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CUSTOMER REQUIREMENTS FOR AIRPORT MOBILE APPLICATIONS

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Abstract

Digital technologies are increasingly entering into the day-to-day life of everyone. It is possible to observe it in every area, and air transport is no exception. In the context of the digital transformation of air transport, the potential is tremendous, and enterprises in air transport are being forced to constantly introduce new digital technologies to keep up with the competition. The significant trend now is to carry all the information in the pocket - in the smartphone. Many airports around the world are introducing digital technologies into all processes in the airport environment, including the implementation of a mobile application. Competent representatives of many airports have understood that the introduction of modern services can motivate passengers to make more use of the airport and help increase attractiveness and improve the perception of the airport. The aim of this scientific article is to identify requirements of passengers and their expectations from the airport mobile application.

Keywords

airport, mobile application, digital transformation, customer requirements, smart solutions, airport operations

1. Introduction

Digital transformation is the integration of digital technology into all areas of business, which fundamentally changes the way we work and brings value to customers (Siebel,2019). It is also a cultural change that requires organizations to constantly question the current situation and to experiment (Siebel, 2019). Digital transformation is the profound transformation of business and organizational activities, processes, competencies and models to take full advantage of the changes and opportunities of digital technologies and their accelerating impact on society in a strategic and priority way with regard to current and future changes (Iscoop, 2019).

The aviation industry has been at the forefront of the digital transformation since the digital revolution began in 1995 (Burbaite, 2019). Companies around the world are increasingly realizing that the key to unlocking the full potential of the aviation market is not only embracing the digital transformation, but also remaining at the forefront of this development by offering breakthrough solutions based on new forms of digital technology (Valdes et al., 2018).

The aim of airlines and airports is to develop a transformation program that will be closely linked to operations (Valdes et al., 2018). One of the new concepts that can revolutionize ground operations and air traffic is the Internet of Things. Internet-based devices, which will become the standard for increasing customer satisfaction, are gradually seeing growth in the aerospace industry with aircraft data management, scanners, electronic tags and many other applications (Kazda et al., 2013).

1.1. Smart Airport

As a result of the Fourth Industrial Revolution, the concept of smart airports has evolved around the world, eliminating the shortcomings of the conventional airport system (Veber, 2018).

Airport 4.0 can be defined as a concept that uses big data and open data to improve its own innovation (Rajapaksha & Jayasuriya, 2020). At these airports, operators create value for operational efficiency by collecting real-time passenger flow data when analysing the passenger profile (Materna et al., 2020). The Internet of Things creates an environment for interaction with various smart devices, and this approach generates many new applications in various areas, such as the environment, health, smart cities and industry (Novák Sedláčková & Remencová, 2021).

The definition of Smart Airport is related to the definition of Smart City. Smart cities use technology for urban life to create a more comfortable and sustainable environment (Bouyakoub et al., 2017). Smart Airport is a subsystem of a specific smart city (Rajapaksha & Jayasuriya, 2020). The system combines city life and aircraft movements. Information is seamlessly exchanged between urban traffic management, suburban traffic management and air traffic management (Mrňa et al., 2021). This connection is intended to achieve the optimization of individual processes and operations of the airport, as well as customer satisfaction (Nagy & Csiszar, 2016).

1.2. Airport mobile application

One of the solutions that can be implemented within the Smart Airport concept is an airport application for mobile devices (Rajapaksha & Jayasuriya, 2020).

Passengers can have information regarding airport services available through mobile applications. In general, the Smart Airport experience begins 48 hours before departure. After entering the details of the itinerary, the application will start working and help the passenger with all available functions. The main options of the smart airport mobile application are activated by route details, such as picking up a passenger's

luggage from anywhere. Passengers then do not have to take their luggage to the airport. Thanks to the smart application, the passenger can contact the carrier and his luggage will be picked up from the house and arrive at the airport on time. The passenger will receive ongoing information and reminders about the flight status (Nagy & Csiszar, 2016).

The Google Indoor map will help with the walk in the terminal with instructions for navigating within the terminal (Rajapaksha & Jayasuriya, 2020). When a passenger obtains a boarding pass, he can change his seat according to his preferences. After unloading the luggage, the passenger's guide guides through other formalities, such as a security check. If they have sufficient time to board, passengers can receive special duty-free trade promotions on their mobile phones as a promotional tool to improve airport revenues. Furthermore, this application shows restaurants, toilets, smoking areas, lounges and other facilities that are available during their waiting time. All relevant public announcements come to the mobile phone in the form of both voice and / or text. When the aircraft is ready to board, the passenger should scan the boarding pass at the gate and the RFID scanning device will open the gate on board as well as the boarding bridge to the aircraft door (Nagy & Csiszar, 2016).

2. Analysis of the level of digital transformation of selected European Union countries

Three evaluation indices were selected for the analysis of the level of digital transformation: Network Readiness Index, Global Innovation Index and Digital Economy and Society Index (DESI Index). Each of the indices evaluates various areas of digitization of the evaluated country, thus creating a comprehensive picture of its current state. Based on the geographical point of view, the neighbouring countries of Slovakia were selected: the Czech Republic, Hungary, Poland and Austria.

2.1. Network Readiness Index 2020

The Network Readiness Index measures a country's ability to use upcoming information technology changes to increase its competitiveness and improve living standards in the country. It evaluates more than 60 indicators from the political, regulatory, innovative environment, through the readiness and availability of modern infrastructure, to their overall impact on the economic and social sphere (NRI, 2020).

The index has become one of the world's leading indices for the use of technology to develop and increase competitiveness. At the same time, it has been recognized as a global benchmark for assessing progress and readiness for technology deployment in countries around the world (NRI, 2020).
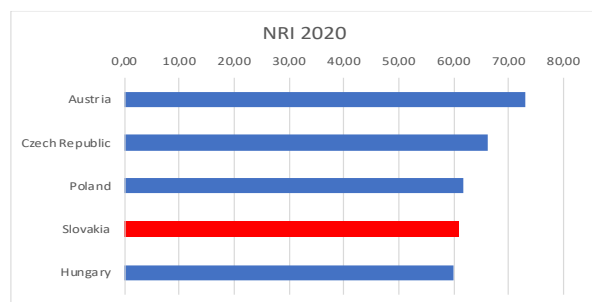

Figure 1: Network Readiness Index. Source: NRI (2020.)

Within the Network Readiness Index for 2020, Austria was leading among the selected countries, which is rated significantly better than the other 4 countries. Slovakia is in 4th place, but the differences between Poland and Hungary are minimal.

2.2. Global Innovation Index 2020

The Global Innovation Index helps to create an environment in which innovation factors are constantly evaluated. It provides detailed indicators of innovation for the economies of the evaluated countries. The Global Innovation Index total score is the average of the input and output sub-index scores (GII, 2020).

The input innovation sub-index consists of five pillars, which capture elements of the national economy and enable innovative activities. The pillars include institutions, human capital and research, infrastructure, market sophistication and business complexity (GII, 2020). The sub-index of innovation outputs provides information on the outputs that result from innovation activities within economies. There are two output pillars, knowledge and technological outputs and creative outputs (GII, 2020).
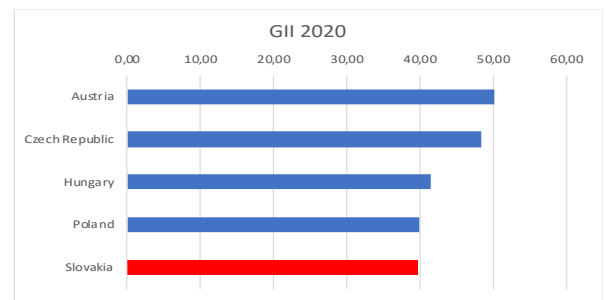

Figure 2: Global Innovation Index. Source: GI (2020).

The Global Innovation Index for 2020 also confirms the high level of digitization in Austria. Slovakia was rated the lowest score among the evaluated countries, but the shortage on Poland or Hungary is minimal, which indicates a very similar situation in each of the countries in the field of innovation.

2.3. DESI Index 2020

The DESI index is a tool for monitoring the state of digitization in European Union countries. It consists of five core areas, including internet connectivity, human capital, the use of internet services, the integration of digital technologies and digital public services. Together, the index evaluates more than 40 diverse indicators in the field of digitization (DESI, 2020).
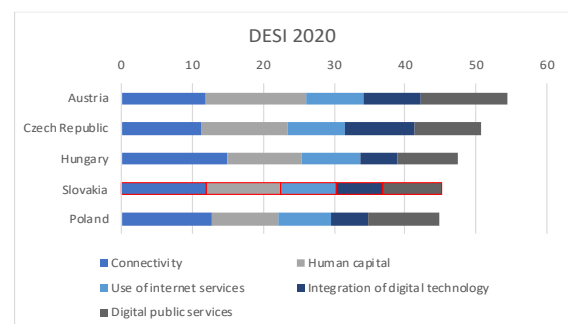

Figure 3: DESI Index. Source: DESI (2020).

As in the previous two indices, Austria achieved the highest overall score within the DESI index, followed by the Czech Republic. Of the selected countries, only Poland has a weaker result than Slovakia.

Based on the performed analysis, it was found that Slovakia lags behind other evaluated values due to valuable aspects. Therefore, it is possible that Slovakia still has reserves in the field of digital transformation, and therefore it is necessary for Slovakia to constantly improve in the field of digitization, bring innovative solutions and make full use of the potential of digital technologies.

3. Competitive analysis of Košice Airport

Košice International Airport is an international airport in Košice. It is the second largest airport in Slovakia according to the number of transported passengers and regular flights (Airport Košice, 2021).

For the needs of the competitive analysis of Košice Airport, airports from the analysed countries were selected. The reason for choosing these countries is the geographical location, as they are neighbouring states of Slovakia. Selected airports are important hubs for air transport in Slovakia. For selected airports, it will be analysed whether they have a mobile airport application, and then the individual functions available in the application.

3.1. Airport Košice

At present, Košice Airport has not created its own airport application for mobile devices. Only a web application is available to customers, which is accessible via a web browser, but it is not possible to download this application to the end device. The web application does not meet all the requirements of users and does not have the functionality as an application of competing airports.
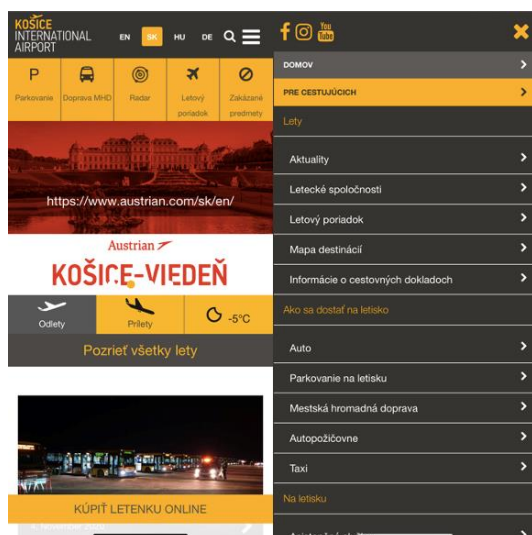

Figure 4: Web application Airport Košice. Source: Airport Košice (2021).

As part of the smart airport concept, it would be appropriate to design and create an airport application for mobile devices. The application could increase the level of digital transformation of the airport and could help increase the attractiveness of the

airport for customers, which could result in an increase in the number of passengers carried, and thus increase the profitability of the airport.

3.2. Airport Bratislava

Bratislava Airport and Košice Airport are the two largest Slovak airports. However, like Košice Airport, Bratislava Airport has not created its own mobile application for smart devices, and therefore Bratislava Airport will not be rated.

3.3. Airport Praha

The airport has created its own mobile application, which is available for all Android and iOS devices. The application offers the option of adding a passenger flight in two ways: by scanning the barcode from the boarding pass or by selecting a flight from the scheduled flights displayed in the application. Subsequently, the passenger has all the information about his flight on a smartphone and will be informed of any changes in the form of notifications. In addition, the application is largely informative. The passenger can read instructions and information about the check-in of the passenger or luggage, what restaurants and cafes are available at the airport, as well as their opening hours. The same goes for shops and services. In the next section, the user will find information about parking options at the airport with hyperlinks to the reservation page. There is also an overview of bus and train connections with the airport, as well as a Taxi offer. Answers to frequently asked questions are also available. The application also has a built-in Google map, from which it is possible to navigate to the destination. The last section is all important contact details for the company's management and its address. There is also a form to report the problem directly from the application. The application is only available in English (Prague Airport, 2021).
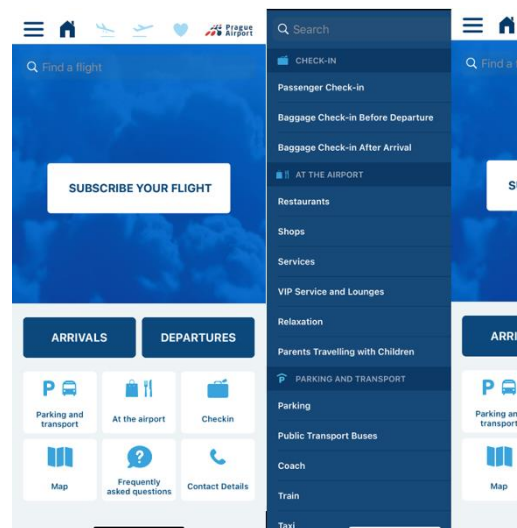

Figure 5: Prague Airport mobile application. Source: Prague Airport (2021).

3.4. Airport Vienna

Vienna Airport offers passengers its own mobile application, which can be downloaded to either iOS or Android devices. It offers the possibility to monitor the flight status of a passenger, who can add it to their flights either by selecting a specific flight

from the scheduled flights or by uploading a QR or ticket barcode. The passenger thus receives notifications of changes in flight status in real time to his smart device in the form of notifications. The application also offers the possibility to add the position of his parked vehicle in the parking lot, where it is also possible to add a photo of the vehicle with the exact position. The application also offers an interesting option, a travel list, where the passenger can check if he has not forgotten any of the necessary things needed for his trip. In the application it is also possible to find a map of the airport, within which it is possible to search for a specific restaurant, shop or gate. There is also a list of all available shops, restaurants and services located at the airport. The next section shows information for people coming to and from the airport, in which all transport options are described in more detail, such as car, bus, train, taxi. All available connections are displayed in real time. There is also a separate section for parking lots, where the number of free spaces is displayed, and after clicking on a specific area of the parking lot, the application can navigate the user to this location and calculate the price for parking after entering the time of arrival and departure. There is also a link to the airport's website, an overview of the notifications received and basic information about the application and the company as such. The application is in English (Airport Vienna, 2021).
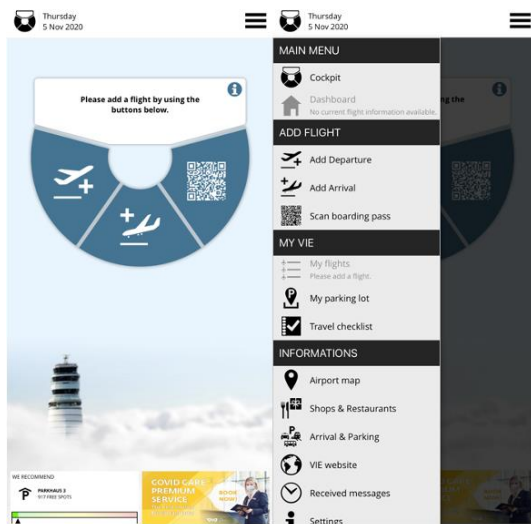

Figure 6: Airport Vienna mobile application. Source: Airport Vienna (2021).

3.5. Airport Budapest

Budapest Airport has its own application. The home screen displays current arrivals and departures. Clicking on one of the flights will display more detailed information about the flight, such as the terminal number and the airline and type of aircraft. Flight notifications are also available, which the user will mark as favourites. Furthermore, it is possible to find information in the application about the possibility of parking at the airport and also about access to and from the airport by bus, train or taxi. In the shopping tab, it is possible to view which shops, restaurants and services are located at the airport with their opening hours. There are also banners of the advertising nature of individual shops available at the airport. In following section, it is possible to find information about luggage, check-in or other important information related to the use of Budapest airport.
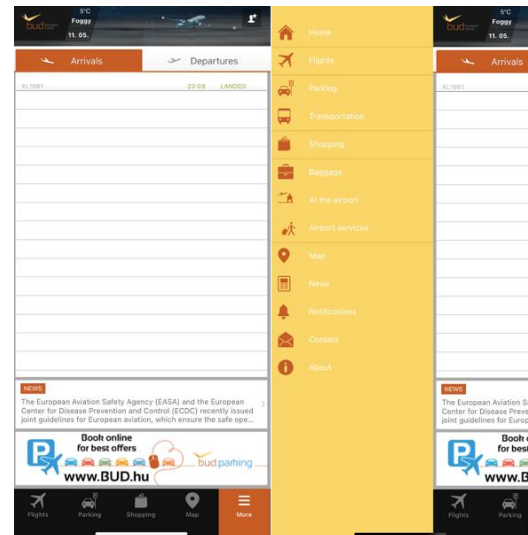

Figure 7: Airport Budapest mobile application. Source: Budapest Airport (2021).

An airport map is also available in the application with the option to view a specific store or service, but it is not possible to navigate. The application also has a news bulletin board where the user can find the latest information and articles published by the airport. The application contains also contact information together with a link to send feedback and basic information not only about the application but also about the airport. The application is only available in English (Budapest Airport, 2021).

3.6. Airport Krakow

Krakow Airport has also created its own application for mobile devices, which is available for iOS and Android operating systems. The home page displays the main menu, the current waiting time during the security check or the current time and weather. An overview of currently scheduled departures and arrivals is available, where after clicking on a specific flight, information about the flight number, aircraft type, check-in number and gate number will be displayed. There is also the option to add the flight to "my flights" and it displays information about the stage of preparation of the flight (baggage retrieval, check-in, gate opening and more). It is also possible to add a flight to the "my flights" list by entering the flight number. Furthermore, the Covid-19 section is available in the application, where after clicking the user will be redirected to the airport website to the Covid-19 section. There is also information on access to and from the airport by car, public road, train or taxi. The next section is a link to the Krakow Airport blog. The application also offers a plan / map of the airport with the possibility of starting navigation to a specific location. There is also information on the shops and services available at the airport. No less important features of the application include a direct link to the telephone numbers of the call centre, emergency services or information about the location of available defibrillators. The application is in English (Airport Krakow, 2021).

Figure 8: Airport Krakow mobile application. Source: Airport Krakow (2021).

3.7. Comparison of airport applications

Table 1 shows the resulting comparison of mobile applications of competing airports: Prague Airport, Vienna Airport, Budapest Airport and Krakow Airport.

Table 1: Comparison of mobile applications. Source: Author.

	Prague	Vienna	Budapest	Krakow
English language	Yes	Yes	Yes	Yes
More language options	No	No	No	No
iOS	Yes	Yes	Yes	Yes
Android	Yes	Yes	Yes	Yes
Information regarding arrivals	Yes	Yes	Yes	Yes
Information regarding departures	Yes	Yes	Yes	Yes
Add a flight by selecting from upcoming flights	Yes	Yes	Yes	Yes
Add a flight by scanning QR code	Yes	Yes	No	No
Flight status change notifications	Yes	Yes	Yes	Yes
Summary of notifications received	No	Yes	Yes	Yes
Information regarding check-in	Yes	No	Yes	No
Information regarding baggage	Yes	No	Yes	no
Restaurants	Yes	Yes	Yes	Yes
Shops	Yes	Yes	Yes	Yes
Services	Yes	Yes	Yes	Yes
Travel list	No	Yes	Yes	No
My parking space	No	Yes	No	No
Parking	Yes	Yes	Yes	Yes
Public bus transport	Yes	Yes	Yes	Yes
Public train transport	Yes	Yes	Yes	Yes
Taxi	Yes	Yes	Yes	Yes
FAQ	Yes	No	No	No
Map	Yes	Yes	Yes	Yes
Navigation	Yes	No	No	Yes
Contact info	Yes	No	Yes	No
Information regarding weather	No	No	No	Yes
Waiting time at security check	No	No	No	Yes
Quick contact for medical service	No	No	No	Yes
Defibrillator position information	No	No	No	Yes
Modern design	Yes	Yes	Yes	Yes
Clarity and comprehensibility	Yes	Yes	No	Yes

4. Analysis of the level of demand for the implementation of a mobile application for Košice Airport

As part of the previous focus on this issue, we conducted primary research, which focused on the level of demand for the implementation of applications of the Smart Airport concept at the airports in Bratislava and Košice. One of the research goals of the research was to find out which application of the Airport 4.0 concept would be most welcomed by the respondents at the airport in Košice.

The questions were answered by respondents who used Košice Airport at least once in the last 5 years. A total of 155 respondents answered the question. Table 2 shows the number of "Yes" answers for the individual applications of the Airport 4.0 concept and their percentage.

Table 2: Primary research findings. Source: Author.

Application	Yes	
	Amount	%
Self-boarding	96	16
Indoor navigation	62	10
Biometric services	88	14
RFID baggage tags	80	13
Autonomous baggage tags	105	17
Kiosk for lost baggage	67	11
Airport app for mobile devices	118	19
Total	616	100

Based on the evaluation of the respondents' answers, it was possible to assess that the respondents at the airport in Košice would most welcome the airport application for mobile devices, which represents 19% of all the answers counted. Therefore, it is possible to say on the basis of the research that the respondents would welcome the implementation of an airport application for mobile devices at the airport in Košice.

5. Methodology

5.1. CTQ Diagnostic Method

Within the diagnostic method CTQ, the general requirements of customers for quality are transformed into specific, measurable indicators. The main tool of the CTQ method is the creation of a CTQ tree, which shows the transformation of general customer requirements into specific measurable parameters. General requirements for the quality of a mobile application include technical parameters such as availability, functionality, clarity, security or price. The aim of the application of the method is to find out what quality the current web application for Košice Airport has from the point of view of users.

The first step was to create a CTQ tree with a defined passenger need, i.e., as found out through marketing research, respondents would welcome the creation of a mobile airport application that would be available for download directly to the

terminal rather than improving the current web application, which is only available through a web browser.

The second step was to compile the first level of the CTQ tree, which contains the general requirements of passengers for the mobile application. Furthermore, it was necessary to specify the requirements for the second and third level of the CTQ tree, which were obtained by a questionnaire from customers of Kosice Airport.

The third step was to create a questionnaire with such questions that it is possible to find out the real situation after answering them. Subsequently, it was necessary to define the target group, which are passengers who use Košice Airport and the airport's web application.

The fourth step is to calculate a sample to determine the number of respondents from whom it is necessary to obtain answers. The calculated sample size represents at least 384 respondents.

6. Results

The primary research was carried out in the form of an electronic inquiry through a questionnaire via the Google Forms website. Respondents were contacted via the social network - Facebook. The research results were processed in Microsoft Excel.

The comparison of customer requirements for the application with the actual measured parameters is expressed in the following table 3.

Table 3: Comparison of customers' requirements. Source: Author.

		Requirements		Current state
	Level 1	Level 2	Level 3	Website app
Creating mobile application	Availability	Multiple language options	min. 2	4
		Multiple operating systems	min. 2	3
		Price	max. 0€	0
		Multiple terminal devices	min. 2	3
	Clarity	Modern design	75% satisfaction	55%
		App guide	yes	no
		Responsive design	100% success	91%
	Functionality	Terminal battery consumption	max. 10%/hour	10-15%/hour
		Application stability	100% success	97%
		Number of available functions	min. 8	5
		Quick search	yes	yes
		Arrival information	yes	yes
		Departure information	yes	yes
		Option to mark favorite flight	yes	no
		Notification	yes	no
		Basic information about check in	yes	no
		Basic information about baggage	yes	yes
		List of restaurants, shops and services	yes	yes
		Parking information	yes	yes
		Public bus information	yes	yes
		Information on waiting time at the security check	yes	no
	Security	Request consent for the processing of personal data	yes	no
		The ability to create and log in to your own account	yes	no
		Number of login methods	min. 1	0
	Customer care	Frequency of feedback requests	1x/year	0
		Application update frequency	1x/month	0
	Speed	Response time	1 second	< 1 second
		Search time	2 seconds	< 1 second
		Subpage loading time	1 second	> 1 second

Within the availability, the CTQ method found that the application meets all 4 requirements. The web application is available in 4 languages, it can be accessed from more than 2 operating systems and also from more than 2 end devices. The web application is completely free, which was also a customer request.

In terms of application clarity, none of the three customer requirements listed are met. Only 55% of respondents are satisfied with the modernity of the application design,

responsive design was functional in only 91% of cases and, in addition, the application does not contain an application guide.

As part of the functionality of the application, it was found that the application consumes more than 5% of the battery of the terminal device than required by customers. Also, in 3% of cases, the application was not stable. According to the respondents, the total number of functions of the application is 5, while the request was at least 8 functions. Although the web application provides a quick search option, it displays information about arrivals and departures, but it is not possible to mark your flight by selecting from the displayed flights. The presence of notifications or basic information about check-in is also absent. Basic information about luggage, a list of restaurants, shops and services, and information about parking and public bus connections are available in the web application. However, the application does not provide information about the current waiting time at the security check.

In the security section, not a single customer requirement is met, because the web application not only does not require consent to the processing of personal data, but it is also not possible to create your own account and then log in to it.

As part of customer care, it was found that the web application never once offered respondents the opportunity for feedback on satisfaction with the application.

Regarding the speed of application, the CTQ method found that the application meets two of the three requirements. The unfulfilled request was only due to the loading speed of the web application subpages.

The current application offers an insufficient number of functions, it is not clear enough and the design is not modern enough. For example, the new application would provide customers with the ability to add their flight to a favourite so that the customer can later receive notifications of flight status changes (check-in information, gate number, delays, and more). This could make it easier and more pleasant for many passengers to travel through Košice Airport.

7. Conclusion

One of the aspects of increasing the attractiveness of the airport is the introduction of digital technologies, which bring new possibilities and opportunities. This paper is focused on customer requirements for airport mobile application; new airport application for mobile devices, which offers a wide range of functions, is clear and easy to use for all types of customers. The application offers from basic information about check-in, luggage, arrivals and departures through real-time notifications to the possibility of creating and logging in to the account or sending the feedback.

Based on the analysis of the digital transformation of selected European Union countries, it was found that Slovakia lags behind its 'neighbours' in each of the three rankings, and therefore it is essential for Slovakia to constantly introduce new innovations and solutions in the field of digitization, thus increasing the general level of digital transformation.

As result of the competitive analysis, it was found that the surrounding airports such as Prague, Vienna, Krakow and Budapest already have such an application. Although Košice

Airport has a web application, people prefer to use mobile applications over web applications.

Based on the research, which focused on the level of demand for the implementation of applications of the Airport 4.0 concept at the airport in Košice, it is possible to say that among the intelligent solutions, respondents would most welcome a mobile application.

After creating a new, high-quality, feature-packed application, it is possible to anticipate an increase in interest in traveling using Košice Airport, which could mean an increase in the number of passengers transported, increased profits and last but not least to the increased customer satisfaction. The recommendation is to create a mobile application, which is only the first of a whole range of intelligent solutions that would be appropriate to implement in the future at Košice Airport.

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