Chapter

Mapping Smart Mobility Technologies at Istanbul New Airport Using the Customer Journey

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"Any sufficiently advanced technology is indistinguishable from magic."
-Arthur C Clarke

Abstract

We are in an era in which urban populations exceed rural populations for the first time in history. Therefore, it is becoming more difficult to manage cities due to overcrowding. On the other hand, developing technology enables city administrations to benefit from citizens' data and serve them in smarter ways. A component of this management tool, smart mobility refers to beneficial technology that improves individuals' mobility. Technology is also an important tool for providing customer experiences in smart cities. This study is focused on Istanbul New Airport as a case for smart mobility in which various technologies are implemented to create memorable experiences for passengers. These experiences were mapped with a strategic management tool, customer journey mapping (CJM), which is increasingly popular with both academics and urban administration because it helps to identify customer touch points. Using this tool, passenger experiences are matched with technological applications, and some suggestions are provided based on customers' experiences.

Keywords: smart cities, smart mobility, customer experiences, customer journey, touch points, technology, innovation

1. Introduction

Today, 55% of the world's population lives in urban areas, and this proportion is expected to reach 68% by 2050 [1]. City governments face the challenge of producing wealth, innovation, health, and sustainability [2], but with an increase in urban populations, these challenges become harder for city governments to manage. For this reason, instead of continuing to use old-fashioned methods, some cities have applied updated, innovative methods to manage such issues in smarter ways [3], much as we do in our daily lives. We have moved from using "dumb" technologies (e.g., a road atlas or telephone) to interacting with "smart" technologies (e.g., personalized journey planning apps on smart phones) that "exist to help us, serve us, to make our lives easier and more interesting" [4].

As internationalization has become a widely discussed topic in recent years [5], the problem of overcrowding of cities is considered a global issue, and smart city applications have spread rapidly worldwide [2]. These applications not only enable city governments to facilitate the routine functions of individuals, buildings, and traffic systems but also enable them to monitor, understand, analyze, and plan cities to improve their efficiency, equity, and quality of life in real time [6]. The concept "smart," therefore, means the ability to manage the complexity through Big Data, which comes from a variety of sources in a huge volume and in a rapid way. As an example, in their daily lives, individuals check their social media accounts from mobile devices and share or like posts. They also read personalized news and check traffic jams. They then check their e-mail when they arrive at their offices. At lunchtime, they order food using online applications, and they watch personalized videos during free time. In other words, individuals produce a great deal of personal data and consume many more services based on that data. Thus, they also desire cities that support this lifestyle [7].

For instance, in Milton Keynes, a large town in the middle of England, the rapid expansion of the Internet together with young and technically inclined population gave rise to the concept of "smart cities." This included the application of technology, especially Big Data principles, to improve residents' quality of life. Such applications ranged from waste management to public transportation [8]. Now, many more cities, such as London, Stockholm, Amsterdam, Vienna, Luxembourg, Turku, Eindhoven, and Montpellier, have adopted a "smart" approach. The smart city theme also provides a city more stable and higher brand equity than green and creative themes [9]. In a project conducted at the Vienna University of Technology, six indicators of smart cities were identified:

1. "Smart economy," including competitive components, such as innovation, entrepreneurship, and productivity

2. "Smart people," which is the result of ethnic or social diversity and related to online education to raise social capital and qualification

3. "Smart governance," such as e-government, which can include all parties in transparent decision-making processes

4. "Smart mobility," which includes transportation planned using information and communications technologies (ICT)

5. "Smart environment," which encourages cities to use energy efficiently by employing innovative technologies, such as solar energy and other renewable sources

6. "Smart living," which refers to systems that improve quality of life, such as services and public safety tools [10]

These components are associated with different aspects of urban life: (1) industry, (2) education, (3) e-democracy, (4) logistics and infrastructure, (5) efficiency and sustainability, and (6) security and quality, respectively [11, 12].

This study is focused on smart mobility and examines the case of Istanbul New Airport, which officially opened on 29 October 2018. With a capacity of 200 million annual passengers and 3500 flights per day, Istanbul New Airport is the first smart airport of its size [13].

2. Bases of smart mobility

As an indicator of smart cities in terms of logistics and infrastructure, smart mobility requires urban planning that shifts the focus of transportation modes from individual to collective through the extensive use of ICT [14]. Smart mobility is concerned with local and global accessibility, ICT infrastructure, and innovative and sustainable transport systems [15]. Moreover, it should serve individuals' needs by reducing time spent traveling and helping travelers avoid unnecessary travel altogether [16]. To provide these outputs, smart mobility should [17] accomplish the following goals:

1. Use technology to generate and share data, information, and knowledge that influence decisions.

2. Use technology to enhance vehicles, infrastructure, and services.

3. Derive improvements for transport system operators, users, and shareholders.

In certain situations, IT-supported service experiences can enhance customer satisfaction significantly [18]. Therefore, customer journey maps can be analyzed to observe the effects of technologies on customers' experiences with the provided services.

3. Customer experiences enhanced with technology

Shorter life cycles make products and services more commoditized. Therefore, the differentiation has shifted from the offerings themselves to their providers that create experiences related with the acquisition, use, and maintenance of these offerings. People are naturally inclined to prefer pleasant, special experiences that have important lasting effects [19]. Thus, the opportunity for new revenue growth depends not only on driving sales of existing goods and services but on creating experiences for which customers are willing to pay [20]. Experiences can be conceptualized as "events that engage individuals in a personal way" [21] or as "enjoyable, engaging, memorable encounters for those consuming these events" [22], so creating strong customer experiences is a leading objective for management [23] to create competitive advantage [24].

Given the current progress of technology, it is possible to use it to develop customer experiences. For instance, in the fashion industry, information technologies enhance customer experiences by creating interactive and exciting shopping experiences [25]. In the banking industry, the increase of the Internet services and automated teller machines (ATMs) in various locations provides more services and more comfortable customer experiences than before [26]. In addition to B2C context, technology is used also to create B2B customer experiences, such as salespeople's use of information technology [27].

In addition to enhancing experiences, technology advancement also provides multiple ways for customers to interact with product and service providers. These interactions are crucial to creating superior customer experiences [28]. To depict the events through which customers may interact with a service organization, academics and practitioners use a strategic management tool called customer journey mapping (CJM) [29].

4. Customer journey mapping at Istanbul New Airport

Cities are considered smart when "investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance" [30]. As a dimension of smart city planning, smart mobility is considered in this study. Smart mobility can be summarized as planning and controlling transport systems through the extensive use of ICT. This kind of system has recently been applied in the building of Istanbul New Airport.

Airport information systems are divided into seven sections [31]:

- Flight planning and operation
- Passenger process
- Business administration
- Security
- Facility management
- Business center and airport management
- Contact and information

Recently, airports in the Middle East and in Istanbul have begun to compete with European airports to create a "global hub" for connecting (transfer) passengers [32]. With the increased capacity and technologies developed at Istanbul New Airport, an improved customer experience would provide a competitive advantage. Thus, CJM is proposed in this study to depict customer experiences based on the technologies adapted at Istanbul New Airport.

The format used by Rosenbaum et al. was considered when creating the CJM [29]. On the CJM's horizontal axis, the customer touch points take place according to a process timeline. The timeline is also divided into three periods: pre-service, service, and post-service. The pre-service period refers to customer experiences that occur before a service begins. The service period refers to customer experiences during the actual service. Finally, the post-service period refers to customer experiences occurring after the service [29]. In parallel with this process, a CJM can represent customer experiences prior to going to the airport, at the airport, and after leaving the airport, respectively.

4.1 Horizontal axis of the customer journey map

To develop a CJM for Istanbul New Airport, customer touch points are determined first to build the CJM's horizontal axis. The general limitation of CJM indicated by Rosenbaum et al. was that a common underlying assumption for customer touch points was the consideration that each touch point was equally important to the planning process; however, not all customers experience all touch points [29]. Thus, 62 students with previous flight experiences were recruited from two undergraduate marketing classes at Marmara University using a convenience sampling method. As the Istanbul New Airport was not operating at full capacity at the time of the study, the selection criterion was limited to participants' previous

flight experience at other airports in Istanbul (Istanbul Atatürk Airport or Istanbul Sabiha Gökçen Airport). To determine a unique CJM, only flights departing from the airports were considered. The main assumption for this approach was that passengers spend more time—or, in other words, they experience more—at the departure airport.

	(% listed)
Pre-service period (before passengers arrive at the airport)	
Please list your pre-service (before going to the airport) touch points with the airport (such as "seeing an advertisement on a street billboard about the airport")	
1. Preparing luggage	1.61
2. Buying tickets (online or through agencies)	37.10
3. Transportation (public or private) to the airport	41.94
4. Checking in online	9.68
5. Visiting the airport's website or mobile application	9.68
6. Searching for information about facilities at the airport	1.61
7. Seeing advertising (on a street billboard, a website, or a social media service) about the airport	40.32
Service period (when passengers are at the airport)	
Please list your during-service (when you are at the airport) touch points with the airport (such as "using the parking lot of the airport")	
1. Using the parking lot	16.13
2. Security screening process	9.68
3. Checking in at the airport	19.35
4. Delivering luggage	8.06
5. Asking for help from airport personnel (such as asking for general information or for a wheelchair)	1.61
6. Eating or drinking in the cafés at the airport (including smoking rooms)	56.45
7. Using an ATM to withdraw money	1.61
8. Exchanging money	1.61
9. Using lounge services	9.68
10. Using the toilets	9.68
11. Shopping at the airport	11.29
12. Paying for stamp fees	3.23
13. Passport control	0
14. Tracking flight gates on the screens	1.61
15. Going to flight gates	4.84
16. Visiting duty-free stores	11.29
17. Waiting in the waiting areas (such as reading a book or listening to music)	16.13
18. Connecting to Wi-Fi	8.06
19. Taking photos in the airport	1.61
20. Boarding	3.23
Post-service period (after passengers leave the airport)	
Please list your after service (when you leave the airport) touch points with the airport (such as "talking to friends or family about the airport")	

	(% listed)
1. Baggage collection (at the destination airport)	9.68
2. Calling (informing) family about arrival	12.90
3. Talking to friends or family about experiences at the airport	48.39
4. Communicating with the airport post-services (completing a survey about experiences at the airport)	3.23
5. Writing about the airport on the Internet	1.61
6. Sharing photos taken at the airport on social media	1.61

Table 1.
Istanbul New Airport's key horizontal axis customer touch points.

As discussed previously, the main assumption of CJM is that each passenger's touch points are considered to be of equal importance. To address this limitation, the students were asked to indicate the first touch points that came to mind regarding the departure airports in Istanbul. As they all experienced different touch points, all the steps gathered from the students are listed in **Table 1** to create a complete list of customer journey touch points. The percentages of listed touch points are indicated next to them. At the end of this step, a total of 33 touch points was identified by the respondents. Of the steps, 7 occurred during the pre-service period (before passengers arrive to the airport), 20 occurred during the service period (when passengers are at the airport), and 6 occurred during the post-service period (after passengers leave the airport). After the collection of the touch points for Istanbul Airport as a departure airport, two marketing professors from Marmara University checked them for a potential missing point.

4.2 Vertical axis for corresponding technological applications

The vertical axis for CJM reflects the managerial practices that enable passengers to experience each touch point in a satisfactory way [29]. As the purpose of this study is to reveal customer experiences with technology applications, only the corresponding technological application is considered regarding passenger touch points at Istanbul New Airport.

Turkish Airlines' move from Istanbul Atatürk Airport to the Istanbul New Airport coincides with the time of this study (5–7 April 2019), so it was not possible to meet with authorities at Istanbul New Airport. However, secondary data were used to list the corresponding technological applications. A meeting was held with Ms. Hülya Zerener Gürbaşak, the corporate account manager of Technopc, which provides more than 4000 hardware products to Istanbul New Airport. These products include desktop, mini, integrated, industrial, and kiosk computers used at check-in, security, card access, and passport control points. In addition, Mr. Mertcan Tanaydı, the communication chief of İGA Istanbul Airport, provided several documents and a video [33] in which the technologies of the airport are explained in detail from a customer's point of view.

In terms of technological infrastructure at Istanbul New Airport, three data centers support artificial intelligence (AI) and smart systems. There are 647 servers, 3267 flight displays, 4549 computers, and more than 3000 card access points. To integrate these systems, 1740 km fiber and 4500 km copper cables were used. Data from all systems can reach up to 209 million GB. A total of 708 employees works in technology support roles [33].

The main focus of the technology was a mobile application developed to assist passengers. The airport mobile application can be used before, during, and after service. It guides passengers from home to the airport, assisting with time

Passenger touch points during the service period	**Corresponding technological applications**
1. Using the parking lot	A total of 4500 cameras tracks the cars in the parking lot; they take photos of the cars and upload them on the airport mobile application. Visitors may find their cars by writing their license plate on the application
2. To be controlled by security	Electronic screens at the airport entrance show wait times at the security points (based on sensors and cameras that produce heat maps showing the density of people). Accordingly, the number of security points increases or decreases. In addition, the security cameras with AI use facial recognition systems and warn security if they detect unfavorable movements in the airport
3. Checking in at the airport	Self-check-in points allow passengers to check in for their flights and leave their luggage
4. Delivering luggage	
5. Asking airport personnel for help (asking for general information or for a wheelchair)	An interactive passenger assistant located at the airport enables passengers to connect to customer service and make a video call with a responsible party who can see the passenger's flight details; the customer opens the e-ticket's QR code and puts the mobile phone to the device. The cameras and sensors on the top scan the e-ticket's QR code, enabling the responsible party to see both the passenger and the ticket. In this way, the responsible party can generate a personal map for the passenger from the current location to the flight gate
6. Eating and drinking in the cafés at the airport (including lounge services and smoking rooms)	The airport location guide provided by the airport mobile application lists all facilities and stores at the airport
7. Using an ATM to withdraw money	
8. Exchanging money	
9. Using lounge services	
10. Using the toilets	
11. Shopping at the airport	
12. Paying for stamp fees	
13. Passport control	The iGate-fast passport control system includes two steps. The first door is opened when the passport is scanned by a device, and the second door is opened when a passenger's face and hand are scanned by a device and matched to the passport
14. Tracking flight gates on screens	Flight information screens and the airport mobile application provide flight information
15. Going to flight gates	Personalized direction is provided by the airport mobile application to the gate for the selected destination
16. Visiting duty-free stores	Pre-ordering is available in duty-free stores, where salespeople can reserve passengers' pre-ordered items
17. Waiting in the waiting areas (reading a book and listening to music)	USB inputs between the seats enable passengers to charge their mobile devices
18. Connecting to Wi-Fi	Up to 1 h of free Wi-Fi is available at the airport
19. Taking photos in the airport	
20. Boarding	Boarding time can be seen in the airport mobile application

Table 2.
Corresponding technological applications during the service period at Istanbul New Airport.

management by considering the traffic on the road (corresponding to the pre-service touch point). Its "Where is my car?" service also helps passengers find their cars in the parking lot among 19,000 cars in the closed area and 40,000 cars in

the open area (corresponding to the post-service touch point). All corresponding technological applications for the service period are listed in **Table 2**.

In addition to existing technologies, new ones are planned for the airport. There will be a store offering inventions and technological products where visitors may have such experiences as flying a drone. Moreover, three types of robots will work in the airport. Service robots will assist passengers and will reply to their questions about such topics as flight gates and ticket offices. The other robots will be responsible for cleaning and safety. They will be called "İGAbots." Another innovation will be autonomous vehicles, which will be called "İGAbus." They will carry passengers to various places at the airport [33].

5. Conclusion

City governments today must manage increasing urban populations in smart ways. In other words, large amounts of data produced by the population should be used to create sustainable places by decreasing the chaos of overcrowding, such as traffic, pollution, and waste. One smart city dimension is smart mobility, which refers to enhancing individuals' mobility using innovation and technology. Technology is also essential to creating customer experiences. CJM can be used to analyze touch points and their corresponding created experiences.

In this study, an attempt was made to use CJM as a tool to analyze Istanbul New Airport, one of the largest smart airports in the world, which promises memorable customer experiences. In this way, Istanbul New Airport aims to compete with other airports defined as hubs in Europe. Therefore, a customer journey was created based on a survey of 62 undergraduate students who were asked which touch points came to mind first. The corresponding technologies were indicated based on secondary data.

According to the results, the most indicated touch point from the participants was "talking to friends or family about experiences at the airport" (48.39%). However, the question should be considered to evaluate this high rate. To make the questions clear and to get more touch points, an example was provided for pre-service, service, and post-service periods. Therefore, these three questions were recalls rather than the points coming to the respondents' minds first. Nevertheless, the findings provide evidence that touch points do not have equal importance for all passengers. Different passengers experience different touch points during their journeys, so they perceive different experiences with the technological applications.

As can be seen from the touch point-technology match, Istanbul New Airport provides experiences through technological applications for most passenger touch points. Of these technologies, the main focus is on the mobile application created to affect various points of a customer journey, including time management and considering the traffic on the road to the airport, car location in the parking lot, guides listing all the facilities and stores in the airport, flight information for the selected destination, and personalized directions to the flight gate. In addition, various technologies are used to enhance passenger experiences, such as self-check-in points, interactive passenger assistants, AI-integrated security cameras, fast passport control system, and free Wi-Fi. According to the CJM, customer experience creators should also consider passengers' use of social media and create a strategy accordingly. Passengers like to take photos at the airport and share them on their social media accounts, so there may be several photo opportunities when they experience a new technology. In this way, passengers may share and transfer their experiences with their surroundings, leading to positive word-of-mouth communication about the airport.

Regarding the limitations of this study, as the airport was not running at full capacity, the CJM was created based on participants' experiences at other airports in Istanbul. Therefore, a new CJM should be created after the airport begins to run at full capacity by considering the airport from both departure and arrival perspectives to extend customers' experiences. In addition to technological applications, other managerial practices can be also included in the CJM's vertical axis.

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