

The Impact of Service Innovation on Passenger Satisfaction in Dubai Metro

Impak Inovasi Perkhidmatan terhadap Kepuasan Penumpang di Metro Dubai

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Abstract: The metro systems have witnessed a significant growth and development over recent decades due to the advancement in innovated technologies in transport industries. Dubai Metro is a result of the tremendous development in the United Arab Emirates. However, metro service operations have become challenging, especially in urban areas that are characterized by the dynamic increase in population so passenger satisfaction could be a difficult objective to obtain. The particular mechanisms by which service innovation influences passenger satisfaction have not been well investigated in the literature, especially in the case of Dubai Metro. Due to that, studying passenger satisfaction allows for the identification of areas that require attention and improvement, leading to more efficient and effective metro transportation systems. Therefore, this paper aims to highlight the role of service innovation on passenger satisfaction in Dubai Metro. A study on Dubai Metro is based on the perspective of disruptive innovation theory to help this company to attain a high level of passenger satisfaction due to service innovation. The analysis of literatures reveals a substantial relationship between service innovation in metro transport sector and passenger satisfaction. the research on passenger satisfaction is critical for the development of public transport in general and metro systems in particular because it provides valuable insights into the needs and preferences of commuters. By understanding what makes passengers satisfied, transport authorities can make informed decisions to improve the quality of services, enhance overall customer experience, and ultimately increase ridership.

Keywords: Service Innovation, Passenger Satisfaction, Metro Systems;

Abstrak: Sistem metro telah menyaksikan pertumbuhan dan pembangunan yang ketara sejak beberapa dekad kebelakangan ini disebabkan oleh kemajuan dalam teknologi berinovasi dalam industri pengangkutan. Metro Dubai adalah hasil daripada pembangunan yang luar biasa di Emiriah Arab Bersatu. Walau bagaimanapun, operasi perkhidmatan metro telah menjadi mencabar, terutamanya di kawasan bandar yang bercirikan dinamik pertambahan penduduk sehingga kepuasan penumpang boleh menjadi objektif yang sukar diperolehi.

Walaupun mekanisme tertentu yang mana inovasi perkhidmatan mempengaruhi kepuasan penumpang belum diasas dengan baik dalam literatur, terutamanya dalam kes metro Dubai. Untuk itu, mengkaji kepuasan penumpang membolehkan mengenal pasti kawasan yang memerlukan perhatian dan penambahbaikan, yang membawa kepada sistem pengangkutan metro yang lebih cekap dan berkesan. Oleh itu, tujuan kertas kerja ini adalah untuk menonjolkan peranan inovasi perkhidmatan terhadap kepuasan penumpang di metro Dubai. Kajian mengenai metro Dubai adalah berdasarkan perspektif teori inovasi yang mengganggu untuk membantu syarikat ini mencapai tahap kepuasan penumpang yang tinggi dalam inovasi perkhidmatan yang wajar. Analisis literatur mendedahkan hubungan yang ketara antara inovasi perkhidmatan dalam sektor pengangkutan metro dan kepuasan penumpang. Penyelidikan dalam kepuasan penumpang adalah penting untuk pembangunan pengangkutan awam amnya dan sistem metro khususnya kerana ia memberikan pandangan berharga tentang keperluan dan keutamaan penumpang. Dengan memahami perkara yang membuat penumpang berpuas hati, pihak berkuasa pengangkutan boleh membuat keputusan termaklum untuk meningkatkan kualiti perkhidmatan, meningkatkan keseluruhan pengalaman pelanggan dan akhirnya meningkatkan jumlah penumpang.

Kata kunci: Inovasi Perkhidmatan, Kepuasan Penumpang, Sistem Metro;

Introduction

For decades, public transport networks have been critical components of big cities since they enable spatial mobility for at least half of a city's population who cannot use private transport (Petrov & Petrova, 2021). Public transport is also an important component that acts as the lifeblood of economic, social, political, and demographic mobility. It expands with and responds to the development of economies and societies (Nasution et al., 2020). Indeed, it is now universally recognized that developing countries are trying to reduce their dependence on cars to reduce the effects of climate changes, environmental problems, noise, accidents, and air contamination (Borhan et al., 2019). One of the essential steps in ensuring sustainability and green cities is providing good public transport networks and modern metros which offer a high-quality and affordable alternative for citizens. With the rapid advancement in technologies in the current era, organizations cannot succeed solely based on their expertise and talented workforce; they must also be innovative to satisfy the customers, this fact applies to transport companies. In broader sense, organizations that continue to use innovation will be able to react to challenges from outside the organization more quickly and effectively than others who do not focus on innovation. To that end, fostering service innovation should be a priority goal for

public organizations (Gustafsson et al., 2020). This scenario applies to metro companies seeking passengers' satisfaction and striving to keep their reputation clear from criticism. Unfortunately, the investment and speedy development of metros by governments is not always focused on innovation in service but mostly on service quality (Ibrahim et al., 2020). Service innovations challenge existing offerings and business models, shape existing markets, and create new ones. Over the last decade, academic works in services offered by organizations, especially in the public and government sector have shown increasing interest in the concept of service innovation and should by now have reached maturity in this topic and establish a strong theoretical basis. However, there is no coherent theoretical framework that captures all the facets of service innovation and shifts this concept forward. To that end, researchers must evaluate the key assumptions of what an innovation is (Gustafsson et al., 2020), especially in rail transportation domain. Countries that seek prosperity for their people attempt to provide all types of transport in the cities, while the quality of metro service takes the biggest share of interest and funds in developing countries like United Arab Emirates (UAE) as well as developed countries, e.g., US, European countries, China, and Japan. The satisfaction of passengers in these countries is a priority. Thus, passenger satisfaction is a hot topic in countries like UAE, while service innovation and service quality need more research, especially with

the advancements in technology and innovation in metro systems. However, we need to know more about the impact of service innovation on people using metros in their daily life, while the attributes of service quality that contribute to their satisfaction on the transport service also important (Gustafsson et al., 2020). Hence, these topics and scenarios will be discussed in this study to understand how service innovation in public transport (i.e., metros) influence passengers' satisfaction in Dubai.

Dubai Metro

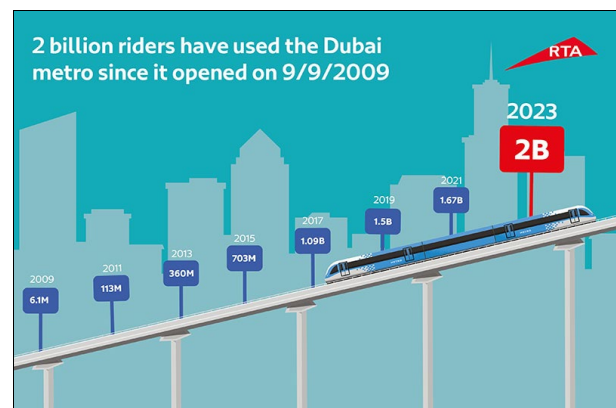
Following the re-organization of the United Arab Emirates in 1971, the three primary modes of transportation have helped to shape Dubai's global identity (Keilo & Montagne, 2012). Because of its ease and transportation advancements, Dubai is regarded as one of the most modern cities in the UAE. During a period of increasing local and expatriate population, Dubai's government recognized the need to build a Metro system, as the city's road network system could cause challenges in providing efficiency for the growing population (Nassar, 2014; Keilo & Montagne, 2012). Dubai made tremendous progress in terms of economics, investment, infrastructure, and population, but these gains were occasionally delayed by the city's growing population, a problem shared by most industrialized and developing cities throughout the world. To alleviate traffic congestion caused by the city's growing population, world-class infrastructure was suggested, which would upgrade and transform the current location into a metropolitan city. As a result, in July 2005, the government established the Dubai Rapid Link to carry out the design plan (Narayanawami, 2017). The Dubai Metro opened on September 9, 2009 (Boble, 2016; Acuto, 2010), at a time when the Dubai Metro was critical in restoring Dubai's image in the aftermath of the global financial crisis (Keilo & Montagne, 2012).

The Dubai Metro is now a world-class infrastructure that connects individuals within the city (Kamarudeen et al., 2018). Dubai Metro has grown tremendously in the three years it has been in operation. Maintaining business excellence has been fundamental to defining the activities undertaken by this corporation to manage market competition. Today, Dubai Metro faces severe rivalry for market share in the UAE from a range of other industry competitors. As a result, Dubai Metro's management has been keen on implementing various quality management systems in order to ensure that it maintains high quality transportation service, for example, ISO 9000:2008 is one such model that has benefited this company's current success. This strategy has aided in establishing quality on the company's procedures, ensuring that Dubai Metro reaches the

highest level of customer satisfaction. The notion starts with defining customers' demands and ends with market customer satisfaction. It describes what activities management should take to ensure that the firm's productivity satisfies passenger expectations (Parahoo et al., 2018).

According to the UAE Roads and Transport Authority (RTA), the number of Dubai Metro users has surpassed two billion since the metro's inaugural public inauguration on September 9, 2009. The Red Line transported 1.342 billion passengers, while the Green Line transported 673.531 million. Furthermore, the Dubai Metro has a 99.7% on-time performance rate, above international safety norms and demonstrating high operational efficiency (Alarabiya News, 2023). The Dubai Metro's continued growth and success illustrate Dubai's commitment to providing commuters with safe and dependable transportation. The average daily traffic on the Dubai Metro surpassed 616,000 in 2022, indicating that the RTA's efforts to increase public transit utilization have been successful. This achievement also reflects a positive shift in the community's attitude toward public transportation, as residents have acknowledged the benefits of smoother travel as well as lower fuel and vehicle maintenance costs (Saundalkar, 2023). Figure 1 shows passenger growth per year since 2009.

Figure 1. Metro passenger growth over the years (Saundalkar, 2023)



The Dubai Metro's quality is acceptable; for example, seating capacity exceeds 142 seats, with a maximum capacity of 897 passengers in a single voyage. Furthermore, on an average day, Dubai Metro can transport 1.2 million passengers. As of 2016, the Dubai Metro service had over 830 million riders, which equates to 329,365 riders per day, 13,723 riders per hour, 229 riders per minute, and 3.8 riders per second (Tesoro, 2016). The Dubai Metro network now consists of 47 stations divided into two zones: Red Line and Green

Line, with a total track length of more than 75 kilometers. The red line serves 29 stations along a 52.1-kilometer track, while the green line serves 18 stations along a 23-kilometer track. According to Shahbandari (2017), the red line is currently being extended to include 8 additional stations across a 15-kilometer track length connecting the EXPO 2020 site in order to build a supportive infrastructure for the upcoming EXPO 2020. Furthermore, the RTA provides feeder bus services for passengers who are unable to complete their route using the Dubai Metro. To summarize, a well-functioning public transportation system not only promotes the growth of the city, but it also helps to reduce pollution and traffic congestion.

To summarize, a well-functioning metro system is critical to the transportation infrastructure of a city. It not only provides inhabitants with a convenient and effective form of transportation, but it also helps to reduce traffic congestion and air pollution. Furthermore, as it improves accessibility and connection inside the city, a well-functioning metro system can help to economic growth by attracting businesses and tourists.

Literature Review

Service Innovation

Today, innovation has become part of the strategies for success and growth in the market. In various ways, such as market share, revenue, economic growth, and organizational profit, innovation methods play a key part in the creation and development of the services given by companies. The innovation strategy, which specifies where, when, and what type of innovation is necessary to be implemented, is now one of the most significant components of corporate planning (Gemici & Alpkan, 2015). The development and implementation of new ideas, strategies, and procedures that improve the value and quality of services given to clients is referred to as service innovation (Pasquale et al., 2016; Ahmad et al., 2022; Lee et al., 2022). It entails the development of new service offerings as well as the enhancement of existing services (Jaskyte & Liedtka, 2022). At the moment, adopting new ways is the greatest strategy to provide exceptional customer experiences (Wang et al., 2023). In this context, service innovation refers to a wide variety of actions, such as the introduction of new technology, the redesign of service delivery procedures, and the incorporation of customer input to constantly improve service offerings (Lee et al., 2022). Furthermore, service innovation entails the creation and implementation of strategies to satisfy changing customer wants and preferences. This can entail customizing services to meet the needs of specific customers (Anna & Emma, 2019),

as well as exploring new markets and target segments (Buccieri et al., 2023). Furthermore, to ensure seamless service delivery and customer satisfaction, service innovation necessitates a significant emphasis on collaboration and partnerships with external stakeholders such as suppliers, distributors, and other service providers. To that end, service innovation is critical for firms seeking customer pleasure and wishing to remain competitive in today's dynamic and ever-changing business market (Soto Setzke et al., 2023).

Service innovation in transportation firms refers to the development and implementation of new ideas, methods, and technology to improve the entire customer experience and the efficiency of transportation services (Gómez-Ortega et al., 2023). It comprises the introduction of new services, procedures, or business models that have the potential to change the way transportation companies operate and interact with their customers (Pasquale et al., 2016). Service innovation in the transportation business focuses on creating value for both the transportation firm and the passengers by providing distinctive and differentiated services that meet their evolving needs and preferences. One example of transportation service innovation is the emergence of ride-sharing applications such as Uber and Lyft, which have changed the way customers hail and pay for rides (Rhee et al., 2023). In addition, the implementation of real-time tracking systems and mobile ticketing solutions has made it easier for clients to plan their excursions and use transportation services while on the go (Agarwal et al., 2023). These technological advancements not only improve the comfort and accessibility of transportation services but also aid in the reduction of traffic congestion and carbon emissions, making them more sustainable (Schroten et al., 2020). According to the Web of Science (WOS), the scholarly literature on the deployment of smart technologies in public transportation has grown exponentially over the last five years (2018-2022) (Brakewood & Watkins 2019, Drabicki et al. 2021). In recent years, transportation businesses have prioritized service innovation as a means of differentiating themselves in a highly competitive industry (Lopez et al. 2021). The introduction of ride-sharing systems, which have transformed the way consumers hail and pay for rides, is one example of service innovation (Ingvardson et al. 2018). Apart from making transportation booking more convenient and efficient, these platforms also include features such as driver ratings and cashless transactions. This has significantly improved user satisfaction and experience (Alade & Edelenbos, 2020). Service innovation is an important factor in the success of service organizations like metros (Arfat et al. 2022). For example, research conducted by YuSheng and Ibrahim (2019) proves that service innovation has a positive effect on customer satisfaction, and customer

loyalty which in turn raises the degree of happiness among the customers who benefit from the service. Furthermore, some transportation firms have begun to provide personalized travel packages, which allow consumers to tailor their itineraries and select from a selection of activities and lodgings. This trend responds to the increased demand for one-of-a-kind and personalized experiences by providing tourists with greater control and flexibility over their journeys. In line with this argument, Romero et al. (2022) stated that personalized travel packages added the value of a customized transit app for metropolitan bus trips. This innovative apps boosts customer satisfaction and loyalty by making people feel appreciated and catered to throughout their travel experience (Gómez-Ortega et al., 2023). Other studies analyze innovation linked to the improvement of factors that can be considered subjective (Duleba & Moslem, 2019), along with the development of techniques and policies based on the planning, design, and operation of transport systems (Alonso et al. 2018; Alkharabsheh et al. 2021; Gutiérrez et al. 2021). In brief, service innovation is crucial in determining the service quality of transportation enterprises. These companies can distinguish themselves from the competition by constantly seeking for methods to develop and enhance their products (Solano et al. 2021). As a result, transportation companies can use service innovation to detect and address difficulties in their service delivery, ensuring that clients receive efficient, dependable, and convenient transportation options (Schot & Steinmueller, 2018). In other words, service innovation not only enhances overall service quality, but it also fosters a favorable brand image and increases passenger happiness (Meelen et al., 2019). As a result, transportation companies like metros can establish strong customer connections and a reputation for excellence by consistently listening to consumer feedback and taking proactive steps to improve their services. Table 1 indicates the key findings from the literature in service innovation in the transport industry.

Table 1. Key findings in service innovation in transport companies

Authors	Transport	Country	Variables	Findings
Gómez-Ortega et al., 2023	Public transport	Spain	Innovation, Sustainability management, Public transport	The policies implemented in both innovation and sustainability are perceived positively but do not seem to have much impact on the service user.

Authors	Transport	Country	Variables	Findings
Pasquale et al., 2016	Urban public transport	Europe, China, Latin America and Singapore	Innovative public transport	The need for innovative public transport solutions is a priority for all cities; integrated network and enabling infrastructure are relevant for most of them
Alade & Edelebos, 2020	Light-Rail Transport	Ethiopia	Sustainable transport, Sustainability factors, Pricing-innovation, Infrastructural-innovation, Innovation-adoption	Economic sustainability factors account for 12 out of 14 sustainability factors and 2 out of 14 social and environmental sustainability factors
Nalmpantis et al., 2019	Co-creation works hops, Crowdsourcing campaigns	Greece, Italy, Netherlands and German	Innovative ideas, Public transport	Innovations are the most promising and provide valuable insight into how to integrate innovation with Public Transport to make it more attractive
Arfat et al., 2022	Metro service	Qatar	Augmented trolley services, Innovative metro journey experience, Internet of Things, Smart city, Radio frequency identification	The Internet of things enabled proposed design of the trolley will take the idea of a smart city step ahead.
Bert et al., 2022	N/A	N/A	Innovations in transport	Innovations have played a very important role in the transport sector and will continue to do so in the future

Authors	Transport	Country	Variables	Findings
Schroten et al., 2020	Transport sector	European Parliament	Emerging technologies, Transport system, Smart mobility	The evidence on the impacts of Smart Mobility applications is only available from small scale pilots, scenario studies and stated preferences studies.
Drabicki et al., 2021	Urban public transport	Poland	Real time crowding information, Urban public transport systems	Its negative effects upon travel experience can be potentially addressed by disseminating real-time crowding information to passengers. However, impacts of real time crowding information provision in urban public transport networks remain largely unknown.
Ingvarsson et al., 2018	Train service	Denmark	Passenger arrival, waiting time distributions, train service frequency, smart card data analysis	important policy implications in terms of providing actual timetables, even at high service frequencies, in order for passengers to be able to minimise their waiting times.
Alam et al., 2021	Metro Rail based Rapid Transport System	Bangladesh	Smart ticketing system, User authorization, Seat reservation, Online payment, Destination announcement system	Incorporated to examine the necessity of the proposed system
Romero et al., 2020	Metro politan bus trips	Madrid	Real-Time Information, Bus passengers, Transit	Apps like Google Maps do not compete with specific transit apps that include

Authors	Transport	Country	Variables	Findings
			app	real-time information because daily commuters require that specific information of their routes
Duleba & Moslem, 2019	Local bus transportation	Turkey	Public transport service development, Analytic hierarchy process	The eigenvectors derived from pairwise comparison matrices are not Pareto optimal in all cases
Alonso et al., 2018	Public Transport	Spain	Urban sprawl, Economic crisis, Public transport efficiency	Policy strategies need to include land use and transport measures to achieve more sustainable public transport systems
Alkharabshah et al., 2021	Public transport	Jordan	Multi-criteria decision-making, Grey theory, Urban public transportation systems	The effectiveness and the applicability of the developed approach for enhancing the quality of the public transport system
Solano et al., 2021	Urban public transport	Spain	Environmental information, Urban public transport	The urban public transport companies in Spain have much to improve about disclosure of their environmental stance

Passenger Satisfaction

Passengers are the essence of every mode of transportation, thus providing a high level of service is the best way to attract and retain them. Every transportation business strives to improve public rail and metro passenger satisfaction (Ibrahim et al., 2019). Passenger satisfaction with public transportation is the deciding element in attracting new and retaining existing passengers (Javid et al., 2013; Ricardianto et al., 2021). To that aim, understanding the wants and requirements of passengers is critical in developing tools to better serve them (Bhanu, 2023). Researchers discovered

several elements that influence passenger happiness, including metro quality, service quality, empathy with commuters, and fare cost (Akob et al., 2021; Javed & Wu, 2020; Simanjuntak 2021). A survey of the literature suggests numerous techniques that metro firms can apply to improve passenger satisfaction (Gemici & Alpkan, 2015, for example, increasing the general cleanliness and maintenance of metro stations and trains is critical). Passengers value a clean and well-maintained environment since it contributes to their comfort and overall experience (Saw et al., 2020). Furthermore, providing accurate and real-time information on train schedules, delays, and any disruptions is critical for keeping passengers informed and reducing frustration (Brakewood & Watkins, 2019). According to reports (Díez-Mesa et al., 2018), metro businesses' service quality has a significant impact on passenger satisfaction. When passengers are content with the service they receive, it reflects well on the overall quality of the service given. This relationship between passenger satisfaction and service quality is critical for transportation companies because it affects their reputation, customer loyalty, and, ultimately, their success (Ekwiriyaton & Hamra, 2022). Ensuring high levels of passenger satisfaction can lead to improved customer loyalty, since satisfied customers are more likely to choose the same service provider for their future travel needs (Esmailpour et al., 2022). Low passenger satisfaction, on the other hand, can have a negative impact on service quality, resulting in decreased customer retention and a tarnished company image. As a result, consistently evaluating and enhancing passenger satisfaction is critical for firms in the transportation industry to thrive and remain competitive (Grujičić et al., 2014; Harahap et al., 2021). In summary, passenger satisfaction research is crucial for the development of public transportation since it provides vital insights into commuter requirements and preferences. Understanding what makes passengers satisfied allows transportation authorities to make informed decisions to improve service quality, improve overall customer experience, and eventually boost ridership. According to the literature analysis in Table 2, evaluating passenger satisfaction allows for the identification of areas that require attention and improvement, resulting in more efficient and effective public transportation systems.

Table 2. Key findings in passenger satisfaction in transport companies

Aut hors	Trans port	Cou ntry	Variabl es	Findings
Abe noza et al.,	Rural motorist comm	Swe den	Travel satisfact ion Public	Three critical attributes-customer interface, operation, network, and journey time-that

Aut hors	Trans port	Cou ntry	Variabl es	Findings
2017	uters		transport	should be given priority by stakeholders are found by contrasting satisfaction with the significance of each quality-of-service feature.
Ayd in et al., 2015	Rail	Turk ey	Custom er satisfact ion	To analyze customer satisfaction levels, statistical analysis, fuzzy analytic hierarchy process, trapezoidal fuzzy sets, and Choquet integral are combined.
Bhar adw aj et al., 2020	Metro rail	Indi a	Service quality, Commut ers' satisfact ion, Organiz ational image	The primary element influencing commuter happiness is their friendliness, followed by factors such as dependability, certainty, safety, and security.
Che n, 2008	Airpla ne	Tai wan	Service quality, perceiv ed value, satisfact ion, behavio ural intentio ns	Passengers' behavioral intentions are found to be directly influenced by perceived value and overall pleasure.
Das et al., 2013	Monor ail	Mal aysi a	Consum er satisfact ion	Waiting area and escalator down, seats given in the train, comfort while boarding train, additional coach and routes to other destinations, parking and public transportation in the surrounding region do not meet the requirement to boost job performance.
De Oña & De Oña, 2015	Metro and bus	Spai n	Service quality, public transport, custome r satisfact ion surveys	Offer an insightful and thorough analysis of the main concerns surrounding the assessment of service quality in the public transportation industry.
De Oña	Light rail	Spai n	Service quality,	Passengers' perceptions of the quality of LRT

Authors	Transport	Country	Variables	Findings
et al., 2016	transit (LRT)		customer satisfaction	service and their happiness with the service have the greatest influence on their behavioral intentions.
Eboli & Mazulla, 2009	Bus	Italy	Customer Satisfaction, Transit Service Quality	Compared to the judgments on perceived quality (degree of satisfaction), the passenger assessments on predicted quality (rating of importance) are substantially more uniform.
Esmailpour, et al., 2022	Bus	Iran	Public transport, Service quality, customer satisfaction and loyalty	Evaluating the COVID-19 pandemic's moderating impact on customer loyalty and offering predictions about future public transportation usage
Giao, 2021	Airplane	Vietnam	Customer satisfaction, Domestic service, Service quality	In order of decreasing significance, the following six indicators of domestic service quality on Vietnam Airlines may be measured: boarding/deplaning/baggage, check-in, in-flight services, reservation, aircraft, and flight crew. They are all directly linked to customer satisfaction.
Ibrahim et al., 2020	Railway	Malaysia	Public transport, Service quality, User satisfaction	If the quality of this essential mode of transportation is to be improved, give useful information to politicians, researchers, and service providers on which service elements are most worth looking at.
Javid et al., 2013	Wagon	Pakistan	Public transportation, Paratransit, Commuters' satisfaction, Service quality	Enhancing the wagon service quality in accordance with the preferences and levels of satisfaction of various forms of transportation

Authors	Transport	Country	Variables	Findings
Jou et al., 2023	Bus	Philippines	Service quality, Customer satisfaction	Supplying a sustainable public bus transportation system can also aid in identifying the important and non-important elements that contribute to raising the standard of service and raising customer satisfaction levels for bus companies across the globe.
Kökalan & Tutun, 2021	Rail	N/A	Passenger satisfaction, public transportation	The demonstration of the readiness for implementation of the passenger satisfaction measure for public transportation
Kumar, 2021	Metro Rail	India	Consumer satisfaction	Most consumers are quite pleased with Hyderabad Metro's convenience offerings.
Laisak et al., 2021	Bus	Malaysia	Service quality, Customers' satisfaction	The characteristics of service quality - empathy, assurance, and responsibility - had a noteworthy impact on consumers' satisfaction.
Niet al., 2020	N/A	China	Passenger satisfaction, public transport	Public transportation companies may focus on three primary components of service characteristics when developing a satisfaction promotion strategy: convenience, safety, and comfort.
Ojo et al., 2014	Bus	Ghana	Service quality, Customer satisfaction, public transport	More over half of the traits were dissatisfied by respondents.
Ong et al., 2022	Light Rail Transit	Malaysia	Service quality, Customer satisfaction	Enhance Malaysia's public transportation system, considering that service quality is a key driver of customer satisfaction.
Pasharibu et al.,	N/A	Indonesia	Price, Service quality, Trust,	Price does not considerably affect consumer satisfaction; instead, service quality

Authors	Transport	Country	Variables	Findings
2018			Customer satisfaction, Online transportation	and trust have a large impact.
Saeidi et al., 2020	Metro	N/A	Service quality, Passenger satisfaction	The latent factors of service quality had a considerable impact on passenger satisfaction.
Sahraei et al., 2023	Metro	Iran	Customer satisfaction	Transit managers should give careful consideration to the quality of service provided by public transportation.
Sawet al., 2020	Metro	Malaysia	Public transport, Passenger satisfaction	Security, safety, and comfort, as well as infrastructure quality and ticket buying facilities, are three important elements in determining passenger satisfaction.
Shamsudin et al., 2020	Bus	Malaysia	Service quality, Customer satisfaction, public transport	In terms of customer satisfaction, tangibles and reliability are important, but the other three dimensions are not supported.
Stuart et al., 2000	Subway	USA	Customer Satisfaction	A number of factors directly affect satisfaction, while other ones do so through intermediary variables.
Tran et al., 2023	Bus	Vietnam	Passengers' satisfaction, Service quality	Habit was a major predictor, although most demographics were not important.
Xue & Chen, 2019	Metro	China	Service quality, Passenger satisfaction, Passenger loyalty	Passenger loyalty and satisfaction are significantly positively impacted by service quality.

Theoretical Background

The innovation in metro services is based on making this service more affordable and accessible. There are several innovation theories that are applicable to transport companies. One commonly used theory is the disruptive innovation theory, popularized by Clayton Christensen in 1997, can also be relevant to transport companies. This theory suggests that new entrants with innovative solutions can disrupt established players in the industry by offering more affordable or convenient alternatives (Si & Chen, 2020). Sustaining innovation is the process of improving products and services for existing customers. As the transportation industry continues to evolve, it is crucial for transport companies to stay ahead by embracing disruptive innovations (Kivimaa et al., 2021). By adopting new technologies or processes, transport companies can improve their efficiency and meet the ever-changing demands of customers (Bongaerts et al., 2017). The theory of disruptive innovation emphasizes the importance of staying agile and open to new ideas, as new entrants with innovative solutions can quickly disrupt the market by offering more affordable or convenient alternatives to traditional transport services (Christensen & Raynor, 2013).

In the context of metro companies, service innovation can be seen as a disruptive force that challenges traditional modes of transportation and revolutionizes the way people commute within urban areas. For example, a metro company may introduce a new app-based ride-sharing service that allows commuters to book shared rides with fellow passengers heading in the same direction. This technology-driven innovation not only provides a more convenient and flexible option for commuters but also reduces congestion and carbon emissions by optimizing vehicle occupancy. As a result, this disruptive service innovation transforms the traditional metro company into a comprehensive urban mobility provider, catering to the evolving needs of urban dwellers. There are lots of reports from the literature that shows how the disruptive innovation helped transport companies to foster innovation in their service and boost service quality, e.g., Urbinati et al. (2018) conducted an exploratory analysis on the contextual factors that influence disruptive innovation by selecting Uber as a case study. While Raynor (2011) studied how disruptive innovation helped the Southwest Airlines case in become more competitive. In other sense, the Southwest's disruptive strategy of innovative operational cost reduction did not produce striking financial returns until it adopted more efficient aircraft, which made its fuel costs competitive. Likewise, Albers et al. (2020) analyzed the effect of the long-haul low-cost airline business model on the air

transport industry from a disruptive innovation perspective.

In the same context, Gemici and Alpkın (2015) applied the disruptive innovation theory to create a competitive strategy in Turkish air transportation industry. They referred to the neglecting of emergence of disruptive forces and eventually, will cause companies unable to survive. Their study revealed the power of disruptive forces and investigating the rapid response to latest innovation in airline industry. In line with aforementioned argument, Fox (2020) highlight of the risks of disruptive technology today and urge transport companies to deal with new technologies with more caution and critically analyze the risks that come with innovation in technologies, especially when it comes to transport companies because complex technologies may cause fatal incidents such as including two fatal crashes, involving the Boeing 737 MAX 8.3. Both of which had a software system fitted called Maneuvering Characteristics Augmentation System (MCAS). While the MCAS4 was intended to help prevent a stall, the unfamiliar action of the plane, due to the system, was believed to be the related cause of these accidents. To that end, the theory of disruptive innovation propounded by Clayton Christensen has been successful in explaining why some apparently well managed companies like Boeing fail under the attack of some new entrants (Madhusudan & Panneerselvam, 2020).

A study on Dubai Metro based on the perspective of disruptive innovation theory should help this company to avoid catastrophic accidents due to the adoption of latest innovation services for metros, e.g., Gui et al. (2018) concluded that sustainable development of mega-projects has drawn many concerns around the world. They suggested that the theory of disruptive innovation in mega-projects is a typical sustainable development pattern but still lacks systematic understanding. In the context of service innovation, disruptive innovations can lead to significant improvements in service quality and passenger satisfaction by introducing novel approaches, technologies, and business models that challenge traditional transport service providers. Thereby, this study used the disruptive innovation theory to develop a framework for understanding the impact of service innovation on service quality and passenger satisfaction. In other words, disruptive innovations are ideal for metro companies and explain how Dubai Metro create value transport networks.

The Impact of Service Innovation on Passenger Satisfaction

Service innovation and passenger satisfaction are two concepts are linked to each other in the ever-evolving

world of transportation. As technology advances and customer expectations rise, transportation companies are constantly seeking new ways to improve their services and enhance passenger satisfaction. Whether it's through the introduction of new amenities, the implementation of innovative technologies, or the adoption of customer-centric approaches, service innovation plays a crucial role in ensuring that passengers have a positive and enjoyable experience throughout their journey. For example, Xu et al. (2020) applied a hybrid method to measure the total effect of each service component in Beijing metro in China on overall passenger satisfaction using a total number of passengers 8,011 as the sample of their study, they found the components of service quality have a significant effect on passengers' satisfaction, e.g., security check and waiting for boarding have the greatest effect on the overall satisfaction. The literature shows lots of academic works that confirm the impact of service innovation on passenger satisfaction in public transport domain, e.g., the result of a study conducted by Chen et al. (2015) showed that customer value was influenced by customer satisfaction and service innovation. In this regard, Shamsudin et al. (2023) referred to understanding passengers' satisfaction and loyalty towards ridesharing services. In the same context, Zahra (2023) reported the effect of e-service quality as the implementation of public service innovation on customer satisfaction and its impact on customer engagement. These findings reveal that service innovation plays a crucial role in shaping passenger satisfaction. By constantly introducing new and improved services, transportation providers can enhance the overall travel experience for passengers. These innovations can range from the introduction of state-of-the-art entertainment systems to personalized in-board services, to streamlined and efficient transit processes. Each of these advancements not only meets the evolving needs and expectations of passengers but also adds value to their journey, ultimately leading to higher levels of satisfaction among the passengers.

In the same context, Etale and Akpi (2022) carried out to provide a clear-cut understanding of the concept and principles of customer satisfaction, as it relates to service innovation of transportation in Indonesia. Service innovation was used as the independent variable to ascertain the nature and strength of the relationship of its dimensions which were selected to be technological innovation and service process innovation, and their relationship with customer satisfaction. The findings of their study pointed to a significant positive relationship between the two variables and informed the study to recommend that: firms should strive to innovate their service to match the dynamic needs of the customers, and firms should constantly improve on the service processes to become more efficient and effective. In line

with the aforementioned findings, Gui and Wu (2020) reported that customized passenger transport services through innovated tools gained positive awareness within the vast majority of passengers and it had a bright future in the field of road transportation markets. Likewise, Rahaju et al. (2020) fostering public service innovation in bus service improves the accessibility of public transportation which enhanced passengers' satisfaction. While Yudhanto and Nurjaman (2022) found that public service innovation through the implementation of the e-boarding pass system on long-distance trains contributed to passenger satisfaction. It is evidenced that innovation in public transport plays an important role in shaping passenger satisfaction. With the ever-evolving needs and demands of passengers, it is essential for transportation authorities to constantly innovate and improve their services. By introducing new technologies, implementing efficient systems, and enhancing the overall passenger experience, public transport such as metros can become more convenient, reliable, and enjoyable for its users. Ultimately, by prioritizing innovation, metro transport authorities can create a more efficient, user-friendly, and sustainable transportation system that meets the evolving needs of passengers.

Conclusions

The public transit service such as metro usage relies significantly upon passengers' satisfaction with its service quality. Therefore, the influence of service innovation in Metro systems needs to be studied from passenger perspectives to ensure that those who are using Dubai Metro are pleased with the service and satisfied, all these factors will ensure sustainable development in metro systems not only in Dubai but also in other Emirates. To that end, investing in and maintaining a well-functioning metro infrastructure is critical for constructing sustainable and livable cities, allowing Dubai Metro to focus on service innovation to increase passenger satisfaction and stay ahead of the competition. Dubai Metro can provide passengers with a seamless and efficient travel experience by constantly improving their technology and services. This might involve adding smart ticketing systems, real-time train timetable updates, and eco-friendly efforts such as energy-efficient trains. By prioritizing innovation, Dubai Metro can not only fulfill the changing requirements of its citizens but also establish itself as a world-class transportation system that other cities may emulate.

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