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## USABILITY OF APPLICATIONS FOR CUSTOMERS OF POZNAŃ URBAN TRANSPORT

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The article presents the expectations and needs of urban public transport customers in terms of obtaining up-to-date information about the possibility of reaching a specific destination using an available means of public transport. The main aim of the article is to analyze the usability of websites and applications for urban transport customers. The research was in the form of a case study and was limited to the Poznań agglomeration. Both heuristic research and survey research were selected to assess customer satisfaction in the study. Webpages and mobile applications were taken into consideration since either could be chosen by the users to acquire information about public transport systems. The research was based on the model of usability, including group as well as elementary criteria.

Compared to previous studies, it can be concluded that the user ratings for particular groups of criteria were more diverse. This may have resulted from different expectations, but also from users' previous experience of the currently available applications. In addition, it was claimed that website authors overload websites with information that is of secondary importance to customers, making it difficult for them to access crucial information. Some of the changes focused primarily on improving the aesthetics and visual attractiveness of the webpages. Moreover, some mobile apps are not fully developed and updated on an ongoing basis. In addition, users noted that subsequent modifications in the developed applications do not necessarily lead to an increase in the usability of the services.

**Keywords:** public transport, usability, application

### 1. INTRODUCTION

The considerable use of computers has resulted in an increased interest in the issues of human-computer interaction (HCI). The term has been used since the 1980s and is now defined as “a field of science that studies the design and use of computer

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technology” and concentrates “on interfaces between people and computers and how to design, evaluate, and implement interactive computer systems that satisfy the user” (HCI, 2020). HCI combines a series of processes and activities carried out by a human to perform a specific task and communicate with a computer. Communication is two-way and consists of entering data as well as getting feedback via the user interface. The development of websites and then web applications has made them an important object of research within HCI. The same was true when mobile devices became widespread.

In recent years, there seems to have been a more prominent development of mobile technologies compared to websites. However, in many applications both tools are used in parallel at the same time. The use of a specific tool depends on many factors, including where one is located, access to the device and convenience of use. In addition, access via mobile devices makes it possible to search for the information one needs in places where using a computer is difficult or even impossible. It is also common to choose a smartphone over a computer as it is always ready for use. In addition, regardless of the choice of device, thanks to the constant development of mobile network infrastructure, we can access the Internet almost anywhere.

Internet services are becoming progressively more developed and give more and more opportunities for web applications. In many cases, it is also possible to use databases or automatically updating data based on information from devices or measuring instruments, where human intervention is not necessary or could cause a delay in providing the information. This also applies to tracking the location of objects in real time.

Mobile applications and websites for public transport customers are also being developed. Originally, information on scheduled routes was placed on websites in a form similar to that posted at stops. Mobile applications initially developed in the same direction. They mainly contained information about the routes of individual lines, as well as stops and departure times. An Internet connection was used by the applications to display advertisements rather than news about the services of public transport. Applications for finding the most favorable connection were based on a static database of departures and travel times on individual routes.

The use of the long-known vehicle tracking technology to disclose the location of a means of transport has significantly increased the possibilities of enhancing the functionality of applications and websites prepared for public transport operators. Since tracking requires real time data updates, the importance of a continuous and steady connection to the Internet has grown and, as a result, the use of mobile devices has increased. It is also possible to search for alternative routes or means of transport, taking into account the current location of vehicles and their expected arrival at a specific stop.

Increased functionality encourages more and more people to use websites and applications created specifically for mobile devices. However, the use of websites and mobile applications is not always easy and intuitive. The various levels of the



technological literacy of potential users, as well as limitations relating to their disabilities and older age, should in turn force the adaptation of websites to varied needs. One crucial aspect of such adaptation is how information is presented and user expectations are important in the shaping of this.

The aim of this article is to analyze the usability of websites and applications intended for public transport users. The research was conducted using the agglomeration of Poznan as an example, although some applications for mobile devices can be used in many locations. Therefore, it should be emphasized that the research is a case study.

The authors had previously analyzed websites relating to public transport in the Poznan agglomeration, but at that time monitoring of the location of public transport vehicles was not available. The new possibilities did not have a significant impact on the basic websites of operators, but there was a development of applications for mobile devices using the new technology. It was decided that research would be continued in relation to websites but this would be supplemented with applications for mobile devices.

The article presents the results of usability studies based on user assessment employing a model developed during a previous study. These assessments were supplemented by interviews with users conducted after the survey. The purpose of the research was to discover whether the analyzed websites and mobile applications met the needs of the users. The conclusions of the research were based on the opinion of the surveyed users with regard to easiness of use, comprehension, integrity, adequateness, using fastness, self-descriptiveness, ease learning of use, accessibility, error tolerance, usefulness and aesthetics.

## 2. USABILITY

### 2.1. Usability definitions

Human Computer Design, as mentioned earlier, is the study of the interaction between humans and computers. “HCI overlaps user-centered design, UI, and UX to create intuitive products and technologies” (Fawcett, 2021).

In the literature, the word ‘usability’ is often used interchangeably with the terms ‘quality in use’ or ‘ergonomic quality’. Jacob Nielsen contributed to the popularization of the term usability. Nielsen (1993; 2012) defines usability as “a quality attribute that assesses how easy user interfaces are to use”. Usability is the sum of product characteristics that make software efficient, understandable, and easy to learn and use”.

Another well-known definition is the one contained in the international standard ISO 9241. According to this definition, usable quality is “effectiveness, efficiency



and satisfaction with which specified users achieve specified goals in particular environments” (ISO 9241-210, 2019).

Other authors also equate usability with ease of learning, effectiveness in use and providing a pleasant experience to the user (compare with Preece et al., 2002) and (Bevan, 1999). More recent definitions do not contribute significantly to the meaning of usability. In any case, elementary components are analyzed and tested to evaluate usability (compare with Hankiewicz & Prussak, 2007).

When analyzing usability, the fact that users have previously used visited other websites and applications and have had diverse experiences is not taken into account. It differs from User Experience, which can be defined as “the experience the product creates for the people who use it in the real world” (Garrett, 2011). The ISO 9241-210 standard also defines User Experience as a “person’s perceptions and responses resulting from the use and/or anticipated use of a product, system or service” (ISO 9241-210, 2019).

Thus, User Experience is a broader concept than usability (Norman and Nielsen, 2021). The term also describes what happens when using a product and how it affects the user’s feelings and emotions.

Furthermore, it can be observed that the development of web application evaluation is moving towards the evaluation of Actual Usability and Actual User Experience. Relationships between Quality in Use, Actual Usability, and Actual User Experience are presented by Lew, Olsina and Zhang (2010). However, the use of many concepts with a similar meaning and, for many, hard-to-see differences can displace the term usability from common awareness.

## 2.2. Usability evaluation

The following methods dominate website research:

- expert tests carried out in the form of heuristic evaluation (Nielsen, 2000),
- inspection and reviews using checklists conducted to verify the degree of compliance with the requirements contained in the list; this activity is increasingly referred to as an audit (Hollingsed & Novick, 2007),
- comparison, allowing the selection of a solution from several alternatives or checking whether the modernization of the website has brought the expected results (Sikorski, 2010).

Each of these methods, of course, has its advantages and disadvantages. It may also be the preferred method in certain situations.

User evaluation for websites and, in the case of pre-tests, potential users is usually highly valued. However, in this case, the number of users participating in such evaluations is not a decisive factor, but rather the precision in formulating assessments (compare with Krug, 2013). Good results can be achieved if the evaluation process is preceded by the users’ performance of specific tasks relating to the basic functionality of the website being tested (compare with Hankiewicz & Prussak, 2007).



In some cases, the methods may be combined with each other. For example, a comparative study can be performed by both experts and users. In any case, the research process should be well thought out to minimize the element of randomness. An example here may be a relatively precise comparative method, where the order in which pages are evaluated by the user may influence the results obtained (Hankiewicz & Prussak, 2007). To illustrate the basic evaluated components, the usability and quality in use website evaluation model is presented (Figure 1).

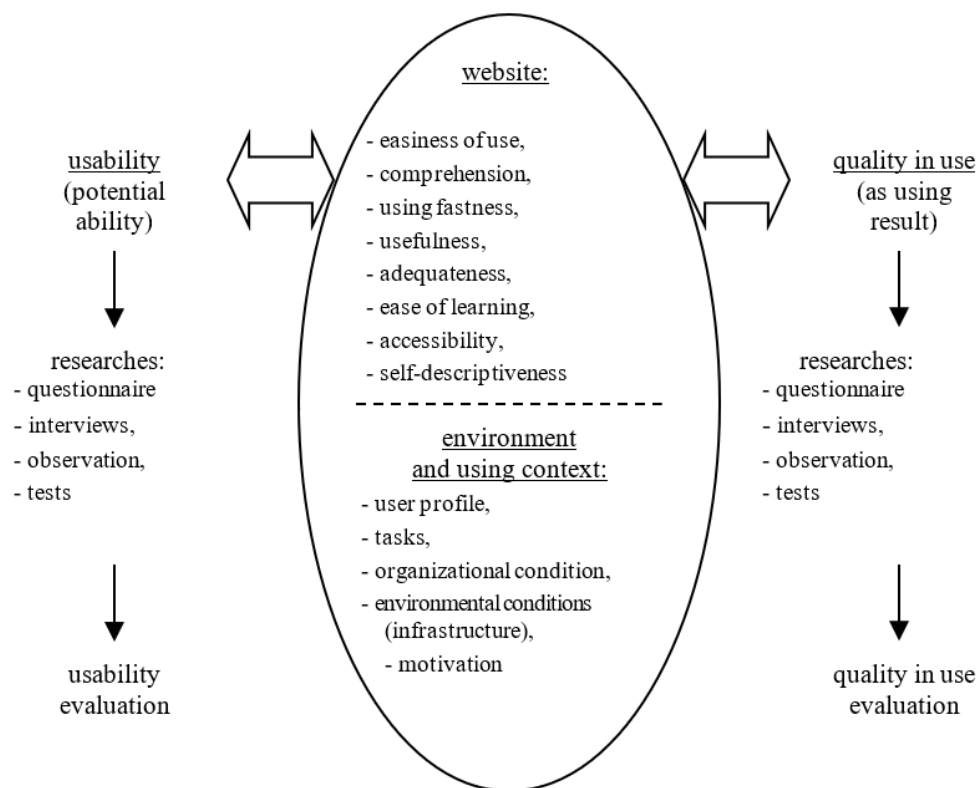


Fig. 1. Usability and quality in use website evaluation model (Prussak & Hankiewicz, 2008)

Even when using a reliable user assessment, the needs of the elderly, people with disabilities and those with certain health conditions may not be taken into account. Therefore, it is worth adapting to WCAG 2.0 (Web Content Accessibility Guidelines), i.e. guidelines on facilitating access to content published on the Internet (WCAG, 2018).

Applications for mobile devices used for public transport do not differ significantly from those used for other purposes. However, it is worth mentioning some examples of how to test analogous applications. A typical approach is for users to perform specific tasks. However, the methods of assessment are more diverse. For example, in research carried out at Aachen University (Habermann et al., 2016), the data was assessed descriptively. The report included ease of navigation and outcomes on the perceived interface quality. In order to correctly assess the usability of web and mobile applications, a wide variety of methods can be used. One such method could be the usage of software evaluation tests conducted with the think-aloud method (Schäfer et al., 2021). The most commonly employed usability metrics for public transport applications are: satisfaction (top of the list), followed by ease of use and efficiency, and then learnability. At the end of the list is usefulness, errors occurring during use, accuracy and consistency (Hussain et al., 2017).

### 3. RESEARCH

#### 3.1. Research methodology

User evaluation was the basic way of analyzing both the website and the applications for mobile devices. 120 people young people aged 18 to 25 participated in the study. The research method consisted of a usability assessment based on a previously developed hierarchical structure (compare Hankiewicz & Prussak, 2007). According to this method, the superior criterion – usability – is subordinated to group criteria, comprising elementary criteria. Therefore, fulfillment of the elementary requirements affects fulfillment of the group criterion.

The list of group criteria in the form of the following features was retained, consistent with previous research (Hankiewicz & Prussak 2007) (Hankiewicz & Lasota, 2015):

- easiness of use,
- self-descriptiveness,
- ease learning of use,
- usefulness,
- aesthetics,
- using fastness,
- integrity,
- accessibility,
- comprehension,
- error tolerance,
- adequateness.





Fig. 2. Hierarchic model of website usability (Hankiewicz & Prussak, 2007)

Figure 2 shows the hierarchical model of website usability used in the research. In the survey version, the elementary criteria visible on the right took the form of questions that the users answered. For example, for the group criterion easiness of use, the list of questions was as follows:

- Is the website easy to navigate?
- Is the site too complex?
- Is the page legible, taking into account the size of the characters, the typeface, etc.?

- Does the graphic diversity of the website help in its use?
- Can the page be adjusted to your needs?

The respondents were selected from the group of people who use the selected website and mobile applications.

### 3.2. Research results

A summary of the evaluation results for individual group criteria for the mpk.poznan.pl website, which is the official website of the public transport operator in Poznan, is presented in Figure 3. Based on these results, it can be concluded that relatively good results were obtained for Easiness of use, Integrity and Ease learning of use, and weak for Accessibility, Using fastness, Self-descriptiveness and Error tolerance. A certain discrepancy in the answers obtained confirmed the different expectations of users, as well as minor variation in the understanding of the elementary questions. An example is the difficulty in interpreting questions regarding the Error tolerance category, which was confirmed in the interviews. The problem was that the choices made when using the surveyed website were not of a transactional nature, so there was no need to undo user choices. Therefore, it is worth noting that questionnaire research should be verified by collecting comments from the respondents.

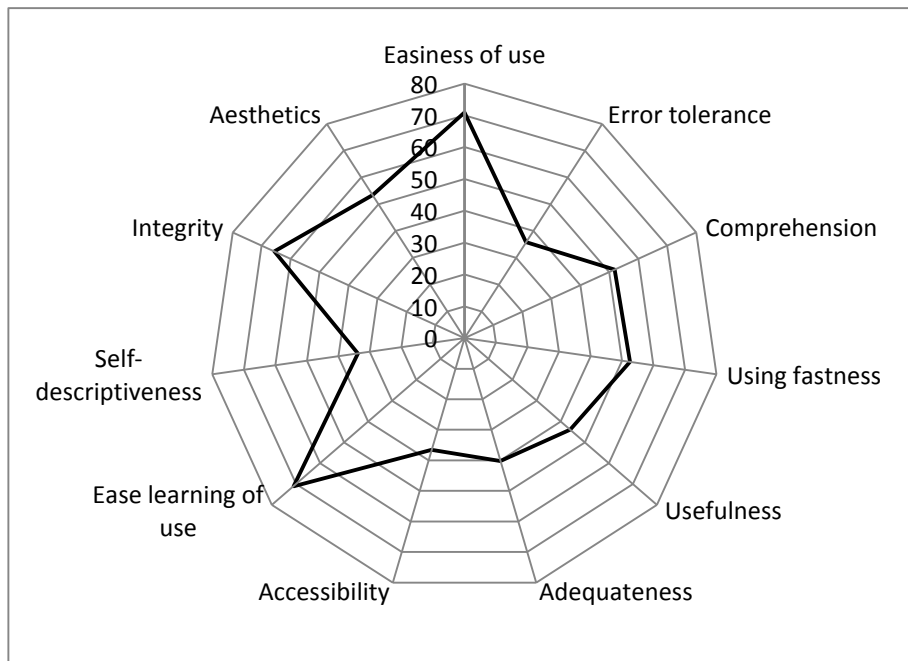


Fig. 3. Results for mpk.poznan.pl WEB service evaluation (authors' own elaboration)



After the assessments were made based on the questions concerning the elementary criteria, interviews with the users were carried out. The following comments were dominant among the comments concerning the examined website:

- news updates interfere with using the basic functions of the website,
- irritating (aggressive) colors,
- bright colors,
- the page is dominated by a slideshow, which is not important for the functionality of the page,
- illegible and disordered page organization,
- trouble finding the timetable, which is the most important part of the website,
- no monitoring of the location of vehicles directly on the site.

Summarizing the above comments of the users, it can be said that most of the imperfections could be improved with a minor correction of the website. This is the case when changing colors and changing the proportions between the presented content. The link to the timetable could also be easily highlighted. On the other hand, “unclear and disorderly organization of the page” requires a more thorough analysis. The lack of vehicle position monitoring could be solved by linking to an external service.

The second part of the research was to analyze the applications for mobile devices. This was particularly important due to the possibility of tracking the location of the means of transport in real time. The advantages of this system are visible when we can check this position anywhere.

Two mobile applications “czynczas” (Figure 4) and “Gdzie ta bimba” (Figure 5) were selected for the study. The selection was based on the popularity of the applications within the research group.

The main features of the “czynczas” application are:

- a vehicle location map,
- the ability to select a stop on the map,
- the ability to select a vehicle on the map,
- the ability to search for stops and vehicles,
- real-time notifications regarding the functioning of public transport,
- a virtual version of the dynamic timetable,
- detailed information about the vehicle.

The evaluation of the applications for mobile devices was carried out based on the same method. The results obtained seem to be less unambiguous compared to those obtained for the website.

For the “czynczas” application, a very good result was obtained for the Aesthetics category and good results for Self-descriptiveness, Ease learning of use, Usefulness and Easiness of use. The worst result was obtained for the Accessibility category. Other categories received average marks.

On the other hand, the results from the application “Gdzie ta bimba” were surprising due to the evenly distributed average ratings in most categories. Slightly higher scores were found for Ease learning of use, Easiness of use and Usefulness. Accessibility and Adequateness were the weakest.



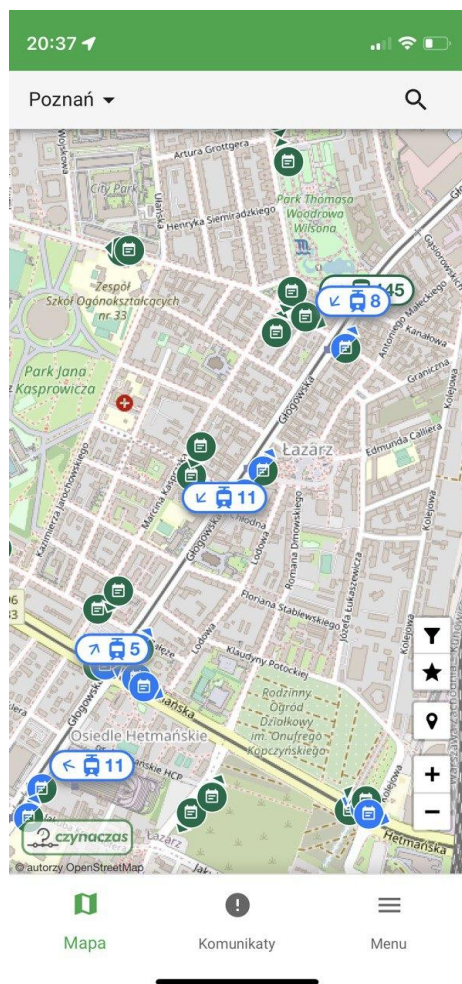


Fig. 4. An example screenshot of the „czynczas” application (authors’ own elaboration)



Fig. 5. An example screenshot of the „Gdzie ta bimba” application (authors’ own elaboration)

In the case of both the evaluated applications, the users pointed to their limited functionality. This made it difficult to make such an accurate assessment. In the interviews, it was found that both applications correctly fulfilled the basic function – they gave information regarding the location of the public transport vehicle. However, the color composition for the application “Gdzie ta bimba” was assessed negatively.

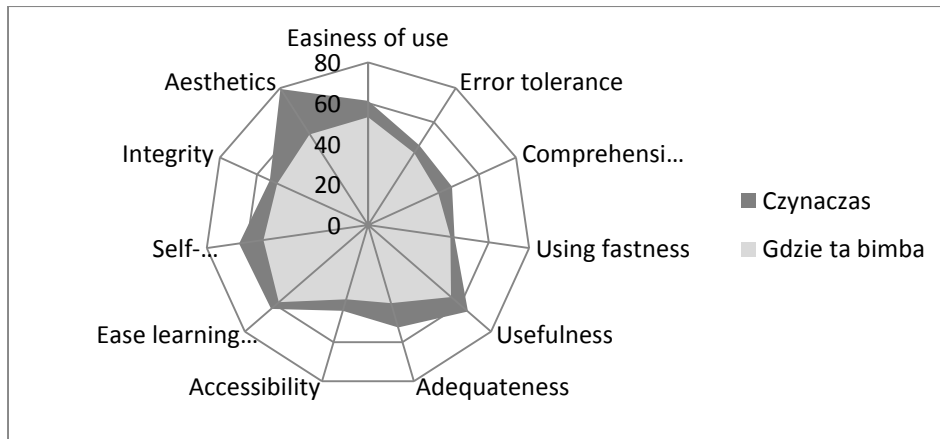


Fig. 6. Results for mobile application evaluation (authors' own elaboration)

The need to answer so many questions in the survey might be considered burdensome to some extent, but it was meant to be used as a basis for analyzing the features of the website and the applications for mobile devices. The opinions formulated after completing the questionnaire may be considered very valuable, because they took into account more aspects than those that were formulated at the beginning. Usually, these opinions are not appreciated by researchers.

#### 4. CONCLUSIONS

Analysis of the features of public transport services that determine their efficient use when searching for necessary information seems to be crucial for their improvement. To sum up, it can be said that although it is difficult to list all the features that determine the usability of these websites, it is certainly possible to distinguish a certain set of key characteristics.

Based on observations and research, it can be concluded that some websites are overloaded with information that is not adequate to the needs of public transport users. These include, among others, information about employment offered by transport companies. The shortage of employees means that information about employment opportunities dominates the presented websites. This sometimes makes it difficult to access relevant information, therefore, it might be advisable to separate the job offers section in some way within the site.

In the case of applications for mobile devices, especially those of a commercial nature, advertisements become a problem when they obscure informational elements. Such a situation was observed in the free version of the application in this study, probably in order to persuade the user to purchase its full version. However, in the research group there was no interest in purchasing the application, the functionality and usability of which was difficult to assess.

It was also observed that subsequent modifications of websites and applications often lead to an improvement in visual attractiveness without increasing the quality of use. In such cases, the first impression of users is positive, but long-term use reveals their shortcomings. User comments should be taken into consideration by website and application development teams more often than they are at the moment.

An analysis of the characteristics of websites and applications for mobile devices relating to public transportation systems enables selection of the right tool for users' needs. However, their efficient operation when searching for necessary information seems to be crucial. The obtained results indicated the strengths and weaknesses of the websites and applications for mobile devices, providing the opportunity for further improvement.

Summarizing the research results presented in the previous chapter, it should be stated that the level at which users' expectations were met differed for individual criteria. Nevertheless, it can be concluded that the tested applications met the needs of the users. It should be noted that since applications for mobile devices compete with each other, their improvement is important for retaining existing users, as well as attracting new ones.

Due to the real-time nature of public transport data, it is expected that the number of users of applications for mobile devices will increase. So, too, will the number of older users and users with disabilities, for whom minor imperfections in the quality of use, noticed by able-bodied users, may be a significant barrier.

For these reasons, it is necessary to conduct further research, taking into account people of different ages and with different disabilities.

## LITERATURE

- Bevan, N. (1999). Quality in use: Meeting user needs for quality. *The Journal of Systems and Software*, 49, 89-96.
- Fawcett, A. (2021). *Introduction to Human-Computer Interaction & Design Principles*. Retrieved from <https://www.educative.io/blog/intro-human-computer-interaction>.
- Garrett, J.J. (2011). *The Elements of User Experience: User-centered Design for the Web and Beyond*. Berkeley, CA: New Riders.
- Habermann, A.L., Kasugai, K., Ziefle, M. (2016). Mobile App for Public Transport: A Usability and User Experience Perspective. In: B. Mandler et al., *Internet of Things. IoT Infrastructures. IoT360 2015. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering*, vol 170. Cham: Springer.



- Hankiewicz, K., Lasota, A.M. (2015). Cechy determinujące jakość użytkową serwisu internetowego przeznaczonego dla klientów transportu publicznego. *Logistyka*, 3, 5670-5673.
- Hankiewicz, K., Prussak, W. (2007). Quality in Use Evaluation of Business Websites. In: L.M. Pacholski, S. Trzcieliński (eds.). *Ergonomics in Contemporary Enterprise*. Madison: IEA Press, 84-91.
- Hollingsed, T., Novick, D.G. (2007). *Usability Inspection Methods after 15 Years of Research and Practice. Proceeding SIGDOC '07. Proceedings of the 25th annual ACM international conference on Design of communication*. New York: ACM Press, 249-255.
- Human-Computer Interaction: What Is It, Why Does It Matter & Best Practices* (2020). Retrieved from <https://exaud.com/human-computer-interaction/>.
- Hussain, A., Mkpojiogu, E., Jasin, N. (2017). Usability metrics and methods for public transportation applications: A systematic review. *Journal of Engineering Science and Technology*, 4, 94-102.
- ISO 9241-210, (2019). *Ergonomics of human-system interaction – Part 210: Human-centred design for interactive systems*.
- Krug, S. (2013). *Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability*. New Riders.
- Nielsen, J. (1993). *Usability Engineering*. New York: Academic Press.
- Nielsen, J. (2000). *Designing Web Usability*. New Riders Publications Div of Pearson.
- Nielsen, J. (2012). *Usability 101: Introduction to Usability, Nielsen Norman Group*. Retrieved from <https://www.nngroup.com/articles/usability-101-introduction-to-usability/>.
- Norman, D., Nielsen, J. (2021). *The Definition of User Experience (UX)*. Retrieved from <https://www.nngroup.com/articles/definition-user-experience>.
- Preece, J., Rogers, Y., Sharp, H. (2002). *Interaction design: beyond human-computer interaction*. New York: John Wiley & Sons.
- Prussak, W., Hankiewicz, K. (2008). *Application of QFD Method in Designing of Website, AHFE 2008 Conference Proceedings – DVD*.
- Schäfer, G., Kreisel, A., Stopka, U. (2021). Usability Study of an Innovative Application in Public Transport by Using Hardware-Based Security Technology. In: H. Krömker (ed.), *HCI in Mobility, Transport, and Automotive Systems. HCII 2021. Lecture Notes in Computer Science*, vol. 12791. Cham: Springer.
- Sikorski, M. (2010). *Interakcja człowiek – komputer*. Warszawa: Wydawnictwo PJWSTK.
- Web Content Accessibility Guidelines (WCAG) 2.1, (2018). Retrieved from <http://www.w3.org/TR/WCAG>.

## UŻYTECZNOŚĆ APLIKACJI DLA KLIENTÓW POZNAŃSKIEGO TRANSPORTU MIEJSKIEGO

### Streszczenie

W artykule przedstawiono oczekiwania i potrzeby klientów miejskiego transportu zbiorowego w zakresie uzyskania aktualnej informacji o możliwości dotarcia do określonego celu za pomocą dostępnych środków transportu publicznego. Głównym celem artykułu jest analiza użyteczności stron internetowych i aplikacji dla klientów komunikacji miejskiej. Badania



miały formę studium przypadku i ograniczały się do aglomeracji poznańskiej. Do oceny satysfakcji klientów wybrano zarówno badania heurystyczne, jak i badania ankietowe. Pod uwagę wzięto strony internetowe i aplikacje mobilne, ponieważ użytkownicy mogli wybrać jedną z nich w celu uzyskania informacji o systemach transportu publicznego. Badania przeprowadzono w oparciu o model użyteczności uwzględniający kryteria grupowe i elementarne. W porównaniu do poprzednich badań można stwierdzić, że oceny użytkowników poszczególnych grup kryteriów są bardziej zróżnicowane. Może to wynikać z odmiennych oczekiwań, ale także z wcześniejszych doświadczeń w korzystaniu z aktualnie dostępnych aplikacji. Ponadto stwierdzono, że twórcy serwisów przeładują je informacjami, które dla klientów mają drugorzędne znaczenie, utrudniając im dostęp do istotnych informacji. Część zmian skupia się przede wszystkim na poprawie estetyki i atrakcyjności wizualnej stron. Ponadto niektóre aplikacje mobilne nie są jeszcze dopracowane i na bieżąco aktualizowane. Należy też dodać, że użytkownicy zauważają, że późniejsze modyfikacje w tworzonych aplikacjach nie prowadzą zwykle do wzrostu użyteczności usług.

**Słowa kluczowe:** transport publiczny, użyteczność, aplikacje

