Smart Airports: Review and Open Research Issues

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Abstract. Airport exercises and action plans have significantly improved in the last two decades. They help in the development of the worldwide carrier industry. The amendment of the tenets, controls and the deregulation of the new aeronautics period in North America, Europe, Asia, and creative nations have given movement development, enhancement and noteworthy decisions for carrier travelers. In the course of the last few decades, airports have turned out to be more required with more unpredictable tasks. In doing such, they have fortified their capacity to center around and effect instead of productivity. Various factors that can be considered for developing smart airports have been studied so as to address the lackings. The main objectives of this study are to improve the experience of travelers, to make new income streams and to increase operational excellence and enhance security. This research identifies the areas for different sectors supporting the airport management to provide better smart services to the travellers leading to smart world.

Keywords: Smart airport · Smart city · Smart security · Internet of Things

1 Introduction

Variable fuel prices decline in demand, and all the global financial crisis have contributed to the transformation of the aeronautical industry. From the airlines and their international unions to the airports, the broad aviation ecosystem has been forced to implement new strategies for staying today's economic realities. A steep increase in oil prices in 2008 caused unprecedented airline losses [1]. So that fuel costs increased by up to more than 30% from 10% of operating expenses. Airlines, which had bought future's items, faced the enormous amounts of high fuel prices by a sudden price drop. At the same time, business and personal travel were limited by the deterioration of the economic situation. Supply over demand was aggravated by intense competition among many airlines for the trip.

"The International Air Transport Association (IATA)" predicts a 3% drop in passenger traffic in 2019. While a 5% drop in shipments. The prices were also overwhelming when falling demand reduced prices. Only a few Airlines did not get an effect. IATA predicted that airlines would experience net losses of more than $ 9 billion

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in 2019. The United States shipments account for about 80% of damage and perhaps the worst disaster which was expected by 2020 [2].

The airlines supported an excellent business model while still were profitable. However, dropping the number of passengers would have lower returns and revenue, the impact would not be uniform in all airlines. Nevertheless, large corporations and airline of origins and destinations would have a severe drop in recreational passenger traffic by continuing the experience of the number of passengers dropping down [3].

Traffic and demand may eventually return to its first stage in the next three to four years. As the IATA predicted, the four fundamental changes in the market are likely to have irreversible and lasting changes. Demographic change, new corporate governance conditions, emergence and maturity of communication technology create new patterns that require new business models and strategies [4]. The complexity of the future turmoil of this industry will raise the requirements and needs of the travellers who are always striving and quickly getting adopted to the advanced technology in all the domains. The customers expect real-time aircraft delay information, gates, and special offers from airlines and airports at a more economical and fast pace. Passengers are demanding workflow processes for the delivery of cargo, transportation, and personalized services with a higher level of expectation. This study discusses the evolution of airports with a closer look [5].

1.1 Airport 1.0: Primary Airport Operation

In the airport phase 1.0, airports concentrate on the abilities that are needed to manage efficient and safe landings, outbound flights and other airline operations. They provide essential services, including the delivery of cargo, boarding passengers, security, luggage removal and so on. The airports display evolved activities but do not pay enough attention to the needs of the passengers. While there is always a broader strategy for the airport [6].

1.2 Airport 2.0: Fast-Moving Airports

The highlights of these airports are that they are all around adjusted to natural changes and their working pace is expanded. At these airports, operational technology has been dramatically enhanced and implemented throughout business units and operational environments. Business entities share data rapidly and flawlessly and empower quick airplane terminal stations to react to ecological and operational changes fastly. By utilizing a unified and shared administration system, these airplane terminal stations frequently prevent the utilization of constrained use innovations. Rather, a huge air terminal will share the genius presented interconnected engineering with administrations in standard essential administration. The airports benefit from modest facilities provided and video surveillance [7]. From business value, fast-moving airports offer high-performance operations that can provide airlines with high speed and improve passenger expectations. An example of these airports is “Pearson International Airport Toronto”, “London Heathrow Airport”, “Changi International Airport”, “Hong Kong International Airport”, and “McCarran International Airport (Las Vegas)”.

1.3 Airport 3.0: Smart Airports

At these airports, the maturity of advanced technologies in the sensory analyzes is steadily evolving. Systems are functioning on the digital platform that often converges with an IP network with classes and in the whole ecosystem, such as airports, city airports, airlines, ports, logistics, government departments, and other sectors, can have a bandwidth Create high-speed traffic [8]. These are the digital networks of the nervous system of the airports that touch and control each point of the interactions and illustrated in Fig. 1. Exchanging the information in the real time environment, deep-seated cooperation, and the integration of extensive airport processes made these smart airports to have improved the efficiency of operations, passenger services, and advanced security capabilities. They have likewise upgraded their movement encounter by giving a scope of customized administrations that can coordinate voyagers' data and foresee the administrations they require in various segments. Expansive incorporated between line applications Littler units, fuel suppliers, prepping and other living community accomplices have made new advantages all through the esteem chain [9].

Fig. 1. Smart airport [10].

The digital network can create real-time operations and integrate processes and generate a new revenue stream. It will also improve the experience of the passengers.

2 Increasing Experience, Operations, and Values

Smart airports provide an excellent experience for passengers and the airport. Airports, airlines, and partners use technologies, sensors, processors for airports 2.0 and 3.0, and they always provide a framework for communication that can respond and analyze in real time. At these airports, passengers are not checked in different parts, and their crucial information comes in one section. Instead, there is an inclusive continuous connection between the passenger and any place and at any time [11]. The airport may likewise work past the physical limits to upgrade the experience of voyagers at all phases of their excursion. For instance, the airport ought to give data relying on the parameters defined

for the traveller to enable them to design their takeoff time and pick ending and different administrations. Currently, some airports are offering Type 2.0 services. For example, the "Baltimore Washington International Airport (BWI)" uses "Twitter" to alert you about airport change, weather conditions, and flight status. While this is simple, innovative work. The airport is trying to use social networks for air travel [12].

These new intelligent airport capacities will make another plan of action, including better and more extensive incorporation and urban biological communities from organizations and associations that altogether communicate with airports. As a result, airport revenues from related departments and affiliates will increase. The increase in these emerging commercial airports will attract new business customers in the new sectors and may even create a brand-new service that delivers excellent services from various industrial clusters with free zones. Accordingly, smart chains will expand their values beyond the boundaries of traditional airports to the smart airport, which can provide innovative services that can create value among business partners [13].

Smart city airports target lots of customers, including travellers, under-handed areas, greetings part, and logistics companies. To do this, they need a broad approach. For example, imagine a traveller arriving by air on an internal flight. He goes to the airport in and meets his customer, a coordination's organization situated in the city of the airport. At all stages of his trip, information is provided in real-time and in person to give a complete and uninterrupted journey from the airport to his workplace. By the use of smart systems, integrated solutions, external and internal airport ecosystem partners, real-time information on the travel status to provide better services, the trip would be more than perfect. Alerts can also be sent to the hotels and the taxi services regarding the delay of flights to enable them to render efficient services. With these facilities, these companies can increase the delivery of services and improve the satisfaction of travellers [14].

With the evolution of airports, virtual airport service providers (VSPs) that integrate value propositions into different markets for different customers, the service portfolio of airports will also change (Fig. 2). Traditional airport service prototypes include IT services, facility management and human resources that can be turned into specific and advanced targeted services, for example, canny transportation, activity administration, and that's only the tip of the iceberg. This up and coming age of airport administrations will produce new income streams for airports, and the part of administration development will progressively be moved in focal airport tasks [15].

Fig. 2. Providing virtual services by airports [16].

3 Opportunity: Turning Business Models into New Revenue Streams

Revenues other than aviation, such as stop, land, unimportant deals, promoting and sustenance and drink, have been a crucial part of the airport's income for a considerable length of time. The airline's recent downturn has led airlines to rely more on revenues other than aviation. Many airports get a more significant part of their income from these sources. The airports combine creativity with good business. The industry is experiencing a new impetus, and new financial profiles, including plant revenue, multi-million-dollar retail expansion, large industrial parks, and land. The development of these sources of new income at airports could reduce airline costs. Competitive conditions between airports would be created to attract passengers by providing air services, which would benefit the entire community [17].

Figure 3 provides further details on revenue generation and the relative position of strategies other than aviation based on the geographic location of airports. Accordingly, there are noteworthy contrasts between income streams in various zones in retail and auto stopping administrations. Airports will get significantly more income from parking areas than central airports, which can undoubtedly exchange travellers starting with one plane then onto the next. Smart airports can take advantage of this opportunity to provide innovative services that enhance the well-being of customers. With this incorporated esteem chain, airports and carriers can go through an offer and strategically pitching procedures and give more customized administrations to fulfill clients and increment their income. Up-selling is one of the techniques where encouraging customers to buy more expensive products. Cross-selling is also a technique in which the customer decides to purchase related products, such as a warranty, etc. after the customer chooses to buy the outcome [18].

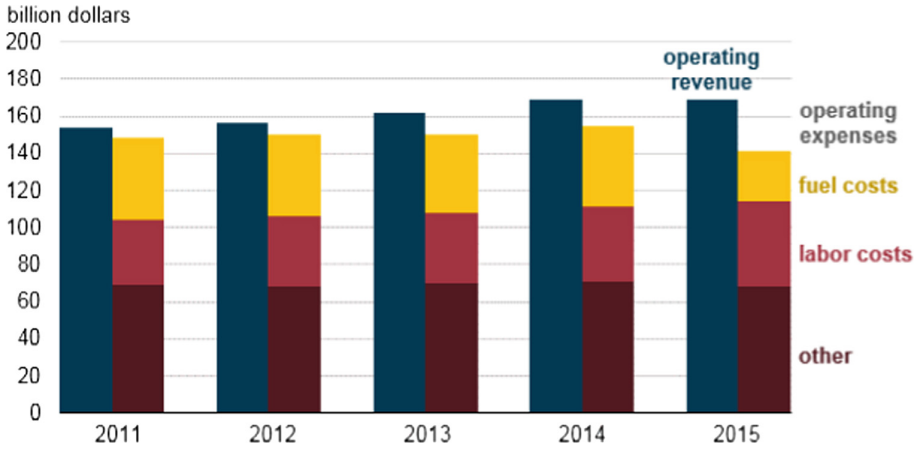

Fig. 3. Percentage of non-aviation revenue by source and region [19].

4 An End-to-End Framework for the Experience of Travelers

Airports can build their non-business income by growing administrations, for example, retail, stopping, and lodgings. With a specific end goal to boost these administrations, they must receive a client-driven approach, concentrating on expanding traveller encounter. As airlines nowadays have a widespread relationship with the client, airports must find ways to have a better travel experience for travellers [20].

Few leading airlines provide an innovative personal experience for travellers, at least for their valued customers, with superior service delivery. With the decline in the economy and the need for security equipment, these airlines will take tolls to enhance the quality and experience of travellers. Increasing security measures means that passengers should be faced with long queues, missed connections, and gate changes. The propensity toward more significant aeroplane delivers more aircraft tasks. But it's likely to cause a lot of passengers in the gates and when boarding aeroplanes [14]. Peer-to-peer expanding the services between passengers and airports has certain benefits such as:

- A more prominent capacity to up-offer and strategically pitch customized administrations in light of ongoing data and travel conditions, for example, giving auto stopping too late entries or in benefits if there should be an occurrence of aeroplane delay [21].
- Additional revenue through the provision of stores and pre-trip information designed for purchases at airports, for example, providing discounts and availability information for goods especially needed for destination or travel [22].
- The ability to utilize the combined knowledge of travellers regarding climatic changes in the weather, congestion to improve the travel experience [23].
- Creating location-based exceptional services, including searching for ways to transfer people at an airport at the right rate and minimizing delays, the ability to provide reliable travel advice [24].

CRM (Airlines' customer relationship management) Specifically, centres around visit and up-offer and strategically pitch projects and highlights of different flight classes. Often little effort has been made to manage and increase overall end-to-end travel for passengers. Airports and airlines have a huge chance to fabricate a decisive and coordinated understanding for explorers from the season of booking to movement through airports until the finish of their trip. In creating such a journey for customers, the role of airports should be shifting from passive landlords to active participants and improve the travel ecosystem as a critical partner. To this end, a bonus system must be built at the airports and airlines integrated. This superior passenger experience is the key to the difference between airports and airlines, and it also improves the loyalty of passengers [21].

As an example of the expansion of Cisco Services, IBSG has introduced five types of smart services that airports can put at the top of their smart structure. The administrations utilize the developing innovation and systems administration capacities to enhance the experience of voyagers, make new income streams, increment operational magnificence and improve security. The needs of every airport rely upon their plan of action. For example, retail revenue for hub airports is vital, and car park services at

destination airports are of great importance. By giving top-notch explorers each or these five focuses, airports can gain high incomes, decrease costs, and accomplish their objectives [25].

4.1 Smart Transportation and Parking Services

Travel services in real time inform passengers of all travel problems and offer superior facilities, including parking, changing the route. Smart transportation Administrations, a touchy area variant, can track a traveller through the cell phone and illuminate the explorer before movement, recommending the best course considering activity conditions and flight conditions. Value-added services, including carriers and crew, can be provided to the passenger. A travel guide gives details of flight status at all stages on the smartphone and kiosks at the airport. The guide can also offer positioning services and help to guide travellers to cross the airport to the gateways, retail offers, and hospitality services [26].

4.2 Retail, Hospitality and Entertainment Services

Uncommon traveller retailers and visitor administrations can be offered through cell phones from the basic client data available at the airlines. Based on the passenger's profile, the purpose of the flight (work, leisure, tourism, etc.) or the destination of the passenger, offers can be announced. Smart advertising allows messages about destinations or special conditions to the passengers at different locations. Also, advanced promoting sheets can show travel data or primary data in a crisis. Retail deals to retailers will expand agreements [27].

4.3 Smart Workplace Services

Telecommunication equipment is used to detect radio frequencies for tracking portable apparatus. For instance, an airport can track wheelchairs by these frequencies to help decrease the desires for their asking for travellers. A mobile and a specific locator can tailor the correct data at the opportune time. Furthermore, effectively and rapidly manage airport issues influencing travellers. This incorporates client connections, support, and security issues [28].

4.4 Airport Smart Processes

Location-based services use details of the arrivals and destinations of travellers and, along with location information and airports, will guide travellers to reduce stress, minimize queues and increase retail sales. Check baggage tags based on airport frequencies. It empowers the different proof of gear from a separation or outside of anyone's ability to see, making it less demanding to discover missing and dislodged baggage, and give cutting-edge data to voyagers. Checking tickets without a queue using tagged cards for tracking or using smartphones with activation codes will increase the speed of the passengers to reach their flight. This can be done through tags even from hotels [29].

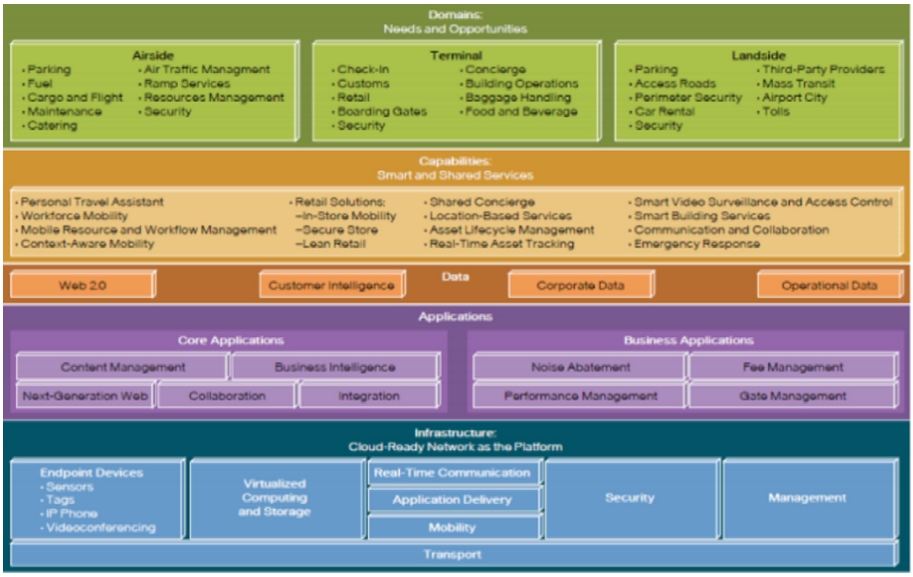

Fig. 4. Structural resources for high-level smart airports [1].

4.5 Smart Business Services

Smart airports provide business customers with a range of value-added services. These administrations incorporate activity administrations and office administration and security administrations. Likewise, in airport urban areas that attention particularly on coordination's suppliers, there is the chance to offer smart chain administrations. Administrations for structures include: advanced signage loads up for promoting, crisis circumstances and data for discovering headings, checking these in the lodging, office or different structures remotely, continuous flight data in the airport urban areas and focal mechanization of structures, observing and enhancing vitality utilization [30]. A very important aspect here is the role IoT is going to play with 5G to still more provide better services as most of the organizations are moving towards industry 4.0, i.e. digitization. And also the authors in [31] have proposed a framework considering the challenges and factors influencing the security for smart cities with smart security paying highest attention towards a safe environment.

5 High-Level Structure for Smart Airport Operations

Intelligent services that support efficient airport operations require a high-level structure. This structure is illustrated in Fig. 4 with the needs and opportunities in each area of the airport, including flight areas, larger airports, and the urban airport environment with the ability to integrate information and applications on the network.

At the highest level, the smart airport landside meets the needs and opportunities to change the experience of the passengers.

The feature layer captures important topics that meet the needs and opportunities in each of the airport districts. These creative services include empowerment throughout airport operations and business units to give better experience for travellers. The data layout outlines important topics for content and support deals [21]. This layer includes airport operations and data companies as well as information gathered about travellers from all angles, landslides, and canals throughout the journey. The data layer also covers extensive and expanding web 2.0 data, including social networking services.

In the next layer, applications that manage data and support capabilities include:

- An example of next-generation applications and optional tools that improve the interactive experience of travellers [32].
- Collaboration programs that enable real-time interactions between all stakeholders.
- Content management to coordinate the upcoming events.
- Smart business to support the continuous improvement of the Smart Airport experience using intellectual resources and newer areas such as social media.
- A series of integrated applications, including intelligent interaction manager that can predict and feel the needs of passengers and respond to them.

Business applications include airport applications, integration and mainstreaming. Examples of these include noise reduction, performance management, cost management, and gate management. Hardware, tools, and software-level services make up the foundation of the higher layers.

6 NFC Mobile Benefits for Air Travel

This section aims to explain the advantages of mobile NFC services based on the work done by the GSMA on NFC services and IATA work to advance the operations of the air travel industry [33].

The objective is to determine how NFC Mobile services based on the UICC can be used for airline industries and improve the convenience and facilities of travel for valuable customers. The UICC is an open source platform with standards that provide multiple NFC services to the customer [34]. Also, it allows space for fair competition between service providers to be created on a joint application. The advantage of this to the customer is that they can choose between services and service providers.

6.1 GSMA's Role

GSMA is a global trading community that has more than 750 GSM mobile operators in more than 200 countries and has over 200 manufacturers and suppliers in the world [35]. GSMA's primary goals is to make sure that the services are available globally in an efficient way through portable devices and play a role in improving the nation's economy by their customers satisfaction, which in turn provides new business opportunities for operators and their suppliers. MNO's cooperation ensures the expansion of mobile NFC services between mobile operators and other sectors involved in this industry [36]. Thus, it improves interoperability and leads to follow common acceptable standard through out the globe and prevents market segregation. Currently, more than 61 organizations from

the largest MNOs in the GSMA Pay-Buy-Mobile project collaborated to expand a public view based on the UICC, NFC mobile services. They provide over 50% of the global GSM market and are handling more than 1.5 billion customers [37].

6.2 IATA's Role

Aviation is a standout amongst the most unique enterprises in the world. The International Air Transport Association (IATA) is the business association of this industry [36]. For over 60 years, IATA has extended the norms that have made a worldwide industry. Today, IATA's main goal is to give, oversee and work the aircraft business administrations. Its individuals incorporate around 230 carriers and 93% of worldwide air traffic arranging that offers 2.4 billion travelers [37].

6.3 Performance

IATA tries to improve industry understanding among chiefs and bring issues to light of the advantages that flight has for national and worldwide economies [38]. It likewise battles for the interests of aircrafts around the globe to challenge unreasonable laws and charges, account controller and endeavors to direct sensible costs.

6.4 Governance

IATA likely helps aircrafts by disentangling forms, expanding traveller comfort, lessening costs and improving effectiveness. Likewise, security is the main need of IATA and intends to additionally improve wellbeing benchmarks, specifically through the IATA Safety Inspection (IOSA) [39]. Also, another essential concern is limiting the effect of aeronautics on the earth. IATA budgetary frameworks broadens support in transport and expand travel industry income [40].

6.5 Added Values

For customers, IATA has simplified the carrier and cargo functions at a low cost. Travellers can book a ticket, pay for it and also get a voucher for different airlines to get added benefits. IATA plays the role of an agency between airlines and travellers and serves as cargo agents through the services of the official agency and centralized financial systems [38]. Group of vendors of different industries along with the service providers supported by IATA render their expert services based on their specilizations. For government point of view, IATA makes sure that they make more extended and better decisions in terms of maintaining the airline industry.

7 Conclusions

Nowadays, many airlines and airports fail to meet their customers' expectations. This failure is not easy to reconstruct and requires order, investment and a deeper understanding of the demands of travellers with respect to population, behaviour, requirements

and needs [39]. Profound understanding amongst carriers and aeroplane terminals can give a more total and robust recommendation for passengers, which covers the whole adventure rather than the airports by allowing the airlines to share the passengers information with the airports. While sharing traveller data via aircraft does not look an exceptionally great arrangement, but rather it will give a full knowledge into the necessities of the voyager and will enable them to outline and convey new items and administrations which urge the traveller eagerness to pay [40]. The "Cisco Business Solutions Group (IBSG)" trusts this will make a noteworthy open door for income, development and aggressive position [41].

The results of this study increase the knowledge of intelligent airports, recognition of brilliant airports advancement, and support the utilization of innovations as per the feasible improvement paradigm. However, this study has some limitations, since the smart airports' applications are limited, it might impact the inspiration of speculation given prioritization which appears the requirement for specialized and monetary achievability contemplates. Moreover, the administrations are yet not supporting the brilliant aeroplane terminals, its control, and purchaser and maker's rights. Therefore, it could be a future study concern about smart airports implementation.

While this innovative approach has clear benefits for travellers and their experiences, they need to update airport infrastructures such as NFC gateway readers or payment terminals. Additionally, at the time of writing this article, the financing industry standards have not been fully launched, that is why the costs and challenges, the exact details of the aviation industry and business need to allocate credit for this technology and its application in the aviation industry.

References

1. Fattah, A., et al.: Smart Airports: Transforming Passenger Experience to Thrive in the New Economy, pp. 1–16. Cisco Internet Business Solutions Group (IBSG) (2009)
2. Nagy, E., Csiszár, C.: Airport Smartness Index–evaluation method of airport information services. Osterreichische Zeitschrift Fur Verkehrswissenschaft **63**(4), 25–30 (2016)
3. Merelli, E., Paoletti, N., Tesei, L.: Adaptability checking in complex systems. Sci. Comput. Program. **115**, 23–46 (2016)
4. Ghazal, M., et al.: Towards smart wearable real-time airport luggage tracking. In: 2016 International Conference on Industrial Informatics and Computer Systems (CIICS). IEEE (2016)
5. Hussein, D., et al.: Towards a dynamic discovery of smart services in the social internet of things. Comput. Electr. Eng. **58**, 429–443 (2017)
6. Barnett, J.: Smart growth in a changing world. In: Barnett, J. (ed.) Smart growth in a changing world, pp. 5–10. Routledge, New York (2018)
7. de Rubeis, T., et al.: Multi-year consumption analysis and innovative energy perspectives: the case study of Leonardo da Vinci International Airport of Rome. Energy Convers. Manag. **128**, 261–272 (2016)
8. Lee, Y.-K., Park, J.-W.: Impact of a sustainable brand on improving business performance of airport enterprises: the case of Incheon International Airport. J. Air Transp. Manag. **53**, 46–53 (2016)

9. Wang, X., et al.: Exponentially weighted particle filter for simultaneous localization and mapping based on magnetic field measurements. IEEE Trans. Instrum. Meas. **66**(7), 1658–1667 (2017)
10. Ying, X., et al.: TACAN: transmitter authentication through covert channels in controller area networks. In: Proceedings of the 10th ACM/IEEE International Conference on Cyber-Physical Systems, Montreal, Quebec, Canada, pp. 23–34. ACM (2019)
11. Elliott, A., Radford, D.: Terminal experimentation: the transformation of experiences, events and escapes at global airports. Environ. Plan. D Soc. Space **33**(6), 1063–1079 (2015)
12. Grant-Muller, S.M., et al.: Transport policy: social media and user-generated content in a changing information paradigm. In: Nepal, S., Paris, C., Georgakopoulos, D. (eds.) Social media for government services, pp. 325–366. Springer, Cham (2015). https://doi.org/10.1007/978-3-319-27237-5_15
13. Sniukas, M., Lee, P., Morasky, M.: The Art of Opportunity: How to Build Growth and Ventures Through Strategic Innovation and Visual Thinking. Wiley, Hoboken (2016)
14. Barkham, R., Bokhari, S., Saiz, A.: Urban Big Data: City Management and Real Estate Markets. GovLab Digest, New York (2018)
15. Neckermann, L.: The Mobility Revolution: Zero Emissions, Zero Accidents. Zero Ownership. Troubador Publishing Ltd., Verlag (2015)
16. Oldekop, J.A., et al.: 100 key research questions for the post-2015 development agenda. Dev. Policy Rev. **34**(1), 55–82 (2016)
17. Gottdiener, M., Budd, L., Lehtovuori, P.: Key Concepts in Urban Studies. Sage, London (2015)
18. Pogorelova, E., et al.: Marketing Mix for E-commerce (2016)
19. Fasone, V., Kofler, L., Scuderi, R.: Business performance of airports: non-aviation revenues and their determinants. J. Air Transp. Manag. **53**, 35–45 (2016)
20. Bogoch, I.I., et al.: Assessment of the potential for international dissemination of Ebola virus via commercial air travel during the 2014 west African outbreak. Lancet **385**(9962), 29–35 (2015)
21. Taneja, N.K.: Airline Industry: Poised for Disruptive Innovation? Routledge, New York (2016)
22. Birdir, S.S., Dalgic, A., Birdir, K.: Destination marketing and destination image. In: Gursoy, D., Chi, C.G. (eds.) The Routledge Handbook of Destination Marketing, pp. 71–81. Routledge, New York (2018)
23. Buhalis, D., Foerste, M.: SoCoMo marketing for travel and tourism: Empowering co-creation of value. J. Destin. Mark. Manag. **4**(3), 151–161 (2015)
24. Robarts, J.O., Newell, D., Abbott, K.H.: Automated selection of appropriate information based on a computer user's context. Google Patents (2018)
25. Riva Sanseverino, E., Riva Sanseverino, R., Vaccaro, V.: The role of sharing practices and dematerialized services in smart cities. In: Riva Sanseverino, E., Riva Sanseverino, R., Vaccaro, V. (eds.) Smart Cities Atlas, pp. 187–206. Springer, Cham (2017). https://doi.org/10.1007/978-3-319-47361-1_7
26. Peng, G.C.A., Nunes, M.B., Zheng, L.: Impacts of low citizen awareness and usage in smart city services: the case of London's smart parking system. IseB **15**(4), 845–876 (2017)
27. Kuo, C.-M., et al.: SMART SWOT strategic planning analysis: for service robot utilization in the hospitality industry. Consort. J. Hosp. Tour **20**(2) (2016)
28. Brubaker, C.M.: System and method for obtaining revenue through the display of hyper-relevant advertising on moving objects. Google Patents (2015)
29. Alghadeir, A., Al-Sakran, H.: Smart airport architecture using Internet of Things. Int. J. Innov. Res. Comput. Sci. Technol. **4**(5), 148–155 (2016)

30. Wu, D., Zhang, G., Lu, J.: A fuzzy preference tree-based recommender system for personalized business-to-business e-services. IEEE Trans. Fuzzy Syst. **23**(1), 29–43 (2015)
31. Belgaum, M.R., et al.: A framework for evaluation of cyber security challenges in smart cities. In: IET Conference Proceedings, vol. 4, 6 pp.
32. Turban, E., et al.: Intelligent (smart) E-commerce. In: Turban, E., et al. (eds.) Electronic Commerce 2018, pp. 249–283. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-58715-8_7
33. Gamage, M.N., Colombo, S.: Adaptation of Near Field Communication (NFC) technology to enhance the operational efficiency and performance of pre-departure operations of airlinesi. J. Electron. Syst. **5**(1), 23 (2015)
34. Srivastava, A.N., et al.: Unmanned aerial vehicle platform. Google Patents (2017)
35. Raj, P., Raman, A.C.: The Internet of Things: Enabling Technologies, Platforms, and Use Cases. Auerbach Publications, New York (2017)
36. Pourghomi, P.: Managing near field communication (NFC) payment applications through cloud computing. School of Information Systems, Computing and Mathematics, Brunel University (2014)
37. Lobaccaro, G., Carlucci, S., Löfström, E.: A review of systems and technologies for smart homes and smart grids. Energies **9**(5), 348 (2016)
38. Ivanova, M.G.: Air Transport-Tourism Nexus: A Destination Management Perspective. Zangador, Varna (2017)
39. Lovelock, C., Patterson, P.: Services Marketing. Pearson Australia, Sydney (2015)
40. Jiang, C., Zhang, A.: Effects of high-speed rail and airline cooperation under hub airport capacity constraint. Transp. Res. Part B Methodol. **60**, 33–49 (2014)
41. Ylijoki, O., Porras, J.: Perspectives to definition of big data: a mapping study and discussion. J. Innov. Manag. **4**(1), 69–91 (2016)