket offices, which generate more revenue, so the drop in revenue is not as significant as in the case of a drop in sales share (Fig. 1 and Table 2) [11].

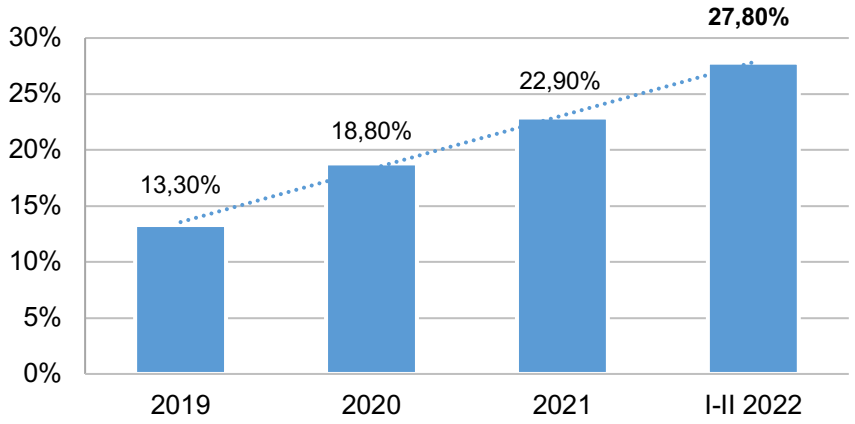


Fig. 1. Share of revenue from online ticket sales in the revenue of the largest railway carrier
Source: [27]

Table 2

Share of distribution channels in ticket sales revenue from 2021-2023

Distribution channel/sales revenue	2021 (%)	2022 (%)	2023 (%)
Stationary ticket offices	40.9	35.8	31.5
Applications and online sales systems	27.0	34.3	41.6
On-board service (conductor teams)	17.6	16.7	15.0
Stationary vending machines (at stations)	7.6	6.8	6.0
Mobile machines (in vehicles)	0.8	0.9	0.9
the remaining	6.1	5.4	4.9

Source: [11, 26]

The share of remote channels in revenue is regularly growing and gaining increasing popularity among passengers (Fig. 1). Therefore, the development and promotion of this form of ticket distribution is a natural process aimed at increasing sales profitability. Due to the growing share of remote channels, which are also the cheapest distribution channels, the carrier strives to further reduce the cost intensity in these channels by creating its own sales platform. Currently, sales are conducted through four platforms of external operators (koleo, e- podróżnik, skycash, bilkom) and one sales platform and mobile application.

The share of remote sales channels is systematically growing, and by the second quarter of 2023, this form of purchase had already been chosen by 41% of passengers. More expensive tickets are still purchased at ticket offices than on other distribution channels—monthly, network, and for longer routes. Sales at stationary ticket offices generate 31.5% of revenue from ticket sales, representing a share of 25.5% of the number of tickets sold. The share of revenue also indicates the growing popularity of sales through the Internet and mobile applications from year to year. Last year, such sales accounted for 41.6% of revenue (with a share of 42.9% in the number of tickets), and in 2021, this figure was 27%. Interestingly, in 2021, tickets sold at box offices accounted for 40.9% of revenue, which is almost as much as online sales in 2023. Online channels are most often used by travelers when they need a single-use ticket. Similarly, tickets for single routes and shorter distances are purchased at ticket machines and train services—the shares in revenue in these distribution channels are lower than the shares in the number of tickets sold. This means that the share of sales through remote channels more than tripled from 2019 to 2023. This trend, along with the market's development potential, suggests that the share of sales through remote channels will continue to grow in the coming years. Therefore, the largest Polish railway carrier plans to gradually increase the number of various types of self-service devices to meet passengers' expectations [12]. These activities are also justified by the cost intensity of individual ticket distribution channels, which are presented in Table 3. Cost intensity should be understood as all the costs of commercial activities (ticket sales) incurred by the carrier concerning the carrier's revenue from ticket sales. These include both indirect costs (e.g., the maintenance of ticket sales points, the rental of box office rooms and cashier's remuneration, and commissions for agents and distributors) and direct costs (e.g., materials and the cost of operating online portals offering tickets).

Table 3

Cost intensity of individual ticket distribution channels from 2019-2021

Type of distribution channel/cost intensity	2019 (%)	2020 (%)	2021(%)
Traditional channels	12.68	14.10	15.65
Remote channels	4.97	3.30	3.22

Source: [27]

Increasing revenue in remote channels, which are characterized by many times lower cost intensity, reduces the share of much more cost-intensive traditional channels in costs. Analyses have shown that if revenue is migrated to remote channels, ticket distribution costs will be reduced by over 42% (Table 4).

Table 4

Hypothetical structure of ticket distribution costs (estimated savings) with the increasing share of remote channels

CHART A. Current situation	Traditional channels [1]	Remote channels [2]
Revenue	80%	20%
Cost share	92%	8%
CHART B. Situation after migration revenue	Traditional channels	Remote channels
Revenue *(predominantly electronic channels)*	20%	80%
Cost share	38%	62%

[1] ticket offices *(private, agency, of other carriers),* conductor ticket sales
[2] Internet, mobile applications, ticket machine
Source: [27]

The latest solution in ticket sales introduced by the largest railway carrier in Poland is video machines. They eliminate an important gap in the sales automation process, allowing passengers to maintain contact with another person in the ticket purchasing process [13]. Video machines combine the capabilities of a ticket machine with the functionality of a traditional ticket counter. This is an innovative technological solution that enables one to supplement the network of ticket offices with self-service devices equipped with a service that allows for contact in the form of video transmission with a consultant, known as the e-cashier.

In 2022 was started a pilot program for selling tickets via internal video machines (*videomats*), and from 2023, it has been developing a ticket sales offer expanded to include external video machines and mobile ticket machines in trains. The introduction of as many as three types of self-service devices will allow the railway carrier to reduce ticket sales costs while increasing the availability of this sales channel. Self-service devices are designed to meet the needs of passengers of all age groups, including individuals with disabilities [10, 12].

One of the largest suppliers of self-service devices in Poland has decided to use its extensive experience in the railway industry. Based on its expertise, the company designed devices tailored to the needs of rail passengers, paying attention to the various places where they may need to buy a ticket – at stations, platforms, or even directly on trains [13]. The appearance of *videomats* has been designed to easily fit into the station's landscape, regardless of its architecture. Outdoor devices are made to work in all weather conditions. This means that they can be placed, for example, in front of stations, at transport hubs, or in busy public spaces. They are also resistant to acts of vandalism. This extremely innovative solution was very positively received by passengers during the pilot project. Thanks to the further development of the number of devices and their types (internal and external *videomats*), the method of checking in passengers will change, making it more convenient.

Ten years ago, ticket machines and payments using payment cards were a similar innovation; today, no one can imagine railway stations and cities without these devices and their functionality [10, 12]. Thanks to modern technology, when purchasing a ticket, the passenger uses the assistance of an e-cashier (i.e., a person located in the call center), which helps them buy the cheapest train ticket. E-cashiers are available from 6:00 a.m. to 10:00 p.m. (i.e., during train operating hours). These e-cashiers are much more accessible than most stationary cash registers [10, 12].

The sales application is easy and intuitive to use. In the case of video machines, at the beginning of the process, the passenger chooses the option of purchasing a ticket yourself or calling a call consultant center. The application is available in Polish, Ukrainian, English, and German. The sales system can be integrated with the systems of other carriers, allowing tickets for long-distance trains, such as PKP Intercity, to also be available. In the future, there will also be other forms of integration (e.g., the possibility of purchasing public transport tickets). Forecasts indicate that by 2030, the total share of ticket machines in terms of the number of tickets sold will surpass that of stationary ticket offices, resulting from further digitization and generational change [10, 12].

4. RESEARCH METHOD

This demand-side research was carried out using the CAWI method (Computer Assisted Web Interviewing) on the PBS Sp. company panel. z o. o., Poznaj.to in November and December 2023. The CAWI method was chosen by the research company selected in the competition, which has experience in reaching a representative sample in a short time. The study population consisted of individuals aged 18 or older residing in Poland (according to the Central Statistical Office, as of 2021, over 31 million people aged 18 or older lived in Poland). Completed a total of N=1117 interviews. The percentage was based on the number of respondents who traveled by train (N = 722).

The quantitative method and sampling used in the study allow the results to be generalized to the entire adult population with an estimation error of +/- 3.0% (95% confidence level). This study was conducted using a random sample, facilitated by the proprietary respondent sampling system and a tool for maintaining a grace period for participating in the research. The results were generalized based on a representative sample drawn from the population. Moreover, the set selected for this purpose was

subjected to a weighting procedure in order to correct the results in relation to the structure of the general population. Control tests were conducted in two ways:

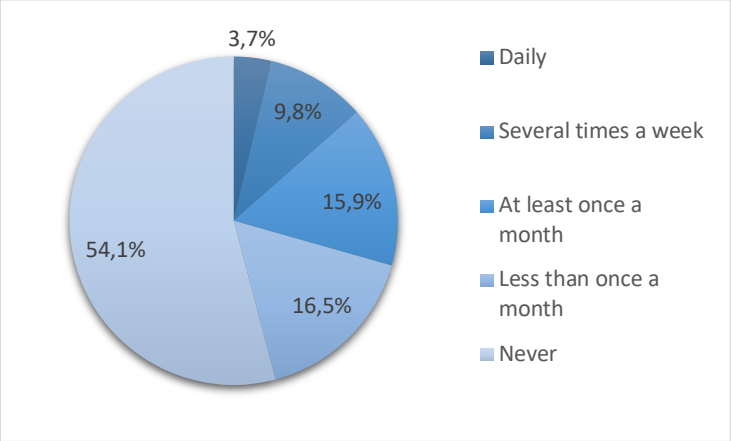
- Field control: During the implementation of the study, responses were monitored on an ongoing basis, allowing us to react and eliminate cases where the data raised doubts, such as when the time to complete the questionnaire was too short, undesirable trends, inconsistencies, or discrepancies in the responses were observed. The questionnaire script prevented the panelists from omitting key questions (e.g., those presenting content important from the point of view of the study).
- Non-field inspection: Substantive analysis enabled the elimination of incomplete or unreliable material. Quality control covered 100% of the collected material, during which the consistency of answers, response patterns, and records of answers to semi-open questions were analyzed.

The research tool was designed by the author and consulted with the research company PBS Sp. z o. o. Before starting the analyses, the data set was subjected to a weighting procedure intended to correct discrepancies in the resulting empirical distributions in relation to the structure of the general population, specifically in terms of gender, age, and place of residence. The iterative weighting methodology (RIM) was used using the mentioned features. Statistical analyses were performed using the IBM SPSS Statistics 26 package to analyze the significance of differences in responses among individual groups of respondents. Chi-square tests were performed, and significant differences in column proportions were compared – the percentage of responses in specific groups (gender and age). The level of significance was $\alpha = 0.05$. Bonferroni correction was used to adjust the significance value. This research is a continuation of the original research on the use of modern technologies by public transport passengers conducted in 2020–2023 using the CAWI method on representative samples: in 2020, N=1012; in 2021, N=1129; in 2022, N=1067; and in 2023, N=1117.

Research carried out in 2020–2023 on a nationwide sample included collecting information on passengers' choices regarding the use of modern technologies in planning and implementing travel, including purchasing tickets. This article presents only some of the results directly related to the issue discussed.

5. THE USE OF MODERN TECHNOLOGIES TO PURCHASE TICKETS IN RAIL TRANSPORT – PASSENGER RESEARCH RESULTS

The first issue was to examine whether respondents used modern technologies in rail transport in 2023. As many as 78% of respondents indicated that they used modern technologies, and only 22% did not. However, there are differences in the declarations of what exactly the respondents use. Over 50% of respondents indicated that they never use applications to purchase tickets when planning or during a trip, 16% of respondents do it sometimes, and 12.6% always do (Fig. 2).



Percentage basis: Respondents who traveled by train in 2023, n=722

Fig. 2. Frequency of use of ticketing apps by passengers to purchase tickets when planning or during a trip
Source: Own research

Women statistically significantly more often than men indicated that they never used applications to purchase electronic tickets in 2023 (45.4% vs. 34.9%, $p < 0.05$). This answer was also given significantly more often by people who were over 60 years old (58.3%) than by younger respondents (Figs. 3–4). In the case of respondents aged 18–30, this percentage was 28.4%; in the case of respondents aged between 31 and 60, it was 35.1% (Figs. 5–7).

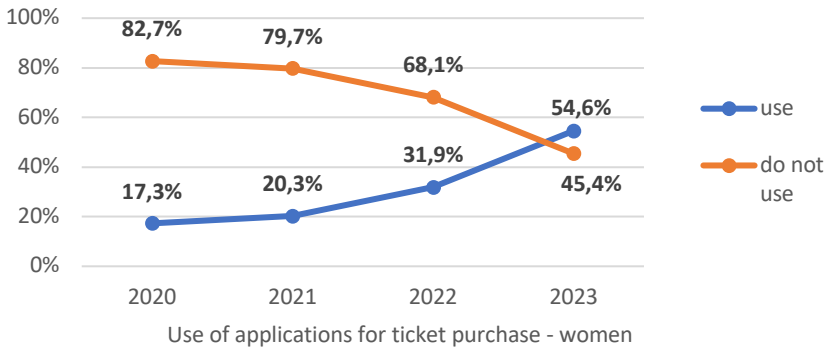


Fig. 3. Use of applications for ticket purchase among women
Source: Own research

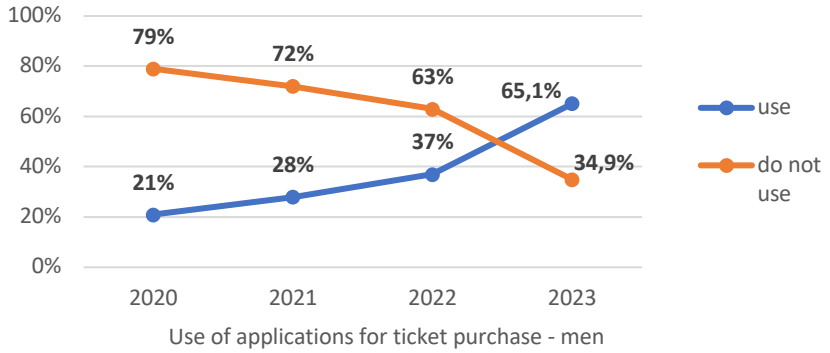


Fig. 4. Use of applications for ticket purchase among men
Source: Own research

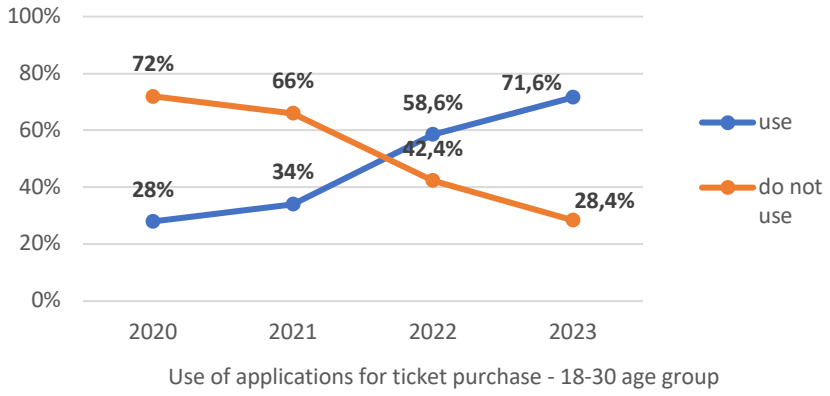


Fig. 5. Use of applications for ticket purchase (18–30 age group)
Source: Own research

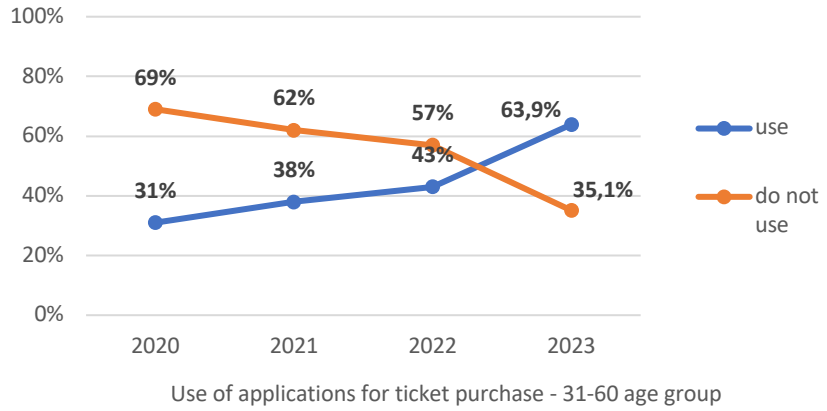


Fig. 6. Use of applications for ticket purchase (31–60 age group)
Source: Own research

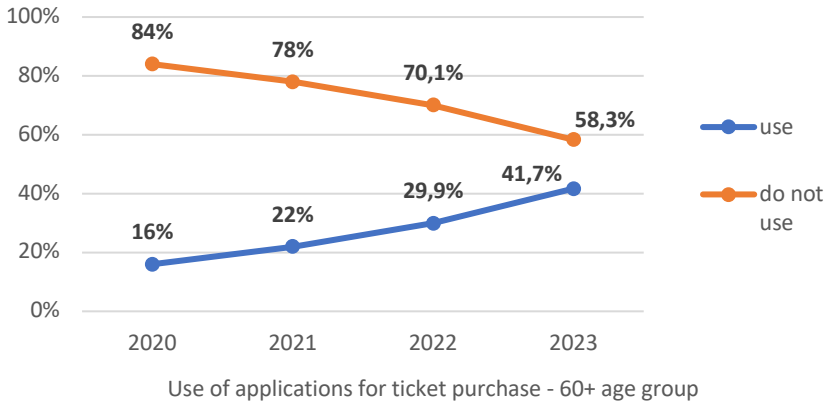


Fig. 7. Use of applications for ticket purchase (60+ age group)
Source: Own research

The size of the respondents' place of residence is also a factor that differentiated the answers to this question. Residents of rural areas (19.6% of responses) and cities with up to 20,000 inhabitants (21.8% of responses) indicated significantly more often that they rarely use this type of application than residents of cities with more than 100,000 inhabitants and up to 400,000 residents (5.9% of responses, $p<0.05$).

The results are also differentiated by education ($p<0.05$). People with primary, mainly vocational, and secondary education were significantly more likely than people with higher education to indicate that they do not use applications to purchase tickets.

6. DISCUSSION

The results are similar to the results presented in the report of the Office of Rail Transport: "Passenger satisfaction survey - 2nd edition" from 2021 [2]. Overall, 1,516 people completed the survey. The respondents indicated that the most frequently used methods for checking the timetable, ticket prices, or purchasing a ticket include searching for connections (75%), carriers' websites (64.1%), and mobile device applications (51.6%) [2].

Confirmation of the research results can also be found in the works of other authors [14, 20, 21]. They investigated the usefulness of information and communication technology solutions in passenger transport from the perspective of transport users, taking into account real case studies from various European environments. Their main conclusion was that users in different regions, characterized by very distinct characteristics such as wealth, GDP levels, geographical location, and cultural background, have surprisingly similar attitudes toward ICT [28-30].

In 2023, after the end of the COVID-19 pandemic, an increase in both transport and the use of modern technologies by travelers was observed. As many as 85% checked the waiting time for the selected means of transport on the Internet, 70% used applications for mobile devices, and 96% checked the timetable before the trip. However, relatively few travelers bought tickets online (just under 50%), while the rest purchased tickets in the traditional form. More than 60% of respondents assessed ticket sales in various forms—traditional and online—as positive.

Age also differentiates the distribution of responses. Statistically, people under 30 years of age gave good ratings more often (35.5% of responses) than older respondents.

The size of the place of residence also influenced differences between groups. Residents of cities with up to 400,000 inhabitants indicated significantly more often that they assessed ticket sales in various forms as very good (33.4% of responses) than residents of rural areas (19.3% of responses) and towns with a population of up to 20,000 residents (15.9% of responses, $p<0.05$). The respondents positively assessed the intuitiveness and ease of use of the application on the Internet—63.7% of respondents evaluated this aspect positively, while only 6.4% held the opposite opinion.

Statistically, people under 30 years of age gave significantly more positive ratings (27.5% of responses) than older respondents. In the case of respondents aged between 31 and 60, this percentage was 17.5%, and in the case of respondents over 60 years of age, it was 9.4%. The results of the research conducted are similar to those presented by carriers based on their calculations.

Tomanek [16], in his research on public communication, showed that the modern world is becoming a digital world. Alvin Toffler's global village is becoming a reality today thanks to modern technologies. Modern communication instruments, the power and effectiveness of which were so clearly demonstrated during the COVID-19 pandemic, have provided an opportunity to change future mobility models [9], [17, 24].

One limitation of this research is the small sample size (approximately 1,000 people). Moreover, in many cases, respondents had access only to selected technological possibilities. Also, the research was conducted in November 2023, during winter and low temperatures, which could have influenced some of the answers. Furthermore, the attitudes of travelers towards video cameras were not studied due to their short functioning and still low popularity and availability. The initial phase of their introduction concerned the largest cities in Poland. Against this background, a new research field emerges, focusing on the detailed assessment and reasons for using various forms of railway ticket sales, including stationary ticket offices, applications, online sales systems, on-board services (conductor teams), and stationary and mobile machines (at stations and in vehicles).

7. CONCLUSIONS

The present research allowed for the formulation of several conclusions:

- Over the past few years, noticeable changes have occurred in the transportation behavior of travelers. The above-mentioned change in the behavior and way of thinking of passengers in rail transport was also combined with the unexpectedly rapid development of modern technologies forced by the need to function in new environmental conditions. Many people have learned to use modern solutions only because the situation forced them to do so. However, once they have overcome this barrier, it is no longer possible to return to their old habits.
- Young and professionally active people generally use modern technologies, including those designed for purchasing tickets. Over time, this group will grow, and the age limit of this segment will increase. However, the group of people who cannot cope with the use of modern technologies (i.e., digitally excluded individuals) will decrease. There is a noticeable

generational change. In the transport market, people from Generation Z are becoming an important segment of travelers, with characteristic features, including impatience, impulsiveness, and high efficiency in using mobile devices.
- As many as 85% checked the waiting time for the selected means of transport on the Internet, 70% used applications for mobile devices, and 96% checked the timetable before traveling.
- According to respondents' declarations, relatively few travelers bought tickets online (almost 50%). The rest purchased tickets in a traditional way. According to the railway operator's estimates, 37% of tickets were sold through remote channels.
- More than 60% of respondents assessed ticket sales in various forms—traditional and online—as positive. These were mainly young buyers (up to 30 years old) and residents of large cities. Every second respondent rated websites and applications for purchasing tickets and passenger information, ticket machines, stationary ticket offices, and traveler service points as positive.
- Passengers are increasingly willing to buy tickets on mobile applications and the Internet. The percentage of such travelers increased during the pandemic, but only in 2022 did this form of purchasing tickets become the most popular, overtaking traditional ticket offices for the first time.
- The latest solution in ticket sales is video machines (*videomats*). These were introduced by the largest railway carrier in Poland.

8. IMPLICATIONS FOR THEORY, APPLICATION, OR POLICY—FUTURE WORK

This article provides a detailed understanding of the determinants of the development of ticket distribution in rail public transport using modern technology. Moreover, the article fills in gaps in the existing literature by considering the unique challenges, benefits, and opportunities for transport organizers in the context of electronic ticket purchases for rail travel.

The above conclusions are relevant for rail carriers that operate in both intra- and inter-industry competition. Learning about the mechanisms of passenger behavior will allow the development of strategic measures aimed at retaining regular customers and attracting new ones through the introduction of modern, IT-enabled, multi-channel ticket distribution systems. It will also be the basis for developing an information and promotional strategy for ticket distribution using modern technologies.

As information technologies are becoming increasingly embedded in the public transportation system, this study makes a timely and important contribution to the ongoing discourse on the future of their implementation in ticket distribution.

Considerations have helped outline directions for further research:
- In particular, it is worth investigating passengers' reasons against using modern ticketing technologies and developing scenarios to overcome these barriers.
- The next step in this area will be to assess the possibility of further use of artificial intelligence.

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