THE IMPACT OF TRANSIT ORIENTED SHOPPING MALL DEVELOPMENTS ON METRO STATION RIDERSHIP: DUBAI CASE

A Thesis submitted by

Ayman Ragab Abutaleb

For the award of

Doctor of Philosophy

2021

Dedication

To the soul of my father who passed away during the revision of this thesis, the caring people around me who lit my way during dark and difficult times,

with a heart full of love, I

dedicate and attribute my achievement to you.

My father

I will miss you and miss your support. I am sure you are in a better place now. May your soul rest in peace.

My mother

All I want is your happiness and for you to be satisfied with your son.

You are the reason I am who I am. I hope that you are proud of me. May god bless you and keep you healthy and happy.

My wife

I know it took a lot to support me in my study, Rania Aldeeb, thank you for being patient and supportive when I needed support. May god reward you with all that you wish for and give you joy and happiness.

My children

You are my life and the better future I wish for.

Brother and sister

May god fill your life with joy and happiness.

Thank you all.

Abstract

Shopping malls can be developed as Transit Oriented Developments (TODs), where shoppers drive their cars less and ride nearby mass transit. By design, TODs, such as shopping malls near transit stations, invite shopper passengers to use those nearby transit stations. In this research, the attractiveness of Transit Orientated Shopping Mall Developments (TOSMDs) are considered. The existing modelling of transit station ridership forecasting does not adequately integrate all salient factors impacting transit station ridership and does not specifically consider different TOSMD attractiveness factors. Therefore, this research aims to identify TOSMD attractiveness factors and empirically clarify their impact on shopper passenger ridership at Dubai Metro Redline stations near TOSMDs.

This research systematically reviewed the urban transport planning and retail literature to establish a framework for these attractiveness factors, using the elements of the extended service marketing mix (product, price, place, promotion, people, physical evidence and process) and the five factors related to TODs (density, diversity, urban design, destination accessibility and distance). Guided by the established framework, a sample of 700 shopper passengers was then surveyed at seven metro stations near TOSMDs in the United Arab Emirates (UAE). The survey data was analysed using a Principal Component Analysis approach to Exploratory Factor Analysis, and then Structural Equation Modelling was employed to explain the attractiveness factors' impact on shopper passenger ridership at the stations near the shopping mall developments.

The analysis validated 12 independent attractiveness factors associated with the extent of shopper passenger intention to use stations nearby shopping mall developments. In the case of the Dubai Metro Redline, seven factors (product, price, place, people, promotion, density and distance) were shown to have a significant impact on shopper passenger ridership preferences. This impact was found to be mediated by two contextual attractiveness factors: the location context and the store context. Furthermore, resident and tourist shopper passengers differed in the factors impacting their ridership at stations near shopping mall developments.

This research contributes to the further understanding of TOD as it combines the retail and urban transport design literature and provides an insight into transit station usage. It empirically demonstrates the links between TOSMD attractiveness factors and shopper passenger ridership at nearby stations, where other level of service factors such as punctuality, availability, public transport policies and fare level are neutralised. The study identifies TOSMD attractiveness factors as a modifying input to be considered for future passenger forecasting models at station level to ensure that they align the transit service level with the demand pattern of shopper passengers flowing from nearby shopping malls.

Certification of Thesis

This thesis is the work of **Ayman Ragab Abutaleb** except where otherwise acknowledged, with the majority of the authorship of the journal articles presented as a Thesis by Publication undertaken by the Student. The work is original and has not previously been submitted for any other award, except where acknowledged.

Principal Supervisor	Professor Kevin McDougall
Associate Supervisor	Associate Professor Marita Basson
Associate Supervisor	Dr Rumman Hassan
Associate Supervisor	Dr Muhammad Nateque Mahmood

Student and supervisors' signatures of endorsement are held at the University.

Statements of Contributions

The journal articles produced from this study were a joint contribution of the authors. The details of the scientific contribution of each author are provided below:

- **Journal Article 1:** Abutaleb, A., McDougall, K., Basson, M., Hassan, R., & Mahmood, M. N. (2019). Towards a Conceptual Framework for Understanding the Attractiveness of Rail Transit-Oriented Shopping Mall Developments (TOSMDs). *Urban Rail Transit*. (Q1 journal)
  DOI: https://doi.org/10.1007/s40864-019-00112-4

  The overall contribution of **Ayman Abutaleb** was 60% for the concept development, design of experiments, experimental works, analysis and interpretation of data, drafting and revision of the first and subsequent versions. **Kevin McDougall**, **Marita Basson**, **Rumman Hassan** and **Nateque Mahmood** contributed to the concept development, design of experiments, analysis and interpretation of data, editing, and provision of important technical input at **15%**, **9%**, **9%**, and **7%**, respectively.

- **Journal Article 2:** Abutaleb, A., McDougall, K., Basson, M., Hassan, R. and mahmood, M. N. (2020b). Understanding Contextual Attractiveness Factors of Transit Orientated Shopping Mall Developments (Tosmds) for Shopping Mall Passengers on the Dubai Metro Red Line. *Planning Practice & Research*, 1-22. (Q2 journal)
  DOI: https://doi.org/10.1080/02697459.2020.1829282

  The overall contribution of **Ayman Abutaleb** was 65% for the concept development, design of experiments, experimental works, analysis and interpretation of data, and drafting and revision of the first and subsequent versions. **Kevin McDougall**, **Marita Basson**, **Rumman Hassan** and **Nateque Mahmood** contributed to the concept development, design of experiments, analysis and interpretation of data, editing, and provision of important technical inputs at **13%**, **8%**, **6%**, and **8%**, respectively.

- **Journal Article 3:** Abutaleb, A., McDougall, K., Basson, M., Hassan, R. and Mahmood, M. N. (2020). The Impact of Transit-Oriented Shopping Mall Developments (TOSMDs) on Metro Station Ridership: Dubai Metro Redline. *Urban Rail Transit.* (Q1 journal)
  DOI: https://doi.org/10.1007/s40864-020-00129-0

  The overall contribution of **Ayman Abutaleb** was 70% for the concept development, design of experiments, experimental works, analysis and interpretation of data, and drafting and revision of the first and subsequent versions. **Kevin McDougall**, **Marita Basson**, **Rumman Hassan** and **Nateque Mahmood** contributed to the concept development, design of experiments, analysis and interpretation of data, editing, and provision of important technical inputs at **11%**, **7%**, **5%**, and **7%**, respectively.

Acknowledgements

There are a number of individuals/organisations without whom this thesis may not have been possible to present in its current form. I am heartily grateful to:

- **Professor Kevin McDougall**:

No words can describe my appreciation for your support throughout my PhD study. Your academic knowledge, professionalism and dedication have always inspired me. I will never forget how you regularly dedicated your time to me, even when you were travelling or when you were experiencing personal and health issues. All I can say is, thank you so much!

- **Associate Professor Marita Basson**:

I felt your support like nobody else in the world, particularly when I had family issues in 2018. During those bad moments, only you overwhelmed me with warm, comforting and cheering words. Your advice and support were very helpful. Your word choice and writing skills are absolutely exceptional. I have admired your academic writing style and guidance in improving my academic writing. I have always felt lucky to learn from you. All I can say is, thank you so much!

- **Dr Rumman Hassan**:

I am extremely grateful to you for your support in strengthening my research. Your guidance in Marketing was a cornerstone of my research project. I have admired your research skills and learned a lot from you about setting up my research project. All I say is, thank you so much!

- **Dr Nateque Mahmood**:

Like the conclusion of my research, I left you until last because this is how I feel about your support. I will never forget how the dream of completing my PhD vanished when I did not have a supervisory team. Then I received that email from you saying that you found the kind supervisory team I have. May God return your favour to me and send an angel to help your children the day they need support in their study. God bless you and your family. Without you, my research would not have been possible. All I can say is, thank you so much!

- **Dr Enamul Kabir** and other members of the USQ Statistical Consultancy Unit (SCU) for their assistance in the statistical work relevant to this thesis.
- **Ms Sandra Cochrane** for proofreading this thesis.
- A special thanks goes to **my father Ragab Abouelseoud Abutaleb** who passed away during the review of this thesis **and my mother** for their prayers and support and **Rania Aldeeb** (my wife) **and my children** for their personal support, patience, and sacrifice.
- This research has been supported by an Australian Government Research Training Program Scholarship.
- Last but not least, the **ALMIGHTY ALLAH**, for placing such good people around me, including my supervisors and family.
- To those whom I failed to mention but have been a great part of this endeavour, thank you.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

AFC	Automatic Fare Collection
AGFI	Adjusted Goodness of Fit Index
CBD	Central Business District
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
df	Degrees of freedom
EDLP	Every Day Low Pricing
EFA	Exploratory Factor Analysis
GFI	Goodness-of-Fit
GLA	Gross Leasable Area, also known Gross Floor Area (GFA)
NFI	Normed Fit Index
O-D	Origin–Destination
PCA	Principal Component Analysis
PFMs	Passenger Forecasting Models
RMR	Root Mean Square Residual
RSP	Resident Shopper Passenger
RTA	Roads and Transport Authority (Dubai)
SBFs	Station Boarding Factors
SEM	Structural Equation Modelling
SM	Shopping Mall
TCRP	Transit Cooperative Research Program
TOD	Transit Oriented Development
TOSMD	Transit Oriented Shopping Mall Development
TSP	Tourist Shopper Passenger
TTP	Tourist Transit Passenger
UAE	United Arab Emirates

Chapter 1 Introduction

1.1 Background

In 2014, the Global Shopping Centre Report released by Cushman & Wakefield (2014), noted a significant increase in the gross leasable areas (GLA) of shopping malls in a number of countries. In the second half of 2013, the growth in added shopping area was 10.8% in Ukraine (approximately 340,000 m^2) and 6.9% in Poland (approximately 340,000 m^2). Similar growth was taking place in other countries such as Turkey and France. The report indicated that shopping malls are a major economic ecosystem in a city and drive economic and social development. Although the GLA of U.S. malls (618.3 million m^2) dominated the GLA of global shopping centres (924.5 million m^2), growth was higher in Russia where 34 new shopping malls were added (approximately 1.0 million m^2) in the previous two years.

However, the mall GLA growth rate has been variable across different countries (Cushman & Wakefield, 2016). The U.S. report released by Cushman & Wakefield (2017) showed more than 4000 major chain closures, and the changing consumer attractiveness of grocery stores, dollar stores and dining experiences. Changes in shopping mall attractiveness factors helped explain different shopping mall development patterns and a focus on mixed-use redevelopment. Since this change in focus, shopping malls most often include stores, food courts, restaurants, cinemas, children's play areas, interactive entertainment, social use areas, relaxation spaces and promotional areas (Farrag et al., 2010).

In some cities, the growth of shopping malls has become a significant element in the urban landscape as better mobility can improve a city's economy, tourism intensity (Albalate and Bel, 2010) and place marketing. Place marketing is the design of a place to satisfy the needs of its target markets (Kotler et al., 2002). It implies creating competitive market offerings that satisfy the city's target market needs better than other places (Colomb, 2012; Eshuis et al., 2012; Gertner, 2011; Hospers, 2011; Kavaratzis, 2007; Kotler and Gertner, 2011).

The timing, scale and location of new malls are also not predictable, and a lack of planning and vision has led to chaotic developments and people congestion at market places (Kok, 2007). In addition, the level of people congestion is likely to be higher when there is a wider assortment of services and products being provided by large shopping malls (Rajagopal, 2009).

A transit station near a shopping mall can reach its capacity in a short time as a result of the passenger congestion experienced in the nearby shopping mall (Kok, 2007). Reaching transit station capacity can result in costly upgrades and disruption to the rail service and travellers. The growth in a city's resident population, as well as visiting tourist ridership, exacerbates this problem. Therefore, the issue of people congestion at metro stations due to the failure to cope with shopper passengers visiting nearby shopping malls can sometimes be disguised. People congestion at the station can be incorrectly perceived as a sign of successful station design and location decisions.

In countries such as the United Arab Emirates (UAE) and cities such as Dubai (one of the fastest growing cities in the world), understanding the factors which impact the attractiveness of major shopping mall developments near metro stations is important for the future planning of the transit system. Dubai is home to some of the largest shopping mall developments in the world; many of which are in close proximity to the city's transit system. Additionally, as a major airline hub and stopover location, there is a significant mix of resident and tourist passengers utilising the metro system and shopping malls. Such experience motivated this research which examines Transit Orientated Shopping Mall Developments (TOSMDs) attractiveness factors and empirically clarifies their impact on shopper passenger ridership at stations on the Dubai Metro Redline.

To understand passenger ridership on a transit system, Passenger Forecasting Models (PFMs) are utilised to predict passenger numbers at transit stations on a metro network as a function of station environment and transit features (Cervero, 2006; Chu, 2004; Kuby et al., 2004). These models have applications such as forecasting the potential station ridership along transit corridors, identifying the factors contributing to station boarding, optimising the transit station design, and deciding a station's future expansions and design modifications. Several studies have also been conducted to determine the factors driving station ridership and station boarding (Chan and Miranda-Moreno, 2013; Sohn and Shim, 2010; Taylor and Fink, 2003; Zhao et al., 2013a, 2013b).

The relationship between TOSMD attractiveness factors and nearby transit station capacity has not been investigated extensively. A TOSMD is simply a shopping mall (SM) near a transit station in a transit oriented development (TOD) context. By design, it invites residents, workers, and shoppers to drive their cars less and ride mass transit more (Bernick and Cervero, 1997; Cervero, 2004). As a result, a metro station near a TOSMD can reach its capacity, fail to

absorb its shopper passengers (both resident and tourist), and experience people congestion inside the station soon after its development.

The array of TOSMD attractiveness factors impacting ridership is not currently included in station ridership forecasting models (Cervero, 2006; Chu, 2004; Gutiérrez et al., 2011; Kuby et al., 2004; McNally, 2000). Several scholars have studied TOD principles (Mingqiao et al., 2014; Newman, 2009; Thomas and Bertolini, 2014), rail ridership (Boyle, 2006; Choi et al., 2012; Chu, 2004; Taylor and Fink, 2003), and the relationships between them (Acheampong and Silva, 2015; Cervero, 1994; Sung and Oh, 2011). The majority of these studies focus on the impact of transit systems, stations, land use, and value creation. Studies of transit level of service and Origin-Destination (O-D) trip analysis took over attention (Cervero and Duncan, 2002; Chen et al., 2011; Du and Mulley, 2007; Gutiérrez et al., 2011; Zhao et al., 2007). Other studies focus on shopping mall characteristics and analyse shopping mall patronage within the shopping mall context, without mentioning the reverse impact of the specific mall characteristics on the forecasting models of ridership of a nearby transit station (De Juan, 2004; Mundell, 2013; Telci, 2013; Thang and Tan, 2003).

Furthermore, less attention has been given to the factors impacting access and mobility within a tourist attraction or destination (Hall, 1999). Therefore, passenger forecasting models tend to pay less attention to tourist passengers by keeping the supply of public transport at the same level and tolerating a certain degree of congestion during tourist seasons (Albalate and Bel, 2010). Recent studies have focused solely on the general impact of the characteristics of TOD on increasing transit ridership and dispersing transit ridership in a timely manner (Chan and Miranda-Moreno, 2013; Lin and Shin, 2008; Sung and Oh, 2011).

In summary, several studies have been conducted to evaluate and clarify the factors driving station ridership and station boarding (Chan and Miranda-Moreno, 2013; Sohn and Shim, 2010; Taylor and Fink, 2003; Zhao et al., 2013b) without capturing TOSMD attractiveness and tourist shopper passengers (TSPs) in passenger forecasting models (PFMs).

1.2 Research problem

As discussed, the existing forecasting modelling of transit station ridership does not adequately integrate all salient factors impacting transit station ridership and neglects to consider different TOSMD attractiveness factors. Investment in infrastructure needs to be distributed where the best effect can be achieved when developing future metro stations.

Additionally, enhancements to existing transit station forecasting models need to capture the varying impact of TOSMD attractiveness factors of both resident shopper passengers (RSP) and tourist shopper passengers (TSP) on ridership at transit stations in tourist locations. Hence, in order to contribute to the solution to this problem, there is a need to understand the relationship between metro station shopper passenger ridership represented by the preference for using nearby stations and the attractiveness factors, for optimal TOD implementation and transit network sustainability.

1.3 Aim and objectives

The aim of this research is to contribute to the accuracy and comprehensiveness of existing models used to forecast a transit station's ridership by understanding the impact of TOSMD attractiveness factors as a modifying input to be considered for future passenger forecasting models at a metro station. Therefore, the main objectives are summarised as follows:

1. Establish a conceptual framework for TOSMD attractiveness factors and their impact on shopper passenger ridership at metro stations near rail TOSMDs **(Chapter 2)**
2. Identify critical contextual TOSMD attractiveness factors contributing to the shopper passenger ridership at metro stations serving those TOSMDs **(Chapter 4)**
3. Identify and clarify the factors of attractiveness of Resident Shopper Passenger (RSP) ridership that makes up part of the total ridership at metro stations near TOSMDs **(Chapter 5)**
4. Identify and clarify the factors of attractiveness of Tourist Shopper Passenger (TSP) ridership that makes up part of the total ridership at metro stations near TOSMDs **(Chapter 5)**
5. Evaluate correlations and significant direct and mediating effect of TOSMD attractiveness factors impacting resident and tourist shopper passenger ridership at stations near TOSMDs **(Chapter 5 and 6)**.

1.4 Research questions

The main question of the research is: How do TOSMD attractiveness factors impact the ridership preferences (in the form of shopper passengers) at a nearby transit station?

To answer this question, the following research sub-questions were framed:

1. What are the TOSMD attractiveness factors influencing close metro station shopper passengers?
2. What is the relationship between the metro station's RSP ridership, explained by RSP ridership preferences and TOSMD attractiveness factors?
3. What is the relationship between the metro station's TSP ridership, explained by TSP ridership preferences and TOSMD attractiveness factors?
4. How do the ridership of resident and tourist shopper passengers at a metro station change with different TOSMD attractiveness factors?

1.5 Initial conceptual framework for TOSMD attractiveness factors

The research proposed an initial conceptual framework for TOSMD attractiveness factors as shown in Figure 1.1. It is adapted from the station ridership conceptual framework developed by Sohn and Shim (2010) based on previous studies of Chu (2004), Taylor and Fink (2003) and Estupiñán and Rodríguez (2008). Their theory holds that metro station ridership factors are driven by the built environment, external connectivity and intermodal connection (Sohn and Shim, 2010). The built environment can be a shopping mall, and shopper passengers can be part of the total station ridership. TOSMD was explained earlier as a shopping mall (SM) near a rail transit station in a TOD context, where shoppers drive their cars less and ride nearby mass transit. This shopper passenger ridership is assumed to vary based on the characteristics of the built environment, including TOSMDs.

Therefore, this research assessed TOSMD attractiveness factors (independent variables), explained by shopping mall attractiveness factors (internal factors) and TOD design factors (external factors), on shopper passenger ridership (dependent variable) at metro stations near TOSMDs, as illustrated in Figure 1.1.

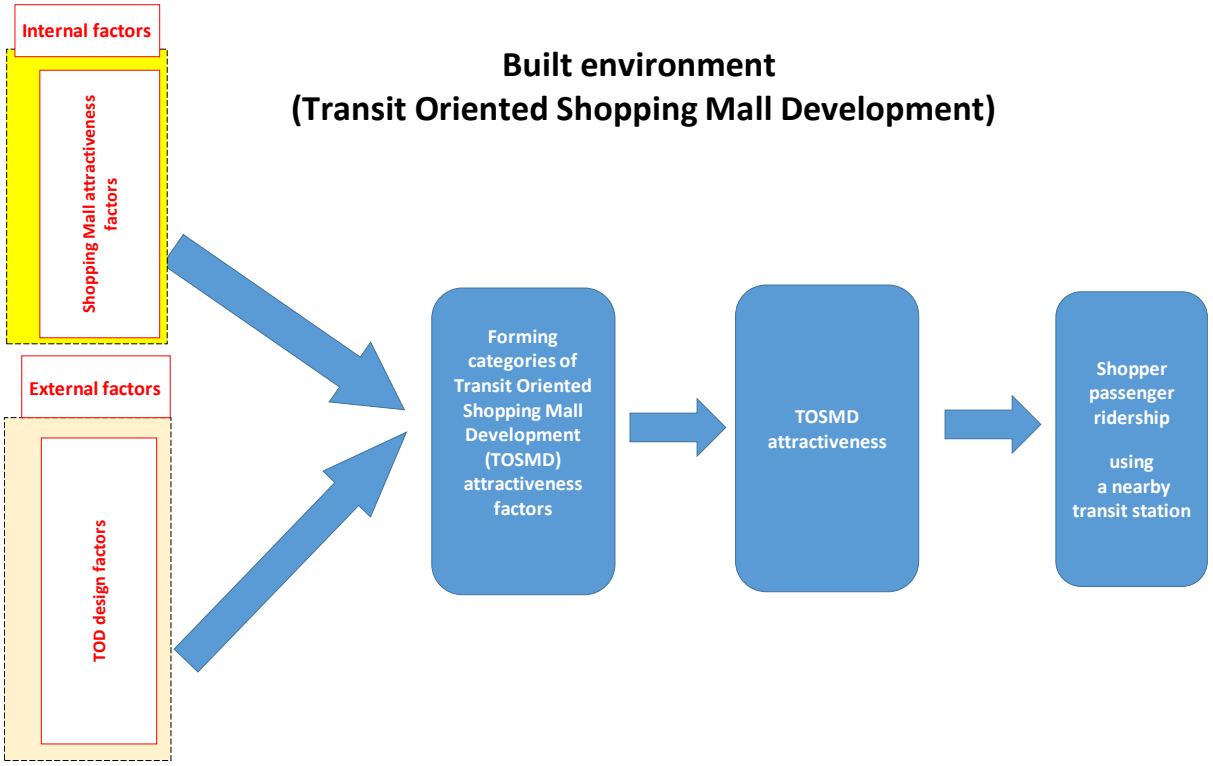


Figure 1.1 Initial conceptual framework for TOSMD attractiveness factors. Adapted from Sohn and Shim (2010)

However, some variables may not only have a direct impact on shopper passenger ridership preferences at stations near TOSMDs, but they may also play a mediating role. Therefore, the proposed framework in Figure 1.1 shows the initial relationship between the attractiveness factors and shopper passenger ridership variables. The above framework helped to perform the review of the literature and develop a conceptual framework for TOSMD attractiveness factors impacting shopper passenger ridership at nearby transit stations (refer to Journal Article 1). The literature review and final conceptual framework for TOSMD attractiveness factors were then used to design the research methodology used to answer the research questions (see Chapter 3). The next section explores the scope and limitations of the research.

1.6 Scope and limitations

This research is limited to considering the one-direction impact of the attractiveness factors on shopper passenger-ridership at metro stations within a walkable distance of approximately 0.8 km (Gutiérrez et al., 2011; Kuby et al., 2004; O'Neill et al., 1992; Zhao et al., 2003). Level of service factors such as headway, punctuality, reliability, public transport policies and fare level

were neutralised by selecting a geographical service context, namely the Dubai Metro Redline. Intermodal connections, external connectivity (Sohn and Shim, 2010) and other modal choice behaviours of passengers were not included in the research.

There are few studies directly addressing the study problem within a homogeneous one-study context capturing metro station ridership and TOSMD attractiveness factors. So, this research used a single case rather than a comparison of different cases. Although the case study methodology, particularly a single case, is inconsistent with the requirements of generalisation (Schofield, 2002; Yin, 1981), Yin (1994) and Flyvbjerg (2001) indicated the value of using typical cases in analytical generalisation and the ability of a theory to be tested in a similar theoretical setting to further define its explanatory power (Thomas and Bertolini, 2014).

1.7 Research major areas of contributions

This research contributes to:

1. providing clarity on mall attractiveness factors and transit station ridership details (Objective 1)
2. expanding the knowledge base for contextual TOSMD attractiveness factors contributing to malls' mixed-use choices, variation in mall growth, and passenger ridership preferences at stations serving those malls (Objective 2)
3. better explaining resident and tourist shopper passenger ridership preferences and the factors that could encourage the utilisation of stations near TOSMDs (Objectives 3 and 4)
4. the understanding of shopper passenger ridership factors which inform transit station design and the design of surrounding externalities (Objectives 3 and 4)
5. the understanding of shopper passenger ridership factors in increasing the economic sustainability of transit networks and guiding government spending on them (Objectives 3 and 4)
6. enhancing existing transit station PFMs, particularly in the case of the Dubai Metro Redline (Objective 5).

Moreover, this research encourages further studies to align transit service level and TOSMD operating hours with the demand pattern of shoppers and day-visit tourist shopper passengers' flight schedules, to maximise tourists' shopping experiences in cities and improve cities' place marketing strategies.

1.8 Definition of key terms

As terms may vary, definition of key terms are provided in this section. Table 1.1 lists the key terms used in this thesis. The primary areas of research are the attractiveness factors of a shopping mall (SM) near a transit station in a transit oriented development (TOD) context.

Table 1.1 Summary of variables and respective survey questions

Context	The layout and configuration of an urban form; including blocks, parcels, buildings, street networks, pedestrian-oriented attributes, and property land uses (Lee, 2013)
Destination	A region or place with a distinct image that has natural attractions such as climate, hydrology, topography and/or iconic attractions such as amusement parks and shopping facilities (Lawton & Weaver, 2014; Tkaczynski, Rundle-Thiele, & Beaumont, 2010). It will have resources such as accommodation, food and beverages, tour operators and transportation that can be utilised by tourists (Tkaczynski, Rundle-Thiele, & Beaumont, 2010)
Mediating effect/role	Since TOD can result in increased transit ridership (Singh et al., 2017b), contextual factors can have a double (direct and mediating) effect/role on the direct relationship between the independent variables (TOSMD attractiveness factors) and the dependent variable (shopper passengers ridership using a nearby station) based on the conceptual framework for TOSMDs attractiveness factors and the study of Sohn and Shim (2010) and previous studies of Chu (2004), Taylor and Fink (2003) and Estupiñán and Rodríguez (2008). (Singh et al., 2017b)
Resident Shopper Passenger	A person who is not a tourist (refer to tourist definition). Therefore, in this thesis a resident shopper passenger (RSP) refers to a person who is not a tourist, resides in the Dubai area and travels to and from a station nearby a shopping mall using Dubai metro Redline.
Tourism	The sum of the processes, activities and outcomes arising from the interactions among tourists, tourism suppliers, host governments, host communities, origin governments, universities, community colleagues and nongovernmental organisations, in the process of attracting, transporting, hosting and managing tourists and other visitors (Lawton & Weaver, 2014; Tkaczynski, Rundle-Thiele, & Beaumont 2010)
Tourist Shopper Passenger	A person who travels temporarily outside of his or her usual environment (usually defined by some distance threshold) for certain qualifying purposes (Lawton & Weaver, 2014; Tkaczynski, Rundle-Thiele, & Beaumont 2010) of 1) leisure and recreation, 2) visiting friends and relatives, and/or 3) business (Lawton & Weaver, 2014). Therefore, in this thesis a tourist shopper passenger (TSP) refers to a tourist who does not live in Dubai and travels to and from a station nearby a shopping mall using Dubai metro Redline.
Transit Oriented Development (TOD)	A compact, mixed-use community centred around a transit station that -by design- invites residents, workers, and shoppers to drive their cars less and ride mass transit more (Bernick & Cervero, 1997; Cervero, 2004)
Transit Oriented Shopping Mall Development (TOSMD)	A novel concept established by the author referring to a shopping mall (SM) near a transit station in a Transit-Oriented Development (TOD) context (Abutaleb et al., 2019)

1.9 Research road map

The research followed the typical structure suggested by Perry (1998), as shown in Figure 1.2, with reference to the relevant produced journal articles (see the journal articles listed under statement of contributions).

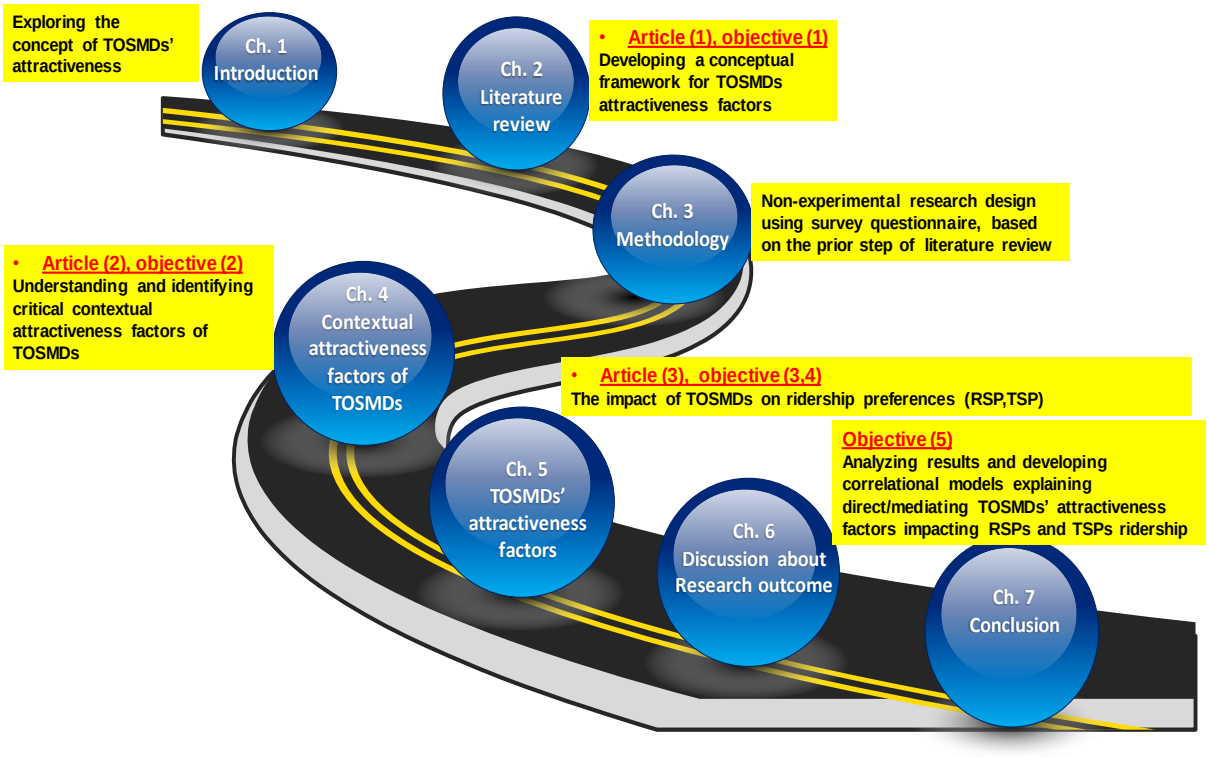


Figure 1.2 Research road map

As can be seen in Figure 1.2, the research comprises seven chapters as follows:

Chapter 1: Introduces the research background, literature review leading to the focus of the research problem, research aim and objectives, and the research questions. An initial conceptual framework of the research follows with the proposed relationships which are to be tested empirically. The methodology determined by similar research is then discussed and the scope and limitations, case study area, major areas of contributions, and definition of key terms are detailed.

Chapter 2: Focuses on reviewing the literature on retail and urban transit planning to identify the attractiveness factors of shopping malls and the design factors of TOD and clarify TOSMD attractiveness factors. This chapter discusses and establishes a conceptual framework for TOSMD attractiveness factors **(refer to Objective 1 and Journal Article 1)**.

Chapter 3 The chapter discusses the research methodology, which utilises the conceptual framework for TOSMD attractiveness factors that was established from the literature review in Chapter 2 as a basis for research design and approach. The chapter discusses the case study choice and the data collection processes, including the survey questionnaire technique used to collect the research data. The sampling design is explained, including the process used to ensure the validity and reliability of the collected responses. The data analysis approach is also discussed to understand the effect of the attractiveness factors on shopper passenger ridership at transit stations near TOSMDs.

Chapter 4: This chapter empirically demonstrates the impact of the location, stores and space contextual factors on shopper passenger ridership measured by their preferences in the case of the Dubai Metro Redline; and is guided by the conceptual framework for TOSMD attractiveness factors established in Chapter 2 **(refer to Objective 2 and Journal Article 2)**.

Chapter 5: This chapter is divided into two parts. The first part empirically identifies the critical TOSMD attractiveness factors and clarifies their impact, in the form of resident and tourist shopper passenger's ridership preferences at Dubai Metro Redline stations near TOSMDs and is guided by the conceptual framework for attractiveness factors established in Chapter 2. The second part covers the relationship between the significant attractiveness factors and the contextual factors of attractiveness, and the ridership of resident and tourist shopper passengers **(refer to Objectives 3 and 4, and Journal Article 3)**.

Chapter 6: Discusses all empirical results from chapters 4 and 5 to answer the research question of how TOSMD attractiveness factors impact shopper passenger ridership at a nearby transit station; guided by the conceptual framework for attractiveness factors established in Chapter 2. It comprises four main sections. First, clarification of the conceptual framework for TOSMD attractiveness factors. Second, clarification of the contextual factors of a TOSMD. Third, clarification of the attractiveness factors of a TOSMD. Fourth, clarification of the interrelationships between the independent attractiveness factors, the mediating contextual factors of attractiveness, and the dependent **(refer to Objective 5 and Journal Articles 2 and 3)**.

Chapter 7: Summarises the overall research findings, including the achievement of the research aim and objectives. It also identifies the research contribution to knowledge and the implications for urban planning and shopping mall operations. Finally, it provides some

concluding remarks for planning practitioners and researchers and directions for future research.

In summary, this chapter provides a background and overview of the research. It specified the research gap and the study's initial framework. Chapter 2 provides a literature review and a conceptual framework for TOSMD attractiveness factors impacting shopper passenger ridership at stations near TOSMDs. Chapter 3 provides a methodology for empirically applying the conceptual framework in the case of the Dubai Metro Redline. The analyses and consolidation of all empirical results are then presented in Chapters 4, 5 and 6 to answer the research question of how TOSMD attractiveness factors impact shopper passenger ridership at a nearby transit station. Contribution to the theory and the body of knowledge is then summarised in Chapter 7. Chapter 7 also provides directions for future research.

Chapter 2 Literature Review

2.1 Introduction

This chapter provides a review of the retail and urban transport planning literature. It includes an outline of the key areas of research in terms of understanding and building knowledge, and it provides a literature review across the relevant areas applicable to this research. The chapter is divided into two parts.

The first part is **Journal Article 1** (Section 2.2). The journal article includes a comprehensive review of the primary research literature of TOSMD attractiveness factors. As a TOSMD is defined as a shopping mall (SM) near a transit station in a Transit-Oriented Development (TOD) context, the article reviews the areas of shopping mall (SM) attractiveness factors and Transit-Oriented Development (TOD) design factors. It then summarises the literature to establish a framework for TOSMD attractiveness factors impacting shopper passenger ridership at stations near TOSMDs.

The second part of the chapter (Sections 2.3, 2.4 and 2.5) reviews passenger forecasting models (PFM), Station Boarding Factors (SBFs) and tourist shopper passengers (TSP), respectively. These areas are not included in the first part (Journal Article 1); however, they have been added to the literature review to provide further understanding and a basis for identifying the research gaps. Several studies have been conducted to evaluate and clarify the factors driving station ridership and station boarding (Chan and Miranda-Moreno, 2013; Sohn and Shim, 2010; Taylor and Fink, 2003; Zhao et al., 2013b) with none capturing TOSMD attractiveness in relation to tourist shopper passengers and the possible impact on passenger forecasting.

The chapter concludes with Section 2.6, which provides a summary of the key findings from the review and the implications of these findings.

2.2 Towards a conceptual framework for understanding the attractiveness of rail Transit Oriented Shopping Mall Developments (TOSMDs) – Journal Article 1

Abutaleb, A., McDougall, K., Basson, M., Hassan, R., & Mahmood, M. N. (2019). Towards a Conceptual Framework for Understanding the Attractiveness of Rail Transit-Oriented Shopping Mall Developments (TOSMDs). *Urban Rail Transit.*

DOI: https://doi.org/10.1007/s40864-019-00112-4

Journal article 1 provided a review of the literature to identify the attractiveness factors of TOSMDs. A Transit Oriented Development (TOD), by design, invites a community to use nearby transit stations. A shopping mall can be developed as a TOD. Transit Oriented Shopping Mall Development (TOSMD) refers to a shopping mall (SM) located nearby a transit station in a TOD context. The attractiveness factors of transit oriented shopping mall developments (TOSMDs) are not specifically addressed in the literature. From the review, it was identified that the majority of researchers distinguish between attractiveness factors of shopping malls and design factors of TODs. The article proposed a conceptual framework for the attractiveness of TOSMDs to clarify the demand of shopper passengers using a transit station near shopping mall developments. The conceptual framework delivers a basis to potentially enhance the existing transit station's passenger forecasting models and increase the economic sustainability of transit networks.

Urban Rail Transit
https://doi.org/10.1007/s40864-019-00112-4

http://www.urt.cn/

ORIGINAL RESEARCH PAPERS

Towards a Conceptual Framework for Understanding the Attractiveness of Rail Transit-Oriented Shopping Mall Developments (TOSMDs)

Ayman Abutaleb[1] · Kevin McDougall[2] · Marita Basson[2] · Rumman Hassan[3] · Muhammad Nateque Mahmood[2,4]

Received: 11 March 2019 / Revised: 30 September 2019 / Accepted: 9 October 2019

Abstract Transit-oriented development (TOD) links residential, retail, commercial, and community service developments to frequent, accessible rail transit services to stimulate sustainable development in the form of decreased land use and transport integration. A mixed-use shopping mall can be developed as a TOD with moderate to high density with diverse land use patterns and well-connected street networks centred around and integrated with a rail transit station. Shopping mall developments are now considered as the retail, social, and community centres of their communities. Therefore, understanding their services' mixed impact on nearby transit stations will provide further insight into the success of the TOD approach. As a result, this study aims to review and link the recent literature on attractiveness factors of shopping malls and the design factors of TOD and report the researchers' analytic observations (themes) clarifying transit-oriented shopping mall developments' (TOSMDs) attractiveness factors. The review systematically synthesises 208 guiding articles. It uses the elements of the extended service marketing mix (product, price, place, promotion, people, physical evidence, and process) and the five factors related to TODs (density, diversity, urban design, destination accessibility, and distance) as an indicator system for the factors determining the attractiveness of TOSMD. The review outcome is utilised to establish a conceptual framework for the attractiveness of rail TOSMDs. The study revealed fragmented causes of attractiveness factors of rail TOSMDs. It contributes to further understanding of TOD as it cross-reviews retail and urban design literature findings. The resultant conceptual framework will also inform and potentially enhance the existing rail transit station passenger forecasting models and increase the economic sustainability of rail transit networks.

Keywords Attractiveness factors · Shopping mall · Transit-oriented development · Rail · Design factors · Service marketing mix

✉ Ayman Abutaleb
aymanabutaleb@hotmail.com

Kevin McDougall
Kevin.McDougall@usq.edu.au

Marita Basson
Marita.Basson@usq.edu.au

Rumman Hassan
Rumman.Hassan@usq.edu.au

Muhammad Nateque Mahmood
n.mahmood@deakin.edu.au

[1] RTA – Rail Agency (CEO Office), P. O. Box 118899, Dubai, UAE

[2] School of Civil Engineering and Surveying, University of Southern Queensland, Toowoomba, Australia

[3] School of Management and Enterprise, University of Southern Queensland, Toowoomba, Australia

[4] School of Architecture and Built Environment, Deakin University, Geelong, Australia

Communicated by Haixiao Pan.

1 Introduction

The concept of transit-oriented development (TOD) is a relatively recent development design approach that links frequent and accessible rail transit services to residential, retail, commercial, and community services [1]. The TOD concept was first proposed by an American architect Calthorpe [2] in the 1990s. It was seen as a response to rapid

Published online: 01 November 2019

urbanisation and traffic congestion and emphasised the greater use of public transport and a reduction in private car use. The TOD approach potentially has significant implications concerning future patterns of development and land use planning in particular, and the understanding of the impact of associated developments such as shopping malls on supporting rail transport planning.

Hence, many researchers have investigated TOD as a planning strategy [3–6]. Generally, transit-oriented developments (TODs) are located within a radius of about 600–800 m of a rail transit station, as outlined in Fig. 1. This distance is considered an appropriate scale for pedestrians walking to and from the station [7–10]. Handy [11] postulated that TODs would serve as a "catalyst" for conserving land use and increase the density of nearby developments, including shopping malls.

With their origins in the USA over half a century ago, shopping malls have brought together multiple retail outlets and facilities within a single complex. However, the function, size, and popularity of shopping malls have changed dramatically over time. As a consequence, many researchers have attempted to shed light on the attractiveness factors of shopping malls to understand the needs of the customers, improve patronage, and increase their turnover [3, 12, 13].

The major elements of shopping malls can include retail stores, food courts, restaurants, cinemas, children's play areas, interactive entertainment, social areas, relaxation spaces, and promotional areas [14]. It was conceived that mixed-use developments such as shopping malls could increase pedestrian activity, as shown in Fig. 2, where people can easily walk to places where they can shop, eat, and play [15]. A mixed-use shopping mall can be developed as a transit-oriented development (TOD), where shoppers drive their cars less and ride nearby mass transit [16]. It is characterised by the creation of a mix of land use and residential density development around rail transit stations to attract customers, with access mainly by foot rather than by cars [17].

A lack of planning and vision has led to poorly designed, accessed, and located developments and to marketplace congestion [18]. The level of human congestion is also likely to be higher due to the wider assortment of services and products provided by shopping malls [3]. Also, the development of shopping mall facilities can contribute to making a rail station area more attractive and potentially increase the potential customer base for the shopping mall [19]. Therefore, in order to better understand and plan for the future demands of TODs that incorporate shopping malls as a key component of the infrastructure, there is a need to consider the attractiveness or "pull" factors of these shopping malls as part of a TOD. The attractiveness factors of transit-oriented shopping mall developments (TOSMDs) are not specifically addressed in the literature. The majority of researchers distinguish between attractiveness factors of shopping malls and design factors of TODs. They are studied separately in retail and urban planning literature, respectively. Therefore, a literature review of both types of factors was essential to identify the attractiveness factors of TOSMDs and establish a conceptual framework for TOSMD attractiveness. The proposed framework will lay the foundation for understanding the extent of shopper passengers using a rail transit station near a TOSMD and potentially enhance existing forecasting models used to estimate the number of passengers using a rail transit station.

Therefore, this study is structured and organised as follows. Section 2 of the paper presents a literature review and findings in the fields of attractiveness factors of shopping malls and design factors of TODs. Section 3

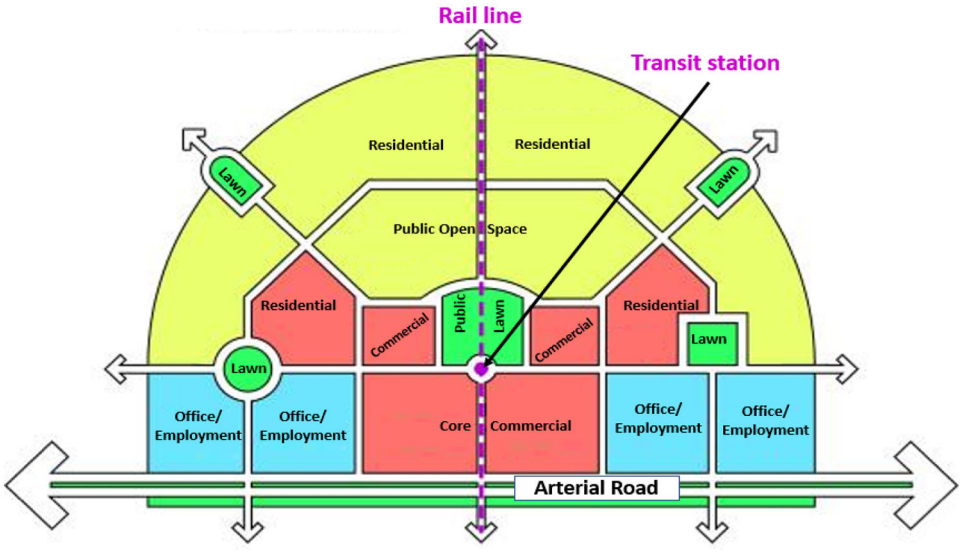


Fig. 1 A basic structure of the TOD community. Adapted from Mingqiao et al. [5]

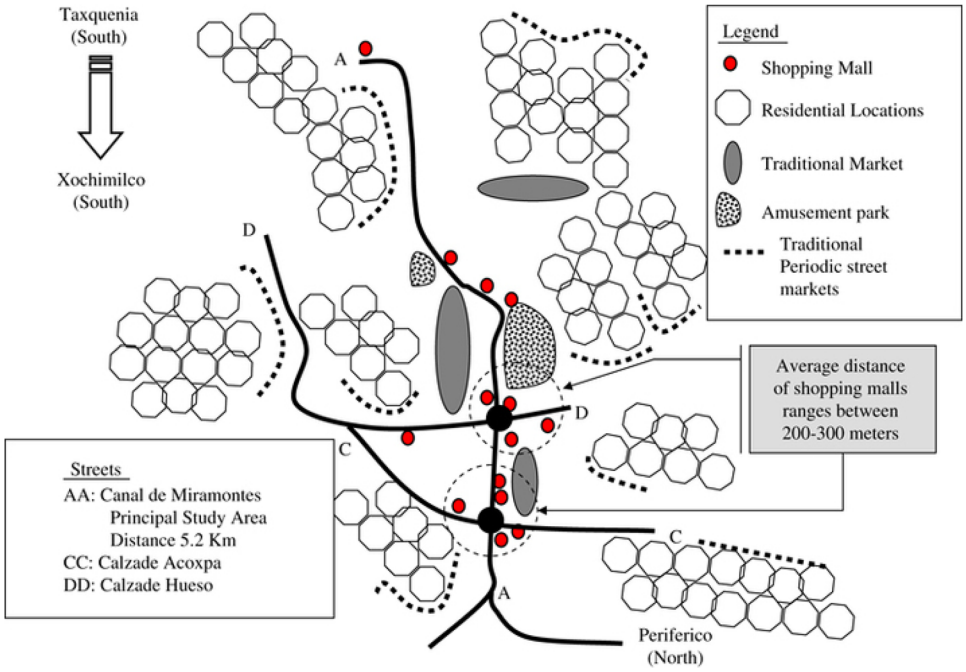


Fig. 2 Example of residential walkways to shopping malls in a TOD community. Adapted from Rajagopal [3]

proposes a conceptual framework for the attractiveness of rail TOSMDs based on a thematic analysis. Section 4 presents a discussion on the application of the framework of rail TOSMDs' attractiveness. Finally, the paper concludes by summarising the major findings from the review, the conceptual framework for the attractiveness of rail TOSMDs, and the implications and limitations of its use.

2 Methods and Literature Review

We took the literature elements of the extended service marketing mix and the TOD concept in order to understand the varying range of attractiveness factors related to shopping malls and the design of TODs, as shown in Fig. 3 to establish a conceptual framework for the attractiveness of rail TOSMDs.

The authors systematically performed an online review of the attractiveness factors of shopping malls and design factors of TODs under the retail and urban land use planning literature. We identified the studies through the search procedure adopted by Busse and Siebert [20]. Using a deductive approach in our search, we limited the literature search to English empirical journals and conference proceedings after 2007. The search summary results are shown in Table 1.

Next, an iterative search of the identified articles resulted in reviewing 208 related articles to identify rail TOSMDs' attractiveness factors. The identified factors were analysed and thematically reclassified using the generic extended service marketing mix (product, price, place, promotion, people, physical evidence, and process) and the 5 Ds (density, diversity, urban design, destination accessibility, and distance) of TOD [21] to establish a conceptual framework for the attractiveness of rail TOSMDs.

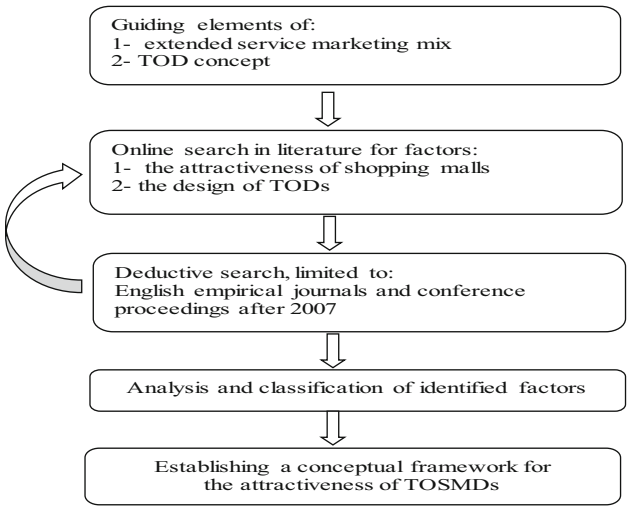


Fig. 3 Research method

2.1 Attractiveness Factors of Shopping Malls

According to Feinberg and Meoli [22], shopping malls emerged in 1907 in Baltimore, Maryland, USA, where a group of stores established off-street parking. In 1922, a group of stores only accessible by car was built in suburban Kansas City. The first enclosed shopping mall was

Table 1 Statistics of journals and conference proceedings

Search dimensions of TOSMDs	Search identifier	Number of journals and conference proceedings	Limiters
Shopping mall attractiveness factors	((“shopping mall”) OR (“shopping centre”) OR (“shopping center”)) AND (“attractiveness factors”)	127	English and after 2007
Transit-oriented development factors	(“Transit Oriented Development”) AND (“factors”) AND ((“shopping centre”) OR ((“shopping center”) OR (“shopping mall”))	81	English and after 2007

developed in a suburb of Minneapolis in 1956. A shopping mall can be a separate complex of shops, department stores, services, and entertainment which simultaneously meet different needs [14]. Shopping malls are now the retail, social, and community centres of their communities. Attractiveness factors of shopping malls have been studied for different reasons, such as predicting and optimising mall patronage [23, 24], identifying the optimal mix of

Table 2 Studies in different cities on attractiveness factors of shopping malls

Author (Ref.), location	Sample	Identified attractiveness factors of shopping malls
González-Hernández and Orozco-Gómez [31]; Guadalajara, Mexico	1500 consumers	Mall essence; popularity and promotional programs; personal service; recreational options; internal atmosphere; external atmosphere
El-Adly [26]; UAE	404 university members	Comfort; entertainment; diversity; mall essence; convenience; luxury
Farrag et al. [14]; Alexandria, Egypt	502 mall visitors	Safety; bargain hunting; convenience; entertainment; freedom; appreciation of modernity; self-identity
Larsen et al. [32]; USA	515 college students	Product and stores assortment; perceived management efficiency; centre maintenance; cleanliness; attitudes and behaviour of the staff
Ke and Wang [30]; Wuhan, China	68 shopping centres’ data	Closeness to metro line station; being in the central commercial area
Prashar et al. [33]; Raipur, India	263 shoppers	Mall distance; attractive façade; climatic control; cleanliness; rest benches
Bilková et al. [34]; Bratislava, Slovakia	11,389 shopping customers	A larger selection of the offered goods; higher quality; leisure activities; opening hours; parking possibilities
Singh and Sahay [35]; Delhi national capital region, India	200 shoppers	Ambience; physical infrastructure; marketing focus; convenience; safety and security
Tandon et al. [28]; New Delhi; Kolkata; Chennai; and Mumbai, India	400 shoppers	Tenant management; facilities management; atmosphere; entertainment
Arslan et al. [24]; Bursa, Turkey	621 young consumers	Retail environment; comfort; secure environment; accessibility; leisure
Anselmsson [36]; Lund, Sweden	770 persons	Atmosphere; merchandise selection; refreshments; promotional activities; convenience; salespeople; merchandising policy; location
Ahmad [37]; Jeddah, S.A.	600 shoppers	Product variety; aesthetic; convenience; accessibility; entertainment; service quality
Teller and Reutterer [38]; Vienna, Austria	1073 shopping mall users	Tenant mix; atmosphere
Singh, Prashar and [39]; Dubai, UAE	200 shoppers	Ambience; physical infrastructure; marketing focus; convenience; safety
Gilboa and Vilnai-Yavetz [40]; Israel	725 mall visitors	Convenience; accessibility; parking; security; tenant mix
Tsai [41]; Tokyo, Japan	298 mall shoppers	Entertainment; atmosphere; product arrangement; service; mall image; special events; refreshment
Tsai [41]; Sydney, Australia	216 mall shoppers	
Tsai [41]; London, UK	324 mall shoppers	
Tsai [41]; New York, USA	392 mall shoppers	

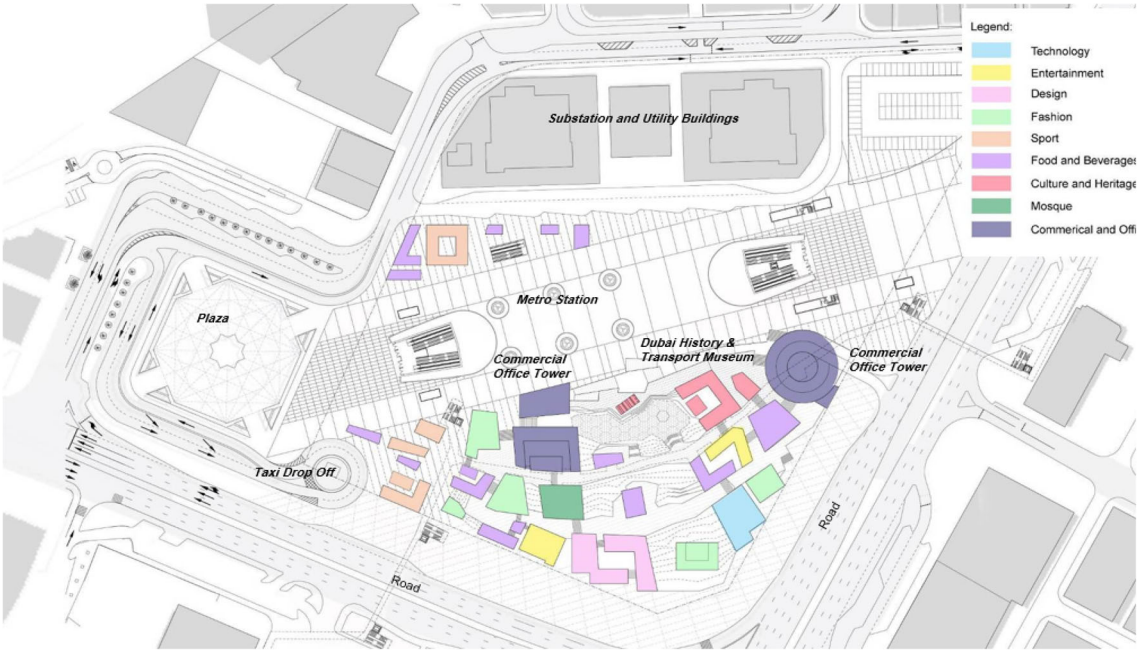


Fig. 4 Universal mixed land use TOD project design drawing and its proposed pedestrian walkways

activities in shopping malls, developing retailing strategies [25–28], understanding socio-spatial dynamics [29], and determining the malls' rent [30]. Attractiveness factors of malls can change from one context to another. The case studies in Table 2 highlight a range of attractiveness factors of shopping malls in several places.

The majority of studies on attractiveness factors of shopping malls focused solely on internal mall characteristics and their impact on mall patronage. Other studies such as Golias et al. [42] and Rajagopal [3] referred to the interrelationship between shopping malls and external context, i.e. habitation pattern, and transit system. For example, the place of a shopping mall is affected by the proximity to areas with increased population. As a result, the commercial growth in some areas led to a reduction of housing and industrial areas as land was converted to shopping malls [43]. However, the current literature does not specifically integrate internal shopping mall characteristics and its external TOD context to adequately explain factors of attractiveness of a shopping mall (pull factors) in a TOD context. We see the general characteristics of products, facilities, and the physical evidence of shopping malls were commonly identified as attractiveness factors. Table 2 shows the diversity of mall attractiveness factors in different places. Although it outlines these factors in different locations, these factors cannot solely explain the attractiveness of shopping malls. Therefore, we argue that other factors relating to the external surrounding context also need to be considered in understanding the attractiveness of a shopping mall (shopping malls pull factors), particularly in a TOD context. Therefore, the external design factors of TODs are considered in the following section to characterise this contextual surrounding environment impacting the attractiveness of shopping malls.

2.2 Design Factors of TODs

The term TOD became a common modern planning term when Calthorpe published The Next American Metropolis in 1993 [44]. A TOD is widely defined as a compact, mixed-use community, centred around a rail transit station that, by design, invites residents, workers, and shoppers to drive their cars less and ride mass transit more [16, 45]. It includes dense and pedestrian-friendly elements [6] and emphasises the creation of residential density and the mix of land use to attract trips, with rail transit station access mainly by foot rather than a car [17]. Figure 4 depicts a universal mixed land use TOD project and its proposed pedestrian walkways for illustration, as shown in Fig. 5.

A mixed-use shopping mall can be developed as a TOD, where shoppers drive their cars less and ride nearby mass transit [16]. TOD is an innovative sustainable solution for high-density urban planning and development [17]. By creating "activity nodes" linked by rail transit, as outlined in Fig. 6, TOD can provide mobility choices in congested areas.

TOD can increase public safety for pedestrians and rail transit users [46], increase transit ridership, reduce rates of vehicle kilometres travelled, and increase households' disposable income. This income increase is a result of the freed-up cash from reducing the need for a car and the travelling cost. It can also reduce air pollution and energy consumption rates, conserve valuable land and open space,

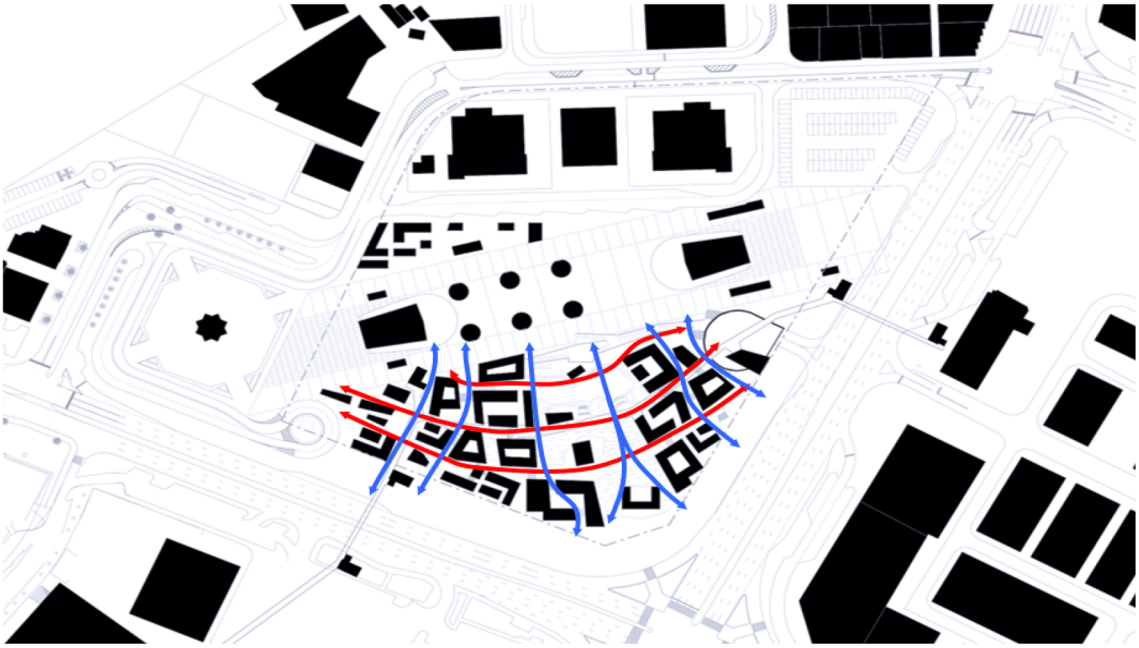


Fig. 5 Universal mixed land use TOD project proposed pedestrian walkways

Fig. 6 Mall of the Emirates' inside link to Dubai Metro

resulting in less land used for urban developments. Consequently, it can improve economic development through transit network sustainability and neighbourhood revitalisation, and contribute to affordable housing with the compact growth pattern and the decrease in infrastructure cost [47].

Design factors of TOD have been studied for different reasons, such as assisting rail transport planners to improve transport sustainability [48], leveraging benefits and quality of urban design [17, 49], urban city policymaking and encouraging the use of public transport [6, 50, 51], optimising investments schemes around transit stations [52], and rail transit ridership forecasting [53]. The effective design factors of a TOD can change from one context to another, e.g. zones [54]. There are case studies in different cities showing a range of effective TOD design factors, as can be seen in Table 3.

The review of the literature identified that urban design of the area, transport characteristics, and the distance between a development and rail transit services were commonly identified TOD factors. Table 3 shows a range of effective TOD design factors in different geographic locations. Therefore, TOD factors reflecting the surrounding context of a particular shopping mall can impact its attractiveness and the number of shopper passengers using a nearby rail transit station.

Table 3 Studies in different countries on effective design factors of TODs

Author (Ref.), location	Sample	Identified effective design factors of TODs
Searle et al. [49]; Melbourne, Sydney, Brisbane—Australia	8 interviewees and an online survey	Location within larger activity centres, for commercial development at smaller-scale TODs
Yap and Goh [6]; Malaysia	103 respondents	Location; future value of the property; traffic congestion in peak hours; safety; cost of living; accessibility; available alternative travel modes; affordability of properties; amenities; availability of private transportation; convenience of public transportation; time-saving
Zeng [55]; China	478 surveys	Location close to workplace; public transport; shopping centre
Loo et al. [53]; Hong Kong, China	79 stations in Hong Kong	Land use; station characteristics; socioeconomic and demographic characteristics; inter-modal competition
Loo et al. [53]; New York, USA	406 stations in New York	
Olaru et al. [17]; Perth, Australia	509 respondents	Physical features; social dimension; proximity to transport facilities; facilities in 5-min driving distance; facilities in 5-min cycling and walking distance
Taehyun et al. [56]; Seoul, South Korea	The Seoul field survey data on pedestrian traffic volume and metro ridership in 2009	Walking on wider streets, whereas narrower streets were preferred in areas further from the metro station; street connectivity; mixed land use
Sun et al. [57]; Beijing, China	495 surveys	Connectivity; pedestrian-friendly designs; higher building coverage ratio around the metro station
Kamruzzaman et al. [58]; Brisbane, Australia	1734 census collection districts (CCDs) data	Node connectivity; frequency and diversity of transport services; walkable distance; number of residents in the areas; workers degree of land-use diversity
Zemp et al. [59]; Switzerland	Swiss Federal Railway's (SBB) railway station database and an earlier study by Reusser et al. [60], 1700 passenger train stations density	Location of railway tracks; centrality of the station; size of catchment area; concentration; access to railway station; customer types distribution; proximate urban density; reputation of vicinity; cultural heritage and historical reference management; connection frequencies; network density; interconnection quality; reputation of public transport; relative attractiveness of private transport
van Lierop et al. [61]; USA	5 interviews with professionals	Physical design; transportation; environment; economy; collaborations; accessibility
van Lierop et al. [61]; Canada	2 interviews with professionals	
van Lierop et al. [61]; Netherlands	6 interviews with professionals	

Therefore, we argue that, in identifying the attractiveness factors of rail TOSMDs, there is a need to consider both the shopping mall attractiveness factors and the TOD design factors jointly. There is also the potential to thematically outline these factors, which have been partly identified in this section and will be discussed in Sect. 3 to establish a conceptual framework for rail TOSMD attractiveness. The conceptual framework will lay the foundation to support the forecast of the number of shopper passengers using a rail transit station near to a TOSMD and potentially enhance existing mobility forecasting models of the number of passengers using the rail transit station near the shopping malls.

3 The Conceptual Framework for TOSMD Attractiveness

The objective of this study is to clarify the attractiveness factors of rail TOSMDs and establish a conceptual framework explaining the attractiveness of TOSMDs. Existing literature does not comprehensively integrate attractiveness factors of shopping malls and design factors of TOD into a single framework that could help to explain rail TOSMD attractiveness, although both shopping mall attractiveness factors and TOD design factors jointly impact the number of shopper passengers using a nearby rail transit station in a TOD context. Section 2 identified

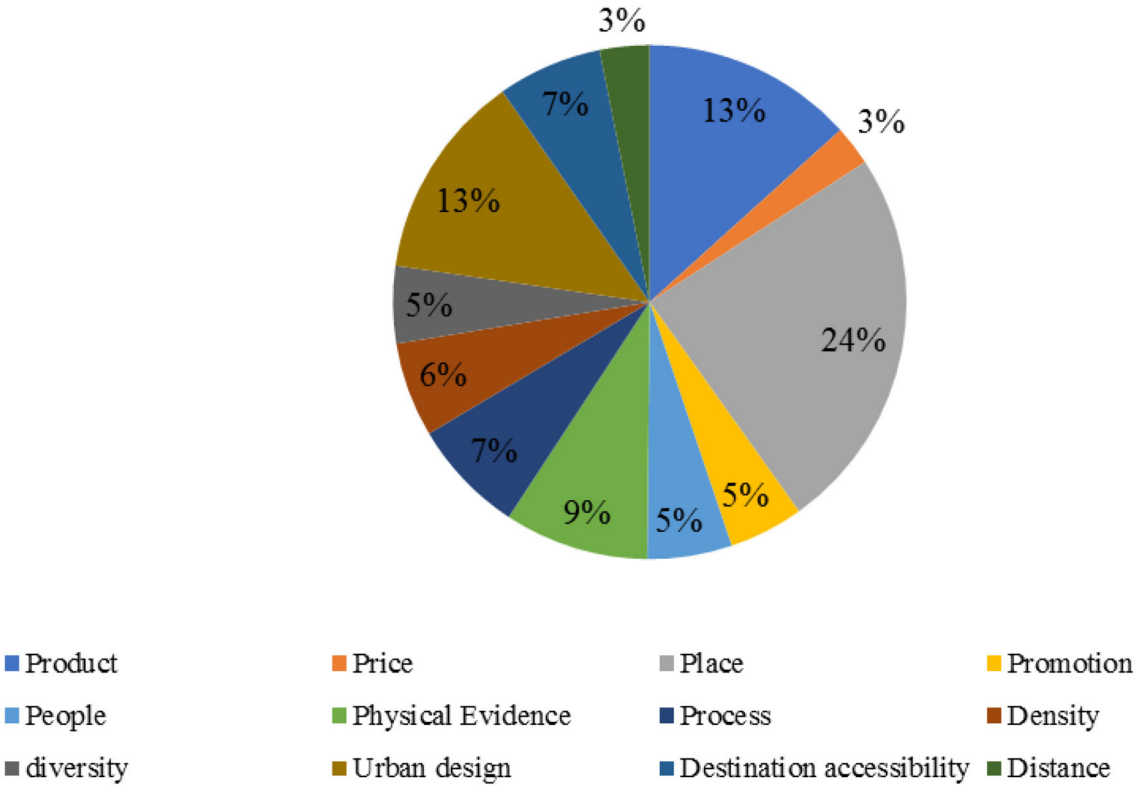


Fig. 7 Indicative weight percentages of the above themes from the study-reviewed cases

the diverse factors underpinning and resulting in shopping mall attractiveness and TOD effective design. Therefore, a generic theoretical framework was used to combine all the literature-identified factors of shopping mall attractiveness and TOD design using the generic extended service marketing mix [62] and the five dimensions (5 Ds, density, diversity, urban design, destination accessibility, and distance) of TOD [21] to establish the framework for rail TOSMD attractiveness. Both types of factors identified in Sect. 2 are thematically presented.

Firstly, the attractiveness factors of shopping malls can be viewed across the following seven dimensions:

Product	It relates to the shopping mall product attributes, in the form of shop types [26, 63], quality [37], variability, and availability [31, 37], the provision and characteristics of mall products [3, 31, 64, 65], and activities [26, 41, 63]. Activities could be leisure and entertainment, cultural activities, cinemas, or game parlours
Price	It relates to the shopping mall pricing attributes, in the form of competitive prices and discounts given at groups of shops in a particular mall. Examples are factory outlet malls [66], bargains [14, 28, 38], price payment options [27], and pricing strategies. Pricing strategies vary from everyday low pricing (EDLP) and promotional pricing (hi-lo pricing) [67]
Place	It relates to the shopping mall place attributes, in the form of mall space [35, 68] mall stores and facilities [41, 63, 64], and mall location [30, 31, 36, 37, 40]
Promotion	It relates to the shopping mall promotional activities, in the form of the mall's promotional campaigns and events [26, 35, 39], incentives and loyalty programs [31, 64], and the mall's advertising [26, 36, 41]
People	It relates to the shopping mall personnel interaction attributes, in the form of the mall's staff helpfulness and friendliness [36, 41, 69], their extended working hours [3, 27, 36], their services offered [14], and the mall's crowdedness [14, 28, 63]
Physical evidence	It relates to the shopping mall exterior and interior environment, in the form of the tangible mall's servicescape [14, 28], internal facilities, and service facilities [14, 26, 28, 35]
Process	It relates to the elements and issues associated with the shopping experience in the shopping mall. It could be in the form of ease of the mall's search process for products and stores [14, 27, 70]. Another form could be in the mall's service offering process, such as home delivery [27, 37, 64, 70]. Also, an additional form could be in the mall's management process, such as crowd management, space management, and freedom [28, 63]

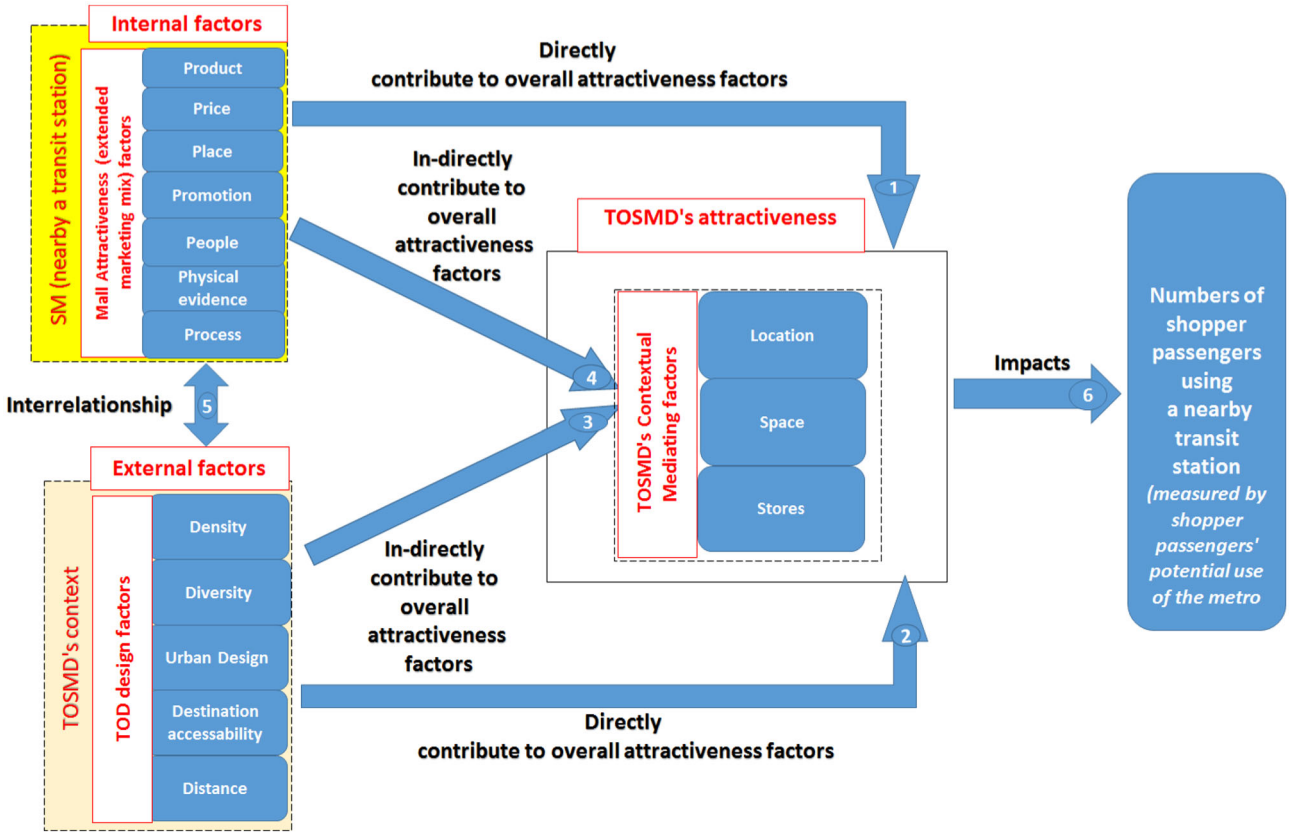


Fig. 8 The proposed conceptual framework for TOSMD attractiveness

Secondly, the design factors of TOD can be considered across the following five dimensions:

Density	It relates to agglomeration and the number of business establishments in a given area [71], built-up area and floor area ratios [57, 72, 73], and population [60, 61, 73]. Hence, it was divisible into a node (e.g. rail transit station) and place (e.g. neighbourhood) components [59]. The idea is that a development with high population density is an indication of high travel demand, possibly high transit ridership, and hence high TOD levels in the area of the development [74]
Diversity	It relates to mixed-use developments' attributes; such as the presence of shops, services, and facilities [17, 57, 75]. It also relates to diverse environment measures, such as the presence of scenic and recreational areas [17, 61, 75], socioeconomically diverse neighbourhoods [72], and land-use homogeneity and dissimilarity [76, 77]
Urban-design	It relates to walkability, such as increasing alternative walkways [6, 57, 58, 78], and walk-encouraging design such as reduced parking areas [61, 75]. Walk-encouraging design could also be applied to environment and landscaping [61, 75], buildings [43, 61, 75], business places [61, 75], and connections [57, 72, 75]. It also relates to cycling-encouraging design, such as cycling ways and cycling areas [6, 17, 60]
Destination-accessibility	It relates to the destination's availability of parking supply and proximity to transit. Destination accessibility could be in the form of walking access [43, 56, 75], facilities access [43, 57, 58, 79], and transport access [17, 60, 61, 75]
Distance	It relates to proximity to transport, the location of rail and bus stations, transport-related service facilities, travel time, and mass rapid transit [17, 61, 73]. TOD, by definition, invites walking for 5–10 min, which is approximately 400–800 m [6]. Studies show that beyond this walking distance, access trips increasingly use cars. Car usage increases as distance increases from the transit station [47]. This increased car usage results in deteriorating traffic conditions and creates the need for parking spaces.

Using the elements of the extended service marketing mix and the 5 Ds of TOD, the study developed a conceptual framework for rail TOSMD attractiveness. The above themes can attract different weights in different contexts. Although a large number of studies related property value and rent. i.e. in a shopping mall to the distance from a

Table 4 Pros and cons of association between TOD factors and attractiveness of a TOSMD

TOD factors	Pros of association between TOD factors and attractiveness of a TOSMD	Cons of association between TOD factors and attractiveness of a TOSMD
Density	It could optimise the prospective number of shoppers, as high population density is an indication of high travel demand and also possibly high patronage [74]	It could increase congestion [18] and eventually make the mall and the area less attractive to some shoppers
Diversity	Commercial growth in some areas led to a reduction in housing and industrial areas as land was converted to shopping malls [43]	The question is what mixtures will optimise effective mixed-use TOSMD [72]
Urban design	It could potentially optimise the attractiveness of a TOSMD. It is common to see metro stations connected with a nearby TOSMD via a walking bridge to encourage and facilitate coming to the mall via public transport and walking from the station to the mall	We showed earlier that some studies showed a negative impact of increased crime, noise, and vibration (as a result of train movement), which in turn could cause shopping malls near a transit station to be less preferred [47, 83]
Destination accessibility	Mall developments could benefit from accessibility by a transit system. In addition to a higher number of prospective shoppers, it could lead to greater tenant occupancy and rent [30]	Attractiveness is not always the case for TOSMDs with accessibility by a transit station. We showed earlier that this could negatively bring crime and noise pollution to the mall
Distance	It was explained earlier that the short walking distance encourages prospective shoppers. Therefore, it optimises attractiveness of a TOSMD [58]	Attractiveness is not always the case for TOSMDs with a near transit station. Similarly, it could negatively bring crimes and noise pollution to the mall

transit station [80–82], other studies showed the negative impact of crime, noise, and vibration (as a result of train movement) increase, which in turn caused properties near a transit station to be less preferred and cheaper [47, 83]. However, this is not the case in all TODs. Mu and Jong [7] argued that density is considered important for TOD, but it is not critical, as it is well known that there are many American and European cities that do not possess density levels as high as those of Asian cities, and they have successfully become transit-oriented metropolises, but it is not the case in all TODS. Figure 7, however, shows indicative weight percentages of the above themes from the study-reviewed cases. It shows place and urban design as being highly identified factors impacting the attractiveness of TOSMDs.

The conceptual framework for the attractiveness factors of TOSMDs is depicted in Fig. 8. It is based on two concepts. Firstly, the context-based station classification of Zemp et al. [59], where differing surrounding contexts impact the attractiveness of TOSMDs. Secondly, the node-place concept [84, 85], where a TOSMD impacts the number of shopper passengers using its nearby rail transit station (the node). The conceptual framework combines the elements of the extended service marketing mix and the 5 Ds of TOD. The framework-independent variables of a shopping mall's attractiveness factors (internal factors) and TOD design factors (external factors), and the mediating variables of location, space, and stores (TOSMD's mediating factors) are used in determining TOSMD attractiveness without any particular weight as it varies in different contexts according to the study review. As it can be seen in Fig. 8, there is an interrelationship between the internal shopping mall attractiveness and the external TOD. Furthermore, TOSMD attractiveness is closely linked to the number of shopper passengers using a nearby rail transit station. This number is measured by shopper passengers' potential use of the rail transit station near the shopping mall. The arrows indicate the causal links among the elements of the framework in Fig. 8.

The basic elements of the framework are as follows. Firstly, the attractiveness factors (product, price, place, and promotion) of a particular shopping mall (internal factors) impact and determine the attractiveness of a rail TOSMD. However, the extended service marketing mix factors (people, physical evidence, and process) of a particular shopping mall near a transit station also have a direct impact on the rail TOSMD's attractiveness, as shoppers tend to use tangible TOSMDs' servicescape cues to assess the intangible quality of the received services of the TOSMD. This relationship is depicted by arrow 1.

Secondly, TOD design factors (external factors), reflecting the surrounding context of a particular TOSMD, have a direct impact on TOSMD attractiveness. For example, a high-density TOD could make a TOSMD less attractive due to human congestion in the vicinity of the TOD context. This relationship is depicted by arrow 2. The study's conceptual framework addresses the one-way impact of TOD measures on TOSMD attractiveness, the "pull effect" (refer to Sect. 1).

Thirdly, TOD design factors also have an indirect impact on TOSMD attractiveness. They determine the mediating contextual factors of location, space, and stores

Fig. 9 Illustrative example of service disruption. Adapted from Kasmi [87]

(internal and external environment distinguishing mediating factors), such as the location of the TOSMD's outdoor dining and events areas, parking space available, and access to the TOSMD. Proximity to a rail station and other facilities determine the location-mediating factor attributes of a TOSMD. High population density can increase TOSMD's shopper numbers, impact the space and store attributes of a TOSMD, and make it more attractive. The stores mediating factor attributes of a TOSMD are impacted by the mixed use of the TOSMD's context (diversity) and the agglomeration of other businesses (density). The relationship between TOD design factors and the TOSMD's mediating factors of location, space, and stores is depicted by arrow 3.

External TOD factors of density, diversity, urban design, destination accessibility, and distance could have a positive or negative impact on the attractiveness of a TOSMD, as explained in Table 4.

Fourthly, the shopping mall attractiveness factors indirectly impact TOSMD attractiveness. They determine the attributes of the TOSMD's mediating factors of location, space, and stores, and could optimise the shopper numbers and retail strategies of a particular shopping mall (that is, near a transit station). This relationship between the attractiveness factors of a shopping mall and the TOSMD's mediating factors of location, space, and stores is depicted by arrow 4.

Fifthly, the interrelationship between the internal shopping mall attractiveness and its external TOD factors is depicted by arrow 5. The interrelationship among the different factors varies in different contexts, as we mentioned earlier in this section.

Sixthly, the TOSMD's attractiveness factors impact the numbers of shopper passengers using a nearby rail transit station (node). This number can be measured by shopper passengers' potential use of the metro station near the shopping mall. This relationship is depicted by arrow 6.

4 Application of the Conceptual Framework

The conceptual framework in Sect. 3 presented the relationships between shopping mall attractiveness factors and TOD design factors and their impacts on the attractiveness of TOSMD (refer to Fig. 8). These relationships impact the number of shopper passengers using a nearby rail transit station. Both shopping mall attractiveness (internal) factors and TOD design (external) factors directly impact the attractiveness of a TOSMD. These internal and external factors indirectly impact the attractiveness of a TOSMD via the TOSMD's contextual (internal and external environment distinguishing) mediating factors of location, space, and stores of the TOSMD. These mediating factors identify and clarify the TOSMD's context.

In order for the conceptual framework to be applied, it requires the collection of a range of data. A quantitative data collection approach is considered to be the most appropriate as it is typically used in generalisable causal relationships [19, 86]. In the conceptual framework, the attractiveness of a TOSMD is clarified using the shopping mall attractiveness factors (internal factors) and the TOD design factors (external factors). The independent variables are considered to be these internal and external factors. The first dependent variable is the TOSMD attractiveness. The

framework identifies that location, space, and stores are mediating variables of the external and internal factors' impact on the attractiveness of a TOSMD. The framework also identifies that the dependent variable of TOSMD attractiveness is, in turn, a mediator for the impact of the internal and external factors on the second dependent variable of the number of shopper passengers using a nearby metro station.

Critical data at various levels will be required to operationalise the framework. First, at the rail transit station level, the required data would include the station's design details and its connections with other modes of transport. At the mall level, data to support the framework would include the mall's size, daily shopper numbers, and mall design details. At the surrounding TOD area level, data would be required for the station and its immediate surrounding area design details, demographic and statistical details of the population around both the station and the TOSMD, the distance between the TOSMD and the nearby rail station, and the geographical and urban characteristics of the TOD area around the rail station. Next, at the passenger level, daily passenger numbers in the station near the shopping mall, including characteristics of shopper and non-shopper passengers, will support the framework. Finally, data regarding the shopper passengers' attitudes, including factors driving shopper passengers' views of the attractiveness of a TOSMD near a transit station, will be necessary. These levels of data might be sourced from multiple sources, including the relevant transportation authority and passengers coming from the TOSMD to the nearby transit station.

The literature review in Sect. 2 identified that the attractiveness factors of a TOSMD impacting the number of shopper passengers at a nearby rail transit station could change from one context to another. Therefore, the study's conceptual framework of TOSMD attractiveness could potentially be utilised to lay the foundation for informing and potentially enhancing a rail transit station's passenger forecasting models. It could be applied by (a) offering mall developers and managers a basis to distinguish and classify TOSMDs, and (b) clarifying the interrelation between the number of shopper passengers and the usage of the rail transit stations near TOSMDs. The enhancement of passenger forecasting models could better direct government spending to where the best effect would be achieved when building or improving metro stations and increase the economic sustainability of rail transit networks.

Hence, the study's conceptual framework is considered useful for cities with large numbers of shopping malls and cities growing their mall developments and connecting them with nearby rail transit stations. Rail transit stations near TOSMDs could reach their capacities in a shorter period than other stations further away from malls. Reaching a transit station's capacity can result in costly upgrades and disruption to the rail transit service and passengers, as illustrated in Fig. 9.

The conceptual framework has limitations in that it is proposed to be applicable to clarify rail TOSMDs within a walkable distance of about 600–800 m of a rail transit station. It does not consider the reverse impact of attractiveness of TOSMDs on its surrounding TOD context as it is beyond the purpose of this study. It also does not consider the other factors of ridership impacting the rail transit station, such as level of rail transit service, intermodal connections, external connectivity, and other modal choice behaviours of shopper passengers. Furthermore, this study has a limitation that it is based on a literature analysis approach, and its sampling strategy was determined by the trade-off between breadth and depth of the analysis included in the study. Despite these limitations, the research contributions of this study remain valid in synthesising the literature on retail and transit urban planning into a conceptual framework for the newly introduced term of rail TOSMD pattern of development.

5 Conclusion

This study thematically analysed 208 guiding research articles to clarify the attractiveness factors of transit-oriented shopping mall developments (TOSMDs). It informed the creation of a conceptual framework to comprehensively explain the impact of rail TOSMD attractiveness on the demand of shopper passengers using a rail transit station near a TOSMD for potential optimal TOD effectiveness, patterns of mall development, transit urban planning, and transport policymaking. It laid the foundation for potentially enhancing existing rail transit station's passenger forecasting models.

In the literature reviewed, the term TOSMD did not exist. For this reason, the study clarified it as a shopping mall (SM) near a rail transit station in a TOD context, where both shopping mall attractiveness factors and TOD design factors impact the number of shopper passengers using a nearby rail transit station. The literature review on attractiveness (pull) factors of shopping malls focused solely on internal mall characteristics. The general characteristics of products, facilities, and physical evidence of shopping malls were commonly identified as attractiveness factors. It also emphasised the TOD design, transport characteristics, and distance as common TOD design factors. Although different factors attract different weights in different contexts, the study provided indicative weight percentages of the attractiveness factors of TOSMDs. However, it does not consider the reverse impact of attractiveness of TOSMDs on its surrounding TOD context

as it is beyond the purpose of this study. The proposed conceptual framework for TOSMDs' attractiveness was outlined in Fig. 8. It was based on synthesising the attractiveness factors of shopping malls (internal factors) and TOD design factors (external factors), using the generic extended service marketing mix elements (product, price, place, promotion, people, physical evidence, and process) and the 5 Ds of TODs (density, diversity, urban design, destination accessibility, and distance) as an indicator system for the factors determining the attractiveness of TOSMD. Location, space, and store attributes were identified as contextual (internal and external environment-distinguishing) mediating factors of TOSMD attractiveness. The conceptual framework also showed that the attractiveness of TOSMDs is, in turn, a mediator for the impact of the internal shopping mall attractiveness and external TOD design factors on the number of shopper passengers using a nearby metro station (node). Applying the conceptual framework to a case study will require data at the levels of the rail transit station, shopping mall, surrounding TOD area, station passengers, and shopper passengers' attitudes. The conceptual framework provides an opportunity to better refine existing passenger forecasting models by understanding the attractiveness or demand for rail TOSMDs. It can offer mall developers and managers, urban policymakers, and rail transit urban planners a basis to (a) distinguish and classify TOSMDs, and (b) clarify the number of shopper passengers using a transit rail station near a TOSMD. It is considered useful for cities that have an existing or growing number of shopping mall developments and would like to sustainably apply an effective TOD approach to their transit rail networks and shopping mall patterns of development.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Xia HS, Shen C, Zhang C, Wang XH, Zhang DZ (2017) Challenges in the integration of light rail and land use: a case study of Yizhuang line in Beijing. Urban Rail Transit 3(1):45–53. https://doi.org/10.1007/s40864-017-0055-3
2. Calthorpe P (1993) The next American metropolis: ecology, community, and the American dream. Princeton Architectural Press, New York
3. Rajagopal R (2009) Growing shopping malls and behaviour of urban shoppers. J Retail Leis Prop 8(2):99–118. https://doi.org/10.1057/rlp.2009.3
4. Tian G, Ewing R, Weinberger R, Shively K, Stinger P, Hamidi S (2017) Trip and parking generation at transit-oriented developments: a case study of Redmond TOD, Seattle region. Transportation 44(5):1235–1254. https://doi.org/10.1007/s11116-016-9702-x
5. Zhou MQ, Lin X, Mao C, Zhang K (2014) Review on the theory and planning principle of transit-oriented development. Paper presented at the 14th COTA international conference of transportation professionals, Changsha, China, July 4–7, 2014
6. Yap JBH, Goh SV (2017) Determining the potential and requirements of transit-oriented development (TOD): the case of Malaysia. Prop Manag 35(4):394
7. Mu R, Jong M (2012) Establishing the conditions for effective transit-oriented development in China: the case of Dalian. J Transp Geogr 24:234–249. https://doi.org/10.1016/j.jtrangeo.2012.02.010
8. Zhao F, Chow L-F, Li M-T, Ubaka I, Gan A (2003) Forecasting transit walk accessibility: regression model alternative to buffer method. Transp Res Rec J Transp Res Board 1835:34–41
9. Kuby M, Barranda A, Upchurch C (2004) Factors influencing light-rail station boardings in the United States. Transp Res Part A Policy Pract 38(3):223–247
10. Gutiérrez J, Cardozo OD, García-Palomares JC (2011) Transit ridership forecasting at station level: an approach based on distance-decay weighted regression. J Transp Geogr 19(6):1081–1092. https://doi.org/10.1016/j.jtrangeo.2011.05.004
11. Handy S (2005) Smart growth and the transportation-land use connection: what does the research tell us? Int Reg Sci Rev 28(2):146–167
12. Sun Y-l, Tarigan A, Waygood O, Wang D-h (2017) Diversity in diversification: an analysis of shopping trips in six-week travel diary data. J Zhejiang Uni Sci A 18(3):234–244. https://doi.org/10.1631/jzus.A1500198
13. Pitt M, Musa ZN (2009) Towards defining shopping centres and their management systems. J Retail Leis Prop 8(1):39–55. https://doi.org/10.1057/rlp.2008.25
14. Farrag DA, El Sayed IM, Belk RW (2010) Mall shopping motives and activities: a multimethod approach. J Int Consum Mark 22(2):95–115. https://doi.org/10.1080/08961530903476113
15. Lee C, Moudon AV (2008) Neighbourhood design and physical activity. Build Res Inf 36(5):395–411. https://doi.org/10.1080/09613210802045547
16. Bernick M, Cervero R (1997) Transit villages in the 21st century. McGraw-Hill, New York
17. Olaru D, Smith B, Taplin JHE (2011) Residential location and transit-oriented development in a new rail corridor. Transp Res Part A 45(3):219–237. https://doi.org/10.1016/j.tra.2010.12.007
18. Kok HJ (2007) Restructuring retail property markets in Central Europe: impacts on urban space. J Hous Built Environ 22(1):107–126. https://doi.org/10.1007/s10901-006-9068-z
19. Chorus P, Bertolini L (2016) Developing transit-oriented corridors: insights from Tokyo. Int J Sustain Transp 10(2):86–95. https://doi.org/10.1080/15568318.2013.855850
20. Busse M, Siebert R (2018) Acceptance studies in the field of land use—a critical and systematic review to advance the conceptualization of acceptance and acceptability. Land Use Policy 76:235–245. https://doi.org/10.1016/j.landusepol.2018.05.016
21. Cervero R, Murakami J (2008) Rail + property development: a model of sustainable transit finance and urbanism. In: UC Berkeley. Center for Future Urban Transport: a Volvo Center of Excellence. Available via eScholarship. https://escholarship.org/uc/item/6jx3k35x. Accessed 08 Nov 2017

22. Feinberg RA, Meoli J (1991) A brief history of the mall. Adv Consum Res 18:426
23. Wei Khong K, Sim Ong F (2014) Shopper perception and loyalty: a stochastic approach to modelling shopping mall behaviour. Int J Retail Distrib Manag 42(7):626–642. https://doi.org/10.1108/IJRDM-11-2012-0100
24. Arslan TV, Sezer FS, Isigicok E (2010) Magnetism of shopping malls on young Turkish consumers. Young Consum 11(3):178–188. https://doi.org/10.1108/17473611011074250
25. Dahsh M, Dasa P (2014) Shopping mall preferences in eastern region: implications for retail strategy. Prestig Int J Manag Res 7/8(2/1):19
26. El-Adly M (2007) Shopping malls attractiveness: a segmentation approach. Int J Retail Distrib Manag 35(11):936–950. https://doi.org/10.1108/09590550710828245
27. Kushwaha T, Ubeja S, Chatterjee AS (2017) Factors influencing selection of shopping malls: an exploratory study of consumer perception. Vis J Bus Perspect 21(3):274–283. https://doi.org/10.1177/0972262917716761
28. Tandon A, Gupta A, Tripathi V (2016) Managing shopping experience through mall attractiveness dimensions: an experience of Indian metro cities. Asia Pac J Mark Logist 28(4):634–649. https://doi.org/10.1108/APJML-08-2015-0127
29. Erkip F (2005) The rise of the shopping mall in Turkey: the use and appeal of a mall in Ankara. Cities 22(2):89–108. https://doi.org/10.1016/j.cities.2004.10.001
30. Ke Q, Wang W (2016) The factors that determine shopping centre rent in Wuhan, China. J Prop Invest Finance 34(2):172–185. https://doi.org/10.1108/JPIF-04-2015-0021
31. González-Hernández EM, Orozco-Gómez M (2012) A segmentation study of Mexican consumers based on shopping centre attractiveness. Int J Retail Distrib Manag 40(10):759–777
32. Larsen V, Shelton R, Wright ND (2015) Shopping center attitudes: an empirical test of predictive attributes. Acad Mark Stud J 19(2):93
33. Prashar S, Gupta S, Singh H, Vijay TS, Parsad C (2016) Clustering shoppers by mall experience for emerging Indian city. Asian Acad Manag J 21(2):53–73. https://doi.org/10.21315/aamj2016.21.2.3
34. Bilková K, Krizan F, Barlík P (2016) Consumers preferences of shopping centers in Bratislava (Slovakia). Hum Geogr 10(1):23. https://doi.org/10.5719/hgeo.2015.101.2
35. Singh S (2012) Determinants of shopping experience. Int J Retail Distrib Manag 40(3):235–248. https://doi.org/10.1108/09590551211207184
36. Anselmsson J (2006) Sources of customer satisfaction with shopping malls: a comparative study of different customer segments. Int Rev Retail Distrib Consum Res 16(1):115–138. https://doi.org/10.1080/09593960500453641
37. Ahmad AEMK (2012) Attractiveness factors influencing shoppers' satisfaction, loyalty, and word of mouth: an empirical investigation of Saudi Arabia shopping malls. Int J Bus Adm 3(6):101
38. Teller C, Reutterer T (2008) The evolving concept of retail attractiveness: what makes retail agglomerations attractive when customers shop at them? J Retail Consum Serv 15(3):127–143
39. Singh H, Prashar S (2013) Factors defining shopping experience: an analytical study of Dubai. Asian J Bus Res 3(1):36
40. Gilboa S, Vilnai-Yavetz I (2012) Segmenting multicultural mall visitors: the Israeli case. Mark Intell Plan 30(6):608–624. https://doi.org/10.1108/02634501211262582
41. Tsai S (2010) Shopping mall management and entertainment experience: a cross-regional investigation. Serv Ind J 30(3):321–337. https://doi.org/10.1080/02642060802123376
42. Golias M, Mishra S, Psarros I (2016) A guidebook for best practices on integrated land use and travel demand modeling. Department of Civil Engineering, University of Memphis, Memphis
43. Pacheco-Raguz JF (2010) Assessing the impacts of light rail transit on urban land in Manila. J Trans Land Use. https://doi.org/10.5198/jtlu.v3i1.13
44. Carlton I (2009) Histories of transit-oriented development: perspectives on the development of the TOD concept. Institute of Urban and Regional Development, Berkeley, CA
45. Cervero R (2004) Transit-oriented development in the United States: experiences, challenges, and prospects, vol 102. Transportation Research Board, Washington
46. Chikomba C (2014) Retail shopping mall security: raising awareness of crime risks against business in Zimbabwe (a case study of Joina City shopping mall, Harare—June 2011–July 2012). J Appl Secur Res 9(2):185–220. https://doi.org/10.1080/19361610.2013.825754
47. Cervero R, Ferrell C, Murphy S (2002) Transit-oriented development and joint development in the United States: a literature review. TCRP Res Results Dig 52:1–144
48. Shiau T, Huang M, Lin W (2015) Developing an indicator system for measuring Taiwan's transport sustainability. Int J Sustain Transp 9(2):81–92. https://doi.org/10.1080/15568318.2012.738775
49. Searle G, Darchen S, Huston S (2014) Positive and negative factors for transit oriented development: case studies from Brisbane, Melbourne and Sydney. Urban Policy Res 32(4):437–457. https://doi.org/10.1080/08111146.2014.931280
50. Jones CE, Ley D (2016) Transit-oriented development and gentrification along Metro Vancouver's low-income SkyTrain corridor. Can Geogr 60(1):9–22. https://doi.org/10.1111/cag.12256
51. Yang J, Chen J, Le X, Zhang Q (2016) Density-oriented versus development-oriented transit investment: decoding metro station location selection in Shenzhen. Transp Policy 51:93–102. https://doi.org/10.1016/j.tranpol.2016.04.004
52. Peng Y, Li Z, Choi K (2017) Transit-oriented development in an urban rail transportation corridor. Transp Res Part B 103:269–290. https://doi.org/10.1016/j.trb.2017.03.011
53. Loo BPY, Chen C, Chan ETH (2010) Rail-based transit-oriented development: lessons from New York City and Hong Kong. Landsc Urban Plan 97(3):202–212. https://doi.org/10.1016/j.landurbplan.2010.06.002
54. Moudon A, Sohn DW, Kavage SE, Mabry JE (2011) Transportation-efficient land use mapping index (TELUMI), a tool to assess multimodal transportation options in metropolitan regions. Int J Sustain Transp 5(2):111–133. https://doi.org/10.1080/15568311003624262
55. Zeng R (2013) Attributes influencing home buyers' purchase decisions: a quantitative study of the Wuhan residential housing market
56. Taehyun K, Dong-Wook S, Sangho C (2016) An analysis of the relationship between pedestrian traffic volumes and built environment around metro stations in Seoul. KSCE J Civ Eng. https://doi.org/10.1007/s12205-016-0915-5
57. Sun G, Zacharias J, Ma B, Oreskovic NM (2016) How do metro stations integrate with walking environments? Results from walking access within three types of built environment in Beijing. Cities 56:91–98. https://doi.org/10.1016/j.cities.2016.03.001
58. Kamruzzaman M, Baker D, Washington S, Turrell G (2014) Advance transit oriented development typology: case study in Brisbane, Australia. J Transp Geogr 34:54–70. https://doi.org/10.1016/j.jtrangeo.2013.11.002
59. Zemp S, Lang S (2011) Classifying railway stations for strategic transport and land use planning: context matters! J Transp Geogr 19(4):670–679
60. Reusser L, Stauffacher S (2008) Classifying railway stations for sustainable transitions—balancing node and place functions.

J Transp Geogr 16(3):191–202. https://doi.org/10.1016/j.jtrangeo.2007.05.004
61. van Lierop D, Maat K, El-Geneidy A (2017) Talking TOD: learning about transit-oriented development in the United States, Canada, and the Netherlands. J Urban Int Res Placemaking Urban Sustain 10(1):49–62. https://doi.org/10.1080/17549175.2016.1192558
62. Rafiq M, Ahmed PK (1995) Using the 7Ps as a generic marketing mix: an exploratory survey of UK and European marketing academics. Mark Intell Plan 13(9):4–15. https://doi.org/10.1108/02634509510097793
63. Khare A (2011) Mall shopping behaviour of Indian small town consumers. J Retail Consum Serv 18(1):110–118. https://doi.org/10.1016/j.jretconser.2010.10.005
64. Rajagopal R (2011) Determinants of shopping behavior of urban consumers. J Int Consum Mark 23(2):83–104. https://doi.org/10.1080/08961530.2011.543051
65. Rajagopal R (2010) Coexistence and conflicts between shopping malls and street markets in growing cities: analysis of shoppers' behaviour. J Retail Leis Prop 9(4):277–301. https://doi.org/10.1057/rlp.2010.17
66. Reynolds KE, Ganesh J, Luckett M (2002) Traditional malls vs. factory outlets: comparing shopper typologies and implications for retail strategy. J Bus Res 55(9):687–696. https://doi.org/10.1016/s0148-2963(00)00213-7
67. Leszczyc PTP, Sinha A, Sahgal A (2004) The effect of multi-purpose shopping on pricing and location strategy for grocery stores. J Retail 80(2):85–99
68. Wang D, Zhou M (2016) The built environment and travel behavior in urban China: a literature review. Transp Res Part D Transp Environ. https://doi.org/10.1016/j.trd.2016.10.031
69. El-Adly MI, Eid R (2016) An empirical study of the relationship between shopping environment, customer perceived value, satisfaction, and loyalty in the UAE malls context. J Retail Consum Serv 31:217–227. https://doi.org/10.1016/j.jretconser.2016.04.002
70. Devgan D, Kaur M (2010) Shopping malls in India: factors affecting Indian customers' perceptions. South Asian J Manag 17(2):29
71. Masoumi HE, Mirmoghtadaee M (2016) Editorial preface. Transit-oriented development in Iran: challenges and solutions. TeMA J Land Use. https://doi.org/10.6092/1970-9870/4028
72. Sung H, Lee S (2015) Residential built environment and walking activity: empirical evidence of Jane Jacobs' urban vitality. Transp Res Part D 41:318–329. https://doi.org/10.1016/j.trd.2015.09.009
73. Li C, Lin C, Hsieh T (2016) TOD district planning based on residents' perspectives. ISPRS Int J GeoInf 5(4):52. https://doi.org/10.3390/ijgi5040052
74. Singh YJ, Fard P, Zuidgeest M, Brussel M, Maarseveen M (2014) Measuring transit oriented development: a spatial multi criteria assessment approach for the city region Arnhem and Nijmegen. J Transp Geogr 35:130–143. https://doi.org/10.1016/j.jtrangeo.2014.01.014
75. Jacobson F (2008) Seven American TODs: good practices for urban design in transit-oriented development projects. J Transp Land Use 1(2):51–88
76. Cervero R, Kockelman K (1997) Travel demand and the 3Ds: density, diversity, and design. Transp Res Part D 2(3):199–219. https://doi.org/10.1016/S1361-9209(97)00009-6
77. Sarkar PP, Chunchu M (2016) Quantification and analysis of land-use effects on travel behavior in smaller Indian cities: case study of Agartala. J Urban Plan Dev 142(4):4016009. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000322
78. Kamruzzaman M, Shatu FM, Hine J, Turrell G (2015) Commuting mode choice in transit oriented development: disentangling the effects of competitive neighbourhoods, travel attitudes, and self-selection. Transp Policy 42:187–196. https://doi.org/10.1016/j.tranpol.2015.06.003
79. Lund H (2006) Reasons for living in a transit-oriented development, and associated transit use. J Am Plan Assoc 72(3):357–366. https://doi.org/10.1080/01944360608976757
80. Duncan M (2008) comparing rail transit capitalization benefits for single-family and condominium units in San Diego, California. Transp Res Rec J Transp Res Board 2067:120–130. https://doi.org/10.3141/2067-14
81. Cervero R, Duncan M (2002) Transit's value-added effects: light and commuter rail services and commercial land values. Transp Res Rec J Transp Res Board 1805:8–15. https://doi.org/10.3141/1805-02
82. Ko K, Cao XJ (2013) The impact of Hiawatha light rail on commercial and industrial property values in Minneapolis. J Public Transp 16(1):47–66. https://doi.org/10.5038/2375-0901.16.1.3
83. Bowes DR, Ihlanfeldt KR (2001) Identifying the impacts of rail transit stations on residential property values. J Urban Econ 50(1):1–25. https://doi.org/10.1006/juec.2001.2214
84. Bertolini L (1999) Spatial development patterns and public transport: the application of an analytical model in the Netherlands. Plan Pract Res 14(2):199–210. https://doi.org/10.1080/02697459915724
85. Bertolini L (1996) Nodes and places: complexities of railway station redevelopment. Eur Plan Stud 4(3):331–345. https://doi.org/10.1080/09654319608720349
86. Phillips DC, Burbules NC (2000) Postpositivism and educational research. Rowman & Littlefield, Lanham
87. Kasmi M (2012) Cut in Dubai Metro boarding time raises train etiquette culture clash. emirates24/7. https://www.emirates247.com/news/emirates/cut-in-dubai-metro-boarding-time-raises-train-etiquette-culture-clash-2012-08-01-1.469671. Accessed 21 Feb 2019

2.3 Passengers Forecasting Models (PFMs)

Traditionally, urban planners use McNally's (2000) regional four-step travel forecasting model, which considers trip generation, distribution, mode choice and route assignment. This method is used despite its complexity and accuracy issues, incomplete travel input data (estimation is typically based on relatively old household surveys which may include a small number of transit trips in the area of interest), insensitivity to land use, institutional barriers to consultation and collaboration (transit providers are often not part of the modelling process), and being cumbersome and expensive (Gutiérrez et al., 2011).

In contrast, direct PFMs have developed based on multiple regression analysis as a complementary approach to estimating ridership (Cervero, 2006; Chu, 2004; Gutiérrez et al., 2011; Kuby et al., 2004). Such models are a less complicated and less expensive alternative to the four-step models. They are also directly responsive to land use characteristics within station catchment areas. However, direct models lack the regional perspective of the four-step models. In determining the variables impacting station ridership, researchers such as Choi et al. (2012) investigated metro ridership at station level and station-to-station level and concluded that ridership factors could be the same. Drawing circles showing prospective passenger areas and GIS mapping approaches (Brès, 2014) have been used to determine the space located near railway stations with a view to increasing their density so as to increase the number of potential train users. Chakour and Eluru (2014) recently added that time to travel to a station has a significant negative impact on the choice of station and ridership.

Policies can also influence users of public transport. Handy (2005) and Vessali (1996) indicated that factors such as zoning and restrictions on parking could play a significant role in the success of TOD and hence, could also have a significant impact on a TOSMD.

The Origin-Destination (O-D) matrix ridership and the distance-decay weighted regression methods are examples of direct PFMs.

1. O-D matrix (Zhao et al., 2007): Automatic Fare Collection (AFC) system data is used to infer rail passenger trip O-D matrices from an Origin – the AFC system replaces the expensive passenger O-D surveys.

2. Distance-decay weighted regression (Gutiérrez et al., 2011): Weight is given to each of the variables affecting station ridership, including station characteristics (type, number of lines, accessibility within the network) and the areas it serves (population and employment characteristics, land use mix, street density, presence of feeder modes) according to the distance-decay functions. Prior direct ridership models at station level used fixed distance thresholds. These models are, therefore, not flexible enough to reflect the impact on the travel of concentrated housing and employment at a longer/shorter distance from the station in cases where these developments are located within the station catchment area.

In conclusion, while many other factors influence transit ridership, population density, employment density, land use mix, walking accessibility, transit accessibility, automobile accessibility, and Central Business District (CBD) characteristics are among the factors most consistently studied by forecasting researchers (Sides, 2012). Furthermore, including these variables in forecasting models, addresses the shortcomings of the four-step model. They deal with the built urban environment, transportation policy, alternatives to the automobile and social factors influencing transit ridership.

2.4 Station Boarding Factors (SBFs)

Sohn and Shim (2010) allocated the factors affecting metro demand to three categories: built environment, external connectivity and intermodal connection. These three categories contain 24 independent metro boarding variables identified in previous studies (Boyle, 2006; Cao et al., 2009; Cervero, 2006; Chu, 2004; Estupiñán and Rodríguez, 2008; Khattak and Rodriguez, 2005; Kim et al., 2007; Kuby et al., 2004; Quade, 1996; Yao, 2007). Among the identified metro boarding variables, the research found seven variables to be significantly associated with station boarding: employment, commercial floor area, office floor area, net population density, the number of transfers, the number of feeder bus lines, and a dummy variable indicating transfer stations.

In line with Huff's (1962) earlier work, Sohn and Shim (2010) and several other researchers (Canepa, 2007; Estupiñán and Rodríguez, 2008; Kuby et al., 2004; Kwoka et al., 2015; Murray et al., 1998; O'Sullivan and Morrall, 1996; Zemp et al., 2011) did not drill down into sub-variables other than those sub-variables of commercial floor area. Figure 2.1, extracted from Sohn and Shim (2010), illustrates the various metro boarding factors.

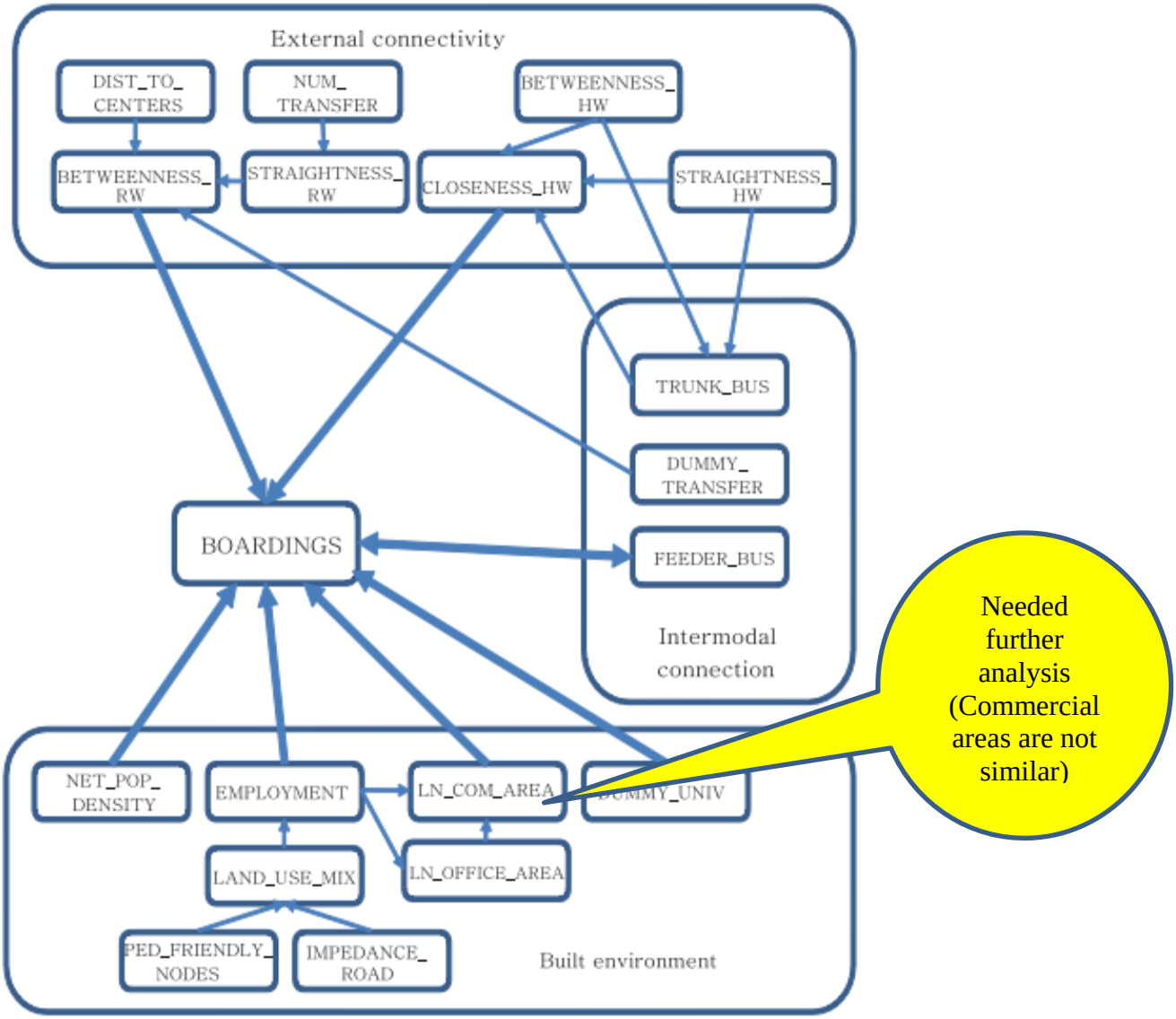


Figure 2.1 Factors affecting metro demand at a station level (Sohn and Shim, 2010)

Therefore, there is a need to investigate commercial floor area sub-variables, specifically in the case of TOSMDs, to improve the accuracy of PFMs at nearby transit stations for optimal TOD and increasing the economic benefits of a transit network.

2.5 Tourist shopper passengers (TSPs) captured in PFMs

Sometimes planners fail to consider the number of tourist arrivals as a factor in the design of transit supply. They tend to extend the benefit from visiting tourists by keeping the supply of public transport

at the same level and tolerate a certain degree of congestion during tourist seasons (Albalate and Bel, 2010).

As a consequence, PFMs tend to give less attention to tourist passengers. Hall (1999) indicated four roles of transport for tourists: linking the origin market with the tourist destination, providing access and mobility within a wide destination area (region or country), offering access and mobility within a tourist attraction or destination and providing travel along a recreational route. Albalate and Bel (2010) noted that studies have given less attention to the factors impacting the third role identified by Hall (1999). They provided guidance to factors impacting Tourist Transit Passengers (TTP), as illustrated in Figure 2.2.

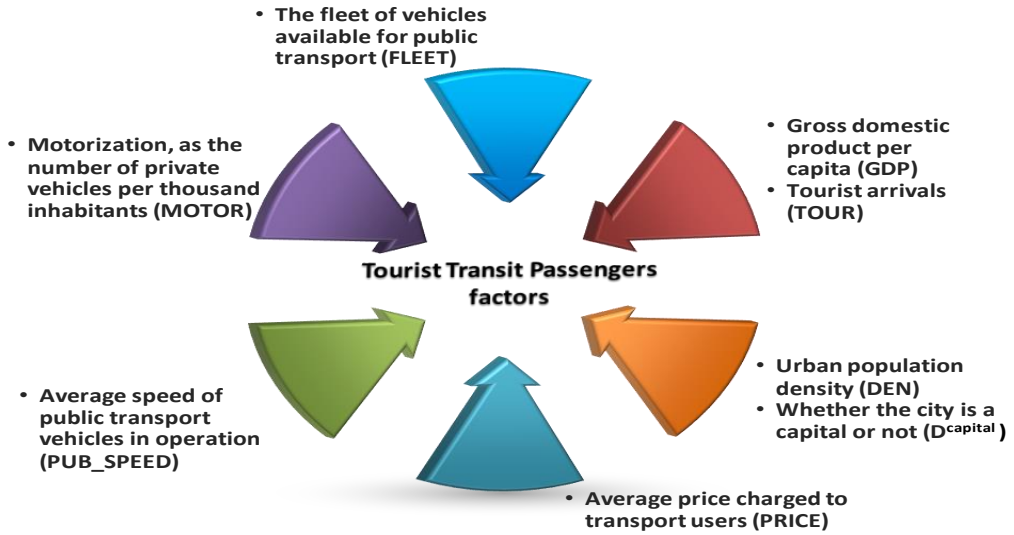


Figure 2.2 TTP factors. Adapted from Albalate and Bel (2010)

Therefore, tourist shopper passengers, as part of TTPs, are captured to a lesser extent in PFMs.

2.6 Summary and implications

The findings from the literature review can be summarised as follows:

1. TOSMD attractiveness is outlined in the conceptual framework shown in Journal Article 1 (refer to Section 2.2). It is based on a synthesis of the attractiveness factors of shopping malls

(internal factors) and TOD design factors (external factors) using the generic extended service marketing mix elements (product, price, place, promotion, people, physical evidence and process) and the 5 Ds of TODs (density, diversity, urban design, destination accessibility and distance) as an indicator system for the factors determining the attractiveness of TOSMDs

2. The conceptual framework shows that the attractiveness of TOSMDs is, in turn, a mediator for the impact of internal shopping mall attractiveness and external TOD design factors on the number of shopper passengers using a nearby metro station (node)
3. The location, space and stores attributes were identified as contextual (i.e. jointly distinguishing internal and external environment) mediating factors of TOSMD attractiveness
4. It was assumed that shopping areas are very similar, except for their size and distance from consumers (Canepa, 2007; Murray et al., 1998; O'Sullivan and Morrall, 1996)
5. On the one hand, recent studies on shopping mall context indicate that different mall attractiveness factors are leading to variable patronage
6. On the other hand, PFMs treat TOSMDs equally without reflecting the various attractiveness factors impacting nearby transit station ridership
7. Previous studies on SBFs (Canepa, 2007; Estupiñán and Rodríguez, 2008; Huff, 1962; Kuby et al., 2004; Kwoka et al., 2015; Murray et al., 1998; O'Sullivan and Morrall, 1996; Sohn and Shim, 2010; Zemp et al., 2011) did not drill down into sub-factors beyond those sub-factors of "*commercial area*" [such as TOSMDs]
8. Less attention has also been given to tourist ridership within a tourist destination (Albalate and Bel, 2010). As a result, PFMs at transit stations tend to ignore tourist passenger ridership numbers
9. The literature shows that four-step (survey-based) travel forecast modelling and direct (multiple regression-based) modelling are used in PFMs for transit stations. Although lacking the regional perspective of the four-step (trip generation, distribution, mode choice and route assignment) models, the direct regression-based models are widely used as they are directly responsive to land use characteristics, are quick, and are less expensive
10. Two approaches are used for PFMs. One approach looks at station to station (O–D matrix) ridership as the basis for the station ridership forecast, while the other looks at station level ridership weighted variables (Distance-decay weighted regression). The study of the two

approaches found that the application of the O-D matrix is more relevant where a computer-based fare collection system is used

11. The four-step process has been developed as a car-based model with alternative transportation modes as a secondary consideration (McNally, 2007). Therefore, the process only forecasts the probability that someone will choose rail over a car, bus or some other mode
12. Although researchers such as Castillo-Manzano and López-Valpuesta (2009) and Zemp et al. (2011)~~,~~ indicated that there is a relationship between railway stations and their context, it is however not clear to what extent this context components, such as TOSMDs impact station ridership.

In conclusion, while many other factors influence transit ridership, population density, employment density, land use mix, walking accessibility, transit accessibility, automobile accessibility, and CBD characteristics are among the most consistently studied factors by forecasting researchers (Sides, 2012). Furthermore, including these variables in forecasting models addresses the shortcomings of the four-step model by dealing with the built urban environment, transportation policy, alternatives to the automobile, and social factors influencing transit ridership. As a result, understanding the impact of TOSMD attractiveness factors on transit station use can assist PFMs in optimising TOSMD planning and the sustainability of transit networks.

Hence, this research addresses the gaps identified for TOSMDs and TSPs and clarifies their impact in the form of shopper passenger ridership flowing from TOSMDs into nearby transit stations. Closing the gap is expected to ensure that stations continue to offer accessibility to shopper passengers arriving from nearby TOSMDs, and potentially enhance existing PFMs at rail transit stations near TOSMDs for optimal TOD and increase the economic sustainability of rail transit networks.

Chapter 3 discusses the research methodology used to investigate the impact of TOSMD attractiveness factors on shopper passenger contributions to ridership at stations near TOSMDs.

Chapter 3 Methodology

3.1 Introduction

The literature review found that previous research has focused on shopping mall characteristics and analysed shopping mall patronage within the shopping mall context, with little consideration given to the impact that specific mall contextual factors have on the forecasting models of ridership at nearby transit stations. As a result, this research was conducted to answer the research question of how TOSMD attractiveness factors impact shopper passenger ridership at stations near TOSMDs.

This chapter describes the research methodology used to answer the above research question and sub-questions (refer to Section 1.4) and is underpinned by the literature review. The chapter covers the research paradigm, research design, methods of data collection and analysis, and concluding remarks. Its sections are as follows:

- Section 3.2 discusses the research paradigm. A paradigm is a worldview or set of shared beliefs that inform the meaning or interpretation of research data (Kivunja and Kuyini, 2017). A number of paradigms are considered, and post-positivism is chosen to inform this research methodology
- Section 3.3 explains the research design to answer the research questions put forward by the researcher and supported by Neuman (2011) and Tkaczynski et al. (2010). It determines that a quantitative approach is appropriate. It then shows the steps followed to address the research objectives
- Section 3.4 explains the methods used to answer the research questions. It discusses the use of the Dubai Metro Redline as a justifiable case study to non-experimentally survey shopper passengers boarding at metro stations near TOSMDs to understand their perspectives on shopping mall attractiveness and ridership preferences. The section briefly discusses the survey design and sampling process. The analysis techniques, the validity of the methods and processes taken to limit any related errors are also described, as are the ethical considerations
- Section 3.5 provides a summary of the chapter.

3.2 Research paradigm

Post-positivism, also called critical realism, is a deterministic philosophy in which causes (likely) determine the outcome (Creswell, 2013). Positivism is based upon exploratory knowledge, values of reason, truth and validity, and the focus is purely on facts which are gathered through direct observation and measured empirically, independent of the researcher, using quantitative survey methods and statistical analysis (Arjun, 2012; Eriksson and Kovalainen, 2008; Tkaczynski et al., 2010). Post-positivism was selected as an appropriate research paradigm as this research seeks to empirically observe and measure the salient shopping mall attractiveness factors and evaluate their contribution to the ridership at nearby metro stations. Therefore, an objective approach is an essential aspect of this research.

Conversely, interpretivism (constructivism), transformism, and pragmatism were not considered suitable approaches to this research because they are impacted by the participants' views of the studied situation. In interpretivism, the key tenet is that theory does not precede research but follows it so that it is grounded in researchers subjectively making meaning of their data through their own thinking and cognitive processing of data informed by their interactions with participants to construct a theory (Bogdan, 1992; Kivunja and Kuyini, 2017; Strauss, 1990). In transformism, the key tenet is that it seeks to change the politics of the area of study, so it is grounded in researchers' utilisation of participatory research to expose the intersection of politics, morality and ethics to confront social oppression and improve social justice (Guba and Lincoln, 1988; Mertens, 2014). Pragmatism advocates that the relationships in research are best determined by what the researcher deems appropriate to that particular study. Individuals have their own unique interpretations of reality, and a mix of quantitative and qualitative approaches can be utilised (Kivunja and Kuyini, 2017; Mertens, 2005).

The research strategy (specifying the methods and procedures of inquiry) is a non-experimental design as the research investigated correlational statistics to describe and measure the degree of association between TOSMD attractiveness factors and ridership in the form of shopper passenger volume at nearby metro stations, and score these factors (Creswell, 2013; Yin, 2009). It was aligned with the conceptual framework for attractiveness factors established in Chapter 2 and detailed in Journal Article 1. The conceptual framework in Journal Article 1 guided the inquiry technique and

was used to achieve the research objectives identified in Chapter 1. The conceptual framework and its relationship to the research design will be discussed in further detail in the next section.

3.3 Research design

The research design is a research guide designed to control or limit the chance of errors in the research process (Arjun, 2012; Zikmund et al., 2013). According to Creswell (2013), a quantitative approach is best suited to identifying factors that influence an outcome. A quantitative research approach involves knowledge development with the intention of testing theory, employing inquiry techniques such as surveys, and collecting data using instruments that produce statistical data (Malhotra, 2008).

As the aim of this research was to investigate TOSMD attractiveness factors that influence shopper passenger ridership at a nearby metro station, a quantitative approach was considered to be appropriate. Furthermore, quantitative research approaches are typically used in this field of studying causal relationships, i.e. TOSMD effect on ridership at a metro station, (Arjun, 2012; Phillips and Burbules, 2000). Therefore, this research used a quantitative approach to undertake an explanatory investigation of the relationship between attractiveness factors and shopper passenger ridership at stations near TOSMDs.

A conceptual framework that proposed a relationship between shopper passenger ridership at transit stations near a TOSMD and TOSMD attractiveness factors is provided in Figure 3.1. It is based on the review of the literature provided earlier in Chapter 2, which was also published in Journal Article 1 (Abutaleb et al., 2019).

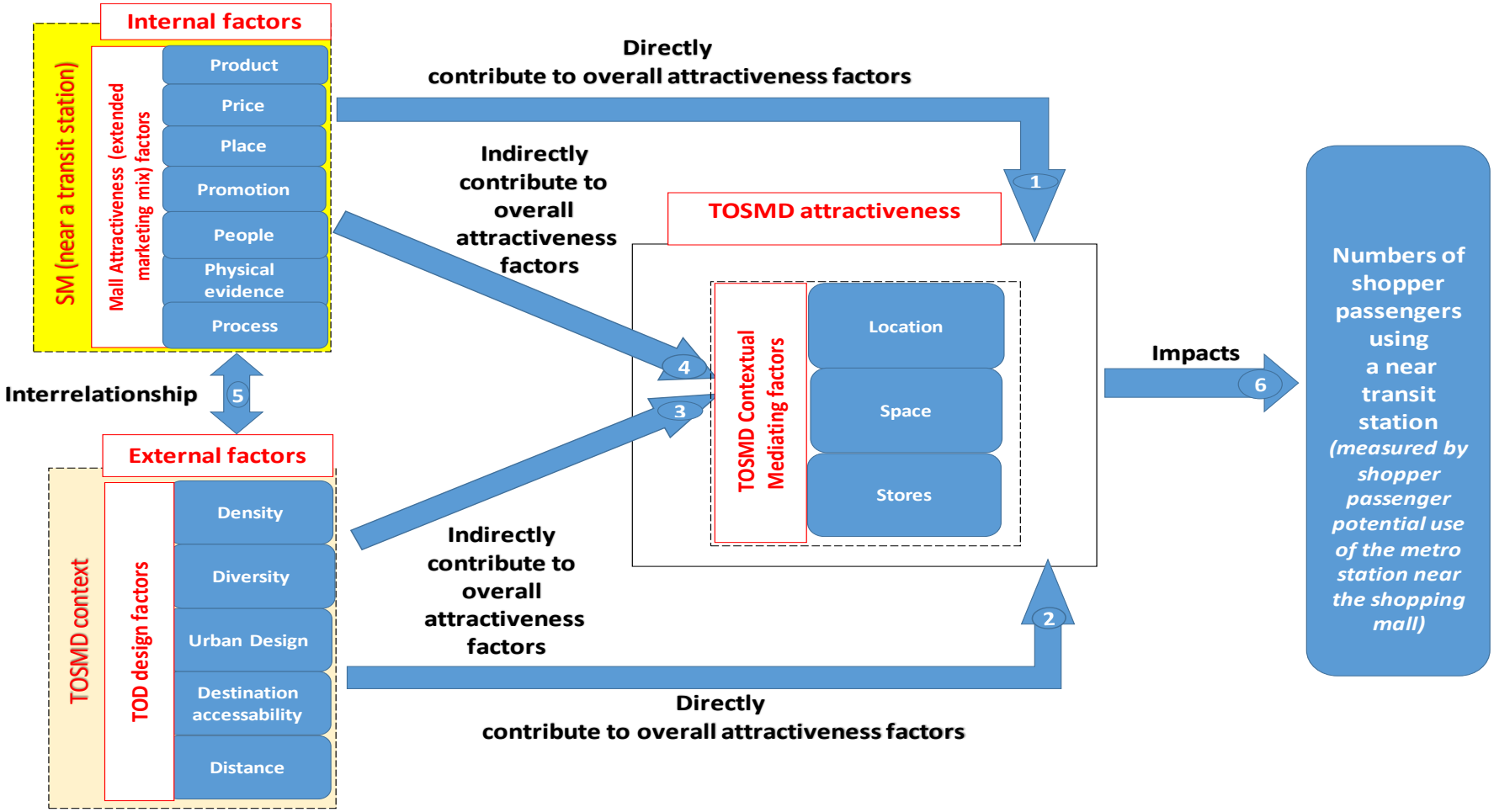


Figure 3.1 The conceptual framework for TOSMDs attractiveness factors

As can be seen in Figure 3.1, the conceptual framework identified attractiveness factors that impact shopper passenger ridership at stations near TOSMDs using the elements of the extended service marketing mix and the 5 (five) Ds of TOD. The elements of the extended service marketing mix include product, price, place, promotion, people, physical evidence, and process; and the five factors related to TODs include density, diversity, urban design, destination accessibility, and distance. The framework was used as a basis for the research design to empirically explain how attractiveness factors impact shopper passenger ridership at stations near TOSMDs.

As the research was conducted within a positivist framework, data were collected in a quantitative form: detached and objective (Arjun, 2012; Leedy and Ormrod, 2005). Surveys using questionnaires were used for inquiry with the intent of quantitatively measuring attitudes and rating behaviours of the population by studying a representative sample of that population (Fowler, 2013). A questionnaire was chosen as the method which is common in the field of research, is relatively easy for passengers to understand and complete, can produce a large quantity of data in a limited period, and its results can be used for statistical analyses (Neuman, 2011; Veal, 2006). The survey employed close-ended questions designed for easy and prompt responses (El-Adly, 2007; Yap and Goh, 2017) using a 5-point Likert scale (Kamruzzaman et al., 2016). The population in this research was comprised of shopper passengers at Dubai Metro Redline stations within an approximately 0.8 km radius of TOSMDs.

The literature review showed that tourist shopper passengers, are part of tourist transit passengers (TTPs), and are not well captured in passenger forecasting models. It also identified that less attention has been given to tourist ridership within a tourist destination (Albalate and Bel, 2010).

Finn and Louviere (1990) identified shopper segments based on the differences in shopping mall consideration sets and investigated the differences in mall choice parameters for these segments. Furthermore, the general approach adopted in 119 resident/tourist segmentation studies developed tourist profiles for one destination using questionnaire surveys (Tkaczynski et al., 2010). Similarly, this research categorised station shopper passengers in the research questionnaire, as illustrated in Figure 3.2 as the main objective of the research involved investigating the impact of attractiveness factors on resident and tourist shopper passengers. Therefore, at the surveyed destination transit stations, passengers were categorised

into shopper passengers and non-shopper passengers using the questionnaire survey (shopper passengers were those passengers at the station who had come from the shopping mall near the station).

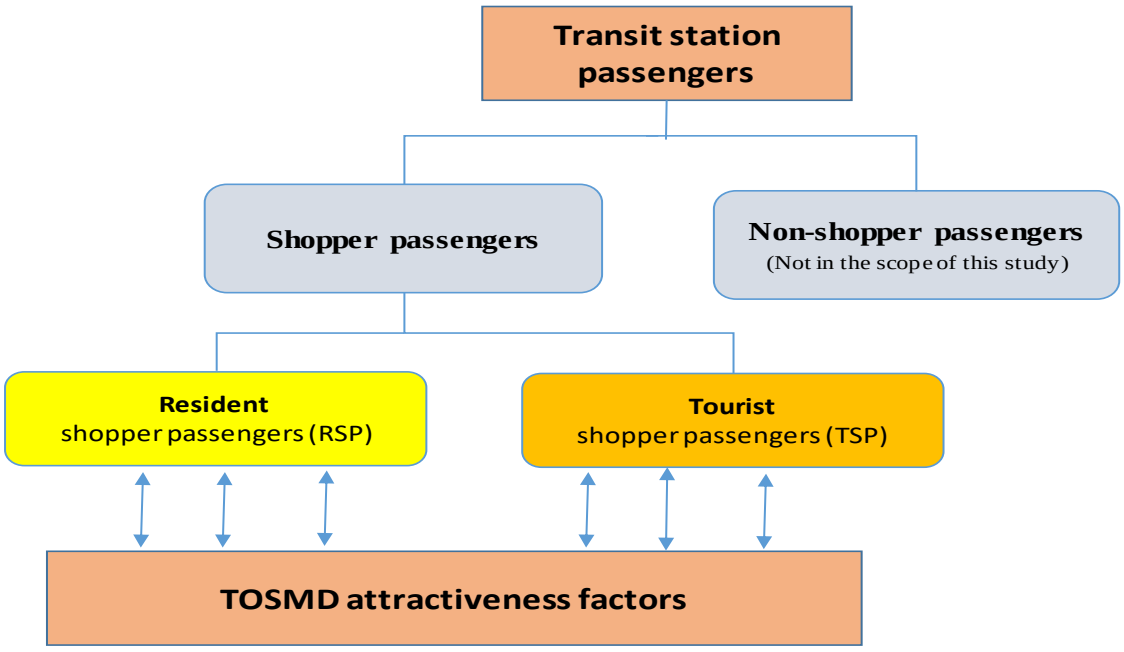


Figure 3.2 Passengers and TOSMD attractiveness factors

As identified by the research question, the research required the selection of a suitable case study where shopping mall developments were sited along a major metro line to gather data regarding the variability in attractiveness factors impacting station shopper passenger ridership. This research used a single case study approach to neutralise the impact of the level of service, transport policies, and fare level on station ridership.

Although the case study methodology, particularly the single case, is inconsistent with the requirements of generalisation (Schofield, 2002; Yin, 1981), Yin (1994) and Flyvbjerg (2001) identify the value of using typical cases in analytical generalisation and the ability of a theory to be tested in a similar theoretical setting to further define its explanatory power (Thomas and Bertolini, 2014).

The Dubai Metro Redline stations include urban designed walkways which connect a significant number of shopping malls to a nearby metro station. These malls are typically located in high density, mixed communities along Sheikh Zaid Road and the Old Deira area. Based on connectivity to Dubai Airport, the number of stations connected to shopping malls and the ready availability of ridership data made the Dubai Metro Redline case highly suitable.

As a result, the Dubai Metro Redline was selected as a case study for this research, as will be discussed in further detail in the next section. Therefore, this research also provides a practical opportunity to identify and clarify the impact of attractiveness factors on ridership at transit stations near TOSMDs along the Dubai Metro Redline, and which could be repeated in other cities' transit networks.

A flow chart of the main stages of research is shown in Figure 3.3 covering four main stages. It was based on the conceptual framework for TOSMD attractiveness factors as described above. Stage 1 involved establishing the conceptual framework, refer to Figure 3.3 (Objective 1). Stage 2 involved surveying shopper passengers to identify critical contextual attractiveness factors impacting shopper passengers, based on the established conceptual framework for TOSMD attractiveness factors (Objective 2). Stage 3 involved identifying resident shopper passenger (RSP) and tourist shopper passenger (TSP) ridership related to TOSMD attractiveness factors **(**Objectives 3 and 4). In Stage 4, RSP and TSP ridership correlations were analysed with respect to significant direct/mediating effect of TOSMD attractiveness factor. Structural equation modelling (SEM) was used to explore the relationship between the attractiveness factors and the tourist and resident ridership and the validity of the models determined (Objective 5).

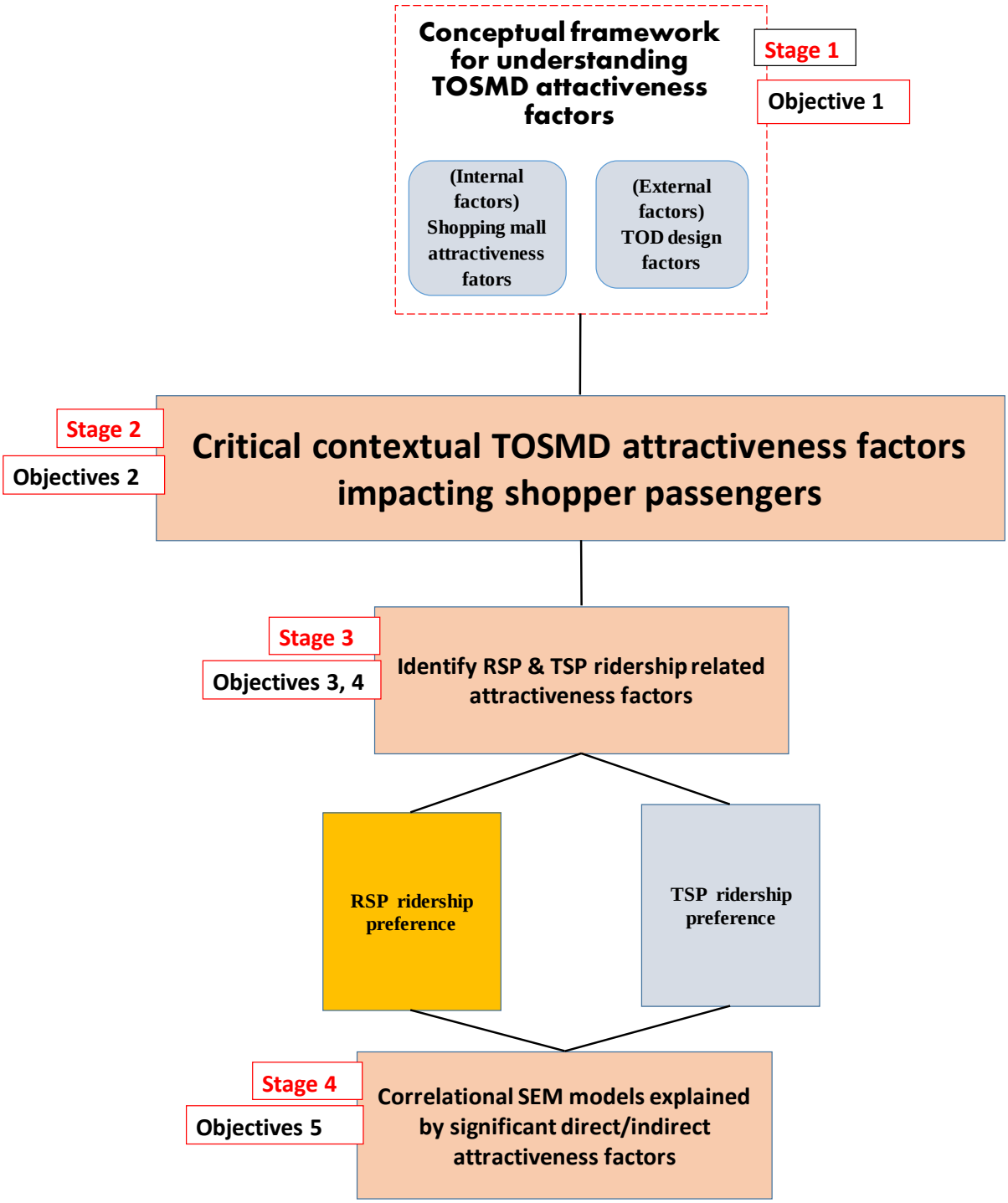


Figure 3.3 Flow chart of the research methodology

3.4 Methods

The research approach explores the impact of attractiveness factors of a TOSMD on shopper passenger ridership at a nearby transit station, with particular reference to resident and tourist shopper passengers.

The methods section describes the case study of Dubai metro Redline, which includes urban designed walkways which connect a significant number of shopping malls and its nearby metro stations. Therefore, it provided an excellent context for the research. The sampling approach is provided. The research was non-experimentally designed using a questionnaire (Fowler, 2013; Phillips and Burbules, 2000). The details of the variables and the questionnaire that was developed as part of the survey instrument are explained. The analysis approach that was used in the research; including Exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and Structural Equation Modeling (SEM) is also discussed.

The research measured the association between attractiveness factors (the independent factors) and the ridership preference factor of shopper passengers using TOSMDs near stations (the dependent factor). The mediating effect of contextual factors (the mediating factors) on TOSMD attractiveness was also measured to evaluate correlations and significant direct/mediating TOSMD attractiveness factors impacting shopper passenger ridership at stations near TOSMDs. Shopper passengers (individuals) boarding at metro stations near TOSMDs were surveyed to understand their perspectives on shopping mall attractiveness and ridership preferences. It was conducted with ethical approval (H18REA003) issued by the University of Southern Queensland.

3.4.1 *Case study*

Dubai is a city which has been seeking to differentiate itself from other transport hubs as a major shopping hub and has more than 65 shopping malls (Jacobs, 2018). The Dubai metropolis has an area of 4114 km^2 and a population of 3.3 million people (Dubai Statistics Center, 2020). However, it hosted 15.92 million visitors in 2018 (Dubai Economic Department, 2019). A large number of visitors and tourists to Dubai shopping malls also utilise the city's domestic Metro Redline.

The Dubai Metro Redline is 52.1 kilometres long and was opened in 2009. This is Phase 1 of the Metro Redline. Figure 3.4 shows the Metro Redline which has two stations connected to Dubai Airport (T1, T3), two interchange stations with the Greenline at Union Station and Burjuman Station, and a number of stations (circled) connected or adjacent (within approximately 0.8 km radius) to major shopping malls. From left to right they are Ibn Battuta Mall, Dubai Marina Mall, Mall of Emirates, Dubai Mall, Burjman Shopping Center, Al Ghurair Centre, and Deira City Centre. These malls are typically transit precinct, located in high

density, mixed communities along Sheikh Zaid Road and the Old Deira area. The Dubai Metro Redline stations include TOD urban designed walkways which connect the mall to a nearby metro station. Based on connectivity to Dubai Airport, the number of stations connected to shopping malls and the ready availability of ridership data made the Dubai Metro Redline case highly suitable.

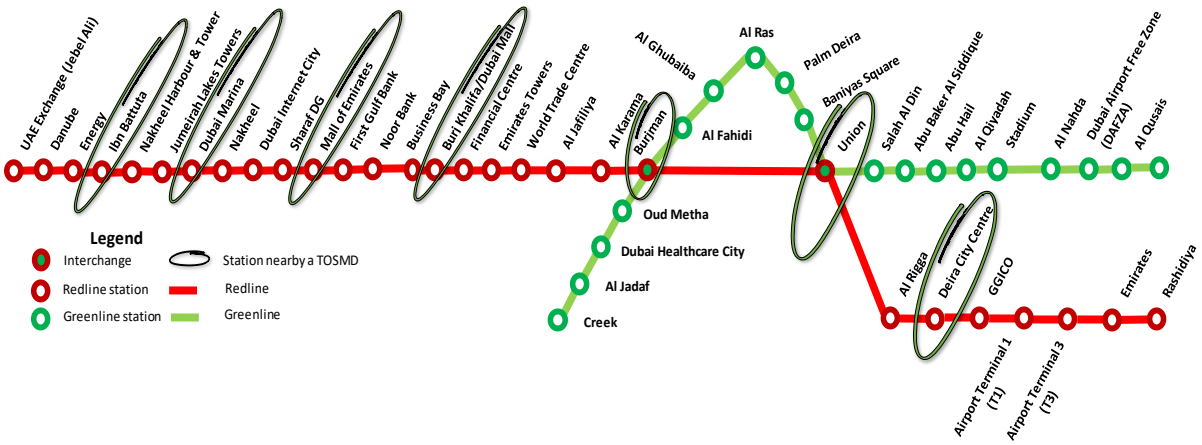


Figure 3.4 Dubai Metro Redline route map and stations within 0.8 km (circled) of shopping malls

The research used a single case study approach, namely the Dubai Metro Redline, to neutralise the impact of the level of service, transport policies and fare level on station ridership, as was mentioned in the research design section. Furthermore, there are few studies directly addressing the research problem within a homogeneous one-study context capturing the relationship between metro station usage and TOSMD context attractiveness.

3.4.2 *Sampling*

The sampling unit was comprised of shopper passengers coming from a shopping mall into a nearby transit station on the Dubai Metro Redline. As explained earlier, there are seven stations near TOSMDs (refer to Figure 3.4). The seven stations (circled) were selected based on their location as being either connected to, or within a walkable distance of, a shopping mall.

To determine a sample size and to ensure that the results would be statistically valid, calculations on a minimum sample size were undertaken. The minimum sample size to obtain an accepted confidence level of 95% (Tkaczynski et al., 2010; Veal, 2006) was calculated using the following formula:

Minimum sample size (Aaker, 2004): $n=z^2\sigma^2 \div (\text{sampling error})^2 = 2^2(0.25) \div (0.05)^2 = 400$

Where: z = 2 for a 95 percent confidence level, population variance (σ^2) = 0.25 (where the population variance is at its maximum when the population proportion is equal 0.50), sampling error = 0.05 (to obtain a confidence level of 95%).

To allow for non-responses or incomplete responses, the sample size was increased to a minimum of 700 shopper passengers. The list of attractiveness factors was eventually used to develop correlations using SEM to explain the ridership of shopper passengers represented by a preference for Dubai Metro Redline stations near TOSMDs and answer the research question of how TOSMD attractiveness factors impact the ridership (in the form of shopper passengers) at stations near TOSMDs.

Using a random intercept technique along with the self-administered questionnaire, participants were selected based first on asking the shopper passengers if they had come from the shopping mall to board the Metro at the nearby station (Guarte and Barrios, 2006). If the answer was "yes", the shopper passengers were purposively asked to unanimously participate in the survey. Shopper passengers were given the option to complete the survey using a provided web link to the research survey. Guarte and Barrios (2006) described purposive sampling as a random selection of sampling units (shopper passengers) within the segment (shopping centre/Metro station) of the population with the most information on the characteristic of interest (visited a mall and intending to use a metro nearby station).

The sample of shopper passengers was selected equally across the seven stations with a target of 100 shopper passengers per station. The majority of empirical studies require a selection of a random sample representing the population; otherwise, the sample will be biased or skewed (Malhotra, 2008; Veal, 2006). The sample selection was stratified to ensure representation of both RSPs and TSPs. Stratification ensures specific characteristics of individuals are represented in the sample, and the sample reflects the true proportions in the population (Creswell, 2013; Fowler, 2013).

Therefore, a minimum sample of 80 shopper passengers from each of the stations would range between approximately 75% of RSPs and approximately 25% of TSPs. These percentages were based on the Dubai Roads and Transport Authority's (RTA's) most recent customer satisfaction survey of 801 passengers in 2016 (RTA-Dubai, 2016), where 602

passengers were residents, 186 passengers were tourists, and 13 passengers were excluded as residency could not be established. The RTA is the authority managing the operation of the Dubai Metro Redline. The RTA's survey was randomly conducted during the period from April 2016 to June 2016 to investigate passenger satisfaction with the Dubai Metro Redline service. The distribution of Dubai Metro ridership into resident and tourist passengers was used as a basis for selecting representative percentages of resident and tourist shopper passengers for the sample.

The survey was generally distributed during the afternoon daily peak time between 4:00 pm and 8:00 pm. It was determined that the period of the survey and the afternoon data collection time provided the greatest diversity of participants, including workers and their families. The daily morning peak time between 6:00 am to 9:00 am was avoided as shopping mall shops commonly open after 9:00 am, and many passengers are travelling to work, so prospective respondents were not available during this time. Shopper passengers were given the option to complete the survey using a provided web link to the research survey.

The link ensured that all questions were answered. For those physically collected surveys, they were later entered on behalf of the respondents under a separate group using the same web link to consolidate all collected data into one CSV file. The file was eventually uploaded into IBM SPSS with AMOS 26 for statistical analysis and modelling.

Out of the 1200 surveys distributed, 700 valid survey responses were collected (response rate=58%); with 366 completed online (52%), and 334 completed as physical forms (48%).

The survey data were collected daily during the period from April 2019 to October 2019. The data was collected from a 72-question survey, refer to **Journal Article 2**. The survey questionnaire was divided into six sections (refer to Table 3.1).

Table 3.1 Research survey summary sections

Section	Number of questions	Details
Section A	11	Demographic characteristics
Section B	7	Mall visit behavioural characteristics
Section C	28	Mall internal characteristics impacting choice to visit it
Section D	20	Mall external neighbourhood characteristics impacting choice to visit it
Section E	4	Level of agreement to potentially use a metro station near the mall
Section F	2	Respondents' voluntary comments and email details

The survey uses closed questions designed for easy and prompt response (El-Adly, 2007), with Sections C, D, and E using a 5-point Likert scale (Kamruzzaman et al., 2016).

A summary of the variables and the respective survey questions is presented in Table 3.2. As can be seen, Question 10 was used to segment respondents (shopper passengers) into residents

and tourists. Then, each latent construct was represented by four survey items. Three survey items can, however, be used to measure each latent construct (Awang, 2012b).

Table 3.2 Summary of variables and respective survey questions

Latent construct	Number of Measures	Question no. (q)	Questions
Segmentation according to residency of Dubai	1	**10**	Resident of Dubai
			Tourist of Dubai
Product	4	**19**	Grocery store present (e.g. Carrefour)
		20	Cinema present
		21	Mall has all that I need
		22	Presence of fun and entertainment activities in the mall (e.g. gaming arcade)
Price	4	**23**	Prices are appropriate to my income
		24	Prices offer value for money
		25	Overall price level in the mall
		26	Comparatively low prices
Place	4	**27**	Size of the mall
		28	Average size of shops
		29	Number of stores
		30	Convenient facilities (e.g. elevators, escalators) and amenities (e.g. toilets)
Promotion	4	**31**	Promotional campaigns in the mall
		32	Organising events in the mall (e.g. shows)
		33	Loyalty programs
		34	Mall image and publicity (e.g. Dubai Mall)
People	4	**35**	Staff helpfulness and friendliness in the mall
		36	Staff knowledge and training
		37	Availability of customer service in the mall
		38	Staff extended working hours (e.g. staff working during public holidays and weekends)
Physical evidence	4	**39**	Lack of crowdedness in the mall
		40	Modern internal mall decoration
		41	Comfortable controlled temperature
		42	Atmosphere in the mall (e.g. music and lighting)
Process	4	**43**	Ease of reaching the mall (e.g. directions)
		44	Ease of finding a desired store inside the mall (e.g. Virgin store)
		45	Ease of finding a desired product inside the mall (e.g. iPhone mobiles)
		46	Freedom in the mall (e.g. no dress restriction)
Density	4	**47**	Crowdedness of buildings around the mall
		48	Total population in the neighbourhood around the shopping mall
		49	Car traffic congestion around the shopping mall
		50	High number of shops surrounding the shopping mall
Diversity	4	**51**	Availability of mixed residential and commercial areas around the mall
		52	Availability of scenic and recreational areas around the mall (e.g. water fountain)
		53	Availability of community services around the shopping mall (e.g. government services)
		54	Economic diversity in the neighbourhood around the shopping mall (e.g. high, low income families)
Urban design	4	**55**	Availability of safe and air-conditioned walkways around the mall
		56	Availability of cycling lanes around the mall
		57	Availability of parking facilities
		58	Availability of clear signage around the mall
Destination accessibility	4	**59**	Availability of walking access around the mall (e.g. pedestrian crossings, bridges and tunnels)
		60	Access to facilities and amenities around the shopping mall (e.g. hospitals)
		61	Access to downtown /or city centre
		62	Access to different transport mode options (e.g. multimodality)
Distance	4	**63**	Proximity of shops in the area around the mall
		64	Proximity of a metro station
		65	Proximity of inter-city public transport
		66	Proximity to other modes of transport
Location_Context	4	**43**	Ease of reaching the mall (e.g. directions)
		47	Crowdedness of buildings around the mall
		49	Car traffic congestion around the shopping mall
		66	Proximity to other modes of transport
Space_Context	4	**27**	Size of the mall
		28	Average size of shops
		29	Number of shops
		57	Availability of parking facilities
Stores_Context	4	**19**	Grocery store present (e.g. Carrefour)
		20	Cinema present
		44	Ease of finding a desired store inside the mall (e.g. Virgin store)
		49	High number of shops surrounding the shopping mall
Shopper Passenger ridership	4	**67**	I intend to use the metro station close to the mall because: the station is at walkable distance from the mall
		68	I intend to use the metro station close to the mall because: there is car traffic congestion in the area of the mall
		69	I intend to use the metro station close to the mall because: there is lack of enough car parking spaces in the area of the mall
		70	I intend to use the metro station close to the mall because: there is walking access from the station to the mall

3.4.3 *Pretesting*

A pretesting of the survey questionnaire was conducted (Cooper, 2011) with a sample of 10 shopper passengers distributed equally between resident and tourist shopper passengers. The pretesting was conducted to identify and eliminate any difficulties in understanding and completing the questionnaire (which was guided by shopping mall attractiveness and TOD design variables). The final TOSMD attractiveness variables included in the actual survey were determined based on the outcome of the pretesting.

3.4.4 *Non-response bias*

Non-response was expected from some shopper passengers due to a lack of time or interest. It was also expected that some shopper passengers might not be able to comprehend an English questionnaire. Therefore, the survey had an Arabic translated version. Non-response creates unacceptable reductions in sample size and increases bias (De Vaus, 2013). So, to reduce the non-response bias, three techniques were utilised (Salant and Dillman, 1994) including increasing the sample size to allow for non-response, administering the survey and encouraging respondents to complete the questionnaire in a short time, and emailing the completed survey to the researcher within two days.

3.4.5 *Reliability and validity of data*

Reliability was achieved in the development of a defined research road map, as illustrated in Section 1.9. Bias was minimised using methods illustrated in Section 3.4.3 and limiting random bias. Reliability was achieved in the development of the questionnaire through the pretesting to clarify question wording and instructions, the calculation of a representative sample size, and allowing for non-response and participants' completion of the question with clarification support. Cronbach Alpha statistical measure test was calculated to examine the reliability of variables retained in each factor, and coefficients equal to or greater than 0.7 were considered acceptable, indicating a good construct reliability (Hair et al., 2006; Lai and Chen, 2011). After testing reliability and validation of variables' relationship guided by the study established conceptual framework for TOSMDs attractiveness factors and using SPSS with AMOS 26 for statistical analysis, SEM was conducted to investigate the impact of attractiveness factors on

resident and tourist shopper passenger ridership at stations near TOSMDs. To maximise construct validity, a homogeneous context of the sample was chosen (namely the Dubai Metro Redline). Also, the questionnaire design using the established conceptual framework for TOSMDs' attractiveness factors. The above sampling process and the pretesting of the survey questionnaire were all consistently applied within the earlier justified research design process. For appropriateness, the questionnaire was guided by the generic elements of the extended service marking mix of product price, place, promotion, people, physical evidence, and process (Rafiq and Ahmed, 1995), and the 5 Ds of TODs of density, diversity, urban design, destination accessibility, and distance (Cervero and Murakami, 2008). These elements were used as the basis of the earlier established conceptual framework for TOSMD attractiveness factors.

3.4.6 *Anonymously administered translated questionnaire*

An anonymous survey method was chosen as the data collection instrument, as it is commonly used in these types of studies (Tkaczynski et al., 2010). It has a high level of accuracy and speed, and limited cost (Malhotra, 2008; Rajagopal, 2009). The survey was anonymous, so participants could disclose information such as demographic details and attractiveness factor preferences without being identified (Veal, 2006). The questionnaire was written in both English and Arabic as the official language of the UAE is Arabic. The translation was achieved using the back translation method, which was used in El-Adly's (2007) study.

The researcher distributed the questionnaire to the participants as they agreed to be involved in the research, to help overcome any expected issues of participant illiteracy and to assist those who required any clarification of the survey's terms without interfering with the participants' survey answers, thereby decreasing the frequency of incomplete data. Participants were also offered the choice of completing the questionnaire and sending it to the researcher via email within two days.

A self-administered questionnaire can have the advantage of greater confidentiality. However, it does not allow the researcher to give assistance, as needed, to the participants (Malhotra, 2008). This situation could have led to participants providing incomplete or incorrect information or leaving questions unanswered, thus increasing the level of missing data. Therefore, the researcher chose to administer the survey with the view to better understand shopper passenger numbers at metro stations nearby TOSMDs, so that the urban planners and

governments responsible for building transit stations could benefit from the outcome of this research.

3.4.7 *Data analysis*

Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) are powerful statistical techniques (Suhr, 2006). EFA is used to identify the possible underlying factor structure of a set of variables without imposing a preconceived structure on the outcome (Child, 2006). CFA allows for scale assessment to determine the factors' structure according to participants' responses (Salleh, 2005; Suhr, 2006). Structural equation modelling (SEM) is a statistical analysis technique developed for analysing the inter-relationships between multiple variables (Awang, 2012a).

The objective of this research was to explain the effect of TOSMD attractiveness factors on shopper passenger ridership at transit stations near TOSMDs. Therefore, similar to research conducted in the past (such as El-Adly (2007) and Lai and Chen (2011)), addressing the effect of correlational factors (i.e. attractiveness factors on mall patronage), and as a practical approach considering the objective of the research, a Principal Component Analysis (PCA) approach with Exploratory Factor Analysis (EFA) were used in this research. Statistical parameters of Kaiser–Meyer–Olkin (KMO) measuring sampling adequacy and Bartlett's test of sphericity with acceptable outcome were used in the statistical analyses.

Similar to Sohn and Shim (2010), the explored principal list of attractiveness factors was used to conduct SEM to ultimately identify and clarify the impact of attractiveness factors on resident and tourist shopper passenger ridership at stations near TOSMDs. The correlational SEMs determining the significant direct/mediating attractiveness factors impacting resident and tourist shopper passenger ridership would provide a previously tested reliable method for explaining ridership of TSPs and RSPs at a Metro station near shopping malls (Lai and Chen, 2011). The correlations identified in the research can guide forecasting TOSMD's contribution of (resident and tourist) shopper passengers to a nearby metro station.

The data obtained from the surveyed 700 shopper passengers were analysed using SPSS with AMOS 26 for statistical analysis and modelling. Attractiveness factors were the independent constructs, and shopper passenger ridership represented by preference to board at a nearby transit station was the dependent construct. The seven Metro stations next to TOSMDs were chosen for survey data collection from shopper passengers (both resident and tourist)

intending to use the Metro stations nearby malls. The CFA was used to validate the outcome of the PCA analysis. Furthermore, modification indices above 10 (indicating a pair of similar items which may be redundant) were eliminated.

The SEM presented the correlations between Metro station resident and tourist shopper passenger ridership and TOSMD attractiveness factors. The SEM was developed as a function of the scoring of the identified attractiveness factors for RSP and TSP at metro stations near the TOSMDs, as shown in the following Chapters 4, 5 and 6.

3.5 Conclusions

This chapter discussed and justified the post-positivist paradigm and the quantitative research design used in this research. The conceptual framework for TOSMD attractiveness factors that was established from the literature review in Chapter 2 was used as a basis for the methodology. The chapter discussed the survey questionnaire technique used to collect the research data. The survey was distributed to shopper passengers at stations near TOSMDs. The sampling was discussed, including the process used to ensure the validity and reliability of the collected responses. The data analysis approach was also discussed. EFA with CFA and SEM were used to explain the effect of attractiveness factors on shopper passenger ridership at transit stations near TOSMDs. The following Chapters 4 and 5 detail the findings of the research.

Chapter 4 Understanding Contextual Attractiveness Factors of Transit Orientated Shopping Mall Developments (TOSMDs) for Shopping Mall Passengers on the Dubai Metro Redline – Journal Article 2

Abutaleb, A., McDougall, K., Basson, M., Hassan, R. and mahmood, M. N. (2020b). Understanding Contextual Attractiveness Factors of Transit Orientated Shopping Mall Developments (Tosmds) for Shopping Mall Passengers on the Dubai Metro Red Line. *Planning Practice & Research*, 1-22.

DOI: https://doi.org/10.1080/02697459.2020.1829282

Journal Article 2 explored the contextual attractiveness factors of Transit Orientated Shopping Mall Developments (TOSMDs) for shopping mall passengers. Shopping mall studies reveal various factors attracting customers and patrons, whilst Transit-Oriented Development (TOD) studies focus on the impact of these developments on transit ridership. There is, however, limited research on Transit-Oriented Shopping Mall Developments (TOSMDs) and their attractiveness to passengers to board at nearby stations. This study investigated the attractiveness of these developments by exploring three contextual factors. Structural modelling indicated two contextual factors related to the preference of shopping mall passengers to board at transit stations near shopping malls. The study contributes to understanding and optimising TOD planning practice and forecasting across transit networks.

PLANNING PRACTICE & RESEARCH
https://doi.org/10.1080/02697459.2020.1829282

Understanding Contextual Attractiveness Factors of Transit Orientated Shopping Mall Developments (Tosmds) for Shopping Mall Passengers on the Dubai Metro Red Line

Ayman Abutaleb [a], Kevin Mcdougall [b], Marita Basson [c], Rumman Hassan [d] and Muhammad Nateque mahmood [e]

[a]RTA – Rail Agency (CEO Office), Dubai, UAE; [b]School of Civil Engineering and Surveying, University of Southern Queensland, Toowoomba, Queensland, Australia; [c]School of Civil Engineering and Surveying, University of Southern, Toowoomba, Queensland, Australia; [d]School of Management and Enterprise, University of Southern Queensland, Toowoomba, Queensland, Australia; [e]School of Architecture and Built Environment, Deakin University, Geelong, Australia

ABSTRACT

Shopping mall studies reveal various factors attracting customers and patrons, whilst Transit-Oriented Development (TOD) studies focus on the impact of these developments on transit ridership. There is, however, limited research on Transit-Oriented Shopping Mall Developments (TOSMDs) and their attractiveness to passengers to board at nearby stations. This study investigates the attractiveness of these developments by exploring three contextual factors. Structural modelling indicated two contextual factors related to the preference of shopping mall passengers to board at transit stations near shopping malls. The study contributes to understanding and optimizing TOD planning practice and forecasting across transit networks.

KEYWORDS

Ridership; station boarding factors; transit-oriented development; shopping mall attractiveness; passenger forecasting models

1. Introduction

In an urban planning context, a Transit-Oriented Development (TOD) seeks to concentrate and integrate both transit and development to encourage people to walk, cycle and use public transit instead of cars (Milakis & Vafeiadis, 2014; Singh *et al.*, 2017). Context refers to the layout and configuration of urban form including land parcels, buildings, street networks, pedestrian-oriented attributes, and property land uses (Lee, 2013). TOD benefits include increased access to public transport and efficient land use, typically in the form of denser, mixed-use, and pedestrian-friendly development oriented to transit (Higgins & Kanaroglou, 2016; Singh *et al.*, 2017). A mixed-use shopping mall (i.e. retail, commercial, residential and social) can be developed as a TOD where shoppers drive their cars less and, instead, ride nearby mass transit (Bernick & Cervero, 1997) thus increasing transit ridership (Singh *et al.*, 2017).

However, the potential benefits of coordinated transportation and land use planning through TOD are sometimes not well-considered (Higgins & Kanaroglou, 2016). This can particularly be the case in Transit-Oriented Shopping Mall Development (TOSMD).

CONTACT Ayman Abutaleb aymanabutalebusq@gmail.com

In this study, TOSMD is defined as a shopping mall (SM) near a transit station in the context of a TOD. Our previous study proposed a framework for TOSMD attractiveness factors using three contextual factors (location, space and stores) to explain transit station use by shopping mall passengers (Abutaleb *et al.*, 2019). However, the impact of these three contextual factors on the ridership preferences of shopping passengers at nearby stations has not been examined empirically.

Shopping malls are often considered to be the retail, social and community centres of their communities (Feinberg & Meoli, 1991). Rydin (2019) recently highlighted the social importance of shopping areas and the need for planning to engage further with this feature of urban lifestyle. Hence, there is a need to empirically study the context of shopping mall developments near transit stations to better understand the number of passengers using a nearby transit station, and its capacity to serve shopper passengers. Such knowledge can help transit urban planners consider developments' contextual factors as modifying inputs, thus enhancing the accuracy of passenger forecasting models at station level. Improvements in passenger forecasting could then be applied to the design of transit network stations, including the space inside the station and connectivity to a nearby shopping mall development. Previous studies have identified that a transit station near a shopping mall development can reach its capacity in a short period of time and create passenger congestion (Kok, 2007), resulting in costly upgrades and disruption to the rail service and travellers. Moreover, the population growth in cities, as well as visiting tourists, can further exacerbate this problem.

Several scholars have studied TOD design principles (Mingqiao *et al.*, 2014; Newman, 2009; Thomas & Bertolini, 2014), rail ridership (Boyle, 2006; Choi *et al.*, 2012; Chu, 2004; Taylor & Fink, 2003), and the relationship between the two (Acheampong & Silva, 2015; Cervero, 1994; Sung & Oh, 2011). The majority of these studies had focussed on analysing the impact of transit systems, stations, land use and value creation. Some studies have also considered transit service level and Origin-Destination (O-D) trip analysis (Cervero & Duncan, 2002; Chen *et al.*, 2011; Du & Mulley, 2007; Gutiérrez *et al.*, 2011; Zhao *et al.*, 2007). Other studies have focussed on shopping mall characteristics, and analyzed shopping mall patronage within the shopping mall context with no mention of the reverse impact of the specific mall contextual impact on the forecasting models of the ridership at a nearby transit station (De Juan, 2004; Mundell, 2013; Telci, 2013; Thang & Tan, 2003). A number of researchers identified the need for more detailed analyses of station environments to better understand the connection between station use and its context (Cardozo *et al.*, 2012; Zemp *et al.*, 2011) based on land use and transport developments often being poorly aligned with each other (Chorus, 2012).

Against this background, our study examines the ridership preferences of shopping mall passengers that comprise part of the total ridership at a metro station close to a shopping mall development. Specifically, it attempts to clarify the related contextual attractiveness factors that affect the preferences of shopping mall passengers to board at a transit station near to a TOSMD on the Dubai Metro Redline in the United Arab Emirates (UAE). Shopping mall passengers are considered to be influenced by a development's location, space, and stores contextual attractiveness. This study examines shopping mall passenger preferences in a TOSMD context to understand the attractiveness with respect to location, stores, and space contextual attributes and station boarding factors (SBF). It then investigates how the

ridership preferences of shopping mall passengers, represented by their preference to board at a nearby station, is associated with these contextual factors.

This study is organized as follows: Section 2 presents a review of the existing literature relevant to TOD, the contextual attractiveness factors of TOSMDs and Station Boarding Factors (SBFs) for transit stations, Section 3 presents the methodology and data analysis techniques, Section 4 discusses the results of the study, and the final section addresses the implications of the findings, study limitations, and proposes further research.

2. Literature review

2.1 Transit-oriented development (TOD)

TOD can be defined as a compact, mixed-use community, centred around a transit station that, by design, invites residents, workers, and shoppers to drive their cars less and ride mass transit more (Cervero, 2004; Lee *et al.*, 2013; Nasri & Zhang, 2014; Singh *et al.*, 2017). Many researchers have attempted to identify the characteristics and planning elements of a TOD (Calthorpe, 1993; Curtis *et al.*, 2009; Knowles *et al.*, 2020; Singh *et al.*, 2014). Five main TOD characteristics are commonly known and referred to as the 5Ds: density, diversity, urban design, destination accessibility and distance (Abutaleb *et al.*, 2019; Ewing & Cervero, 2010). Beyond these 5Ds, Ogra and Ndebele (2014) added demand management, and Huang and Wey (2019) added distinction. Recently, Knowles *et al.* (2020) proposed demand management and high-frequency transit services as additional characteristics of TOD. In line with Huang *et al.* (2018) and Ewing (2008), we argue that the identified TOD characteristics are interrelated and overlap. Hence, this study is based on the 5Ds explained above and our earlier study which presented a conceptual framework that proposed a relationship between shopping mall passengers boarding at transit stations and the contextual attractiveness of TOSMDs (Abutaleb *et al.*, 2019).

TOD primarily links mixed-use developments to frequent, accessible rail transit services to stimulate improved land use and transport integration. The majority of research applying TOD elements has analyzed the surrounding context of a transit network, i.e. city contexts such as Melbourne, Sydney and Brisbane – Australia (Searle *et al.*, 2014), Seoul – South Korea (Taehyun *et al.*, 2016), Beijing – China (Sun *et al.*, 2016), Brisbane – Australia (Kamruzzaman *et al.*, 2014), New York – USA and Hong Kong – China (Loo *et al.*, 2010), Dubai – United Arabi Emirates (Hannawi *et al.*, 2019) and other countries in the Gulf region such as Qatar (Knowles *et al.*, 2020). Oftentimes however, studies do not adequately address all of the salient TOD factors impacting transit station ridership. Specifically, current studies do not consider the impact of the contextual factors of attractiveness (location, space, and stores) on shopping mall passengers using a nearby transit station in a TOD context. The term TOSMD was recently coined to describe a shopping mall (SM) near a transit station in a TOD context (Abutaleb *et al.*, 2019).

Since TOD can result in increased transit ridership (Singh *et al.*, 2017), analysing both the attractiveness of a shopping mall within a TOD context and station boarding factors is considered critical to ensuring that a transit station continues to offer accessibility to shopping mall passengers arriving at a nearby transit station.

2.2 Contextual Attractiveness of Transit-Oriented Shopping Mall Developments (TOSMDs)

Shopping malls often consist of a mix of stores, food courts, restaurants, cinemas, children's play areas, interactive entertainment, social use areas, relaxation spaces and promotional areas (Farrag *et al.*, 2010). The attractiveness factors of shopping malls have been studied for different reasons, such as predicting and optimizing mall patronage (Arslan *et al.*, 2010; Wei Khong & Sim Ong, 2014), identifying the optimal mix of activities in shopping malls, developing retailing strategies (Dahsh & Dasa, 2014; El-Adly, 2007; Kushwaha *et al.*, 2017; Tandon *et al.*, 2016), understanding socio-spatial dynamics (Erkip, 2005) and determining mall rent (Ke & Wang, 2016).

In the Gulf region, Dubai is considered a regional pioneer in urban planning development approaches, and its metro system has led public transport utilisation (Narayanaswami, 2017). With its high regional demand for shopping (Antiado *et al.*, 2017; Zaidan, 2015), and its transformation from car-based transport infrastructure to public transport usage, shopping mall developments are attracting increased ridership from nearby metro stations (Hannawi *et al.*, 2019). Rajagopal (2009) indicated that a large shopping mall can facilitate a greater variety of shops and create a more pleasant environment for shoppers, thus enticing them to visit more often and stay longer. As a result, shopping mall attractiveness and a lack of planning and vision can lead to chaotic development and congestion at shopping malls (Kok, 2007). Albalate and Bel (2010) indicated that better mobility at mall areas can improve cities' economies and tourism intensity. The growth in cities' resident populations, as well as visiting tourists, can exacerbate this problem. However, the attractiveness factors of shopping malls can change from one context to another (Abutaleb *et al.*, 2019), and different shopping mall attractiveness factors in different contexts can contribute to varying levels of mall patronage (El-Adly, 2007; Rajagopal, 2009) and, therefore, different nearby station use (Cervero, 2004; Jacobson & Forsyth, 2008).

Contextual factors refer to the context of TOSMD attractiveness, measured by both shopping mall attractiveness and TOD characteristics. The majority of researchers distinguish between the attractiveness factors of shopping malls and the design factors of TODs (Abutaleb *et al.*, 2019). They are studied separately in both the retail and urban planning literature. The contextual factors of TOSMD attractiveness identified in the literature can be classified into three general categories. TOSMD location context factors such as ease of reaching the mall and the crowdedness of buildings around the mall, TOSMD space context factors such as the mall's size and car park, and TOSMD stores context factors such as the number of stores inside and around the mall (see Table 1 for a summary of studies on the contextual attractiveness factors of TOSMDs).

From the literature review, it was concluded that the effect of shopping mall attractiveness factors is mainly captured in the mall patronage but has not been considered in relation to the ridership at nearby transit stations. Although researchers such as Castillo-Manzano and López-Valpuesta (2009) and Zemp *et al.* (2011) indicated that there is a relationship between transit stations and their context, the extent to which the contextual location, space, and stores attributes of attractiveness may influence ridership at nearby transit stations is not clear.

Table 1. Summary of studies on contextual attractiveness factors of TOSMDs.

Author(s)/year	Country	Contextual attractiveness factors of TOSMDs	Attributes
El-Adly (2007), Farrag *et al.* (2010)	UAE; Egypt	Location context	Ease of reaching mall (e.g. directions)
Jacobson & Forsyth (2008), Li *et al.* (2016)	USA; China		Crowdedness and compactness of buildings around mall
Pacheco-Raguz (2010)	Philippines		Car traffic congestion around shopping mall
Taehyun *et al.* (2016)	South Korea		Proximity of a metro station
González-Hernández and Orozco-Gómez (2012)	Mexico	Space context	Size of mall
Rajagopal (2011)	Mexico		Average size of shops in mall
Rajagopal (2011)	Mexico		Number of shops in mall
van Lierop *et al.* (2017)	USA, Canada, and the Netherlands		Availability of parking facilities
Khare (2011)	India	Stores context	Grocery store present (e.g. Carrefour)
Ahmad (2012), El-Adly (2007)	Saudi Arabia; UAE		Availability of cinema
Farrag *et al.* (2010)	Egypt		Ease of finding desired store inside mall (e.g. Virgin store)
van Lierop *et al.* (2017)	USA, Canada, and the Netherlands		Extent of shops surrounding shopping mall
Kamruzzaman *et al.* (2014)	Australia	TOSMDs contextual attractiveness	Station walkable distance from mall
Pacheco-Raguz (2010)	Philippines		Car traffic congestion in area of mall
Jacobson & Forsyth (2008)	USA		Lacking of parking spaces in area of the mall
Lund (2006)	USA		Walking access from station to mall

2.3 Station Boarding Factors (Sbfs)

Sohn and Shim (2010) divided the factors affecting metro demand into three categories: built environment, external connectivity and intermodal connection. These three categories contained 24 independent metro boarding variables identified in previous studies (Boyle, 2006; Cao *et al.*, 2009; Cervero, 2006; Chu, 2004; Estupiñán & Rodríguez, 2008; Khattak & Rodriguez, 2005; Kim *et al.*, 2007; Kuby *et al.*, 2004; Quade, 1996; Yao, 2007). Among the identified metro boarding variables, Sohn and Shim (2010) showed '*commercial floor area*' as significantly associated with station boarding. However, their study did not capture the impact of variability in '*commercial floor area*', particularly in the context of a TOD shopping mall development. Researchers such as Gutiérrez *et al.* (2011); Rajagopal (2011) and Khare (2011) indicated that the location, space and stores of a shopping mall might limit its attractiveness and, therefore, its impact on the ridership of shopper passengers intending to use a nearby transit station.

In conclusion, although researchers such as Castillo-Manzano and López-Valpuesta (2009) and Zemp *et al.* (2011) indicated that there is a relationship between transit station usage and its context, the extent to which contextual location, space, and stores attributes of attractiveness impact nearby transit stations' ridership is not clear.

3. Methods

This research was designed to explore the contextual attractiveness factors for passengers utilising a station near a shopping mall development on the Dubai Metro Redline, and to

understand the potential impact of these factors on ridership at station level. The research adopted a non-experimental research design strategy (Creswell, 2013), and measured the association between the contextual factors of TOSMD attractiveness (the independent factors) and the shopping mall passengers' preference to board at transit stations near shopping malls (the dependent factor). The literature review indicated that TOSMD contextual attractiveness is comprised of a number of related factors including location, space and stores (refer to Table 1), and that the ridership preferences of shopping mall passengers at nearby stations is a function of these contextual factors.

Therefore, shopping mall passengers boarding at seven metro stations near TOSMDs were surveyed to understand their perspectives on the shopping mall attractiveness context and ridership preference.

3.1 Study area

The Dubai Metro Redline (see Figure 1) has 29 stations with two stations connected to Dubai airport (T1, T3), and two interchange stations with the Greenline at Union Station and Burjuman Station. Seven stations (circled) were selected based on their location as being either connected to, or within a walkable distance of a shopping mall. These stations were identified using GIS and Google Maps to determine a walkable distance of around 0.8 km (Gutiérrez *et al.*, 2011; Kuby *et al.*, 2004; O'Neill *et al.*, 1992; Zhao *et al.*, 1835). These malls are typically in high density, mixed communities along Sheikh Zaid Road and the old Deira area. The Dubai Metro seven stations include urban designed walkways which connect the mall and a nearby metro station. The Dubai Metro Redline is 52.1 km long and was opened in 2009.

The percentage of passengers checking in at Dubai Metro Redline stations in the period from 2013 to 2018 (the period for which there was no major change in line services) is depicted in Figure 2.

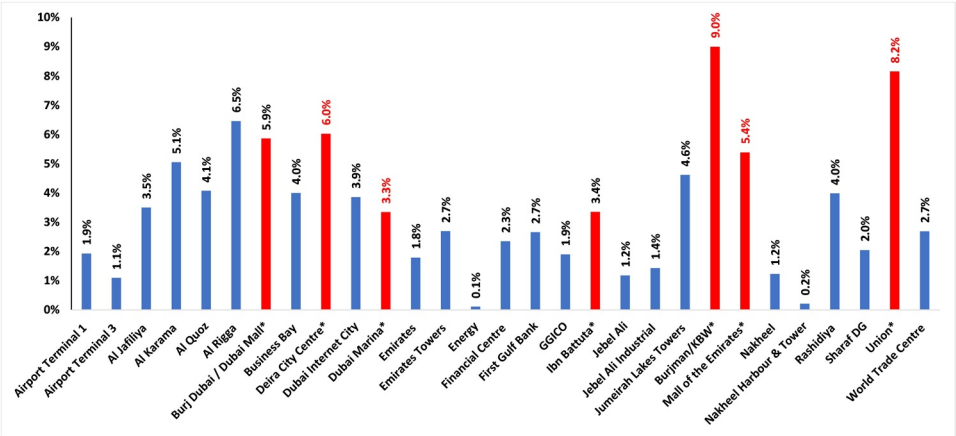


Figure 1. Dubai Metro Redline route map and stations within 0.8 km (circled) of a shopping mall. source: the authors.

As can be seen in Figure 2, the seven stations identified as being within 0.8 km of a shopping mall account for approximately 41.2% of passengers across the Dubai Metro Redline. The two interchange stations with the Green Line, namely Union Station and Burjuman Station, have a higher percentage of checking in passengers.

3.2 Data collection

The study's main data were collected via sampling conducted at the seven metro stations near shopping malls, as shown in Figure 2. The sampling unit in this research was individual shopping mall passengers (unit of analysis) coming from a shopping mall development into a nearby transit station (i.e. one of the seven identified stations on the Dubai Metro Redline).

It was determined that a sample size of 400 shopping mall passengers would achieve an acceptable confidence level of 95% using the following formula (Aaker, 2004):

$$n = z^2\sigma^2 \div (\text{samplingerror})^2 = 2^2(0.25) \div (0.05)^2 = 400$$

Where: z = 2 for a 95% confidence level, population variance (σ^2) = 0.25 (where the population variance is at its maximum when the population proportion is equal to 0.50), sampling error = 0.05 (to obtain a confidence level of 95%).

The stratified sample was considered broadly representative of Dubai Metro ridership with approximately 75% of passengers being residents and approximately 25% being tourists. These percentages align with the Dubai Roads and Transport Authority's (RTA's) recent customer survey which identified the approximate proportion of residents and tourist passengers (RTA-Dubai., 2016). Stratification ensures that specific characteristics of individuals are represented in the sample, and the sample reflects the true proportions in the passenger population (Creswell, 2013; Fowler, 2013).

The initial list of independent TOSMD contextual attractiveness factors was synthesized from the literature review summarized earlier. The study used data collected from a 72-question survey to understand passenger behaviours and agreement on various shopping mall characteristics as well as their transport preferences. The questionnaire was divided into six sections (see Table 2).

The survey used closed questions designed for easy and prompt response (El-Adly, 2007), with Sections C, D and E using a 5-point Likert scale (Kamruzzaman *et al.*, 2016). The questionnaire was pilot-tested using a collaborative participant pre-testing method

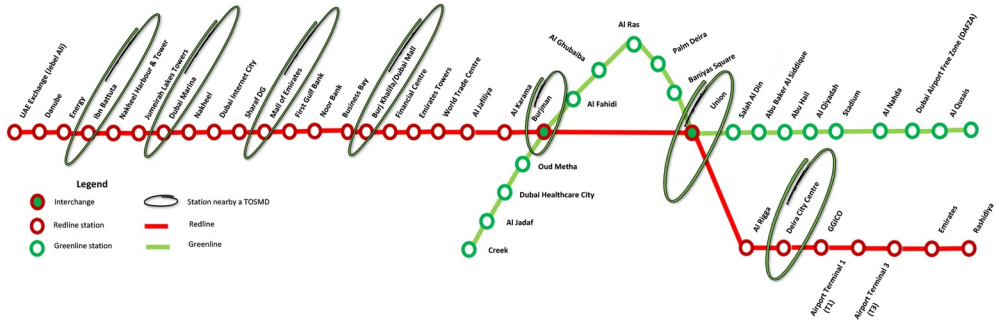


Figure 2. Percentage of passengers checking in at stations of Dubai Metro Redline in the period 2013 to 2018. Source:.Rail Operations Department – RTA (2018)

Table 2. Study survey summary sections.

Section	Number of questions	Details
Section A	11	Demographic characteristics
Section B	7	Mall visit behavioural characteristics
Section C	28	Mall internal characteristics impacting choice to visit it
Section D	20	Mall external neighbourhood characteristics impacting choice to visit it
Section E	4	Level of agreement to potentially use a metro station near the mall
Section F	2	Respondents' voluntary comments and email details

(Cooper, 2011) with a sample of 10 shopper passengers. Data for the main survey was collected during April and May 2019. The survey was distributed during the afternoon daily peak time between 4:00 and 8:00 pm. This time was determined to be suitable for engaging diverse participants, including workers and their families, in the survey. The survey questionnaire was anonymous and self-administered to ensure the reliability and validity of data collected. Participants were purposively selected, based first on asking the shopping passengers at the seven metro stations if they had come from the shopping mall to board the metro at the nearby station (Guarte & Barrios, 2006). If the answer was 'yes', shopper passengers were asked to voluntarily participate in the survey. Shopper passengers were given the option to complete the survey within two days using a web link to the survey. The collected survey data were then uploaded into IBM SPSS with AMOS 26 for statistical analysis and modelling.

Of the 700 questionnaires distributed, 400 complete responses were received (response rate of 57%), including 168 responses completed online (42%) and 232 station-completed questionnaires (58%). The data from the 400 surveyed shopping mall passengers were analyzed to identify the principal list of TOSMD contextual attractiveness factors and to construct the structural equation model (SEM) explaining the ridership preferences of shopping mall passengers using nearby Dubai Metro Redline stations.

3.3 Descriptive statistics

Of the 400 surveyed shopper passengers boarding at the seven metro stations near shopping malls, 69% were identified as residents and 31% as Dubai tourists, 46% were males and 54% females, and 63% were aged between 18 and 34 and 37% were above 34 years of age. Three independent variables were identified and analyzed based on the TOSMD contextual attractiveness factors.

Table 3 presents a profile of the respondents in terms of the level of importance associated with the items of space, location, and stores context, and the level of desire to use a metro station near a shopping mall. As can be seen in Table 3, more than half the respondents ranked the space context items as important (M = 3.88; SD =0.72), including size of the mall (54%), average size of shops (59%) and number of shops (50%). A high percentage of respondents also ranked location context items as important (M = 4.02; SD =0.62), including ease of reaching the mall (62%), ease of finding a desired store inside the mall (45%) and proximity of other modes of transport (35%). However, a high percentage of respondents ranked stores context items as neutral (M = 2.96; SD =0.84), including crowdedness and compactness of buildings around the mall (25%), car traffic congestion around the mall (22%), and high number of shops surrounding the shopping mall (39%). Nonetheless, a high percentage (52%) of respondents agreed that they

Table 3. Attractiveness of TOSMD contextual factors (n =400).

	Not Important		2		3		4		Very Important			
Scale =	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	M	SD
aSpace context												
Size of the mall	6	2%	18	5%	31	8%	216	54%	129	32%	4.11	0.84
Average size of shops	3	1%	29	7%	72	18%	235	59%	61	15%	3.81	0.81
Number of shops	3	1%	34	9%	99	25%	200	50%	64	16%	3.72	0.86
(M =3.88; SD =0.72)												
aLocation context												
Ease of reaching the mall (e.g. directions)	1	0%	3	1%	4	1%	249	62%	143	36%	4.33	0.56
Ease of finding a desired store inside the mall (e.g. Virgin store)	1	0%	2	1%	112	28%	181	45%	104	26%	3.96	0.76
Proximity of other modes of transport	2	1%	49	12%	99	25%	141	35%	109	27%	3.77	1.00
(M =4.02; SD =0.62)												
aStore context												
Crowdedness and compactness of buildings around the mall	35	9%	126	32%	99	25%	118	30%	22	6%	2.92	1.08
Car traffic congestion around the shopping mall	24	6%	115	29%	87	22%	137	34%	37	9%	3.12	1.11
High number of shops surrounding the shopping mall	31	8%	116	29%	154	39%	83	21%	16	4%	2.84	0.97
(M = 2.96; SD = 0.84)												
bShopper passengers ridership preferences												
I intend to use the metro station close to the mall because: the station is at walkable distance.	6	2%	5	1%	5	1%	207	52%	177	44%	4.36	0.72
I intend to use the metro station close to the mall because: there is car traffic congestion in the mall area	11	3%	125	31%	105	26%	76	19%	83	21%	3.24	1.18
I intend to use the metro station close to the mall because: there is lack of enough car parking spaces in the mall area	28	7%	138	35%	155	39%	46	12%	33	8%	2.80	1.02
(M = 3.46; SD = 0.76)												

aScale values range from 1 ('Not important') to 5 (Very important")
bScale values range from 1 ('Strongly disagree') to 5 (Strongly agree"). The higher the mean, the higher the attractiveness with that particular aspect. M = mean, SD = standard deviation, Freq =frequency

intended to use a metro station close to a mall (M = 3.46; SD = 0.76), and mainly because the station was at a walkable distance from the mall.

3.4 Analytical approach

This study explains the effect of TOSMD attractiveness factors (location, stores, and space contexts) on the ridership preferences of shopping mall passengers boarding at a nearby transit station. Similar studies, such as El-Adly (2007), addressed the effect of shopping malls attractiveness factors on mall patronage using a principal component analysis (PCA) approach to measure shopping mall attractiveness factors and to assess the measurement validity. In this analysis, location, stores, and space contextual attractiveness factors were the independent variables, and the ridership preference of shopping mall passengers to board at nearby transit stations was the dependent variable. Therefore, the statistical equation adopted in this study was:

Ridership preferences of shopping mall passengers (Shop_Pass_pref) = f (Spa_cont, Loc_cont, Sto_cont), where:

Shop_Pass_pref is Ridership preference of shopping mall passengers boarding at a nearby metro station.

Spa_cont is Space contextual factor.

Loc_cont is Location contextual factor.

Sto_cont is Stores contextual factor.

The factors identified from the PCA were then subjected to confirmatory factor analysis to validate the outcome from this analysis following the empirical model presented by Sohn and Shim (2010) which examined boarding factors affecting demand at station level (refer to Section 2.3). Similar to Sohn and Shim (2010), our study utilized a structural equation modelling approach to explain the impact of the contextual attractiveness factors. Finally, the study's explanatory model was examined for statistical goodness of fit.

4. Results

4.1 TOSMD Contextual Attractiveness Factors

The result of the principal component analysis (PCA) is shown in Table 4. It identified 12 items from the questionnaire explaining 67.33% per cent of data variability. Only four items (namely, q0019: Grocery store presence, q0020: Cinema presence, q0057: Availability of parking facilities, and q0070: Walking access from the station to the mall) were excluded from the analysis as they were not significantly loaded (less than 0.5) to any of the four revealed factors (Lai & Chen, 2011), namely Space context (Spa_cont), Location context (Loc_cont), Stores context (Sto_cont), and shopper passenger ridership preferences (Shop_Pass_pref). Confirmatory factor analysis (CFA) was then used to relate these variables and assess model fitness.

4.2 Confirmatory Factor Analysis (CFA) and Structural Equation Model (SEM)

Applying the approach of Sohn and Shim (2010), confirmatory factor analysis was used to validate the identified contextual attractiveness factors impacting the preference of shopping mall passengers to board at a station nearby a TOSMD. Figure 3 reveals relationships between the identified variables using pooled measurement modelling (Afthanorhan *et al.*, 2014).

According to Lei and Wu (2007), SEM is well specified and valid if the model meets the following conditions: the sample is large enough, and the Normed Fit Index (NFI), Comparative Fit Index (CFI) and Goodness-of-Fit Index (GFI) are over 0.9 (Bentler, 1990; Bentler & Bonett, 1980). The model in Figure 3 showed a reasonable fit (Rabbanee *et al.*, 2012): Chi-Square =355.30 (p = 0.00), degrees of freedom (df) = 163, the Goodness-of-Fit Index (GFI) =0.97, the Adjusted Goodness of Fit Index (AGFI) = 0.93, the Comparative Fit Index (CFI) = 0.97, the Normed Fit Index (NFI) = 0.94, and the Root Mean Square Residual (RMR) = 0.04.

Structural equation modelling was then employed to test the relationships between the dependent and independent factors, as shown in Table 5.

Table 4. TOSMD contextual attractiveness impacting shopper passengers' ridership preferences.

Code	Variable	Contextual attractiveness factors						
		Space context (Spa_cont)	Location context(Loc_cont)	Store context (Sto_cont)	Ridership Preference of shopper passengers (Shopper_Pass_pref)	Eigenvalue	Variance explained (%)	Cronbach α
q0027	Size of the mall	0.85				3.38	28.13	0.82
q0028	Average size of shops	0.90						
q0029	Number of shops	0.77						
q0043	Ease of reaching the mall (e.g. directions)		0.72			1.87	15.58	0.67
q0044	Ease of finding a desired store inside the mall (e.g. Virgin store)		0.78					
q0066	Proximity of other modes of transport		0.76					
q0047	Crowdedness and compactness of buildings around the mall			0.77		1.78	14.80	0.70
q0049	Car traffic congestion around the shopping mall			0.76				
q0050	High number of shops surrounding the shopping mall			0.82				
q0067	I intend to use the metro station close to the mall because; the station is at walkable distance from the mall				0.63	1.06	8.82	0.66
q0068	I intend to use the metro station close to the mall because; there is car traffic congestion in the area of the mall				0.81			
q0069	I intend to use the metro station close to the mall because; there is lack of enough car parking spaces in the area of the mall				0.79			

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
Rotation converged in 5 iterations
n = 400, Cumulative % of variance explained = 67.33, Cronbach's Alpha = 0.75

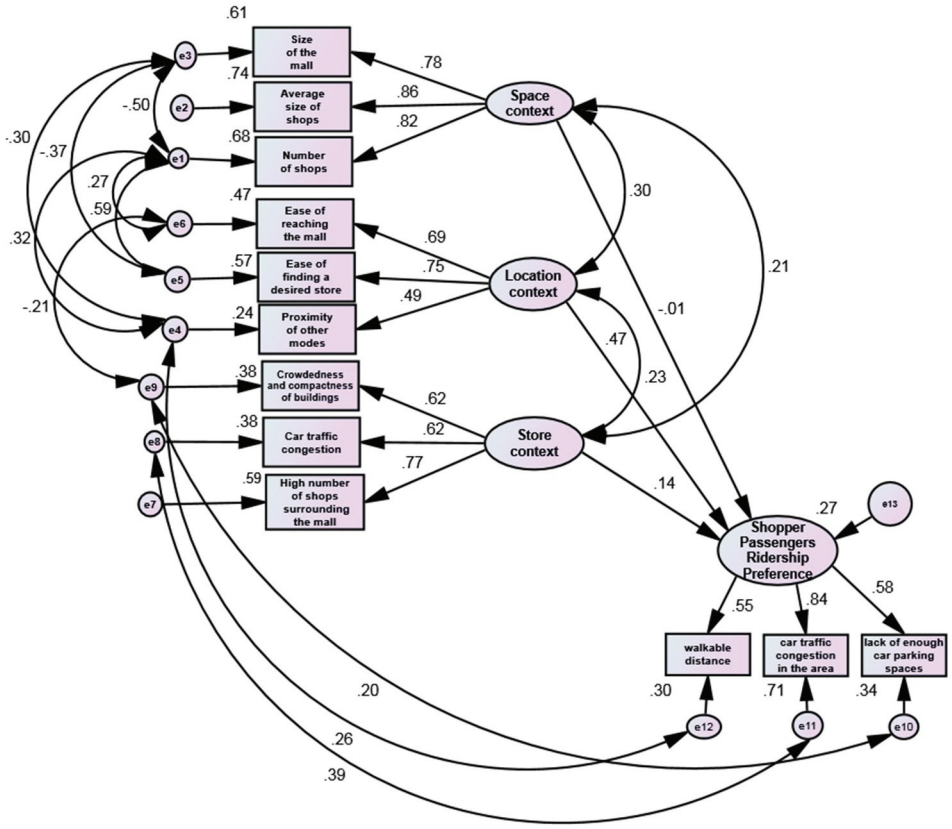


Figure 3. Links between TOSMD contextual attractiveness factors impacting the shopper passenger ridership preference at a nearby transit station.

Table 5 shows that the TOSMD contextual attractiveness factors of location (0.47) and stores (0.14) associate significantly with the ridership preferences of shopping mall passengers using nearby transit stations. Space was not significantly associated with the ridership preference of shopper passengers using metro stations near TOSMDs, but was significantly associated with the location and stores contextual attractiveness factors, as shown in Table 6.

As a result, the impact of TOSMD contextual attractiveness factors on transit station use should be considered in station passenger forecasting models.

Table 5. Estimated regression weights in the structural equation model.

			Estimate	S.E.	C.R.	*P*
Ridership preference of shopper passengers	< –	Location_context	0.47	0.06	7.22	a
Ridership preference of shopper passengers	< –	Store_context	0.14	0.09	2.16	0.03b
Ridership preference of shopper passengers	< –	Space_context	−0.01	0.06	−0.16	0.88

aHighly significant ($p < 0.001$)
bSignificant ($p < 0.05$)
Not significant ($p > 0.05$)

Table 6. Correlation estimates between the independent factors of space, location and stores context in structural equation model.

			Estimate	S.E.	C.R.	*P*
Space_context	<–>	Location_context	0.30	0.06	5.24	a
Space_context	<–>	Store_context	0.21	0.04	3.41	a

aHighly significant ($p < 0.001$)

5. Discussion

This study investigated the effect of shopping mall attractiveness on passenger ridership preferences at nearby transit stations in TOD contexts where residents, workers and shoppers drive their cars less and ride mass transit more. Specifically, it tested the association of location, stores and space contextual attractiveness factors and the ridership preferences of shopping mall passengers using nearby transit stations on the Dubai Metro Redline. In an earlier study (Abutaleb *et al.*, 2019), we constructed a conceptual framework that proposed a relationship between shopping mall passengers utilizing transit stations near a TOSMD and the contextual attractiveness of TOSMDs (Abutaleb *et al.*, 2019). This study has empirically supported the relationship between the TOSMD and the ridership preferences of shopping mall passengers at nearby transit stations on the Dubai Metro Redline. It is recognised that further studies will be required to determine if these attractiveness relationships correlate with passenger volumes at transit stations.

Most previous passenger forecasting models identified '*commercial floor area*' as being significantly associated with station boarding, but the impact of the variability in attractiveness of a TOSMD context was not captured. Therefore, this study addresses this gap in knowledge by exploring this relationship, and will contribute to the transit and urban planning literature by providing a deeper understanding of attractiveness as represented by shopping mall passengers' preference to board at nearby transit stations.

The study was undertaken with other factors, including the level of service (such as punctuality, availability, public transport policies, and fare level) neutralized by selecting the same geographical service context, namely the Dubai Metro Redline. However, it did not discuss the inter-node [station] relationship impact (Huang *et al.*, 2018) as it was limited to the inflow of shopper passengers from a shopping mall to a nearby transit station rather than the outflow of passenger shoppers from the station to a nearby shopping mall.

The results indicate a strong relationship between TOSMD contextual attractiveness factors and ridership of shopper passengers represented by preference to board at nearby transit stations with 67.3% of variance explained (see Table 4). The study results are in line with previous urban planning studies indicating that there is an inter-relationship between transit stations and their context, i.e. TOSMDs (Castillo-Manzano & López-Valpuesta, 2009; Zemp *et al.*, 2011). Retail and marketing studies indicate that attractiveness is likely to be greater at shopping malls with a broader assortment of services and products, which may also increase people congestion. This highlights the need for improved passenger forecasting data to support future transport planning and retail development decisions.

Researchers, such as Tsai (2010), Yap and Goh (2017) and Michon *et al.* (2015), segmented shoppers on the basis of purpose of visiting a mall, generation and gender. LeHew and Wesley (2007) indicated that there are differences in behavioural intention and customer satisfaction between resident shoppers and tourist shoppers. Specific attributes may better satisfy each group of shoppers. Therefore, different segmentations can obtain different levels of attractiveness of a TOSMD's contextual factors. However, in this study, we discussed the impact of the contextual factors on a reflective sample of shopping mall passengers using the Dubai Metro. Therefore, further research may consider various segmentations of shopping mall passengers according their levels of attractiveness to the contextual factors of TOSMDs.

The structural equation model explained how location, stores and space contextual attractiveness factors correlate with the ridership preferences of total shopping mall passengers represented by preference for boarding at a nearby transit station. The model in Figure 3 suggests the location and stores contextual attractiveness factors to be significantly associated with the ridership preferences of shopping mall passengers using nearby metro stations. The space (size of the mall and size of its shops) contextual attractiveness factor was, however, not significantly associated with the ridership preferences of shopping mall passengers using nearby metro stations. This finding indicates that shopping mall passengers are not just attracted to the size of a mall, but the stores and attractions provided within the shopping mall and the location context. These findings disagree with previous research which found that commercial floor area was a key indicator of station boarding. Although commercial floor area may provide an indication of ridership in particular cases studies, it does not seem to be directly applicable in the case of the Dubai Redline. This may be due to the significant number of TOSMDs along with the Dubai Redline network, and the ability of shopping mall passengers to select the particular stores and attractions that suits their needs.

Consequently, this study provides urban planners, policymakers and rail transit planners an understanding of the preferences of shopping mall passengers to board at stations near TOSMDs as they relate to the contextual factors of location, space and stores. For example, the Mall of Emirates shopping mall has a specific attraction called Ski Dubai (see Figure 3) which is a 20,000 square metre themed climate park inside the mall. The mall has a walkway connecting the shopping mall and the Mall of Emirates metro station (see Figure 4 and Figure 5). Ski Dubai is a significant attraction for the mall and the direct connection between the mall and transit station supports the location and stores contexts in relation to the TOSMD. The Mall of Emirates has approximately 42 million visitors per year (Middle East Council of Shopping Centres, 2019), suggesting that exploring the contextual factors of a particular TOSMD can also contribute to the understanding of the ridership at the nearby metro station.

As discussed, the study outcome can contribute to urban transit planning practice by identifying TOSMD contextual factors of attractiveness as a modifying input to be considered for future passenger forecasting models at station level. Enhancements to forecasting modelling can improve the accuracy and comprehensiveness of future growth forecasts at TOSMD stations. Improved forecasts can facilitate the timely design of transit network stations to support future ridership growth (from shopping mall passengers), including the space inside the station and its surrounds. Additionally, transit service levels can be better aligned with the demand patterns of shopping mall passengers

Figure 4. Ski Dubai inside the mall of emirates shopping centre. source: the authors.

Figure 5. Mall of emirates shopping mall direct connection to the metro station. source: the authors.

for optimal TOD and the sustainability of transit networks. Urban planners and mall management may also utilize the study when designing malls within these attractiveness contexts and therefore improve the mall experience.

The space contextual attributes were significantly associated with the location and stores contextual factors. In particular, a large shopping mall is likely to have positive attractiveness factors, but may also have a negative influence due to crowdedness and traffic congestions around the mall. These negative characteristics encourage shoppers to utilize other forms of transport, such as the metro, and generate higher ridership at stations near TOSMDs.

The study may benefit cities with existing or growing network plans which would like to understand the expected impact of contextual factors of TOSMD attractiveness and their impact on the ridership of shopping mall passengers at those stations. This understanding is considered useful for effective TOD approaches to rail networks and proposed shopping mall developments, including the guiding of private or government investment to achieve the best results when developing metro stations. Although the study's causal relationships were only tested on the single case study of seven stations on the Dubai Metro Redline, the approach could be extended to other cases. For a more comprehensive test of causality, the study could be repeated in a number of cities' transit networks. It is also noted that individual personality traits may impact shopper passengers' perception of TOSMD contextual factors of attractiveness. Therefore, future studies could incorporate socio-economic, demographic, and individual personality factors in the study design.

6. Conclusion

Shopping malls are often considered the retail, social and community centres of their communities. In this context, this study explained the relationship of transit station use in a TOSMD context. It empirically clarified how location, space and stores contextual attractiveness factors correlate with the ridership preferences of shopping mall passengers for nearby transit stations. Confirmatory factor analysis showed the location and stores contextual factors to be significantly associated with the ridership preferences of shopping mall passengers using nearby metro stations. Space was, however, not significantly associated with the ridership preferences of shopping mall passengers using Dubai Metro Redline stations near TOSMDs. However, the preference to board was significantly associated with the location and store contextual attractiveness factors of TOSMDs.

The study presents a model that explains the relationship between location, stores and space contextual attractiveness factors and the ridership preference of shopper passengers boarding at a nearby transit station. It reports contextual factors of TOSMD attractiveness as modifying inputs to be considered for future passenger forecasting models at station level to improve the accuracy and comprehensiveness of these forecasting models. The findings of this study are expected to assist transit urban planners, mall management and public transport policymakers in making better public and private sector TOSMD investments, and increase the economic sustainability of transit rail networks. It lays the foundation to potentially enhance the accuracy of existing transit station passenger forecasting models and better align the transit service levels with the demand patterns of shopper passengers, thus maximizing the shopping mall experience in cities.

Acknowledgements

The authors acknowledge using the edit-proofing service of Ms Sandra Cochrane (Email: Sandra.cochrane@gmail.com), an edit-proofing consultant accredited by The University of Southern Queensland – Australia.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

ORCID

Ayman Abutaleb http://orcid.org/0000-0001-9318-8521
Kevin Mcdougall http://orcid.org/0000-0001-6088-1004
Marita Basson http://orcid.org/0000-0001-9731-1128
Rumman Hassan http://orcid.org/0000-0003-1527-8331
Muhammad Nateque mahmood http://orcid.org/0000-0002-1149-0688

References

Aaker, D. A. (2004) *Marketing Research*, 8th. (New York: Wiley).
Abutaleb, A., McDougall, K., Basson, M., Hassan, R., & Mahmood, M. N. (2019) Towards a conceptual framework for understanding the attractiveness of rail transit-oriented shopping mall developments (TOSMDs), *Urban Rail Transit*, 5(4), pp. 225–239. DOI:10.1007/s40864-019-00112-4.
Acheampong, R. A., & Silva, E. (2015) Land use–transport interaction modeling: A review of the literature and future research directions, *Journal of Transport and Land Use*, DOI:10.5198/jtlu.2015.806.
Afthanorhan, W., Ahmad, S., & Mamat, I. (2014) Pooled Confirmatory Factor Analysis (PCFA) using structural equation modeling on volunteerism program: A step by step approach, *International Journal of Asian Social Science*, 4(5), pp. 642–653.
Ahmad, A. E. M. K. (2012) Attractiveness factors influencing shoppers' satisfaction, loyalty, and word of mouth: An empirical investigation of Saudi Arabia shopping malls, *International Journal of Business Administration*, 3(6), pp. 101.
Albalate, D., & Bel, G. (2010) Tourism and urban public transport: Holding demand pressure under supply constraints, *Tourism Management*, 31(3), pp. 425–433. DOI:10.1016/j.tourman.2009.04.011.
Antiado, D., Castillo, F., & Tawadrous, M. (2017) Educational Tourism in Dubai: The global higher education hub across culture, in: *Leadership, Innovation and Entrepreneurship as Driving Forces of the Global Economy*, pp.543–551, (Cham, Switzerland: Springer).
Arslan, T. V., Sezer, F. S., & Isigicok, E. (2010) Magnetism of shopping malls on young Turkish consumers, *Young Consumers*, 11(3), pp. 178–188. DOI:10.1108/17473611011074250.
Bentler, P. M. (1990) Comparative fit indexes in structural models, *Psychological Bulletin*, 107(2), pp. 238. DOI:10.1037/0033-2909.107.2.238.
Bentler, P. M., & Bonett, D. G. (1980) Significance tests and goodness of fit in the analysis of covariance structures, *Psychological Bulletin*, 88(3), pp. 588.
Bernick, M., & Cervero, R. (1997) *Transit Villages in the 21st Century*, (New York: McGraw-Hill).
Boyle, D. K. (2006) *Fixed-route Transit Ridership Forecasting and Service Planning Methods*, Vol. 66. (Washington, D.C: Transportation Research Board).
Calthorpe, P. (1993) *The Next American Metropolis: Ecology, Community, and the American Dream*, (New York: Princeton architectural press).

Cao, X. J., Mokhtarian, P. L., & Handy, S. L. (2009) The relationship between the built environment and nonwork travel: A case study of Northern California, *Transportation Research Part A: Policy and Practice*, 43(5), pp. 548–559.
Cardozo, O. D., García-Palomares, J. C., & Gutiérrez, J. (2012) Application of geographically weighted regression to the direct forecasting of transit ridership at station-level, *Applied Geography*, 34, pp. 548–558, DOI:10.1016/j.apgeog.2012.01.005.
Castillo-Manzano, J. I., & López-Valpuesta, L. (2009) Urban retail fabric and the metro: A complex relationship. Lessons from middle-sized Spanish cities, *Cities*, 26(3), pp. 141–147. DOI:10.1016/j.cities.2009.02.007.
Cervero, R. (1994) Transit-based housing in California: Evidence on ridership impacts, *Transport Policy*, 1(3), pp. 174–183. DOI:10.1016/0967-070X(94)90013-2.
Cervero, R. (2004) *Transit-oriented development in the United States: Experiences, challenges, and prospects* Report No. 102.
Cervero, R. (2006) Alternative approaches to modeling the travel-demand impacts of smart growth, *Journal of the American Planning Association*, 72(3), pp. 285–295. DOI:10.1080/01944360608976751.
Cervero, R., & Duncan, M., (2002) Transit's value-added effects: Light and commuter rail services and commercial land values, *Transportation Research Record: Journal of the Transportation Research Board*, 1805(1), pp. 8–15, doi:10.3141/1805-02.
Chen, C., Varley, D., & Chen, J. (2011) What affects transit ridership? A dynamic analysis involving multiple factors, lags and asymmetric behaviour, *Urban Studies*, 48(9), pp. 1893–1908. DOI:10.1177/0042098010379280.
Choi, J., Lee, Y. J., Kim, T., & Sohn, K. (2012) An analysis of Metro ridership at the station-to-station level in Seoul, *Transportation*, 39(3), pp. 705–722. DOI:10.1007/s11116-011-9368-3.
Chorus, P. R. W. E. (2012) Station area developments in Tokyo and what the Randstad can learn from it. (Doctoral dissertation), University of Amsterdam.
Chu, X. (2004) *Ridership Models at the Stop Level National Center of Transit Research*, (Tampa: University of South Florida).
Cooper, D. R. (2011) *Business Research Methods*, 11th. (New York: McGraw-Hill/Irwin).
Creswell, J. W. (2013) *Research Design: Qualitative, Quantitative*, (and mixed methods approaches: Sage publications).
Curtis, C., Renne, J. L., & Bertolini, L. (2009) *Transit Oriented Development: Making It Happen*, (UK: Ashgate Publishing, Ltd).
Dahsh, M., & Dasa, P. (2014) Shopping mall preferences in easten region: Implications for retail strategy, *Prestige International Journal of Management and Research*, 7/8(2/1), pp. 19.
De Juan, M. D. (2004) Why do people choose the shopping malls? The attraction theory revisited: A Spanish case, *Journal of International Consumer Marketing*, 17(1), pp. 71–96. DOI:10.1300/J046v17n01_05.
Du, H., & Mulley, C. (2007) The short-term land value impacts of urban rail transit: Quantitative evidence from Sunderland, UK, *Land Use Policy*, 24(1), pp. 223–233. DOI:10.1016/j.landusepol.2005.12.003.
El-Adly, M. (2007) Shopping malls attractiveness: A segmentation approach, *International Journal of Retail & Distribution Management*, 35(11), pp. 936–950. DOI:10.1108/09590550710828245.
Erkip, F. (2005) The rise of the shopping mall in Turkey: The use and appeal of a mall in Ankara, *Cities*, 22(2), pp. 89–108. DOI:10.1016/j.cities.2004.10.001.
Estupiñán, N., & Rodríguez, D. A. (2008) The relationship between urban form and station boardings for Bogota's BRT, *Transportation Research Part A: Policy and Practice*, 42(2), pp. 296–306.
Ewing, R., & Cervero, R. (2010) Travel and the built environment: A meta-analysis, *Journal of the American Planning Association*, 76(3), pp. 265–294. DOI:10.1080/01944361003766766.
Ewing, R. H. (2008) Characteristics, causes, and effects of Sprawl: A literature review, *Urban Ecology*, 21(2), pp. 519–535.

Farrag, D. A., El Sayed, I. M., & Belk, R. W. (2010) Mall shopping motives and activities: A multimethod approach, *Journal of International Consumer Marketing*, 22(2), pp. 95–115. DOI:10.1080/08961530903476113.
Feinberg, R. A., & Meoli, J., (1991) A brief history of the mall, *Advances in Consumer Research*, 18, pp. 426.
Fowler, F. J., Jr. (2013) *Survey Research Methods*, 5th. (Thousand Oaks, California: Sage publications).
González-Hernández, E. M., & Orozco-Gómez, M. (2012) A segmentation study of Mexican consumers based on shopping centre attractiveness, *International Journal of Retail & Distribution Management*, 40(10), pp. 759–777. DOI:10.1108/09590551211263173.
Guarte, J. M., & Barrios, E. B. (2006) Estimation under purposive sampling, *Communications in Statistics - Simulation and Computation*, 35(2), pp. 277–284. DOI:10.1080/03610910600591610.
Gutiérrez, J., Cardozo, O. D., & García-Palomares, J. C. (2011) Transit ridership forecasting at station level: An approach based on distance-decay weighted regression, *Journal of Transport Geography*, 19(6), pp. 1081–1092. DOI:10.1016/j.jtrangeo.2011.05.004.
Hannawi, N., Jones, P., & Titheridge, H. (2019) *Development of Transit Oriented Development in Dubai City and the Gulf States.* UK: Edward Elgar Publishing.
Higgins, C. D., & Kanaroglou, P. S. (2016) A latent class method for classifying and evaluating the performance of station area transit-oriented development in the Toronto region, *Journal of Transport Geography*, 52, pp. 61–72. DOI:10.1016/j.jtrangeo.2016.02.012.
Huang, R., Grigolon, A., Madureira, M., & Brussel, M. (2018) Measuring transit-oriented development (TOD) network complementarity based on TOD node typology, *Journal of Transport and Land Use*, 11(1), pp. 305–324. DOI:10.5198/jtlu.2018.1110.
Huang, W., & Wey, W.-M. (2019) Green Urbanism Embedded in TOD for Urban Built Environment Planning and Design, *Sustainability*, 11(19), pp. 1–14. DOI:10.3390/su11195293.
Jacobson, J., & Forsyth, A. (2008) Seven American TODs: Good practices for Urban design in transit-oriented development projects, *Journal of Transport and Land Use*, 1(2), pp. 51–88.
Kamruzzaman, M., Baker, D., Washington, S., & Turrell, G. (2014) Advance transit oriented development typology: Case study in Brisbane, Australia, *Journal of Transport Geography*, 34, pp. 54–70. DOI:10.1016/j.jtrangeo.2013.11.002.
Kamruzzaman, M., Baker, D., Washington, S., & Turrell, G. (2016) Determinants of residential dissonance: Implications for transit-oriented development in Brisbane, *International Journal of Sustainable Transportation*, 10(10), pp. 960–974. DOI:10.1080/15568318.2016.1191094.
Ke, Q., & Wang, W. (2016) The factors that determine shopping centre rent in Wuhan, China, *Journal of Property Investment & Finance*, 34(2), pp. 172–185. DOI:10.1108/JPIF-04-2015-0021.
Khare, A. (2011) Mall shopping behaviour of Indian small town consumers, *Journal of Retailing and Consumer Services*, 18(1), pp. 110–118. DOI:10.1016/j.jretconser.2010.10.005.
Khattak, A. J., & Rodriguez, D. (2005) Travel behavior in neo-traditional neighborhood developments: A case study in USA, *Transportation Research Part A: Policy and Practice*, 39(6), pp. 481–500.
Kim, S., Ulfarsson, G. F., & Hennessy, J. T. (2007) Analysis of light rail rider travel behavior: Impacts of individual, built environment, and crime characteristics on transit access, *Transportation Research Part A: Policy and Practice*, 41(6), pp. 511–522.
Knowles, R. D., Ferbrache, F., & Nikitas, A. (2020) Transport's historical, contemporary and future role in shaping urban development: Re-evaluating transit oriented development, *Cities*, 99, pp. 102607. DOI:10.1016/j.cities.2020.102607.
Kok, H. J. (2007) Restructuring retail property markets in Central Europe: Impacts on urban space, *Journal of Housing and the Built Environment*, 22(1), pp. 107–126. DOI:10.1007/s10901-006-9068-z.
Kuby, M., Barranda, A., & Upchurch, C. (2004) Factors influencing light-rail station boardings in the United States, *Transportation Research Part A: Policy and Practice*, 38(3), pp. 223–247.
Kushwaha, T., Ubeja, S., & Chatterjee, A. S. (2017) Factors influencing selection of shopping malls: An exploratory study of consumer perception, *Vision: The Journal of Business Perspective*, 21(3), pp. 274–283. DOI:10.1177/0972262917716761.

Lai, W.-T., & Chen, C.-F. (2011) Behavioral intentions of public transit passengers—The roles of service quality, perceived value, satisfaction and involvement, *Transport Policy*, 18(2), pp. 318–325. DOI:10.1016/j.tranpol.2010.09.003.

Lee, S. (2013) *Does Context Matter?: Understanding the Urban Design Requirements of Successful Neighborhood Parks*, (Doctoral dissertation). from Arizona State University, USA. https://repository.asu.edu/attachments/110491/content/Lee_asu_0010E_12898.pdf.

Lee, S., Yi, C., & Hong, S.-P. (2013) Urban structural hierarchy and the relationship between the ridership of the Seoul Metropolitan Subway and the land-use pattern of the station areas, *Cities*, 35, pp. 69–77. DOI:10.1016/j.cities.2013.06.010.

LeHew, M. L., & Wesley, S. C. (2007) Tourist shoppers' satisfaction with regional shopping mall experiences, *International Journal of Culture, Tourism and Hospitality Research*, DOI:10.1108/17506180710729628.

Lei, P. W., & Wu, Q. (2007) Introduction to structural equation modeling: Issues and practical considerations, *Educational Measurement: Issues and Practice*, 26(3), pp. 33–43. DOI:10.1111/j.1745-3992.2007.00099.x.

Li, C., Lin, C., & Hsieh, T. (2016) TOD district planning based on residents' perspectives, *ISPRS International Journal of Geo-Information*, 5(4), pp. 52. DOI:10.3390/ijgi5040052.

Loo, B. P. Y., Chen, C., & Chan, E. T. H. (2010) Rail-based transit-oriented development: Lessons from New York City and Hong Kong, *Landscape and Urban Planning*, 97(3), pp. 202–212. DOI:10.1016/j.landurbplan.2010.06.002.

Lund, H. (2006) Reasons for Living in a Transit-Oriented Development, and Associated Transit Use, *Journal of the American Planning Association*, 72(3), pp. 357–366. DOI:10.1080/01944360608976757.

Michon, R., Chebat, J.-C., Yu, H., & Lemarié, L. (2015) Fashion orientation, shopping mall environment, and patronage intentions, *Journal of Fashion Marketing and Management*, 19 (1), pp. 3.

Middle East Council of Shopping Centres. (2019). *The Middle East Council Of Shopping Centres 2019 Directory*.Retrieved from https://issuu.com/search?q=dubai%20malls%20footfall.

Milakis, D., & Vafeiadis, E. (2014) Ado(a)pting the Transit-Oriented Development Model in the Greek Urban and Transport Contexts, *Planning Practice & Research*, 29(5), pp. 471–491. DOI:10.1080/02697459.2014.893952.

Mingqiao, Z., Xi, L., Chao, M., & Ke Zhang, M. L. (2014) *Review on the Theory and Planning Principle of Transit-Oriented Development*. 14th COTA International Conference of Transportation Professionals, Changsha, China.

Mundell, M. (2013) *Shopping Centre Choice: A Behavioural Perspective*, (Doctoral dissertation). from Durham University, UK. http://etheses.dur.ac.uk/7282/1/MLMFinalThesis.pdf?DDD2+.

Narayanaswami, S. (2017) Urban transportation: Innovations in infrastructure planning and development, *The International Journal of Logistics Management*, 28(1), pp. 150–171. DOI:10.1108/IJLM-08-2015-0135.

Nasri, A., & Zhang, L. (2014) The analysis of transit-oriented development (TOD) in Washington, D.C. and Baltimore metropolitan areas, *Transport Policy*, 32, pp. 172–179. DOI:10.1016/j.tranpol.2013.12.009.

Newman, P. (2009) Planning for transient oriented development: Strategic principles, in: *Transit Oriented Development. Making It Happen*, pp. 13–22, (Cornwall, UK: Ashgate Publishing Limited).

O'Neill, W. A., Ramsey, R. D., & Chou, J. (1992) Analysis of transit service areas using geographic information systems, *Transportation Research Record*, 1364, pp. 131–138.

Ogra, A., & Ndebele, R. (2014) *The Role of 6Ds: Density, Diversity, Design, Destination, Distance, and Demand Management in Transit Oriented Development (TOD)*. Neo-International Conference on Habitable Environments, Punjab, India.

Pacheco-Raguz, J. F. (2010) Assessing the impacts of Light Rail Transit on urban land in Manila, *Journal of Transport and Land Use*, 3(1). DOI:10.5198/jtlu.v3i1.13.

Quade, P. B. (1996) *Douglas, Inc: Transit and Urban Form*, (Washington, DC: National Academy Press).

Rabbanee, F. K., Ramaseshan, B., Wu, C., & Vinden, A. (2012) Effects of store loyalty on shopping mall loyalty, *Journal of Retailing and Consumer Services*, 19(3), pp. 271–278. DOI:10.1016/j.jretconser.2012.02.001.
Rail Operations Department - RTA. (2018). RTA.
Rajagopal, R. (2009) Growing shopping malls and behaviour of urban shoppers, *Journal of Retail & Leisure Property*, 8(2), pp. 99–118. DOI:10.1057/rlp.2009.3.
Rajagopal, R. (2011) Determinants of shopping behavior of Urban consumers, *Journal of International Consumer Marketing*, 23(2), pp. 83–104. DOI:10.1080/08961530.2011.543051.
RTA-Dubai. (2016). RTA.
Rydin, Y. (2019) Planning for Sustainability: Lessons from studying neighbourhood shopping areas, *Planning Practice & Research*, 34(5), pp. 522–536. DOI:10.1080/02697459.2019.1679428.
Searle, G., Darchen, S., & Huston, S. (2014) Positive and negative factors for transit oriented development: Case studies from Brisbane, Melbourne and Sydney, *Urban Policy and Research*, 32(4), pp. 437–457. DOI:10.1080/08111146.2014.931280.
Singh, Y. J., Fard, P., Zuidgeest, M., Brussel, M., & Maarseveen, M. V. (2014) Measuring transit oriented development: A spatial multi criteria assessment approach for the City Region Arnhem and Nijmegen, *Journal of Transport Geography*, 35, pp. 130–143. DOI:10.1016/j.jtrangeo.2014.01.014.
Singh, Y. J., Lukman, A., Flacke, J., Zuidgeest, M., & Van Maarseveen, M. F. A. M. (2017) Measuring TOD around transit nodes - Towards TOD policy, *Transport Policy*, 56, pp. 96–111. DOI:10.1016/j.tranpol.2017.03.013.
Sohn, K., & Shim, H. (2010) Factors generating boardings at Metro stations in the Seoul metropolitan area, *Cities*, 27(5), pp. 358–368. DOI:10.1016/j.cities.2010.05.001.
Sun, G., Zacharias, J., Ma, B., & Oreskovic, N. M. (2016) How do metro stations integrate with walking environments? Results from walking access within three types of built environment in Beijing, *Cities*, 56, pp. 91–98. DOI:10.1016/j.cities.2016.03.001.
Sung, H., & Oh, J.-T. (2011) Transit-oriented development in a high-density city: Identifying its association with transit ridership in Seoul, Korea, *Cities*, 28(1), pp. 70–82. DOI:10.1016/j.cities.2010.09.004.
Taehyun, K., Dong-Wook, S., & Sangho, C. (2016) An analysis of the relationship between pedestrian traffic volumes and built environment around metro stations in Seoul, *KSCE Journal of Civil Engineering*, DOI:10.1007/s12205-016-0915-5.
Tandon, A., Gupta, A., & Tripathi, V. (2016) Managing shopping experience through mall attractiveness dimensions: An experience of Indian metro cities, *Asia Pacific Journal of Marketing and Logistics*, 28(4), pp. 634–649. DOI:10.1108/APJML-08-2015-0127.
Taylor, B. D., & Fink, C. N. (2003) The factors influencing transit ridership: A review and analysis of the ridership literature (UCLA Department of Urban Planning working paper). from University of California Transportation Center. https://escholarship.org/uc/item/3xk9j8m2.
Telci, E. E. (2013) High shopping mall patronage: Is there a dark side?, *Quality & Quantity*, 47(5), pp. 2517–2528. DOI:10.1007/s11135-012-9668-5.
Thang, D. C. L., & Tan, B. L. B. (2003) Linking consumer perception to preference of retail stores: An empirical assessment of the multi-attributes of store image, *Journal of Retailing and Consumer Services*, 10(4), pp. 193–200. DOI:10.1016/S0969-6989(02)00006-1.
Thomas, R., & Bertolini, L. (2014) Beyond the case study dilemma in urban planning: Using a meta-matrix to distil critical success factors in transit-oriented development, *Urban Policy and Research*, 32(2), pp. 219–237. DOI:10.1080/08111146.2014.882256.
Tsai, S. (2010) Shopping mall management and entertainment experience: A cross-regional investigation, *The Service Industries Journal*, 30(3), pp. 321–337. DOI:10.1080/02642060802123376.
van Lierop, D., Maat, K., & El-Geneidy, A. (2017) Talking TOD: Learning about transit-oriented development in the United States, Canada, and the Netherlands, *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*, 10(1), pp. 49–62. DOI:10.1080/17549175.2016.1192558.

Wei Khong, K., & Sim Ong, F. (2014) Shopper perception and loyalty: A stochastic approach to modelling shopping mall behaviour, *International Journal of Retail & Distribution Management*, 42(7), pp. 626–642. DOI:10.1108/IJRDM-11-2012-0100.

Yao, X. (2007) Where are public transit needed–Examining potential demand for public transit for commuting trips, *Computers, Environment and Urban Systems*, 31(5), pp. 535–550. DOI:10.1016/j.compenvurbsys.2007.08.005.

Yap, J. B. H., & Goh, S. V. (2017) Determining the potential and requirements of transit-oriented development (TOD): The case of Malaysia, *Property Management*, 35(4), pp. 394. DOI:10.1108/PM-06-2016-0030.

Zaidan, E. (2015) Dubai as a first-choice destination for saudi Tourists: Analysis of socio-economic characteristics, travel behaviour, and perceptions of saudi visitors to Dubai, *The Arab World Geographer*, 18(4), pp. 262–281.

Zemp, S., Stauffacher, M., Lang, D. J., & Scholz, R. W. (2011) Classifying railway stations for strategic transport and land use planning: Context matters!, *Journal of Transport Geography*, 19 (4), pp. 670–679. DOI:10.1016/j.jtrangeo.2010.08.008.

Zhao, F., Chow, L.-F., Li, M.-T., Ubaka, I., & Gan, A. (1835) 2003) Forecasting transit walk accessibility: Regression model alternative to buffer method, *Transportation Research Record: Journal of the Transportation Research Board*, 1835, pp. 34–41.

Zhao, J., Rahbee, A., & Wilson, N. H. M. (2007) Estimating a rail passenger trip origin-destination matrix using automatic data collection systems, *Computer-Aided Civil and Infrastructure Engineering*, 22(5), pp. 376–387. DOI:10.1111/j.1467-8667.2007.00494.x.

Chapter 5 The Impact of Transit Oriented Shopping Mall Developments (TOSMDs) on Metro Station Ridership

5.1 Introduction

This chapter explores the broader impact of TOSMDs on metro station ridership. It covers the relationships between the attractiveness factors and contextual factors of TOSMDs impacting on the ridership of shopper passengers (resident and tourist). It provides the key findings of the research and their implications.

The chapter is divided into two main parts. The first part includes Section 5.2, which covers the direct impact of attractiveness factors on shopper passenger ridership (resident and tourist) at stations near TOSMDs and has been compiled into **Journal Article 3**. It provides the direct impact of the internal (shopping mall attractiveness) factors and external (TOD) factors on shopper passenger ridership using the elements of the extended service marketing mix (product, price, place, promotion, people, physical evidence, and process) and the 5 Ds related to TODs (density, diversity, urban design, destination accessibility, and distance).

The second part contains Section 5.3. It covers the relationships between the significant attractiveness factors and the contextual factors of attractiveness, and the ridership of shopper passengers (residents and tourists). It clarifies the mediating impact/role of attractiveness factors on shopper passenger ridership through the contextual factors (location, stores and space). This relationship was not covered in Journal Article 3; however, it is added here to provide a further understanding of the impact of TOSMD attractiveness factors on shopper passenger-ridership at stations near TOSMDs.

5.2 The Impact of Transit Oriented Shopping Mall Developments (TOSMDs) on Metro Station Ridership: Dubai Metro Redline – Journal Article 3

Abutaleb, A., McDougall, K., Basson, M., Hassan, R. and Mahmood, M. N. (2020a). The Impact of Transit-Oriented Shopping Mall Developments (TOSMDs) on Metro Station Ridership: Dubai Metro Redline. *Urban Rail Transit*.

DOI: https://doi.org/10.1007/s40864-020-00129-0

Journal article 3 explored the internal and external attractiveness factors of TOSMDs, with particular reference to resident and tourist shopper passengers. It was guided by the established conceptual framework for attractiveness of a TOSMD (refer to Journal Article 1). Using the elements of an extended service marketing mix, internal factors included product, price, place, promotion, people, physical evidence, and process. Using the design factors of TOD, external factors included density, diversity, urban design, destination accessibility, and distance. Dubai Metro Redline was also used as a case study to neutralise other service-level factors impacting the ridership at a station level. The data collected using a survey questionnaire and sampling process are provided. The analysis approach using correlational Structural Equation Modelling (SEM) and results are discussed. The results confirmed that 11 of the 12 attractiveness factors of TOSMDs; namely product, price, place, promotion, people, physical evidence, process, density, diversity, urban design, destination accessibility, and distance were associated with the shopper passengers' ridership using metro stations nearby TOSMDs. Five critical TOSMDs attractiveness factors were identified to be contributing to the ridership at stations nearby TOSMDs for the Dubai Metro Redline. Implications for urban transit planners, mall management and urban transit planning practice are also discussed.

Urban Rail Transit
https://doi.org/10.1007/s40864-020-00129-0

ORIGINAL RESEARCH PAPERS

The Impact of Transit-Oriented Shopping Mall Developments (TOSMDs) on Metro Station Ridership: Dubai Metro Redline

Ayman Abutaleb[1] · Kevin McDougall[2] · Marita Basson[2] · Rumman Hassan[3] · Muhammad Nateque Mahmood[4]

Received: 25 December 2019 / Revised: 23 March 2020 / Accepted: 4 May 2020

Abstract Transit-oriented shopping mall development (TOSMD) is a novel concept in urban planning practice. The array of TOSMD attractiveness factors is not currently included in the forecasting models for station ridership. As a result, a station near a TOSMD can reach its capacity because its design and development didn't take into account TOSMD, while TOSMD contributes passenger flow to the station. Depending on the setting, the number of visiting tourists could exacerbate this problem. Therefore, this study aims to empirically identify the critical TOSMD attractiveness factors and clarify their impact in terms of shopper passengers contributing to the ridership at stations near TOSMDs in the case of the Dubai Metro Redline. A sample of 700 shopper passengers were surveyed at seven stations near TOSMDs. We used principal component analysis with confirmatory factor analysis, and structural equation modelling to explain the impact of TOSMD attractiveness on shopper passenger ridership at stations near TOSMDs. Eleven independent TOSMD attractiveness factors were found to be associated with the extent of shopper passengers' intention to use a station near a TOSMD. Resident and tourist shopper passengers showed variability in the factors impacting their use of stations near TOSMDs. The study assists in empirically validating the impact of TOSMD attractiveness on ridership at stations near TOSMDs, as a means of increasing the economic sustainability of transit networks. It provides statistically fit models for clarifying the generated resident and tourist shopper passenger ridership contributing to a station ridership as a result of its nearby TOSMDs. For a more comprehensive analysis, future studies could be repeated for transit networks in other cities.

Keywords Transit-oriented shopping mall development · TOSMD · Attractiveness factors · Station use · Passenger forecasting models

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s40864-020-00129-0) contains supplementary material, which is available to authorized users.

✉ Ayman Abutaleb
aymanabutaleb@hotmail.com

Kevin McDougall
Kevin.McDougall@usq.edu.au

Marita Basson
Marita.Basson@usq.edu.au

Rumman Hassan
Rumman.Hassan@usq.edu.au

Muhammad Nateque Mahmood
n.mahmood@deakin.edu.au

[1] RTA – Rail Agency (CEO Office), P. O. Box 118899, Dubai, UAE

[2] School of Civil Engineering and Surveying, University of Southern Queensland, Toowoomba, Australia

[3] School of Management and Enterprise, University of Southern Queensland, Springfield, Australia

[4] School of Architecture and Built Environment, Deakin University, Geelong, Australia

Communicated by Min Zhang.

1 Introduction

The growth rates of gross leasable area (GLA) of shopping malls in countries such as the USA, Russia, France, and Turkey have been continuously increasing [1]. However, a US report released by Cushman & Wakefield [2] showed that in the USA, while there were more than 4000 major

Published online: 15 July 2020

chain closures during 2016 however, consumers were still attracted to grocery stores, dollar stores, and dining experiences. Changes in shopping mall attractiveness factors can contribute to fluctuating patterns of growth in different areas of shopping mall development, and have increased the focus on mixed-use models in future and redeveloped malls. A mixed-use transit-oriented shopping mall development (TOSMD) refers to a shopping mall (SM) near a rail transit station in a transit-orientated development (TOD) context, where shoppers drive their cars less and instead ride nearby mass transit [3]. Major components of a shopping mall can include stores, food courts, restaurants, cinemas, children's play areas, interactive entertainment, social use areas, relaxation spaces, and promotional areas [4]. Therefore, the development of TOSMDs can contribute to making areas surrounding a rail station more attractive, and could potentially increase the ridership of shopper passengers using the transit station near a TOSMD.

A transit station near a TOSMD can reach capacity in a short time as a result of congestion in a nearby shopping mall [5], resulting in costly upgrades and disruption to the rail service and travellers. In addition, population growth in cities, as well as visiting tourists, can exacerbate this problem. Hence, there is a need to understand the impact of TOSMD attractiveness on the ridership of passengers using a nearby transit station and its capacity to serve boarding shopper passengers.

Our understanding of transit station use as a result of TOSMD attractiveness is limited. Furthermore, the potential benefits of coordinated transportation and land-use planning through TOD are sometimes not adequately considered [6], particularly in the case of TOSMDs. Our previous study proposed a framework for TOSMD attractiveness factors [3]. It used the seven elements of the extended service marketing mix (product, price, place, promotion, people, physical evidence, and process) and the five factors related to TODs (density, diversity, urban design, destination accessibility, and distance) to understand transit station use by shopper passengers as a result of TOSMD attractiveness. However, this framework has not been empirically examined. Therefore, this paper empirically examines the impact of TOSMD attractiveness factors.

The study attempts to link and predict the contribution of those attractiveness factors, in the form of the shopper passenger ridership, to the ridership of a nearby transit station in the case of Dubai Metro Red Line stations. Other level-of-service factors (such as punctuality, availability, public transport policies, and fare level) are neutralised by selecting the same geographical context, namely Dubai Metro Red Line in the United Arab Emirates (UAE). To achieve this goal, the study investigates the research question: "How do TOSMD attractiveness factors impact the ridership in a nearby transit station?" To understand this relationship, the study has the following three objectives:

- To review transit passenger forecasting models (PFMs) and station boarding factors (SBF)
- To review the capture of TOSMD attractiveness factors and the ridership of tourist shopper passengers (TSPs) in PFMs
- To compare and determine how the ridership of shopper passengers (both tourists and residents) boarding at a station near a TOSMD changes with TOSMD attractiveness factors, using seven Dubai Metro Red Line metro stations near TOSMDs.

The study is organised as follows: Sect. 2 presents a review of the existing literature relevant to transit passenger forecasting models (PFMs), station boarding factors (SBF), TOSMD attractiveness factors, and tourist shopper passenger (TSP) ridership for transit stations. Section 3 presents the methodology and data analysis techniques. Section 4 presents and discusses the results of the study, and finally, the last section concludes with the implications of the findings, limitations, and proposed further research.

2 Literature Review

2.1 Introduction

Several studies have been conducted to evaluate and clarify the driving factors behind metro station ridership and station boarding [8–10]. Statistical models have been used to develop passenger forecasting models (PFMs) relating transit stations as a function of the station's environment and the transit features [12–13]. These models have applications such as forecasting the potential station ridership along transit corridors, identifying the factors contributing to station boarding, optimising transit station design, and planning future expansions and design modifications. Therefore, to achieve the study objectives, this section reviews the current literature relating to PFMs, station boarding factors (SBFs), TOSMDs captured in PFMs, and tourist shopping passengers (TSPs) captured in PFMs

2.2 Transit Passenger Forecasting Models (PFMs)

Traditionally, urban planners have used McNally's [14] regional four-step travel forecasting models, which consider trip generation, distribution, mode choice, and route assignment. This method is used despite complexity and accuracy issues, incomplete travel input data (estimation is typically based on relatively old household surveys, which

may include a small number of transit trips in the area of interest), insensitivity to land use, and institutional barriers to consultation and collaboration (transit providers are often not part of the modelling process), in addition to being cumbersome and expensive [15].

Direct models have therefore been developed based on multiple regression analysis as a complementary approach for estimating ridership [12–13, 15]. Such models are a less complicated and less expensive alternative to the four-step models. They are also directly responsive to land-use characteristics within the station catchment areas. However, direct models lack the regional perspective of the four-step models. In determining the variables impacting station ridership, researchers such as Choi et al. [16] have investigated metro ridership at the station level and the station-to-station level and concluded that ridership factors could be the same. Drawing circular catchments showing prospective passenger areas and GIS mapping approaches [17] have been used in determining the space located near railway stations with a view towards increasing their density so as to increase the number of potential train users. Chakour and Eluru [18] recently added that time to travel to a station is a significant factor negatively impacting the choice of a station and ridership, respectively. Policies can also influence users of public transport. Handy [19] and Vessali [20] indicated that factors such as zoning and restrictions on parking could play a significant role in the success of the TOD urban planning concept, and hence could also play a significant role in a TOSMD.

The following two approaches were identified to summarise the recent approaches to station ridership forecasting. The first approach examines a station-to-station (origin–destination matrix) ridership as the basis for the station ridership forecast, whilst the second explores station-level ridership-weighted variables (distance–decay-weighted regression). The origin–destination (O–D) matrix [21] utilises an automatic fare collection (AFC) system data to infer rail passenger trip O–D matrices from an origin to replace expensive passenger O–D surveys. The distance–decay-weighted regression approach [15] applies weights to a range of variables affecting the station ridership; including characteristics of the stations (type, number of lines, accessibility within the network), and the areas it serves (population and employment characteristics, land-use mix, street density, presence of feeder modes) according to the distance–decay functions. Prior direct ridership models at the station level used fixed distance thresholds. They did not reflect the impact on travel of concentrated housing and employment at a longer/shorter distance from the station in cases where these developments were located within the station catchment area.

In conclusion, while many other factors influence transit ridership, population density, employment density, land-use mix, walking accessibility, transit accessibility, automobile accessibility, and central business district (CBD) characteristics are among the most consistently studied factors by forecasters [22]. Furthermore, including these variables in PFMs addresses the shortcomings of the four-step model. Additionally, these factors deal with the built urban environment, transportation policy, and alternatives to the automobile and social factors influencing transit ridership.

2.3 Station Boarding Factors (SBFs)

Sohn and Shim [10] referred to three categories of station boarding factors (SBFs), including (1) built environment, (2) external connectivity, and (3) intermodal connection. These three categories contained 24 metro boarding independent variables identified from previous studies [12–13, 24–29]. Among those identified, seven variables were significantly associated with station boarding, namely employment, commercial floor area, office floor area, net population density, the number of transfers, the number of feeder bus lines, and a dummy variable indicating transfer stations.

However, Sohn and Shim [10] and several other researchers [11, 15, 23, 31–34] did not drill down into the sub-variables of the "commercial floor area". Therefore, there is a need to investigate these sub-variables, specifically in the case of TOSMDs, to improve the accuracy of PFMs at transit stations near TOSMDs for optimal TOD and to increase the economic benefits for transit networks.

2.4 TOSMD Attractiveness Factors

Shopping malls have become a significant element in the urban landscape, as better mobility can improve cities' economies, tourism intensity [35], and place marketing. Place marketing means designing a place to satisfy the needs of its target markets [36]. It implies creating competitive market offerings that can better satisfy the city's target market needs [38–42]. Historically, Huff [43] assumed that the centripetal power exercised by a shopping mall was directly proportional to the size of the retail centre and inversely proportional to the consumer's distance or travel time to the shopping mall. A large shopping mall tends to provide a wider product assortment. Distance, however, represents a cost or disutility to the consumer [44]. Nevin and Houston [44] categorised shopping area attributes into three dimensions, namely assortment, facilities, and market posture. Wong et al. [45] increased the number of shopping mall attributes from the 16 originally identified by Nevin and Houston [44] to 21 factors. These 21 attributes fall under five dimensions, namely (1) location, including convenient location, located at retail belt;

(2) quality and variety, including owner's reputation, merchandise quality, service quality, merchandise variety, service variety, general price level; (3) popularity, including uniqueness, fashion; (4) facilities, including parking facilities, adequate and well-designed vertical transport, store atmosphere, layout, resting seats; and (5) sales incentives, including availability of supermarket, sales promotion, food court, special events/exhibit, and late closing hours.

The majority of shopping mall attractiveness studies have focused on attributes of shopping malls within the shopping mall context, to predict and optimise mall patronage [46, 47], identifying the optimal mix of activities in shopping malls, developing retailing strategies [49–51], understanding socio-spatial dynamics [52], and determining mall rent [53].

However, in order to optimise the potential benefits of coordinated transportation and land-use planning particularly in the case of TOSMDs, there is a need to analyse the impact of the internal and external attractiveness factors of TOSMDs [3, 6, 54]. Therefore, the TOSMD's internal attractiveness factors of product, price, place, promotion, people, physical evidence, and process, and the external attractiveness factors of density, diversity, urban design, destination accessibility, and distance need to be empirically examined [3], to identify which attractiveness factors contribute to ridership in the form of shopper passengers boarding at metro stations near TOSMDs.

2.5 Tourist Shopper Passengers (TSPs) Captured in PFMs

Passenger forecasting models (PFMs) tend to pay less attention to tourist passengers. Therefore, city planners sometimes do not consider the number of tourist arrivals in their studies as a factor in the design of transit supply. They tend to extend the benefit of visiting tourists by keeping the supply of public transport at the same level and tolerating a certain degree of congestion during tourist seasons [35]. Hall [55] indicated four roles of transport for tourists: first, linking the market of origin with the tourist destination; second, providing access and mobility within a wide destination area (region or country); third, offering access and mobility within a tourist attraction or destination; and fourth, providing travel along a recreational route.

Albalate and Bel [35] noted that studies had given less attention to the factors impacting the third role identified by Hall [55]. They provided guidance for factors impacting tourist transit passengers (TTP), as illustrated in Fig. 1.

Therefore, tourist shopper passengers (TSPs), as part of TTPs, are captured to a lesser extent in PFMs.

In conclusion, transit PFMs tend to ignore transit shopper passengers (residents or tourists) in their models. Hence, this study addresses the identified gap for TOSMDs and empirically examines to what extent attractiveness factors of TOSMDs impact ridership in the form of resident and tourist shopper passengers boarding at transit stations near TOSMDs.

3 Methods

This research was designed to identify and clarify the salient TOSMD-related attractiveness factors that affect the ridership caused by shopper passengers (unit of analysis) on the Dubai Metro Red Line stations where a TOSMD exists nearby. A survey was undertaken to gather data on shopper passengers at these stations. This method was selected as it was relatively easy for passengers to understand and complete, and was capable of producing a large volume of data in a limited period, and its results could be used for statistical analyses [56, 57]. Shopper passengers (individuals) boarding at seven metro stations near TOSMDs were surveyed to understand their perspectives on shopping mall attractiveness and ridership preferences. Structural equation modelling (SEM) was used to clarify the impact of the identified TOSMD attractiveness factors on the ridership of shopper passengers. Figure 2 provides an overview of the steps taken in this study.

3.1 Case Study Area

Dubai is an example of a city which has sought to differentiate itself as a shopping hub, and has more than 65 shopping malls [58]. The city has an area of only 4114 km^2 [59] and a population of 3.3 million [60]; however, it was visited by 15.92 million visitors in 2018 [61]. The large number of visitors to Dubai shopping malls are located near the city's domestic Metro Red Line.

The Dubai Metro Red Line, also called Phase (1), is 52.1 kilometres long and was opened in 2009. It has two stations connected to Dubai airport (T1, T3) and a number of stations connected or adjacent to (within around 0.8 km radius) large shopping malls. These stations are circled in Fig. 3 and include (from left to right) Ibn Battuta Mall, Dubai Marina Mall, Mall of Emirates, Dubai Mall, BurJuman Shopping Centre, Al Ghurair Centre, and Deira City Centre. These malls are typically in high-density, mixed communities along Sheikh Zaid Road and the old Deira area. The Dubai Metro Red Line stations include urban-designed walkways which connect the mall and a nearby metro station.

The number of passengers checking in at Dubai Metro Red Line stations during the period from 2013 to 2018 (the period when there were no major changes in the line services) is depicted in Fig. 4.

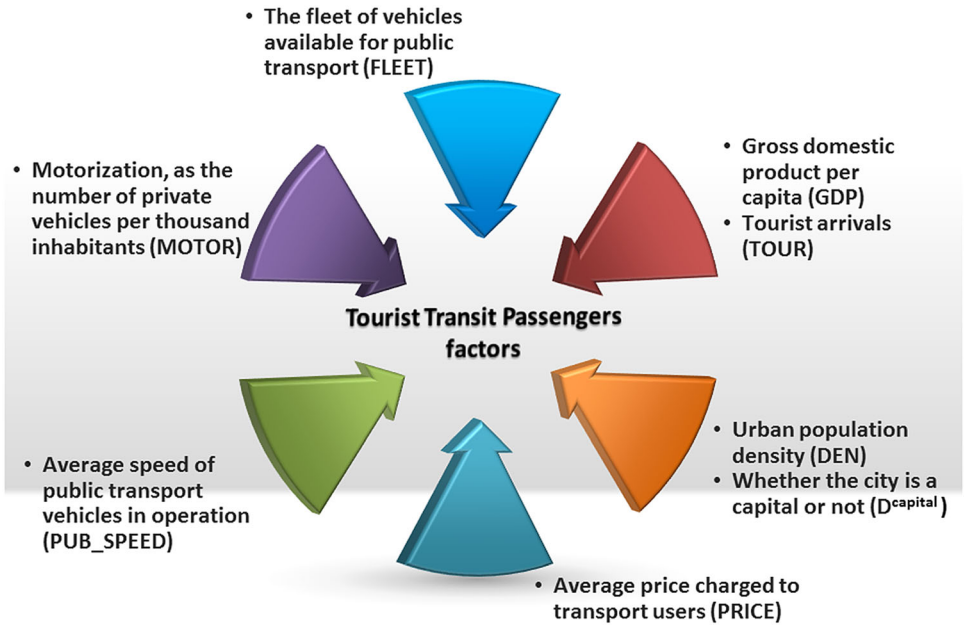


Fig. 1 Tourist transit passengers factors Adapted from Albalate and Bel [35]

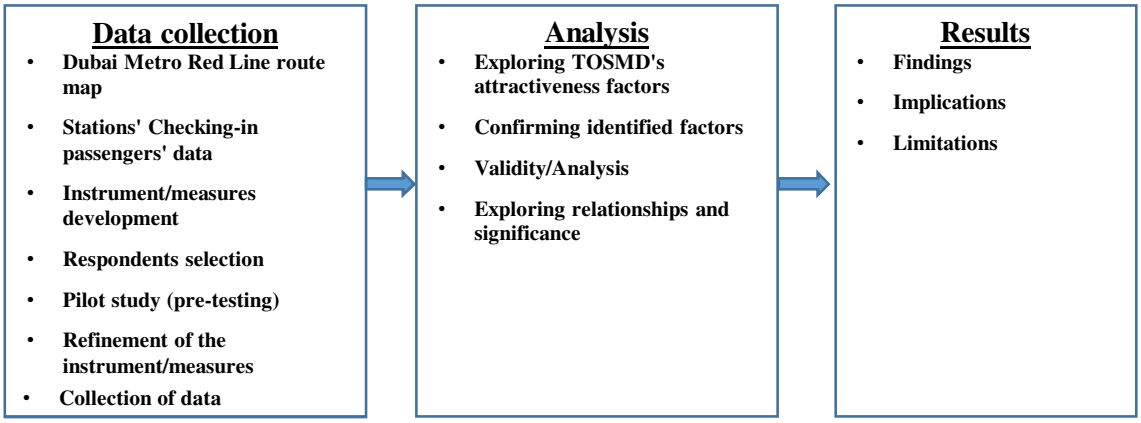


Fig. 2 Research method

As can be seen in Fig. 4, Dubai Metro Red Line stations near the TOSMDs generally have higher numbers of passengers checking in. This study uses the Dubai Metro Red Line as a single case rather than a comparison of different sub-cases, as there are few studies directly addressing the study problem within a homogeneous, one-study context capturing the relationship between metro station use and the attractiveness of TOSMDs. Although the case study methodology, particularly the single case, is inconsistent with the requirements of generalisation [62, 63], Yin [64] and Flyvbjerg [65] identify the value of using typical cases in analytical generalisation and the ability of a theory to be tested in a similar theoretical setting to further define its explanatory power [66]. Hence, this study provides a practical opportunity to identify and clarify the impact of TOSMD attractiveness factors on ridership at transit stations near TOSMDs along the Dubai Redline, and could be repeated for transit networks in other cities.

3.2 Data Collection

The data used to examine the station use by shopper passengers and the attractiveness factors of TOSMDs and the variables in the modelling were collected from various sources. The number of passengers checking in at each station of the Dubai Metro Red Line were obtained from the Rail Operations Department, Road and Transport Authority (RTA), which is responsible for the operation of Dubai Metro. The seven TOSMDs were identified using GIS and Google Maps based on a walkable distance around 0.8 km [11, 15, 67, 68]. The initial list of independent TOSMD attractiveness factors was synthesised from the literature review (refer to Sect. 2.4). The study used data

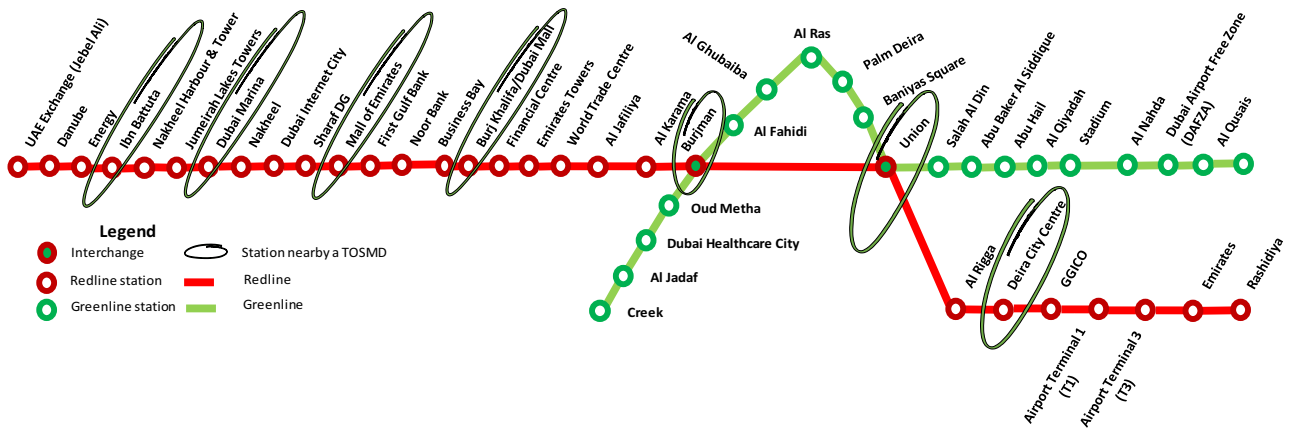


Fig. 3 Dubai Metro Red Line route map and stations within 0.8 km (circled) of the shopping malls

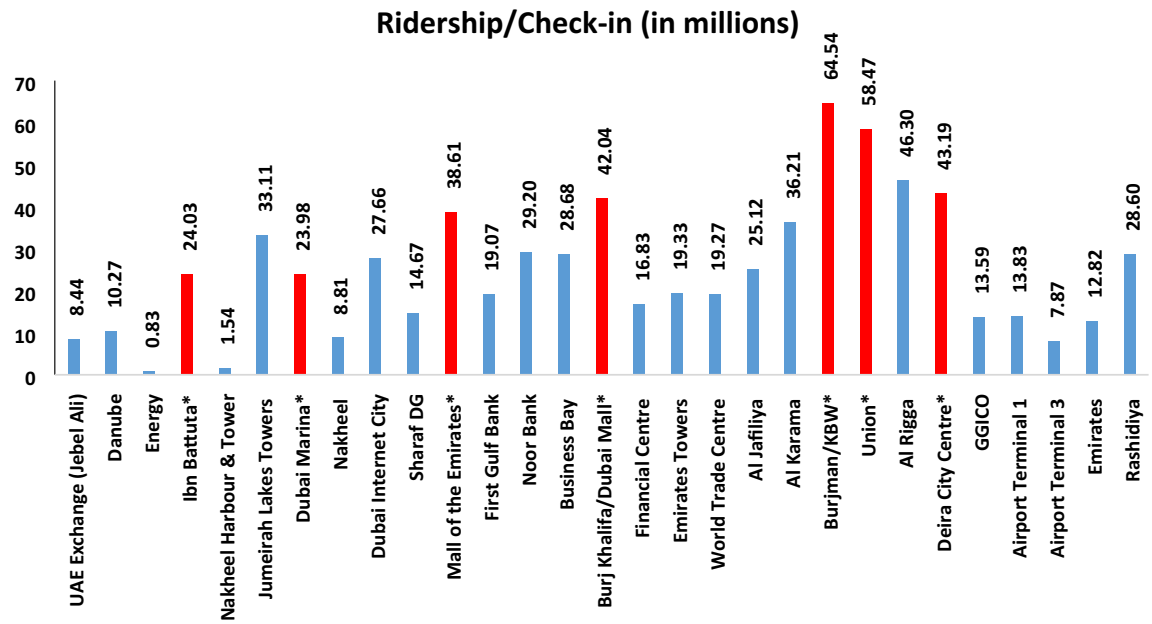


Fig. 4 Number of passengers checking in at stations of the Dubai Metro Redline during the period from 2013 to 2018 *Source*: Rail Operations Department (RTA) Database for Dubai Metro operations from 2013 to 2018

collected from a 72-question survey (refer to the Online Appendix). The survey was divided into six sections addressing demographic and behavioural characteristics of the respondent shopper passengers. It measured the importance of a shopping mall and its neighbourhood characteristics impacting passengers' decisions to visit the mall near a metro station, using a five-point Likert scale [49, 69]. The survey questionnaire was pre-tested using a collaborative participant pre-testing method [70] with a sample of 10 shopper passengers.

Data for the main study was collected daily during the period from April 2019 to October 2019. The survey was mainly distributed during the afternoon daily peak time between 4:00 pm and 8:00 pm by sampling conducted at the seven metro stations near shopping malls, as shown in Fig. 3. It was determined that the survey period and the afternoon data collection time provided the greatest diversity of participants, including workers and their families. Participants were purposively selected based on first asking the shopper passengers if they had come from the shopping mall to board the metro at the nearby station [71]. If the answer was "yes", these shopper passengers were asked to participate in the survey. The daily morning peak time between 6:00 am and 9:00 am was avoided since shopping mall shops commonly open after 9:00 am. Therefore, target shopper passenger prospective

respondents were not available during this time. Shopper passengers were given the option to complete the survey on a paper based form or using a given web link to the study survey. Out of 1200 surveys distributed, 700 survey responses were received (response rate = 58%), including 366 online completed survey responses (52%) and 334 completed forms of survey responses (48%).

The data obtained from the 700 surveyed shopper passengers was used to explore the principal list of attractiveness factors of TOSMDs, which was used to construct the SEM model explaining the impact of TOSMD attractiveness factors on the shopper passenger ridership using Dubai Metro Red Line stations near TOSMDs.

3.3 Descriptive Statistics

Of the 700 surveyed shopper passengers boarding at the seven metro stations near TOSMDs (see Fig. 3), 69% were identified as residents and 31% tourists of Dubai, 47% were men and 53% women, and 54% were aged 18–34 and 46% older than 34. Twelve independent variables were identified and analysed based on TOSMD attractiveness factors (refer to Sect. 2).

Table 1 presents a profile of the 700 respondent shopper passengers (including residents, tourists, and both) in terms of the level of importance of factors of TOSMD attractiveness and the level of agreement to potentially use a metro station near a shopping mall. The table shows the comparative mean (M) and standard deviation (SD) scores of resident and tourist shopper passengers. As can be seen in Table 1, more than half the respondent shopper passengers ranked a TOSMD's internal attractiveness factors as important or very important, including: product (M = 4.229; SD = 0.602), price (M = 4.115; SD = 0.549), place (M = 3.928; SD = 0.576), promotion (M = 3.96; SD = 0.562), people (M = 4.294; SD = 0.517), physical evidence (M = 4.226; SD = 0.544), and process (M = 3.872; SD = 0.616). Resident shopper passengers (RSPs) mean score (3.97) for the promotion factor was slightly higher than its equivalent for tourist shopper passengers (TSPs) (3.939). However, TSP mean scores for product (4.268), price (4.116), place (4.002), people (4.312), and physical evidence (4.277) were generally higher than their TSP equivalents for product (4.211), price (4.114), place (3.895), people (4.285), and physical evidence (4.203).

Similarly, a high percentage of respondents ranked TOSMD external attractiveness factors as important or very important, including density (M = 3.554; SD = 0.988), diversity (M = 3.531; SD = 0.767), urban design (M = 3.987; SD = 0.634), destination accessibility (M = 4.091; SD = 0.582), and distance (M = 3.822; SD = 0.75). RSP mean scores for urban design (3.988) and destination accessibility (4.103) were higher than the equivalents for TSPs (3.983 and 4.067, respectively). However, TSP mean scores for density (3.653), diversity (3.565), and distance (3.825) were higher than their RSP equivalents for density (3.509), diversity (3.515), and distance (3.821).

Nonetheless, a high percentage of respondents agreed with the intention to use the metro station close to a mall (M = 3.462; SD = 0.864) including RSPs (M = 3.553; SD = 0.863) and TSPs (M = 3.263; SD = 0.833). This high percentage was explained in particular by the availability of walking access from the station to the mall (M = 4.09; SD = 0.997), with RSP mean scoring of 4.141, higher than TSPs (3.977).

3.4 Analytical Approach

This study mainly explores the impact of TOSMD attractiveness factors on ridership among shopper passengers boarding at transit stations near TOSMDs. We used a principal component analysis (PCA) approach in measuring the impact of these factors and assessing measurement validity, similar to other studies such as El-Adly [49]. The TOSMD attractiveness factors were the independent constructs, and ridership of shopper passenger boarding at a nearby transit station was the dependent construct.

The statistical data for the Dubai Metro Red Line indicated that stations next to shopping mall developments generally have higher ridership than many other stations. The data provided by the shopper passengers was analysed according to the level of importance they attributed to the identified TOSMD attractiveness factors, and their ridership preference for using a metro station near a shopping mall. Confirmatory factor analysis (CFA) was then used to validate the outcome of the PCA analysis, following the empirical model presented by Sohn and Shim [10], which examined on-boarding factors affecting demand at a station level. Similar to Sohn and Shim [10], structural equation modelling (SEM) was conducted to ultimately identify and clarify the impact of TOSMD attractiveness factors on shopper passenger ridership using stations near TOSMDs.

4 Analysis and Results

4.1 Attractiveness Factors of TOSMDs

Principal component analysis (PCA) showing the salient TOSMD attractiveness factors is displayed in Table 2. It shows that 39 items explain 75.07% of data variability, with reliability of Cronbach $\alpha = 0.821$ and > 0.7 for each factor. Furthermore, 13 items (i.e. q0019: grocery store presence, q0024: prices offer value for money, q0030:

Table 1 Internal and external attractiveness factors of TOSMDs (n = 700)

TOSMDs attractiveness factors	Scale										Shopper passengers					
	1		*2*		*3*		*4*		*5*		**Residents**				**Total**	
Item	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	*M*	SD	*M*	SD	*M*	SD
Internal factors																
***Product**											**4.211**	**0.607**	**4.268**	**0.588**	**4.229**	**0.602**
Cinema present	2	0.3%	22	3%	53	8%	380	54%	243	35%	4.2	0.729	4.201	0.739	4.200	0.731
A variety in product quality present		0%	15	2%	30	4%	384	55%	271	39%	4.289	0.66	4.329	0.637	4.301	0.652
Presence of fun and entertainment activities in the mall (e.g. gaming arcade)	3	0.4%	25	4%	36	5%	411	59%	225	32%	4.146	0.753	4.274	0.641	4.186	0.721
***Price**											**4.114**	**0.543**	**4.116**	**0.563**	**4.115**	**0.549**
Prices are appropriate to my income		0%	5	1%	47	7%	435	62%	213	30%	4.235	0.599	4.196	0.577	4.223	0.592
Overall price level in the mall		0%	8	1%	123	18%	405	58%	164	23%	4.042	0.666	4.023	0.694	4.036	0.675
Comparatively low prices		0%	7	1%	144	21%	331	47%	218	31%	4.067	0.75	4.128	0.724	4.086	0.742
***Place**											**3.895**	**0.554**	**4.002**	**0.617**	**3.928**	**0.576**
Size of the mall	6	1%	20	3%	38	5%	481	69%	155	22%	4.05	0.64	4.16	0.752	4.084	0.679
Average size of shops	3	0.4%	35	5%	80	11%	509	73%	73	10%	3.84	0.653	3.959	0.686	3.877	0.665
Number of shops	3	0.4%	38	5%	122	17%	454	65%	83	12%	3.794	0.708	3.886	0.742	3.823	0.720
***Promotion**											**3.97**	**0.569**	**3.939**	**0.545**	**3.96**	**0.562**
Promotional campaigns in the mall	2	0.3%	26	4%	67	10%	500	71%	105	15%	3.979	0.661	3.954	0.619	3.971	0.648
Organising events in the mall (e.g. shows)	1	0.1%	24	3%	110	16%	470	67%	95	14%	3.892	0.678	3.936	0.617	3.906	0.659
Loyalty programs	2	0.3%	30	4%	90	13%	420	60%	158	23%	4.037	0.746	3.927	0.732	4.003	0.743
***People**											**4.285**	**0.51**	**4.315**	**0.532**	**4.294**	**0.517**
Staff friendliness and helpfulness	1	0.1%	10	1%	32	5%	476	68%	181	26%	4.156	0.58	4.233	0.595	4.180	0.585
Staff knowledge and training	1	0.1%	15	2%	23	3%	443	63%	218	31%	4.243	0.617	4.205	0.642	4.231	0.624
Availability of customer service	1	0.1%	3	0%	12	2%	333	48%	351	50%	4.455	0.569	4.507	0.578	4.471	0.572
***Physical evidence**											**4.203**	**0.559**	**4.277**	**0.505**	**4.226**	**0.544**
Lack of crowdedness in the mall	3	0.4%	20	3%	64	9%	399	57%	214	31%	4.085	0.735	4.274	0.696	4.144	0.728
Comfortable controlled temperature	1	0.1%	10	1%	22	3%	431	62%	236	34%	4.26	0.633	4.301	0.534	4.273	0.604
Atmosphere in the mall (e.g. music and lighting)		0%	13	2%	21	3%	436	62%	230	33%	4.264	0.632	4.256	0.54	4.261	0.604
***Process**											**3.876**	**0.607**	**3.865**	**0.635**	**3.872**	**0.616**
Ease of reaching the mall (e.g. directions)	1	0.1%	3	0%	6	1%	520	74%	170	24%	4.225	0.491	4.215	0.464	4.221	0.482
Ease of finding a desired store inside the mall (e.g. Virgin store)	1	0.1%	3	0%	156	22%	415	59%	125	18%	3.919	0.664	3.995	0.632	3.943	0.655
Ease of finding a desired product inside the mall (e.g. iPhone mobiles)	3	0.4%	138	20%	219	31%	219	31%	121	17%	3.484	0.979	3.384	1.066	3.453	1.007
External factors																
***Density (agglomeration and the number of business establishment in a mall area)**											**3.509**	**0.988**	**3.653**	**0.982**	**3.554**	**0.988**
Crowdedness and compactness of buildings around the mall	35	5%	131	19%	116	17%	312	45%	106	15%	3.41	1.107	3.575	1.104	3.461	1.108
Total population in the neighborhood around the shopping mall	34	5%	83	12%	82	12%	380	54%	121	17%	3.607	1.059	3.817	1.006	3.673	1.047
High number of shops surrounding the shopping mall	31	4%	118	17%	164	23%	224	32%	163	23%	3.511	1.148	3.566	1.153	3.529	1.149
***Diversity (mixed-use developments' attributes)**											**3.515**	**0.798**	**3.565**	**0.696**	**3.531**	**0.767**
The need for mixed residential and commercial buildings around the shopping mall	38	5%	82	12%	275	39%	270	39%	35	5%	3.252	0.954	3.279	0.857	3.260	0.924
Availability of scenic and recreational areas around the mall (e.g. water fountain)	23	3%	70	10%	169	24%	376	54%	62	9%	3.543	0.928	3.562	0.862	3.549	0.907
Availability of community services area around the shopping mall (e.g. government services)	23	3%	59	8%	88	13%	407	58%	123	18%	3.751	0.935	3.854	0.956	3.783	0.943
***Urban design**											**3.988**	**0.662**	**3.983**	**0.57**	**3.987**	**0.634**
Availability of safe and air-conditioned walkways around the mall		0%	62	9%	38	5%	468	67%	132	19%	3.969	0.797	3.932	0.717	3.957	0.772
Availability of parking facilities	4	1%	51	7%	29	4%	487	70%	129	18%	3.996	0.764	3.945	0.734	3.980	0.754
Availability of clear signage around the mall	2	0.3%	47	7%	15	2%	505	72%	131	19%	4	0.753	4.073	0.601	4.023	0.709
***Destination accessibility**											**4.103**	**0.575**	**4.067**	**0.598**	**4.091**	**0.582**
Availability of walking access around the mall (e.g. pedestrian crossings, bridges and tunnels)	1	0.1%	17	2%	119	17%	336	48%	227	32%	4.119	0.767	4.064	0.781	4.101	0.771
Access to facilities and amenities around the shopping mall (e.g. hospitals)	2	0.3%	11	2%	80	11%	385	55%	222	32%	4.148	0.717	4.196	0.672	4.163	0.703
Access to downtown /or city center	1	0%	20	3%	117	17%	395	56%	167	24%	4.042	0.706	3.941	0.779	4.010	0.730
***Distance**											**3.821**	**0.729**	**3.825**	**0.796**	**3.822**	**0.75**
Proximity of shops in the area around the mall	2	0.3%	90	13%	151	22%	283	40%	174	25%	3.767	0.96	3.767	1.012	3.767	0.975
Proximity of a metro station	27	4%	144	21%	59	8%	353	50%	117	17%	3.555	1.077	3.557	1.173	3.556	1.107
Proximity of intercity public transport		0%	17	2%	28	4%	492	70%	163	23%	4.141	0.585	4.151	0.606	4.144	0.591
****Shopper passengers ridership construct**											**3.553**	**0.863**	**3.263**	**0.833**	**3.462**	**0.864**
I intend to use the metro station close to the mall because; there is car traffic congestion in the area of the mall	11	2%	237	34%	170	24%	147	21%	135	19%	3.351	1.19	2.95	1.024	3.226	1.155
I intend to use the metro station close to the mall because; there is lack of enough car parking spaces in the area of the mall	28	4%	212	30%	242	35%	118	17%	100	14%	3.166	1.128	2.863	0.991	3.071	1.095
I intend to use the metro station close to the mall because; there is walking access from the station to the mall	10	1%	62	9%	73	10%	265	38%	290	41%	4.141	0.94	3.977	1.106	4.090	0.997

*Scale values range from 1 ("not important") to 5 ("very important")

**Scale values range from 1 ("strongly disagree") to 5 ("strongly agree"): the higher the mean, the higher the attractiveness of that particular aspect

M mean, SD standard deviation, Freq frequency

convenient facilities and amenities, q0034: mall image and publicity, q0038: staff extended working hours, q0040: modern mall internal decoration, q0046: freedom in the mall, q0049: car traffic congestion around the shopping mall, q0054: economic diversity in the neighbourhood around the shopping mall, q0056: availability of cycling lanes around the mall, q0062: access to different transport mode options, q0066: proximity of other modes of transport, q0067: I intend to use the metro station close to the mall because the station is at a walkable distance from the mall) were excluded from the analysis, as they were not significantly loaded (less than 0.5) to any of the 13 revealed constructs [3]. These 13 constructs were product, price, place, promotion, people, physical evidence, process, density, diversity, urban design, destination accessibility, distance, and shopper passenger ridership at the station.

4.2 Confirmatory Factor Analysis (CFA) and Structural Equation Model (SEM)

Confirmatory factor analysis was conducted to validate the identified attractiveness factors of TOSMDs impacting the ridership of shopper passengers using stations near a TOSMD [72]. According to Lei and Wu [73], a model is well specified and valid if the sample is large enough, and the normed fit index (NFI), comparative fit index (CFI), and goodness-of-fit index (GFI) are over 0.9 [74, 75]. The study's model showed a reasonable fit [76]: $\chi^2 = 2950$ ($P = 0.00$), degrees of freedom (DOF) = 1005, goodness-of-fit index (GFI) = 0.9, the adjusted goodness-of-fit index (AGFI) = 0.83, the comparative fit index (CFI) = 0.9, the normed fit index (NFI) = 0.9, and the root mean square residual (RMR) = 0.054.

However, attractiveness factors of TOSMDs vary from one context to another (refer to Sect. 2.4). Therefore, in line with Sohn and Shim [10], SEM was then used to examine the causal impact of the attractiveness factors of TOSMDs on the shopper passenger ridership (including RSPs and TSPs). Table 3 shows the regression weights of TOSMD attractiveness factors impacting all shopper passenger ridership (including residents and tourists) boarding-in at Dubai Metro Red Line stations near TOSMDs. The r^2 is 0.31 for the ridership of all shopper passengers using Dubai Metro Red Line stations near TOSMDs ($r^2 = 0.39$ for RSPs, and 0.35 for TSPs). Price (0.20), place (0.14), people (0.016), and density (0.35) factors positively impact the ridership of all shopper passengers. However, the promotion factor shows a negative impact (−0.35) on the ridership of all shopper passengers. Furthermore, product, physical evidence, diversity, urban design, and destination accessibility factors are not significantly associated with the ridership of all shopper passengers. Table 3 also shows variability in the TOSMD attractiveness factors impacting the ridership of RSPs and TSPs. While place (0.14), people (0.18), and distance (0.17) factors are associated with the ridership of RSPs, they are not associated with the ridership of TSPs. However, the product (−0.19) factor is negatively associated with only the ridership of TSPs.

5 Discussion and Conclusion

This study investigated the impact of TOSMD attractiveness factors (the independent constructs) on the ridership of shopper passengers using transit stations near TOSMDs (the dependent constructs), to inform and potentially enhance the existing forecasting models of station ridership and increase the economic sustainability of transit networks of the Dubai Metro Red Line. The study initially showed high volumes of ridership at stations near TOSMDs (refer to Fig. 4).

The independent constructs were categorised into (1) internal factors (product, price, place, promotion, people, physical evidence, and process), and (2) external factors (density, diversity, urban design, design accessibility, and distance). The 700 shopper passengers representing the dependent construct were categorised into resident shopper passengers (RSPs), and tourist shopper passengers (TSPs), refer to Table 1.

The study's PCA identified 12 independent constructs of TOSMD attractiveness factors that contributed to the dependent construct of ridership at transit stations near TOSMDs in the form of shopper passenger ridership using those transit stations. The cumulative percentage of variance explained in this relationship was 75.07%, with reliability of 0.821, and attractiveness factors with reliability above 0.7 for each construct shown in Table 2. The table showed all shopper passengers' scoring of a TOSMD's internal attractiveness factors of product, price, place, promotion, people, physical evidence, and process. Also, it showed all shopper passengers' scoring of a TOSMD's external attractiveness factors of density, diversity, urban design, destination accessibility, and distance, where a score of four identified an important factor. Additionally, the results in Table 1 showed differences in scoring of TOSMD attractiveness factors between RSPs and TSPs. All shopper passengers showed an agreement to use a metro station close to a mall mainly because there is walking access from the station to the mall ($M = 4.090$, SD = 0.997).

The study also presented a SEM model that explained the relationship between the identified independent constructs of TOSMD attractiveness factors and the dependent variable of shopper passenger ridership using metro stations near TOSMDs. The model was initially validated and

Table 2 TOSMD factors impacting shopper passenger ridership

Item \ Factor		Product	Price	Place	Promotion	People	Physical evidence	Process	Density	Diversity	Urban design	Destination accessibility	Distance	Shopper passengers ridership
Eigenvalue		***2.017***	***1.51***	***1.335***	***1.256***	***3.333***	***1.562***	***4.433***	***6.069***	***2.56***	***1.921***	***0.877***	***1.352***	***1.054***
Cronbach α	***0.821***	***0.818***	***0.749***	***0.787***	***0.757***	***0.839***	***0.789***	***0.762***	***0.877***	***0.774***	***0.809***	***0.703***	***0.751***	***0.712***
Total variance explained (%)	***75.074***	***5.889***	***5.576***	***5.529***	***5.494***	***6.270***	***5.637***	***6.514***	***6.952***	***5.898***	***5.856***	***4.879***	***5.538***	***5.042***
Item	Code													
Cinema present	q0020X	0.825												
A variety in product quality present	q0021X	0.858												
Presence of fun and entertainment activities in the mall (e.g. gaming arcade)	q0022X	0.814												
Prices are appropriate to my income	q0023X		0.756											
Overall price level in the mall	q0025X		0.801											
Comparatively low prices	q0026X		0.775											
Size of the mall	q0027X			0.714										
Average size of shops	q0028X			0.860										
Number of shops	q0029X			0.774										
Promotional campaigns in the mall	q0031X				0.829									
Organising events in the mall (e.g. shows)	q0032X				0.718									
Loyalty programs	q0033X				0.794									
Staff friendliness and helpfulness	q0035X					0.799								
Staff knowledge and training	q0036X					0.788								
Availability of customer service	q0037X					0.854								
Lack of crowdedness in the mall	q0039X						0.792							
Comfortable controlled temperature	q0041X						0.841							
Atmosphere in the mall (e.g. music and lighting)	q0042X						0.785							
Ease of reaching the mall (e.g. directions)	q0043X							0.657						
Ease of finding a desired store inside the mall (e.g. Virgin store)	q0044X							0.799						
Ease of finding a desired product inside the mall (e.g. iPhone mobiles)	q0045X							0.794						
Crowdedness and compactness of buildings around the mall	q0047X								0.872					
Total population in the neighbourhood around the shopping mall	q0048X								0.794					
High number of shops surrounding the shopping mall	q0050X								0.821					
The need for mixed residential and commercial buildings around the shopping mall	q0051X									0.772				
Availability of scenic and recreational areas around the mall (e.g. water fountain)	q0052X									0.852				
Availability of community services area around the shopping mall (e.g. government services)	q0053X									0.684				
Availability of safe and air-conditioned walkways around the mall	q0055X										0.826			
Availability of parking facilities	q0057X										0.813			
Availability of clear signage around the mall	q0058X										0.850			
Availability of walking access around the mall (e.g. pedestrian crossings, bridges and tunnels)	q0059X											0.751		
Access to facilities and amenities around the shopping mall (e.g. hospitals)	q0060X											0.831		
Access to downtown /or city centre	q0061X											0.707		
Proximity of shops in the area around the mall	q0063X												0.766	
Proximity of a metro station	q0064X												0.701	
Proximity of intercity public transport	q0065X												0.754	
I intend to use the metro station close to the mall because; there is car traffic congestion in the area of the mall	q0068X													0.752
I intend to use the metro station close to the mall because; there is lack of enough car parking spaces in the area of the mall	q0069X													0.739
I intend to use the metro station close to the mall because; there is walking access from the station to the mall	q0070X													0.727

Extraction method: principal component analysis

Rotation method: varimax with Kaiser normalisation

[a]Rotation converged in 7 iterations

n = 700, Cumulative % of variance explained = 75.074, Cronbach's alpha = 0.821

Table 3 Regression weights of TOSMD attractiveness factors impacting shopper passenger ridership using Dubai Metro Redline stations near TOSMDs

			All shopper passengers				Resident shopper passengers				Tourist shopper passengers			
			Estimate	SE	CR	*P*	Estimate	SE	CR	*P*	Estimate	SE	CR	*P*
Shopper passengers no.	<–	Product	−0.01	0.08	−0.24	0.81	0.09	0.08	1.58	0.11	−0.19	0.17	−2.07	0.04
Shopper passengers no.	<–	Price	0.20	0.10	3.35	***	0.19	0.10	3.01	0.00	0.42	0.36	1.99	0.05
Shopper passengers no.	<–	Place	0.14	0.10	2.52	0.01	0.14	0.13	2.20	0.03	0.21	0.21	1.96	0.05
Shopper passengers no.	<–	Promotion	−0.35	0.09	−6.50	***	−0.37	0.09	−5.97	***	−0.28	0.22	−2.57	0.01
Shopper passengers no.	<–	People	0.16	0.08	3.36	***	0.18	0.09	3.44	***	0.17	0.21	1.44	0.15
Shopper passengers no.	<–	Physical evidence	0.02	0.08	0.38	0.70	0.05	0.09	0.94	0.35	0.05	0.23	0.40	0.69
Shopper passengers no.	<–	Density	0.35	0.09	3.98	***	0.31	0.10	2.93	0.00	0.45	0.19	2.57	0.01
Shopper passengers no.	<–	Diversity	−0.08	0.10	−1.06	0.29	−0.03	0.11	−0.30	0.76	−0.11	0.25	−0.75	0.46
Shopper passengers no.	<–	Urban design	0.05	0.08	0.94	0.35	0.00	0.09	−0.01	0.99	0.14	0.26	1.04	0.30
Shopper passengers no.	<–	Destination accessibility	−0.01	0.09	−0.26	0.80	−0.06	0.12	−1.09	0.27	0.04	0.14	0.43	0.67
Shopper passengers no.	<–	Distance	0.07	0.05	1.27	0.20	0.17	0.05	2.97	0.00	−0.29	0.21	−1.46	0.14
			(n = 700)				(n = 481)				(n = 219)			
			R^2 = 0.31				R^2 = 0.39				R^2 = 0.35			

***Highly significant ($P < 0.001$);
*Significant ($P < 0.05$);
Not significant ($P > 0.05$)

statistically considered to be fit. It confirmed that 11 of the 12 TOSMD independent constructs, namely product, price, place, promotion, people, physical evidence, process, density, diversity, urban design, destination accessibility, and distance, were associated with the ridership shopper passengers using metro stations near TOSMDs. The process factor was later eliminated, as its predicting items were distributed to other reflective factors, namely urban design and physical evidence factors, and therefore it became redundant (refer to Table 3).

An earlier study by the authors developed a conceptual framework that proposed a relationship between the latent construct of shopper passenger ridership at transit stations near a TOSMD and the independent constructs of TOSMD attractiveness factors [3]. This study has empirically supported and clarified the impact of the identified factors in the case of the Dubai Metro Red Line, with the exception of the process attractiveness factor. It provided statistically fit outcomes explaining the impact of the 11 factors on the number of shopper passengers (residents and tourists) for the Dubai Metro Red Line (refer to Table 3). The result of the study is also in line with previous urban transport planning studies, postulating that there is an interrelationship between railway stations and their context, namely TOSMDs [30, 77], and retail and marketing studies indicating that the level of congestion is likely to be higher with the broader assortment of services and products provided by larger shopping malls [78].

The study contributes to the transit urban planning literature by providing a practical implementation and a demonstration identifying and clarifying the impact of TOSMD attractiveness factors on ridership at transit stations near TOSMDs. Shopper passenger ridership contributes to the ridership at those stations in isolation from other stations not near TOSMDs in the same line and service context. However, the attractiveness factors of TOSMDs vary from one context to another (refer to Sect. 2.4). As can be seen in Table 3, it identified five independent TOSMD attractiveness constructs, including price, place, people, density, and promotion. These five constructs explained 31% of the dependent construct of shopper passenger ridership using the Dubai Metro Red Line stations near TOSMDs ($r^2 = 0.31$, $P > .05$).

As an insight into the five identified constructs, the price construct was explained by comparatively low prices and overall prices in the mall. Furthermore, the respondents identified a high level of agreement ($M = 4.223$) that the pricing in the mall was appropriate to their income. Not unexpectedly, the price construct showed a higher level of significance to resident shopper passengers than tourist shopping passengers, which would be explained by residents' knowledge of price, and tourists being less conscious of price. The place construct had the lowest level of

significance of the five constructs, which could be explained by the expectation of shoppers that shopping malls would cover large areas, and indicates that the respondents were comfortable with the experience of shopping in larger spaces where there is less shopper congestion. Within the people construct which was rated very high ($M = 4.294$), customer service was very highly considered ($M = 4.471$), followed by staff knowledge and training ($M = 4.231$) and then staff friendliness and helpfulness. The respondents did not rate the issue of the density of shops and population in the area surrounding the mall importantly in the descriptive data, but this may be explained by greater shopper focus on the shopping mall than the surrounding area.

The promotion construct was the only construct shown to be negatively correlated with shopper passenger ridership. This outcome can be accepted, as some shoppers may prefer to avoid Dubai mall crowding, e.g. on New Year's Eve when there is a fireworks event.

Additionally, the product construct (explained by the presence of a cinema, and the fun and entertainment activities, e.g. gaming arcade in the mall) was found to be negatively associated with the ridership of tourists and positively correlated for residents. This result can be explained by the fact that tourists are less motivated to attend cinemas and activities, as this was not their primary reason for travel to Dubai. Similarly, the distance construct (explained by the proximity of a metro station and proximity to intercity public transport) was found to positively impact only the ridership of residents but negatively impact ridership for tourists. This result can be explained by the fact that since residents live in Dubai, they rate the issues of proximity highly.

The five identified TOSMD attractiveness factors can be accepted, as Dubai uniquely has more than 65 malls, while its area is only 4000 km^2. As a result, shopping mall competition is expected to be high. Therefore, the five identified TOSMD attractiveness factors and their explanatory items reflect attributes that allow a shopping mall to outperform its competitors, i.e. in the form of comparatively low prices, staff friendliness, customer service, etc.

As identified in the literature, the impact of TOSMD attractiveness factors has not been adequately considered in passenger forecasting models (PFMs), which have focused on factors such as the association between commercial floor area and station boarding. Hence, there was a need to examine to what extent TOSMD attractiveness factors impact ridership in the form of resident and tourist shopper passengers boarding at transit stations near TOSMDs, in order to better optimise TOD and to increase the economic benefits of transit networks. The study identified critical TOSMD attractiveness factors and clarified their impact in the form of shopper passenger ridership contributing to the ridership at stations near TOSMDs for the Dubai Metro Red Line.

The study was limited in that the causal relationships were tested with a single case study using the seven Dubai Metro Red Line stations near TOSMDs. It did not investigate the reverse causal effect, which might have influenced the latent constructs identified in the study. Furthermore, personality traits, and date and time of the survey may have affected shopper passengers' perceptions of TOSMD attractiveness factors; however, the consistency in descriptive survey data between stations and residents and tourists provides some confidence in the trends. These limitations warrant further investigation and could be incorporated into the design of future studies and be repeated in other cities' transit networks.

Despite its limitations, the study provides urban policymakers and rail transit urban planners with a practical basis from which to clarify shopper passenger ridership (including residents and tourists) using a transit rail station near a TOSMD. Furthermore, it provides a potential means of enhancing the accuracy and comprehensiveness of existing forecasting models (used to forecast transit station ridership) by identifying and clarifying the impact of TOSMD attractiveness factors on ridership at transit stations near TOSMDs. In particular, the approach may provide an understanding of shopper passengers contributing to the ridership at those stations in isolation from other transit stations not near TOSMDs in the same line and service context. Therefore, it is considered useful for cities with existing or growing rail network stations seeking to understand the expected ridership impact of TOSMDs on nearby transit network stations in the form of added shopper passenger ridership flowing into stations near TOSMDs. This understanding is considered useful for effective TOD approaches to rail network and shopping mall patterns of development, and economic sustainability in the form of guiding private or government investment as to where the best results will be achieved when developing metro stations.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Cushman & Wakefield (2016) European shopping centre development report: November 2016. http://bpcc.org.pl/uploads/ckeditor/attachments/10749/european_shopping_centre_development_report_nov_2016.pdf. Accessed 18 Aug 2017
2. Cushman & Wakefield (2017) U.S. Shopping center marketbeat: Q2 2017. http://www.cushmanwakefield.com/~/media/reports/corporate/MarketBeat%20Reports/2017/Q2%20US%20MarketBeat/CW_US_ShoppingCenter_MarketBeat_Q2_17.pdf. Accessed 14 Aug 2017
3. Abutaleb A, McDougall K, Basson M, Hassan R, Mahmood MN (2019) Towards a conceptual framework for understanding the attractiveness of rail transit-oriented shopping mall developments (TOSMDs). Urban Rail Transit. https://doi.org/10.1007/s40864-019-00112-4
4. Farrag DA, El Sayed IM, Belk RW (2010) Mall shopping motives and activities: a multimethod approach. J Int Consum Mark 22(2):95–115. https://doi.org/10.1080/08961530903476113
5. Kok HJ (2007) Restructuring retail property markets in Central Europe: impacts on urban space. J Hous Built Environ 22(1):107–126. https://doi.org/10.1007/s10901-006-9068-z
6. Higgins CD, Kanaroglou PS (2016) A latent class method for classifying and evaluating the performance of station area transit-oriented development in the Toronto region. J Transp Geogr 52:61–72. https://doi.org/10.1016/j.jtrangeo.2016.02.012
7. Taylor BD, Fink CN (2003) The factors influencing transit ridership: a review and analysis of the ridership literature. University of California Transportation Center
8. Zhao J, Deng W, Song Y, Zhu Y (2013) Analysis of Metro ridership at station level and station-to-station level in Nanjing: an approach based on direct demand models. Transportation 41(1):133–155. https://doi.org/10.1007/s11116-013-9492-3
9. Chan S, Miranda-Moreno L (2013) A station-level ridership model for the metro network in Montreal, Quebec. Can J Civ Eng 40(3):254–262. https://doi.org/10.1139/cjce-2011-0432
10. Sohn K, Shim H (2010) Factors generating boardings at Metro stations in the Seoul metropolitan area. Cities 27(5):358–368. https://doi.org/10.1016/j.cities.2010.05.001
11. Kuby M, Barranda A, Upchurch C (2004) Factors influencing light-rail station boardings in the United States. Transp Res Part A Policy Pract 38(3):223–247
12. Chu X (2004) Ridership models at the stop level National Center of Transit Research. University of South Florida, Tampa
13. Cervero R (2006) Alternative approaches to modeling the travel-demand impacts of smart growth. J Am Plan Assoc 72(3):285–295
14. McNally MG (2000) The four step model institute of transportation studies. Center for activity Systems Analysis, University of California, Irvine
15. Gutiérrez J, Cardozo OD, García-Palomares JC (2011) Transit ridership forecasting at station level: an approach based on distance-decay weighted regression. J Transp Geogr 19(6):1081–1092. https://doi.org/10.1016/j.jtrangeo.2011.05.004
16. Choi J, Lee YJ, Kim T, Sohn K (2012) An analysis of Metro ridership at the station-to-station level in Seoul. Transportation 39(3):705–722. https://doi.org/10.1007/s11116-011-9368-3
17. Brès A (2014) Train stations in areas of low density and scattered urbanisation: towards a specific form of rail oriented development. TPR Town Plan Rev 85(2):261–272. https://doi.org/10.3828/tpr.2014.16
18. Chakour V, Eluru N (2014) Analyzing commuter train user behavior: a decision framework for access mode and station choice. Transportation 41(1):211–228. https://doi.org/10.1007/s11116-013-9509-y
19. Handy S (2005) Smart growth and the transportation-land use connection: What does the research tell us? Int Reg Sci Rev 28(2):146–167
20. Vessali KV (1996) Land use impacts of rapid transit: a review of the empirical literature. Berkeley Plan J. https://doi.org/10.5070/BP311113054
21. Zhao J, Rahbee A, Wilson NHM (2007) Estimating a rail passenger trip origin-destination matrix using automatic data collection systems. Comput-Aided Civ Infrastruct Eng 22(5):376–387. https://doi.org/10.1111/j.1467-8667.2007.00494.x
22. Sides PC (2012) Regression model ridership forecasts for Houston light rail. The University of Texas at Austin, Texas
23. Estupiñán N, Rodríguez DA (2008) The relationship between urban form and station boardings for Bogota's BRT. Transp Res Part A Policy Pract 42(2):296–306
24. Yao X (2007) Where are public transit needed—examining potential demand for public transit for commuting trips. Comput Environ Urban Syst 31(5):535–550
25. Boyle DK (2006) Fixed-route transit ridership forecasting and service planning methods. Transportation Research Board, Washington, D.C.
26. Quade PB (1996) Douglas Inc: transit and urban form. National Academy Press, Washington
27. Cao XJ, Mokhtarian PL, Handy SL (2009) The relationship between the built environment and nonwork travel: a case study of Northern California. Transp Res Part A Policy Pract 43(5):548–559
28. Kim S, Ulfarsson GF, Hennessy JT (2007) Analysis of light rail rider travel behavior: impacts of individual, built environment, and crime characteristics on transit access. Transp Res Part A Policy Pract 41(6):511–522
29. Khattak AJ, Rodriguez D (2005) Travel behavior in neo-traditional neighborhood developments: a case study in USA. Transp Res Part A Policy Pract 39(6):481–500
30. Zemp Stauffacher, Lang Scholz (2011) Classifying railway stations for strategic transport and land use planning: context matters! J Transp Geogr 19(4):670–679
31. Kwoka GJ, Boschmann EE, Goetz AR (2015) The impact of transit station areas on the travel behaviors of workers in Denver, Colorado. Transp Res Part A Policy Pract 80:277–287. https://doi.org/10.1016/j.tra.2015.08.004
32. Canepa B (2007) Bursting the bubble: determining the transit-oriented development's walkable limits. Transp Res Rec J Transp Res Board 1992:28–34
33. Murray AT, Davis R, Stimson RJ, Ferreira L (1998) Public transportation access. Transp Res Part D Transp Environ 3(5):319–328
34. O'Sullivan S, Morrall J (1996) Walking distances to and from light-rail transit stations. Transp Res Rec 1538:19–26
35. Albalate D, Bel G (2010) Tourism and urban public transport: holding demand pressure under supply constraints. Tour Manag 31(3):425–433. https://doi.org/10.1016/j.tourman.2009.04.011
36. Kotler P, Hamlin MA, Rein I, Haider DH (2002) Marketing Asian places: attracting investment, industry, and tourism to cities, states, and nations. Wiley, Hoboken

37. Colomb C (2012) Planning, history and environment: staging the New Berlin: place marketing and the politics of urban reinvention post-1989, vol Book. Taylor and Francis, Milton Park
38. Eshuis J, Braun E, Klijn E-H (2012) Bottlenecks in place marketing and their effects on attracting target groups. Perm Study Group Public Nonprofit Mark 28–43
39. Gertner D (2011) Unfolding and configuring two decades of research and publications on place marketing and place branding. Place Brand Public Dipl 7(2):91–106
40. Gj Hospers (2011) Place marketing in shrinking Europe: some geographical notes. Tijdschrift voor economische en sociale geografie 102(3):369–375
41. Kavaratzis M (2007) City marketing: the past, the present and some unresolved issues. Geogr Compass 1(3):695–712
42. Kotler P, Gertner D (2011) A place marketing and place branding perspective revisited. In: Destination brands: managing place reputation, 3 edn. Elsevier Ltd., pp 33–53
43. Huff DL (1962) Determination of intra-urban retail trade areas. Real Estate Research Program, Graduate Schools of Business Administration, University of California
44. Nevin JR, Houston MJ (1980) Image as a component of attraction to intraurban shopping areas. J Retail 56(1):77–93
45. Wong G, Yu L, Yuan L (2001) SCATTR: an instrument for measuring shopping centre attractiveness. Int J Retail Distrib Manag 29(2):76
46. Wei Khong K, Sim Ong F (2014) Shopper perception and loyalty: a stochastic approach to modelling shopping mall behaviour. Int J Retail Distrib Manag 42(7):626–642. https://doi.org/10.1108/IJRDM-11-2012-0100
47. Arslan TV, Sezer FS, Isigicok E (2010) Magnetism of shopping malls on young Turkish consumers. Young Consum 11(3):178–188. https://doi.org/10.1108/17473611011074250
48. Dahsh M, Dasa P (2014) Shopping mall preferences in easten region: implications for retail strategy. Prestige Int J Manag Res 7/8(2/1):19
49. El-Adly M (2007) Shopping malls attractiveness: a segmentation approach. Int J Retail Distrib Manag 35(11):936–950. https://doi.org/10.1108/09590550710828245
50. Kushwaha T, Ubeja S, Chatterjee AS (2017) Factors influencing selection of shopping malls: an exploratory study of consumer perception. Vis J Bus Perspect 21(3):274–283. https://doi.org/10.1177/0972262917716761
51. Tandon A, Gupta A, Tripathi V (2016) Managing shopping experience through mall attractiveness dimensions: an experience of Indian metro cities. Asia Pac J Mark Logist 28(4):634–649. https://doi.org/10.1108/APJML-08-2015-0127
52. Erkip F (2005) The rise of the shopping mall in Turkey: the use and appeal of a mall in Ankara. Cities 22(2):89–108. https://doi.org/10.1016/j.cities.2004.10.001
53. Ke Q, Wang W (2016) The factors that determine shopping centre rent in Wuhan, China. J Prop Invest Finance 34(2):172–185. https://doi.org/10.1108/JPIF-04-2015-0021
54. Lee S, Yi C, Hong S-P (2013) Urban structural hierarchy and the relationship between the ridership of the Seoul Metropolitan Subway and the land-use pattern of the station areas. Cities 35:69–77. https://doi.org/10.1016/j.cities.2013.06.010
55. Hall DR (1999) Conceptualising tourism transport: inequality and externality issues. J Transp Geogr 7(3):181–188
56. Neuman WL (2011) Social research methods: qualitative and quantitative approaches, 7th edn. Allyn and Bacon, Boston
57. Veal AJ (2006) Research methods for leisure and tourism: a practical guide. Pearson Education, London
58. Jacobs H (2018) Why Dubai has so many malls. Business insider. https://www.businessinsider.com/why-dubai-has-so-many-malls-2018-11. Accessed 13 Mar 2020
59. Portal TUAEG (2020) Abount Dubai. The United Arab Emirates' Government portal. https://u.ae/en/about-the-uae/the-seven-emirates/dubai. Accessed 13 Mar 2020
60. Center DS (2020) Population. Dubai Statistics Center. https://www.dsc.gov.ae/en-us/Pages/default.aspx. Accessed 13 Mar 2020
61. Department DE (2019) Dubai Economic report 2019. Dubai Economic Department
62. Yin RK (1981) The case study crisis: some answers. Adm Sci Q 26(1):58–65
63. Schofield JW (2002) Increasing the generalizability of qualitative research. Qual Res Companion 171–203
64. Yin RK (1994) Case study research: design and methods, 2nd edn. Applied Social Methods Research Series. Thousand Oaks (California): Sage Publications, Inc
65. Flyvbjerg B (2001) Making social science matter: why social inquiry fails and how it can succeed again. Cambridge University Press, Cambridge
66. Thomas R, Bertolini L (2014) Beyond the case study dilemma in urban planning: using a meta-matrix to distil critical success factors in transit-oriented development. Urban Policy Res 32(2):219–237. https://doi.org/10.1080/08111146.2014.882256
67. O'Neill WA, Ramsey RD, Chou J (1992) Analysis of transit service areas using geographic information systems. Transp Res Rec 1364:131–138
68. Zhao F, Chow L-F, Li M-T, Ubaka I, Gan A (2003) Forecasting transit walk accessibility: regression model alternative to buffer method. Transp Res Rec 1835:34–41
69. Kamruzzaman Md, Baker D, Washington S, Turrell G (2016) Determinants of residential dissonance: implications for transit-oriented development in Brisbane. Int J Sustain Transp 10(10):960–974. https://doi.org/10.1080/15568318.2016.1191094
70. Cooper DR (2011) Business research methods. The McGraw-Hill/Irwin series in operations and decision sciences, 11th edn. McGraw-Hill/Irwin, New York
71. Guarte JM, Barrios EB (2006) Estimation under purposive sampling. Commun Stat Simul Comput 35(2):277–284. https://doi.org/10.1080/03610910600591610
72. Lai W-T, Chen C-F (2011) Behavioral intentions of public transit passengers—the roles of service quality, perceived value, satisfaction and involvement. Transp Policy 18(2):318–325
73. Lei PW, Wu Q (2007) Introduction to structural equation modeling: issues and practical considerations. Educ Meas Issues Pract 26(3):33–43
74. Bentler PM (1990) Comparative fit indexes in structural models. Psychol Bull 107(2):238
75. Bentler PM, Bonett DG (1980) Significance tests and goodness of fit in the analysis of covariance structures. Psychol Bull 88(3):588
76. Rabbanee FK, Ramaseshan B, Wu C, Vinden A (2012) Effects of store loyalty on shopping mall loyalty. J Retail Consum Serv 19(3):271–278. https://doi.org/10.1016/j.jretconser.2012.02.001
77. Castillo-Manzano JI, López-Valpuesta L (2009) Urban retail fabric and the metro: a complex relationship. Lessons from middle-sized Spanish cities. Cities 26(3):141–147. https://doi.org/10.1016/j.cities.2009.02.007
78. Rajagopal D (2009) Growing shopping malls and behaviour of urban shoppers. J Retail Leis Prop 8(2):99–118. https://doi.org/10.1057/rlp.2009.3

Appendix

Survey questionnaire

Attractiveness factors of Shopping Malls nearby a Metro Station using Dubai Metro Red line

1. Section A

Please answer the following background questions, (all responses will remain strictly confidential)

* 1. Name of the shopping mall

- ◯ Ibn Battuta Mall
- ◯ Dubai Marina Mall
- ◯ Mall of Emirates
- ◯ Dubai Mall
- ◯ Burjman Shopping Center
- ◯ Al Ghurair Centre
- ◯ Deira City Centre
- ◯ None of the above

* 2. Date of the visit

DD/MM/YYYY

DD/MM/YYYY

* 3. Name of the Metro station used after visiting the mall

- ◯ Ibn Battuta Mall station
- ◯ Damac station
- ◯ Mall of Emirates station
- ◯ Dubai Mall station
- ◯ Burjman Shopping Center station
- ◯ Union station
- ◯ Deira City Centre station
- ◯ None of the above

* 4. Time when receiving the survey

HH:MM AM/PM

hh mm -

* 5. Gender

* 6. Nationality

* 7. Age group (Years)

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 or more

* 8. Time spent in the mall (Hours)

- Less than 1
- 1-2
- 3-4
- 5-6
- 7 or more

* 9. Visitor to UAE

- Yes
- No

* 10. Resident of Dubai

- Yes
- No

* 11. What is the highest level of education you have attained?

- Less than high school degree
- High school degree or equivalent
- Some college but no degree
- Associate degree or Diploma
- Bachelor degree
- Post-graduate degree

2. Section B

Please put (x) in the appropriate box to classify your answers, (all responses will remain strictly confidential).

* 12. How did you get to the metro station where you started the origin of your journey

- ◯ Walking
- ◯ Car
- ◯ Taxi
- ◯ Other (please specify)
- ◯ Tram
- ◯ Bus

* 13. For you, what is the comfortable walking distance between a mall and a nearby metro station?

- ◯ 0-300 meters walk
- ◯ 300-500 meters walk
- ◯ More than 1000 meters walk (please specify)
- ◯ 500-750 meters walk
- ◯ 750-1000 meters walk

* 14. What was the main reason for visiting the shopping mall today?

- ◯ Working in the shopping mall
- ◯ Entertainment
- ◯ Shopping
- ◯ Eating/food
- ◯ Other (please specify)

* 15. Typical number of visits to this shopping mall per week

- ◯ Less than once a week
- ◯ Twice a week
- ◯ Once a week
- ◯ Three times a week or more (please specify)

* 16. Number of times you typically use the metro in the visits to this shopping mall per week

- ◯ Less than once a week
- ◯ Twice a week
- ◯ Once a week
- ◯ Three times a week or more (please specify)

* 17. Time spent in this shopping mall per visit on average

- ◯ Less than one hour
- ◯ Two hours - less than 3 hours
- ◯ One hour – less than 2 hours
- ◯ Three hours or more (please specify)

* 18. Typical days of visiting this shopping mall

- ◯ Week days (Sunday to Thursday
- ◯ Weekend (Friday & Saturday)
- ◯ Any day of the week

3. Section C

Choose the appropriate circle to indicate the importance of the following shopping mall characteristics impacting your choice to visit the mall nearby this metro station, please.

* 19. Grocery store present (e.g. Carrefour)

Not important at all | Not important | Neutral | Important | Very important

* 20. Cinema present

Not important at all | Not important | Neutral | Important | Very important

* 21. A variety in product quality present

Not important at all | Not important | Neutral | Important | Very important

* 22. Presence of fun and entertainment activities in the mall (e.g. gaming arcade)

Not important at all | Not important | Neutral | Important | Very important

* 23. Prices are appropriate to my income

Not important at all | Not important | Neutral | Important | Very important

* 24. Prices offer value for money

Not important at all | Not important | Neutral | Important | Very important

* 25. Overall price level in the mall

Not important at all | Not important | Neutral | Important | Very important

* 26. Comparatively low prices

Not important at all | Not important | Neutral | Important | Very important

* 27. Size of the mall

Not important at all | Not important | Neutral | Important | Very important

* 28. Average size of shops

Not important at all | Not important | Neutral | Important | Very important

* 29. Number of shops

Not important at all | Not important | Neutral | Important | Very important

* 30. Convenient facilities and amenities

Not important at all | Not important | Neutral | Important | Very important

* 31. Promotional campaigns in the mall

Not important at all | Not important | Neutral | Important | Very important

* 32. Organising events in the mall (e.g. shows)

Not important at all | Not important | Neutral | Important | Very important

* 33. Loyalty programs

Not important at all | Not important | Neutral | Important | Very important

* 34. Mall image and publicity (e.g. Dubai mall)

Not important at all | Not important | Neutral | Important | Very important

* 35. Staff friendliness and helpfulness

Not important at all | Not important | Neutral | Important | Very important

* 36. Staff knowledge and training

Not important at all Not important Neutral Important Very important

* 37. Availability of customer service

Not important at all Not important Neutral Important Very important

* 38. Staff extended working hours (e.g. staff working during pubic holiday and weekends)

Not important at all Not important Neutral Important Very important

* 39. Lack of crowdedness in the mall

Not important at all Not important Neutral Important Very important

* 40. Modern mall internal decoration

Not important at all Not important Neutral Important Very important

* 41. Comfortable controlled temperature

Not important at all Not important Neutral Important Very important

* 42. Atmosphere in the mall (e.g. music and lighting)

Not important at all Not important Neutral Important Very important

* 43. Ease of reaching the mall (e.g. directions)

Not important at all Not important Neutral Important Very important

* 44. Ease of finding a desired store inside the mall (e.g. Virgin store)

Not important at all Not important Neutral Important Very important

* 45. Ease of finding a desired product inside the mall (e.g. iPhone mobiles)

Not important at all Not important Neutral Important Very important

* 46. Freedom in the mall (e.g. no dress restriction)

◯ Not important at all ◯ Not important ◯ Neutral ◯ Important ◯ Very important

4. Section D

Choose the appropriate circle to indicate the importance of the following shopping mall neighbourhood characteristics impacting your choice to visit the mall nearby this metro station, please.

* 47. Crowdedness and compactness of buildings around the mall

Not important at all | Not important | Neutral | Important | Very important

* 48. Total population in the neighborhood around the shopping mall

Not important at all | Not important | Neutral | Important | Very important

* 49. Car traffic congestion around the shopping mall

Not important at all | Not important | Neutral | Important | Very important

* 50. High number of shops surrounding the shopping mall

Not important at all | Not important | Neutral | Important | Very important

* 51. The need for mixed residential and commercial buildings around the shopping mall

Not important at all | Not important | Neutral | Important | Very important

* 52. Availability of scenic and recreational areas around the mall (e.g. water fountain)

Not important at all | Not important | Neutral | Important | Very important

* 53. Availability of community services area around the shopping mall (e.g. government services)

Not important at all | Not important | Neutral | Important | Very important

* 54. Economic diversity in the neighborhood around the shopping mall (e.g. High, , low income families)

Not important at all | Not important | Neutral | Important | Very important

* 55. Availability of safe and air-conditioned walkways around the mall

Not important at all | Not important | Neutral | Important | Very important

* 56. Availability of cycling lanes around the mall

Not important at all | Not important | Neutral | Important | Very important

* 57. Availability of parking facilities

Not important at all | Not important | Neutral | Important | Very important

* 58. Availability of clear signage around the mall

Not important at all | Not important | Neutral | Important | Very important

* 59. Availability of walking access around the mall (e.g. pedestrian crossings, bridges and tunnels)

Not important at all | Not important | Neutral | Important | Very important

* 60. Access to facilities and amenities around the shopping mall (e.g. hospitals)

Not important at all | Not important | Neutral | Important | Very important

* 61. Access to downtown /or city center

Not important at all | Not important | Neutral | Important | Very important

* 62. Access to different transport mode options (e.g. Multimodality)

Not important at all | Not important | Neutral | Important | Very important

* 63. Proximity of shops in the area around the mall

Not important at all | Not important | Neutral | Important | Very important

* 64. Proximity of a metro station

Not important at all | Not important | Neutral | Important | Very important

* 65. Proximity of intercity public transport

Not important at all | Not important | Neutral | Important | Very important

* 66. Proximity of other modes of transport

Not important at all | Not important | Neutral | Important | Very important

5. Section E

Choose the appropriate circle that indicates your level of agreement to the following statements measuring shopper passengers' POTENTIAL USE OF THE METRO STATION nearby the shopping mall.

* 67. I intend to use the metro station close to the mall because; the station is at walkable distance from the mall

◯ Strongly disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly agree

* 68. I intend to use the metro station close to the mall because; there is car traffic congestion in the area of the mall

◯ Strongly disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly agree

* 69. I intend to use the metro station close to the mall because; there is lack of enough car parking spaces in the area of the mall

◯ Strongly disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly agree

* 70. I intend to use the metro station close to the mall because; there is walking access from the station to the mall

◯ Strongly disagree ◯ Disagree ◯ Neutral ◯ Agree ◯ Strongly agree

6. Section F

Please use the following blank space to

71. Make any additional comments about this survey to make it more valuable in measuring the attractiveness factors of the shopping mall nearby the Metro station.

72. Receive a copy of the survey results, please write your email address in the following box.

Email Address

5.3 Relationships between TOSMD attractiveness factors and contextual factors impacting ridership of shopper passengers (resident and tourist)

Although the literature indicates that there is a relationship between railway stations and their context, the extent to which the attributes of the attractiveness impact nearby transit station ridership is not clear. This section evaluates correlations and significant direct and mediating effect (through contextual factors) of TOSMD attractiveness factors impacting shopper passenger's ridership using a nearby station.

Guided by the conceptual framework for TOSMD attractiveness factors, a correlational structural equation model (SEM) was established to consolidate relationships between the significant attractiveness factors and the contextual factors of TOSMDs impacting ridership of shopper passengers (resident and tourist) for Dubai Metro Redline stations near TOSMDs.

Similar to Lai and Chen (2011), the SEM was designed and examined by utilising the maximum-likelihood-estimation procedure on the data collected and used in the study of the direct impact of TOSMD attractiveness factors impacting shopper passengers ridership using a nearby station that yielded 700 usable questionnaires (refer to section 5.2). Table 5.1 presents the relationship model with the independent variables (product, price, place, people, promotion, density, and distance) contributing toward the dependent variable (shopper passengers ridership including residents and tourist), in the presence of the mediating contextual factors (location context, space context, and stores context). The table is also presented graphically in Appendices 1, 2 and 3. The SEM was considered to be reasonably fit (Lei & Wu, 2007; Rabbanee et al., 2012): Chi-Square= 70 (p=0.00), degrees of freedom (df)= 65, the Goodness-of-Fit Index (GFI)= 0.99, the Adjusted Goodness of Fit Index (AGFI)= 0.97, the Comparative Fit Index (CFI)= 0.99, the Normed Fit Index (NFI)=0.99, and the Root Mean Square Residual (RMR)=0.01.

Table 5.1 Standardised regression weights of TOSMD attractiveness factors impacting ridership of shopper passengers (resident and tourist)

			All Shopper Passengers				**Resident Shopper Passengers**				**Tourist Shopper Passengers**			
			Estimate	S.E.	C.R.	P	Estimate	S.E.	C.R.	P	Estimate	S.E.	C.R.	P
Shopper Passenger Ridership	<--	Product	0.033	0.037	1.279	0.201	0.034	0.037	1.279	0.201	0.031	0.037	1.279	0.201
Shopper Passenger Ridership	<--	Price	0.073	0.036	2.802	0.005	0.076	0.036	2.802	0.005	0.072	0.036	2.802	0.005
Shopper Passenger Ridership	<--	Place	0.317	0.109	4.179	***	0.313	0.109	4.179	***	0.339	0.109	4.179	***
Shopper Passenger Ridership	<--	Promotion	-0.322	0.039	-12.805	***	-0.340	0.039	-12.805	***	-0.304	0.039	-12.805	***
Shopper Passenger Ridership	<--	People	0.078	0.043	3.048	0.002	0.080	0.043	3.048	0.002	0.078	0.043	3.048	0.002
Shopper Passenger Ridership	<--	Density	-0.076	0.042	-1.584	0.113	-0.079	0.042	-1.584	0.113	-0.073	0.042	-1.584	0.113
Shopper Passenger Ridership	<--	Distance	0.010	0.008	1.112	0.266	0.010	0.008	1.112	0.266	0.010	0.008	1.112	0.266
Shopper Passenger Ridership	<--	Location context	0.191	0.051	6.372	***	0.197	0.051	6.372	***	0.188	0.051	6.372	***
Shopper Passenger Ridership	<--	Stores context	0.225	0.052	4.891	***	0.238	0.052	4.891	***	0.210	0.052	4.891	***
Shopper Passenger Ridership	<--	Space context	-0.157	0.115	-2.061	0.039	-0.155	0.115	-2.061	0.039	-0.168	0.115	-2.061	0.039
*** Highly significant ($p < 0.001$); * Significant ($p < 0.05$); Not significant ($p > 0.05$).			(n=700) R^2=0.23				(n=481) R^2=0.26				(n=219) R^2=0.19			

Table 5.1 shows price, place, promotion, people, location context, stores context and space context to be significantly impacting shopper passenger ridership at Metro stations near a TOSMD.

A bootstrap approach was then utilised to compare correlations and significant direct and mediating effect of TOSMD attractiveness factors impacting resident and tourist shopper passenger ridership in absence of (location, stores, space) contextual factors as shown in tables 5.2, 5.3 and 5.4 respectively. In this approach, bootstrapping is used to build two models: first without the presence of mediating effects (existence of the mediating contextual factors), and secondly, with the presence of mediating effects (Aimran et al., 2016). In the absence of the contextual factors of attractiveness, the density factor significantly impacted the ridership of all shopper passengers. In addition, both density and distance factors significantly impacted resident shopper passenger (RSP) ridership (as discussed in Journal Article 3). However, in the presence of the contextual attractiveness factors, density and distance did not significantly

impact the ridership of shopper passengers (refer to Table 5.1). Similarly, in the absence of the contextual factors of attractiveness, the product factor significantly impacted tourist shopper passenger (TSP) ridership (Journal Article 3). However, in the presence of the contextual factors of attractiveness, it did not significantly impact TSP ridership (refer to Table 5.1).

Therefore, the impact of attractiveness factors on shopper passenger ridership at stations near TOSMDs was mediated by the contextual factors of TOSMD attractiveness. Hence, the conceptual framework for TOSMD attractiveness factors (refer to Journal Article 1) was empirically supported.

Contextual factors include the location context, stores context and space context (refer to Journal Article 2). Below is the mediating effect of each of these contextual factors of TOSMD attractiveness:

1. Location context mediating effect

The location context direct and mediating effect is presented in Table 5.2.

Table 5.2 Standardised direct and mediating effects through location context, and significance of TOSMD attractiveness factors impacting on shopper passenger ridership (RSPs and TSPs) for Dubai Metro Redline stations near TOSMDs – two-tailed significance (BC)

Relationship		Direct effect			Mediating effect through **location context**			Results		
		All	RSPs	TSPs	All	RSPs	TSPs	All	RSPs	TSPs
Shopper <--- Pass. ridership	Product	0.033 (NS)	0.034 (NS)	0.031 (NS)	0.012 (*)	0.012 (*)	0.011 (*)	Full mediation	Full mediation	Full mediation
Shopper <--- Pass. ridership	Price	0.073 (*)	0.076 (*)	0.072 (*)	0.039 (***)	0.040 (***)	0.038 (***)	Partial mediation	Partial mediation	Partial mediation
Shopper <--- Pass. ridership	Place	0.317 (***)	0.313 (***)	0.339 (*)	0.017 (*)	0.017 (*)	0.018 (*)	Partial mediation	Partial mediation	Partial mediation
Shopper <--- Pass. ridership	Promotion	-0.322 (***)	-0.340 (***)	-0.304 (***)	-0.006 (NS)	-0.006 (NS)	-0.006 (NS)			
Shopper <--- Pass. ridership	People	0.078 (*)	0.080 (*)	0.078 (*)	0.034 (*)	0.035 (***)	0.034 (*)	Partial mediation	Partial mediation	Partial mediation
Shopper <--- Pass. ridership	Density	-0.076 (NS)	-0.079 (NS)	-0.073 (NS)	-0.044 (NS)	-0.045 (NS)	-0.042 (NS)			
Shopper <--- Pass. ridership	Distance	0.010 (NS)	0.010 (NS)	0.010 (NS)	0.075 (***)	0.076 (***)	0.076 (***)	Full mediation	Full mediation	Full mediation
Shopper <--- Pass. ridership	Location context	0.191 (***)	0.197 (***)	0.188 (***)						
Shopper <--- Pass. ridership	Store context	0.225 (***)	0.238 (***)	0.210 (***)						
Shopper <--- Pass. ridership	Space context	-0.157 (*)	-0.155 (*)	-0.168 (*)						

*** Highly significant ($p < 0.001$); * Significant ($p < 0.05$); Not significant ($p > 0.05$).

Table 5.2 shows that the location context fully mediates the impact of the product and distance attractiveness factors on the ridership of shopper passengers (both RSPs and TSPs). This

outcome would indicate that shopper passengers are very aware of the location of the shopping mall from the metro station and the distance and access are important for regular shopping.

Furthermore, the location context partially mediates the impact of the price, place, people attractiveness factors on the ridership of all shopper passengers. Again, this outcome indicates that both resident and tourist shopper passengers are much more aware of the location context of the shopping mall in relationship to the metro station and will make travel decisions that consider both the internal factors and external factors. However, tourist passengers are perhaps less aware of the locational context, particularly its people, but location context is still a consideration in their decision making.

Therefore, although internal shopping mall and external TOD characteristics might be attractive, the location context can mediate their effect on shopper passenger ridership at a transit station near a TOSMD. Additionally, this mediating effect can vary between resident and tourist shopper passengers.

2. Stores context mediating effect

The stores context direct and mediating effect is presented in Table 5.3.

Table 5.3 Standardised direct and mediating effects through stores context, and significance of TOSMD attractiveness factors impacting shopper passenger ridership (RSP and TSP) for Dubai Metro Redline stations near TOSMDs – two-tailed significance (BC)

Relationship		Direct effect			Mediating effect through **stores context**			Results		
		All	RSPs	TSPs	All	RSPs	TSPs	All	RSPs	TSPs
Shopper Pass. ridership <---	Product	0.033 (NS)	0.034 (NS)	0.031 (NS)	-0.006 (NS)	-0.006 (NS)	-0.005 (NS)			
Shopper Pass. ridership <---	Price	0.073 (*)	0.076 (*)	0.072 (*)						
Shopper Pass. ridership <---	Place	0.317 (***)	0.313 (***)	0.339 (*)						
Shopper Pass. ridership <---	Promotion	-0.322 (***)	-0.340 (***)	-0.304 (***)	-0.005 (NS)	-0.005 (NS)	-0.004 (NS)			
Shopper Pass. ridership <---	People	0.078 (*)	0.080 (*)	0.078 (*)	0.011 (*)	0.011 (*)	0.011 (*)	Partial mediation	Partial mediation	Partial mediation
Shopper Pass. ridership <---	Density	-0.076 (NS)	-0.079 (NS)	-0.073 (NS)	0.189 (***)	0.198 (***)	0.182 (***)	Full mediation	Full mediation	Full mediation
Shopper Pass. ridership <---	Distance	0.010 (NS)	0.010 (NS)	0.010 (NS)	0.021 (***)	0.021 (***)	0.022 (***)	Full mediation	Full mediation	Full mediation
Shopper Pass. ridership <---	Location context	0.191 (***)	0.197 (***)	0.188 (***)						
Shopper Pass. ridership <---	Stores context	0.225 (***)	0.238 (***)	0.210 (***)						
Shopper Pass. ridership <---	Space context	-0.157 (*)	-0.155 (*)	-0.168 (*)						

*** Highly significant ($p < 0.001$); * Significant ($p < 0.05$); Not significant ($p > 0.05$).

Table 5.3 shows that the stores context fully mediates the impact of density and distance attractiveness factors on the ridership of all shopper passengers (RSPs and TSPs).

Also, the stores context partially mediates the impact of the people attractiveness factor on the ridership of all shopper passengers (RSPs and TSPs). However, tourist passengers are perhaps less aware of the stores context, particularly its people, but stores context is still a consideration in their decision making.

Therefore, although internal shopping mall and external TOD characteristics may be attractive, the stores context can mediate the effect on shopper passenger ridership at a transit station near a TOSMD. This mediating effect can vary between resident and tourist shopper passengers.

3. Space context mediating effect

The space context direct and mediating effect is presented in Table 5.4.

Table 5.4 Standardised direct and mediating effect through space context, and significance of TOSMD attractiveness factors impacting shopper passenger ridership (RSP and TSP) for Dubai Metro Redline stations near TOSMDs – two-tailed significance (BC)

Relationship		Direct effect			Mediating effect through **space context**			Results		
		All	RSPs	TSPs	All	RSPs	TSPs	All	RSPs	TSPs
Shopper <--- Pass. ridership	Product	0.033 (NS)	0.034 (NS)	0.031 (NS)	-0.001 (NS)	-0.002 (NS)	-0.001 (NS)	No effect	No effect	No effect
Shopper <--- Pass. ridership	Price	0.073 (*)	0.076 (*)	0.072 (*)	-0.010 (NS)	-0.010 (NS)	-0.010 (NS)	No mediation	No mediation	No mediation
Shopper <--- Pass. ridership	Place	0.317 (***)	0.313 (***)	0.339 (*)	-0.148 (NS)	-0.146 (NS)	-0.159 (NS)	No mediation	No mediation	No mediation
Shopper <--- Pass. ridership	Promotion	-0.322 (***)	-0.340 (***)	-0.304 (***)	0.000 (NS)	0.001 (NS)	0.001 (NS)	No mediation	No mediation	No mediation
Shopper <--- Pass. ridership	People	0.078 (*)	0.080 (*)	0.078 (*)	0.002 (NS)	0.002 (NS)	0.002 (NS)	No mediation	No mediation	No mediation
Shopper <--- Pass. ridership	Density	-0.076 (NS)	-0.079 (NS)	-0.073 (NS)	0.001 (NS)	0.001 (NS)	0.001 (NS)	No effect	No effect	No effect
Shopper <--- Pass. ridership	Distance	0.010 (NS)	0.010 (NS)	0.010 (NS)	-0.017 (NS)	-0.017 (NS)	-0.017 (NS)	No effect	No effect	No effect
Shopper <--- Pass. ridership	Location context	0.191 (***)	0.197 (***)	0.188 (***)						
Shopper <--- Pass. ridership	Stores context	0.225 (***)	0.238 (***)	0.210 (***)						
Shopper <--- Pass. ridership	Space context	-0.157 (*)	-0.155 (*)	-0.168 (*)						

*** Highly significant ($p < 0.001$); * Significant ($p < 0.05$); Not significant ($p > 0.05$).

Table 5.4 results show that the space context has no mediating effect on any of the attractiveness factors for the ridership of shopper passengers (RSP and TSP). Although there is no mediating effect in the case of the Dubai Metro Redline, it was highlighted earlier that the TOSMD attractiveness could vary from one context to another.

Therefore, although the space context did mediate the impact of the internal shopping mall and external TOD characteristics in the case of the Dubai Metro Redline, the space context can mediate the effect in other contexts. Additionally, the mediating effect can vary between resident and tourist shopper passengers, similar to the findings from the contextual factors discussed earlier.

The following chapter provides further discussion of the impact of attractiveness factors on the ridership of shopper passengers at stations near TOSMDs.

Chapter 6 Discussion

By design, TOD invites a community to use nearby transit stations to improve their travel and accessibility experience. Studies on shopping malls reveal variability in attractiveness factors and impact on mall patronage. However, the literature review showed that the majority of TOD studies focus solely on assessing TOD impact on transit ridership with no mention of the reverse impact of the specific mall characteristics on the forecasting models of the ridership at nearby transit stations (De Juan, 2004; Mundell, 2013; Telci, 2013; Thang and Tan, 2003).

Furthermore, less attention has been given to tourist ridership within a tourist destination (Albalate and Bel, 2010). As a result, passenger forecasting models (PFMs) tend to ignore tourist passenger ridership numbers.

As TOD can cause an increased likelihood of transit ridership (Singh et al., 2017a), understanding the impact of attractiveness factors on nearby station ridership was considered crucial to understanding how a transit station can continue to offer accessibility to shopper passengers arriving from a nearby TOSMD. Hence, an improvement to the existing transit station forecasting models is needed to capture the impact of attractiveness factors (independent factors) motivating shopper passenger ridership, both resident and tourist (dependent factor) at stations near TOSMDs.

As a result, the aim of this research was to improve the accuracy and comprehensiveness of the existing PFMs used to forecast transit station ridership. The improvement was to inform and potentially enhance PFMs at transit stations near TOSMDs, to optimise TOD planning practice and increase the economic benefits for transit networks. This aim has been achieved by 1) establishing a conceptual framework to understand TOSMD attractiveness factors impacting shopper passenger ridership, 2) identifying critical contextual factors of TOSMDs, clarifying their impact on the ridership preferences of shopper passengers (resident and tourist), and 3) showing the correlations and significant TOSMD attractiveness factors impacting shopper passenger ridership (as discussed below).

6.1 Conceptual framework for TOSMD attractiveness factors

The literature review showed that the majority of researchers distinguish between the attractiveness factors of shopping malls (internal factors) and design factors of TOD (external

factors). These two categories of factors have been studied separately in the retail and urban planning literature, respectively.

On the one hand, studies on the attractiveness of shopping malls focus on shopping mall internal characteristics. These studies indicate that different mall attractiveness factors are leading to variable patronage at malls. However, the effect of shopping mall attractiveness factors has not been considered in relation to ridership at nearby transit stations. On the other hand, different TOD factors reflecting the surrounding context of a particular TOSMD can impact its attractiveness and the number of shopper passengers using its nearby rail transit station.

Therefore, the research provides a conceptual framework to identify and clarify the "pull" or attractiveness factors of the TOSMD context impacting the flow of shopper passengers boarding at stations near TOSMDs (refer to Journal Article 1). The conceptual framework presents the relationships between shopping malls' attractiveness factors (internal factors) and TOD design factors (external factors), and their impact on the attractiveness of TOSMDs. It proposes that these relationships impact the ridership of shopper passengers using a transit station near a TOSMD.

The established conceptual framework combines the literature-identified factors of shopping mall attractiveness and TOD design, using the generic extended service marketing mix (Rafiq and Ahmed, 1995) and the 5Ds of TOD (Cervero and Murakami, 2008).

Therefore, both urban planners and mall managers can utilise the conceptual framework to improve their understanding of socio-spatial dynamics (Erkip, 2005), identify the optimal mix of activities in shopping malls (Dahsh and Dasa, 2014; El-Adly, 2007; Kushwaha et al., 2017; Tandon et al., 2016) and understand TOSMDs' likely impact on mall patronage and shopper passenger ridership at stations near TOSMDs. Hence, the research is considered useful for cities with large numbers of shopping malls as well as cities growing their mall developments and connecting them with nearby rail transit stations.

The conceptual framework was operationalised to achieve the main research objective to explain the correlations and significant TOSMD attractiveness factors impacting shopper passenger ridership in the case of the Dubai Metro Redline. Consequently, critical data were collected at various levels, including data about the TOSMD, the relevant transportation authority, and the shopper passengers coming from the TOSMD to the nearby transit station.

The established conceptual framework provides additional parameters related to TOSMD attractiveness factors that need to be considered as a foundation for informing, and potentially enhancing, PFMs for rail transit stations so that a station can continue to offer accessibility to shopper passengers arriving from its nearby TOSMD despite increasing ridership.

The following section discusses the empirical application of the established conceptual framework in the case of the Dubai Metro Redline to identify and clarify critical contextual factors of TOSMDs impacting shopper passenger ridership.

6.2 Contextual factors of TOSMD attractiveness

A context refers to the layout and configuration of an urban form; including blocks, parcels, buildings, street networks, pedestrian-oriented attributes, and property land uses (Lee, 2013). Contextual factors refer to the context of TOSMD attractiveness; measured by both shopping mall attractiveness and TOD factors.

To study the contextual factors of TOSMD attractiveness on ridership at nearby transit stations, the Dubai Metro Redline was purposively selected based on the location of its stations. Seven of its stations include urban designed walkways which connect a mall and a nearby Metro station. In addition, station level ridership data was available. The ridership data showed high percentages of passengers boarding at Dubai Metro Redline stations near TOSMDs. Also, an indicative ratio of ridership distribution between residents and tourists was available based on the Dubai RTA's recent customer satisfaction survey of 801 passengers in 2016 (RTA-Dubai, 2016). This distribution ratio was a guide to surveying a representative sample of resident and tourist shopper passengers in the research.

Guided by the established conceptual framework for TOSMD attractiveness factors, 400 shopper passengers (individuals) boarding at seven Metro stations near TOSMDs were surveyed to investigate how the contextual attractiveness factors (location context, space context, and stores context) correlate with shopper passenger preferences to board at a nearby transit station (refer to Journal Article 2). For the data used in the article, the Kaiser-Meyer-Olkin (KMO) value of 0.70 was considered appropriate for the sampling size and the Bartlett's test of sphericity (approx. chi-square = 1544.68, df = 66, p = 000) indicated that there were correlations in the data set that were appropriate for the factor analysis and the statistically fit SEM as shown the article.

In line with urban planning understanding, there is an interrelationship between a transit station and its context (Castillo-Manzano and López-Valpuesta, 2009; Zemp et al., 2011). Similarly, the survey outcome in journal article 2 indicated a significant relationship between the contextual factors of attractiveness and the ridership of shopper passengers represented by a preference for using nearby transit stations.

In 2010, Loo et al. (2010) indicated that there was a shift in the study of TOD to examine the issue of causality between the built environment (such as TOSMDs) and travel behaviour. In regard to the contextual factor of space, shopper passengers showed a preference for the location context (in the form of ease of reaching the mall, ease of finding a desired store inside the mall, and proximity of other modes of transport), and the stores context (in the form of crowdedness and compactness of buildings around the mall, car traffic congestion around the mall, and the high number of shops surrounding the mall). In line with the findings of Mejia and Eppli (1999), shopper passengers did not show a significant preference for the size of the mall, the size of the mall shops, and the number of shops in the mall as represented by the space contextual factor.

As the studied shopping malls connected or adjacent (within approximately 0.8 km radius) to a metro station, shopper passengers were willing to use the Metro station near a TOSMD where: 1) the distance between the mall and the station is walkable, 2) there are directional signs inside the mall and between the mall and its nearby station, 3) there is car traffic congestion in the area of the mall, 4) there is insufficient car parking in the mall area, and 5) there is a high number of retail and service facilities surrounding the mall. Larsen et al. (2015) indicated that sales in the small specialty stores category could be larger when the stores are located near a bigger store selling the same merchandise. Arslan et al. (2010) identified five shopping mall attractiveness factors, including the retail environment, comfort conditions, socialising in a secure environment, accessibility, and leisure. These factors are in line with the research outcome explaining shopper passenger preference for a particular shopping mall context.

Peng et al. (2017) found that a TOD investment can cause population density increases at the TOD zones and a more compact city form. This finding supports the outcome of the research showing the importance of considering the location context and the stores context when it comes to understanding shopper passenger ridership and developing a PFM for a station near a TOSMD. Therefore, a station near a convenient TOSMD, with convenient walkways (Kamruzzaman et al., 2014), and which is crowded (Pacheco-Raguz, 2010), compact

(Jacobson and Forsyth, 2008) and has high number of shops surrounding it (Anselmsson, 2006), is likely to attract a high flow of shopper passengers (Taehyun et al., 2016).

However, such a context is likely to have high car traffic congestion in the mall area (Kok, 2007), particularly when there is a lack of car parking spaces (as part of the TOD design) to stimulate less car usage (Bernick and Cervero, 1997; Cervero, 2004). As a result, urban transit planners need to consider that such a context can increase the flow of shopper passengers into the station near the TOSMD (Abutaleb et al., 2019). This situation will continue until the location and stores contexts become less attractive to shopper passengers, mainly because of the lack of convenience and crowdedness at the walkway inside and around the mall to the stations. In this situation, shopper passengers may no longer prefer to visit the shopping mall or use its nearby station.

This relationship between a TOSMD and its nearby transit station (the node) must be considered when designing a transit station and supporting other modes of transport in the area. The station design should consider the contextual factors to create a balance between the station's future ridership growth and the area inside and around the station, including the walkways to the TOSMD. In an interview conducted by Olaru et al. (2011), the perception of the opportunities offered by TOD was summarised by a 64-year-old interviewee as simply ''This is where I like to live: Max [a Golden Retriever] is happy, we go to the reserve [Blue Gum] each morning, I stop at DeNada [the café] to have a skinny latte and read the newspaper, the neighbours are nice, the shops are pretty good. And, the train is fantastic, but they shouldn't have taken the bus ... plus there is not enough parking but thank God I can still walk up there. It's good, maybe a shop would be nice at the train or something to jazz it up a bit'' (Olaru et al., 2011).

So, considering contextual factors of TOSMD attractiveness factors can provide improved inputs for PFMs at stations near TOSMDs. Consequently, it can assist in forecasting transit network sustainability, support the consideration of alternative modes of transport, and optimise the TOD design application in the area of the TOSMD.

Yap and Goh (2017) and Kamruzzaman et al. (2014) indicated that the "one-size fits all" approach to TOD does not seem to be supported. As a result, urban transit planners need to consider all contextual factors of TOSMD attractiveness (location context, stores context, and space context) in the PFM for optimal TOD effectiveness and better urban transit planning. Furthermore, mall designers may also utilise this outcome in designing malls that are

contextually attractive, specifically connected to convenient transit stations with directional signs inside and around the mall, and other modes of transport available for the mall's patrons.

The next section discusses attractiveness factors on shopper passenger ridership in further detail.

6.3 Impact of TOSMD attractiveness factors on resident and tourist shopper passenger ridership

TOSMD attractiveness factors comprise internal shopping mall attractiveness factors and external TOD factors (refer to Journal Article 1). Using the extended service marketing mix, internal shopping mall attractiveness factors include product, price, place, promotion, people, physical evidence and process. External TOD factors include density, diversity, urban design, destination accessibility, and distance (the 5Ds of TODs).

For the purpose of this research, the conceptual framework of TOSMD attractiveness factors was used as a basis to investigate the shopper passenger ridership impact of the attractiveness factors. To obtain a valid statistical result, the research sample size was increased from 400 to 700 shopper passengers surveyed at seven Dubai Metro Redline stations near TOSMDs (refer to Article 3). For the data used in the article, the Kaiser-Meyer-Olkin (KMO) value of 0.78 was considered appropriate for the sampling size and the Bartlett's test of sphericity (approx. chi-square = 13593.55, df = 741, p = 000) indicated that there were correlations in the data set that were appropriate for the factor analysis and the statistically fit SEM as shown the article.

The survey results in journal article 3 empirically demonstrate the validity of the conceptual framework of attractiveness factors impacting shopper passenger ridership at stations near TOSMDs. It identified seven of the above twelve (internal and external) attractiveness factors (product, price, place, people, promotion, density and distance) to be correlated and significantly associated with shopper passenger ridership in the case of the Dubai Metro Redline. The remaining five attractiveness factors (including physical evidence, diversity, urban design, and destination accessibility) did not show significant association with shopper passenger ridership. Furthermore, the results show differences in the scoring of attractiveness factors between RSPs and TSPs.

Both resident and tourist shopper passengers showed a preference for malls with cheap prices and comparatively low prices. Rajagopal (2010) and Anselmsson (2006) indicated that

malls with a price advantage are attractive to shoppers. Hence, a mall such as Deira city centre with its comparatively low prices that match the profile of residents of the surrounding old Deira area attracts a high ridership of shopper passengers (both resident and tourist) at its nearby transit station (refer to Journal Article 3). Pacheco-Raguz (2010) indicated that the socio-economic status of the neighbourhood impacts land use diversity. Hence, low prices in a mall can initially be attractive to low income residents from its surrounding neighbourhood; however, it can also become attractive to tourists as a destination to visit and, therefore, creates a flow of both resident and tourist shopper passengers using the nearby station.

The result suggests that urban transit planners should consider the demography of both resident and tourist shopper passengers when studying attractiveness factors to inform the PFM for stations near TOSMDs. Similarly, both resident and tourist shopper passengers showed a preference for malls with higher shop density surrounding the shopping mall. This context matches the place marketing of Dubai City as it is trying to promote itself as a shopping hub. However, it should be noted that attractiveness factors could change from one context to another. Therefore, shops everywhere might not fit every TOD context. In fact, TOD showed that TOSMDs tend to move to mixed-use development to remain attractive. Furthermore, as part of the TOD design, ridership; in the form of shopper passengers preferring to use a station nearby the TOSMD; is likely to be impacted. Hence, TOSMD attractiveness is reported to be a modifying input for consideration to improve the accuracy of future PFMs at a station level.

From the consumer point of view, the benefits of choosing a consolidated group of services to satisfy their shopping needs can minimise time and effort in a multi-purpose shopping and entertainment trip, i.e. the surrounding retail and service facilities (Teller, 2008; Teller and Reutterer, 2008). Hence, the Burjman Metro station attracts high ridership for the shops, banks, and offices in the surrounding of Burjman Shopping Centre. Although the high ridership at Burjman Station and Union Station could also be attributed to these two stations being interchanges between the Redline and Greenline, this research did not discuss the inter-node (station) relationship impact (Huang et al., 2018) as it was limited to the inflow of shopper passengers from a shopping mall to a nearby transit station rather than the outflow of passenger shoppers from the station to a nearby shopping mall (refer to Journal Article 2).

González-Hernández and Orozco-Gómez (2012) indicated that mall popularity and promotion programs are the first attractiveness attributes among shopper segments. However, in the Dubai Metro Redline case, both resident and tourist shopper passengers showed a negative association with promotional campaigns and organised events held at TOSMDs. For

example, some shoppers may prefer to avoid Dubai mall crowding on New Year's Eve when there is a fireworks event. This finding is different to that of other researchers, such as Singh and Sahay (2012) and Tandon et al. (2016), who suggest that seasonality and timing (Doi and Allen, 1986; Rantanen et al., 2018) may cause a change in shopper passengers' preferences towards TOSMDs. For example, shopper passengers showed a preference for weekends compared to business days. Also, Dubai' hot weather can cause a particular peak in ridership during specific months of the year, i.e. winter period. According to Kashfi et al. (2016), seasonality and weather can cause different ridership levels and therefore, different TOSMD attractiveness factors. The result suggests that urban transit planners and mall management should consider the change in attractiveness factor preferences by shopper passengers over time and from one place to another.

Researchers such as Tsai (2010), Yap and Goh (2017) and Michon et al. (2015) segmented shoppers based on the purpose of mall visit, generation and gender. Such segments may change attractiveness factors impacting shopper passengers' decisions to visit a TOSMD, and therefore, use of the nearby station. In this research, we only discussed the attractiveness factors of resident and tourist shopper passengers. The research showed that only RSP ridership was associated with the size of the mall, staff knowledge and training, availability of customer service in the mall, and proximity of shops in the areas around the mall. Moreover, it showed that only TSP ridership was negatively associated with the availability of a cinema and having a variety of product quality in the mall. LeHew and Wesley (2007) indicated that there are differences between resident shoppers and tourist shoppers in behavioural intention and customer satisfaction. Specific attributes may better satisfy each group of shoppers. Therefore, shopping malls and the retail industry should use caution when modifying strategies to meet the need of the tourist segment and not forget the importance of resident shoppers to their profitability. Similarly, the result suggests that urban transit planners need to use caution when considering attractiveness factors in PFMs to meet the ridership demand of RSPs and not forget the importance of TSPs for optimal TOD and transit network sustainability.

In conclusion, variability in TOSMD attractiveness factors from one place to another and as a result of timing, weather and seasonality, and the residency of the shopper passengers should be considered in deciding TOSMD factors impacting shopper passengers at stations near TOSMDs.

The following section provides further discussion of the correlations and significant attractiveness factors impacting resident and tourist shopper passengers.

6.4 Impact of TOSMD attractiveness factors on resident and tourist shopper passengers

The previous section showed that, in the absence of the contextual factors of attractiveness, agglomeration and the number of business establishments (density external TOD factor) in the area of a TOSMD significantly impacted the ridership of all shopper passengers. This was also found by Masoumi and Mirmoghtadaee (2016). In addition, the previous chapter showed that proximity to shops and facilities around the mall (distance external TOD factor) significantly impacted RSP ridership, as was previously identified by Kamruzzaman et al. (2015) and Olaru et al. (2011). However, in the existence of contextual attractiveness factors, density and distance did not significantly impact the ridership of RSPs or TSPs (refer to Table 5.1).

Similarly, in the absence of contextual factors of attractiveness, the attractiveness of TOSMD product characteristics (as identified by González-Hernández and Orozco-Gómez (2012) and Rajagopal (2009, 2010, 2011)) and activities (as identified by El-Adly (2007), Khare (2011), and Tsai (2010)), did not significantly impact RSP ridership. However, with the existence of the contextual factors of attractiveness, mall product characteristics and activities significantly impacted RSP ridership (refer product factor in Table 5.2).

Therefore, it was accepted that contextual factors of attractiveness could mediate the impact of TOSMD attractiveness factors. This outcome further supports the conceptual framework for TOSMD attractiveness factors (refer to Journal Article 1). Below is further discussion of the mediating effect of each of the three contextual factors of TOSMD attractiveness:

1. Location context mediating impact

The literature distinguished between the attractiveness factors of shopping malls and the TOD design factors. They have been studied separately in the retail and urban planning literature, respectively (refer to Journal Article 1). However, the location context, as a novel factor, was introduced in this research (refer to Journal Article 2). It was measured by joint internal and external location aspects of the TOSMD context.

Therefore, its effect is explained partly in the form of internal shopping mall attractiveness characteristics separately impacting shopping mall patronage (El-Adly, 2007; González-Hernández and Orozco-Gómez, 2012; Singh and Prashar, 2013; Tandon et al., 2016) and partially in the form of external TOD factors impacting station ridership (Lee et al., 2013;

Singh et al., 2017a). As a result, its mediating effect has not been discussed previously and can only be partly related to the retail and urban planning literature.

The location context's mediating effect was presented in Table 5.2. The table showed that it fully mediated the impact of the attractiveness of the provision and characteristics of mall products and activities, and the proximity to shops and facilities around the mall towards shopper passenger ridership at a transit station near a TOSMD. For example, the difficulty in interpreting/obtaining/understanding the directions to reach a TOSMD (a location context measure) could change the intention of a shopper passenger (particularly a TSP who does not know the area) to use a transit station and visit its nearby TOSMD to watch a movie in its cinema (a mall internal product attractiveness measure). Therefore, a shopper may decide not to visit the TOSMD or use its nearby transit station, and vice versa. Similarly, the location context fully mediated the attractiveness of mall proximity to other shops and facilities around it.

Furthermore, the location context partially mediated the impact of the attractiveness of mall overall price level and mall offering of low prices, previously identified by Khare (2011) and Teller (2008), towards the ridership of all shopper passengers (RSP and TSP). Similarly, it partially mediated the attractiveness of the size of the mall and its shops towards the ridership (RSP and TSP) as previously identified by Singh and Prashar (2013). Additionally, the location context partially mediated the attractiveness of shopping mall personnel interaction attributes towards the ridership of all shopper passengers, especially RSPs, as previously revealed by Anselmsson (2006), El-Adly and Eid (2016) and Tsai (2010).

In conclusion, certain internal shopping mall and external TOD characteristics can be attractive. However, the location context can mediate attractiveness to become less or not at all attractive. Therefore, PFMs need to consider both the attractiveness and contextual factors as determinants of shopper passenger ridership at stations near TOSMDs. Furthermore, the mediating effect can vary between resident and tourist shopper passengers. As a result, mall management may adapt the TOSMD offering to match the prevailing resident/tourist demography of its surrounding area. For example, in areas where there are lots of hotels which are likely to be occupied by tourists, the TOSMD offering of service marketing mix elements such as products, prices, etc., and TOD factors such as density, diversity, etc., can be adapted to tourist attractiveness factors to improve mall patronage. In a TOSMD context, urban transit planners need to be aware that although mall prices might be attractive, the location context

can mediate that level of attractiveness to the extent that a resident or tourist might decide not to take a trip to the TOSMD and use its nearby transit station.

2. Stores context mediating impact

Similarly, the stores context, as a novel factor, was introduced in this research (refer to Journal Article 2). It was measured by joint internal and external stores aspects of the TOSMD context.

The stores context was discussed partly in the form of internal shopping mall attractiveness characteristics separately impacting shopping mall patronage (Khare, 2011; Rajagopal, 2009), and partly in the form of external TOD factors impacting station ridership (Sohn and Shim, 2010; Zemp et al., 2011). As a result, its mediating effect has not been discussed previously and can only be partially related to the retail and urban planning literature. Its mediating effect was presented in Table 5.3.

The table showed that the stores context fully mediated the attractiveness of an agglomeration of businesses in the area of the mall (previously identified by Masoumi and Mirmoghtadaee (2016)) and proximity to shops and facilities around the mall (previously identified by Kamruzzaman et al. (2015) and Olaru et al. (2011)) towards the ridership of both RSPs and TSPs at stations near TOSMDs. Furthermore, the stores context partially mediated the attractiveness of a shopping mall's personnel interaction and customer service attributes, previously identified by Anselmsson (2006), El-Adly and Eid (2016), and Tsai (2010), towards the ridership of all shopper passengers, particularly for resident shopper passengers.

Therefore, the findings of the location context apply for example, in the case of Dubai Metro stations near TOSMDs which are close to Dubai Airport, such as Deira city centre, customer service (people, internal shopping mall attractiveness factor) and its crowdedness (density, external TOD factor) could be adapted to attract both RSPs and TSPs to the Deira city centre and use its nearby station. These factors could be in the form of less agglomeration, proximity to the airport, and having tourist customer service inside the mall. These attributes could attract tourists and encourage them to exit the airport to visit the mall using its nearby transit station, i.e. from Dubai Airport to the Deira city centre and return using the Deira city centre station near the Deira city centre mall.

3. Space context mediating impact

Similarly, the space context, as a novel factor, was introduced in this research (refer to Journal Article 2). It was measured by joint internal and external space aspects of the TOSMD context.

The space context impact was discussed partly in the form of internal shopping mall attractiveness characteristics separately impacting the shopping mall patronage (El-Adly, 2007; Khare, 2011), and partly in the form of external TOD factors impacting station ridership (Cardozo et al., 2012; Zhao et al., 2013b). As a result, its mediating effect has not been discussed previously and can only be partially related to the retail and urban planning literature. Its mediating effect was presented in Table 5.4.

The table showed the space context having no mediating effect on the attractiveness of TOSMDs towards the ridership of shopper passengers (both RSP and TSP) at nearby stations. Although there is no mediating effect in the case of the Dubai Metro Redline, it was indicated earlier that factors of attractiveness could vary from one context to another. Therefore, the space context can mediate the attractiveness of a particular internal shopping mall and external TOD factors in other contexts. Similar to the conclusions of previous contextual factors, the space context mediating effect can vary between resident and tourist shopper passengers, so transport urban planners need to consider the distribution of residents and tourists in a TOSMD's area to adapt the attractiveness factors to serve the target resident and tourist shopper passengers at the TOSMD and its nearby station.

In conclusion, the chapter discussed the impact of attractiveness factors on shopper passenger ridership at stations near TOSMDs. SEM consolidating the results and relationships between TOSMD attractiveness factors and station shopper passenger ridership using a station near a TOSMD was discussed. It empirically validated the final conceptual framework for attractiveness factors impacting shopper passenger ridership at stations near TOSMDs. Therefore, passenger forecasting models should consider TOSMD attractiveness factors as potential determinants contributing to station ridership in the form of shopper passengers flowing into the station from its nearby TOSMD. In the Dubai Metro Redline, models need to consider product, price, place, promotion, people, density and distance attractiveness factors, and the location and stores contextual factors to potentially improve the accuracy of station PFMs.

The impact of attractiveness factors on shopper passenger at stations near TOSMDs in the case of the Dubai Metro Redline context varied from the findings of other studies in shopping mall attractiveness and TOD design factors. Therefore, it is considered that TOSMDs

could also vary with time, weather and seasonality. The location, stores, and space contextual factors were related to the ridership of shopper passenger at stations near TOSMDs.

Although internal shopping mall and external TOD characteristics might be significantly attractive, location, stores and space contextual factors can partially or totally change (mediate) the significance of attractiveness factors impacting shopper passenger ridership. This mediating effect can also vary between resident and tourist shopper passengers in the same TOSMD context.

Therefore, profiled into RSPs and TSPs, the shopper passengers of the Dubai Metro Redline stations near TOSMDs exhibited differences in attractiveness factors correlating with their ridership at stations near the TOSMDs. They scored the factors of attractiveness differently in the same context.

Transit urban planners and mall management, when considering a TOSMD context, may adapt a TOSMD's internal and external context to improve mall patronage and nearby station ridership as a result of the attracted shopper passengers visiting the mall and using its nearby transit station.

Therefore, in addition to improving the accuracy and comprehensiveness of PFMs, considering attractiveness factors can also potentially inform the design of the TOSMD context to optimise cities' transit network sustainability and TOD implementation in the areas of TOSMDs. Considering TOSMDs attractiveness factors is particularly important for a city like Dubai which is endeavouring to position itself as a shopping hub, as well as for other places designing transit networks or allocating funds to transit networks where optimal results could be achieved.

Chapter 7 Conclusion

7.1 Introduction

Shopping malls are often the retail, social and community centres of their communities. They can be developed as Transit Oriented Developments (TODs), where shoppers drive their cars less and ride nearby mass transit. Changes in shopping mall attractiveness factors can help explain the pattern of shopping mall development. While studies of shopping malls show variability in attractiveness factors and impact on mall patronage, the majority of TOD studies focus solely on assessing TOD impact on transit ridership, with no mention of the impact of Transit Orientated Shopping Mall Development (TOSMD) attractiveness factors on ridership at a nearby transit station. Existing modelling of transit station ridership forecasting does not adequately integrate all salient factors impacting transit station ridership, and specifically does not consider different TOSMD attractiveness factors. As a result, a station near a TOSMD can quickly reach its capacity and fail to meet growing shopper passenger demand post-development. The growth of the resident population and visiting tourist ridership exacerbates this problem in a city, such as Dubai.

The research investigated the attractiveness of Transit Orientated Shopping Mall Developments (TOSMDs) impacting metro station shopper passenger ridership represented by the preference for using nearby stations. Dubai Metro Redline was purposively selected as a significant number of its stations include urban designed walkways which connect a mall and a nearby metro station. A single geographical service context, namely the Dubai Metro Redline, was used to neutralise the impact of other level-of-service factors. A sample of 700 shopper passengers were surveyed at seven stations nearby TOSMDs. Principal Component Analysis with Confirmatory Factor Analysis and Structural Equation Modelling was used to explain TOSMD attractiveness impact on shopper passenger ridership at stations nearby TOSMDs. Finally, the research identified the attractiveness factors of TOSMDs and empirically clarified their impact on resident and tourist shopper passenger ridership at stations near TOSMDs.

This chapter discusses the outcomes achieved during this research and highlights the contribution to knowledge and practice. It provides a conceptual framework for TOSMDs attractiveness factors impacting metro station shopper passenger ridership and suggests directions for future research.

7.2 Achievement of aim and objectives

As indicated in the first chapter, the central aim of this research was to:

"*improve the accuracy and comprehensiveness of existing models used to forecast a transit station ridership by understanding the impact of TOSMD attractiveness factors on the ridership of passengers at a metro station*".

To achieve the aim of the research, chapter two provided a conceptual framework for TOSMDs attractiveness factors which was required to be empirically examined. Chapter three identified the research methodology to test the conceptual framework and identified a case study of the Dubai Metro Redline and an appropriate survey and analysis approach. Guided by the developed conceptual framework and utilising the research approach, chapter four reported contextual factors relating to the preference of shopping mall passengers to board at transit stations near shopping malls. Chapter five reported TOSMDs attractiveness factors directly and indirectly impacting resident and tourist shopper passenger ridership. Finally, chapter six discussed the correlations and significant TOSMD attractiveness factors supporting the developed conceptual framework for TOSMDs attractiveness factors. It also suggested the need for passenger forecasting models to consider TOSMD attractiveness factors as potential determinants contributing to station ridership in the form of shopper passengers flowing into the station from its nearby TOSMD.

The main objectives of the research were achieved as follows.

7.2.1 *Objective 1: generate a framework for TOSMD attractiveness factors and their impact on shopper passenger ridership at metro stations near TOSMDs*

The research reviewed the relevant literature and identified that studies on shopping malls show variability in attractiveness factors and impact on mall patronage. However, the majority of TOD studies focussed solely on assessing TOD impact on transit ridership, with no mention of the impact of TOSMD attractiveness factors on ridership at nearby transit stations. It also identified the need to clarify the extent of transit station use specifically in a TOSMD context. The novel term "TOSMD" refers to a shopping mall (SM) near a transit station in a Transit-Oriented Development (TOD) context.

The research developed a conceptual framework to comprehensively identify and clarify the "pull" or attractiveness factors of the TOSMD context and their impact on the flow of shopper passengers boarding at stations near TOSMDs (refer to Journal Article 1). The conceptual framework was based on the attractiveness factors of shopping malls (internal factors) and TOD design factors (external factors). It utilised the generic extended service marketing mix elements (product, price, place, promotion, people, physical evidence and process) and the 5Ds of TODs (density, diversity, urban design, destination accessibility and distance) as an indicator system for the factors determining the attractiveness of TOSMDs. Location, stores and space attributes were also identified as contextual (internal and external environment) mediating factors of TOSMD attractiveness.

7.2.2 *Objective 2: identify critical contextual TOSMD attractiveness factors contributing to the shopper passenger ridership at metro stations serving those TOSMDs*

Guided by the developed conceptual framework for TOSMD attractiveness factors, data was collected using a survey questionnaire and stratified sampling process. The research utilised Principal Component Analysis with Confirmatory Factor Analysis, and Structural Equation Modelling to identify TOSMD attractiveness factors. Similarly, this research successfully applied these techniques and supported the conceptual framework that was developed. The research identified three contextual attractiveness factors (location context, space context, and stores context) correlating with shopper passenger preferences to board at a nearby transit station (refer to Journal Article 2). As a result of these findings, it is recommended that the impact of TOSMD contextual factors on transit station ridership should be considered in passenger forecasting models at station level for optimal TOD design and improving cities' shopping and transit network usage experiences.

7.2.3 *Objective 3: identify and clarify the factors of attractiveness of Resident Shopper Passenger (RSP) ridership that makes up part of the total ridership at metro stations near TOSMDs*

Guided by the developed conceptual framework for TOSMD attractiveness factors and applying the same research approach adopted to achieve objective 2, the research explored the

internal and external attractiveness factors of a TOSMD impacting shopper passenger ridership at nearby metro stations, with particular reference to resident shopper passenger (RSP) and tourist shopper passenger (TSP), refer to Journal Article 3. The results identified differences in the TOSMD attractiveness factors between RSP and TSP. The research identified six attractiveness factors of RSP ridership. The six factors were price, place, promotion, people, density and distance. However, the research also showed that contextual factors of TOSMD (refer to Journal Article 2), such as location and stores contextual factors, mediated the identified RSP attractiveness factors of ridership, such as density and distance attractiveness factors. Therefore, the results clarified the attractiveness factors of RSP ridership at metro stations near TOSMDs and the conceptual framework for TOSMD attractiveness factors was empirically supported.

7.2.4 *Objective 4: identify and clarify the factors of attractiveness of Tourist Shopper Passenger (TSP) ridership that makes up part of the total ridership at metro stations near TOSMDs*

Applying the same research approach adopted to achieve objective 3, the research explored the internal and external attractiveness factors of TOSMD impacting tourist shopper passenger (TSP) ridership at nearby metro stations, refer to Journal Article 3. Guided by the conceptual framework for TOSMD attractiveness factors, the research identified four attractiveness factors of TSP. The four factors were product, promotion, density and distance. The research also showed that contextual factors of a TOSMD such as location and stores contextual factors, mediated the identified TSP attractiveness factors of ridership, such as product, people, distance attractiveness factors. Therefore, the results clarified the attractiveness factors of TSP ridership at metro stations near a TOSMD and the conceptual framework for TOSMD attractiveness factors was again empirically supported.

7.2.5 *Objective 5: explain correlations and significant direct/mediating TOSMD attractiveness factors impacting resident and tourist shopper passenger ridership at stations near TOSMDs*

Chapter six discussed the research structural equation model (SEM) correlations explaining the significant direct/meditating effect of TOSMD attractiveness factors impacting resident and

tourist shopper passenger ridership at stations near TOSMDs. These correlations were presented in chapters four and five based on the conceptual framework for TOSMD attractiveness factors and the review results presented in chapter two. The results identified that the TOSMD attractiveness factors (including internal shopping mall attractiveness factors and external TOD design factors), mediated by the contextual factors of TOSMD (including location context, stores context, space context), and impacted shopper passenger ridership preferences to use a transit station nearby a TOSMD. The results exhibited differences in the attractiveness factors correlating with the ridership of resident and tourist shopper passengers. As a result, it is recommended that TOSMD attractiveness and contextual factors should be considered as modifying inputs for improving the accuracy and comprehensiveness of passenger forecasting models at station level.

7.3 Contribution to knowledge

The literature distinguishes between the attractiveness factors of shopping malls (internal factors) and design factors of TOD (external factors). These two categories of factors have been studied separately in the retail and urban planning literature. While studies of shopping malls show variability in attractiveness factors and impact on mall patronage, the majority of TOD studies focus solely on assessing TOD impact on transit ridership, with no mention of the impact of shopping mall attractiveness factors on ridership at nearby transit stations. The extent of transit station use is not specifically clarified in a TOSMD context.

The research advances urban planning literature with the introduction of the novel term of Transit Oriented Shopping Mall Developments (TOSMDs). TOSMD refers to a shopping mall (SM) near a transit station in a transit oriented development (TOD) context. The term combines shopping mall attractiveness factors and TOD 5D factors to clarify TOSMD attractiveness factors impacting shopper passenger ridership at stations near TOSMDs.

The research provides further insights into the new concept of TOSMD attractiveness. It expands the malls' attractiveness factors knowledge base, contributing to malls' mix-use choices and their variation in growth. Using the generic extended service marketing mix elements (product, price, place, promotion, people, physical evidence and process) and the 5Ds of TODs (density, diversity, urban design, destination accessibility and distance) a conceptual framework for TOSMDs was developed as an indicator system for the factors determining the attractiveness of TOSMDs. The conceptual framework identified location, space and stores attributes as contextual (internal and external environment) factors mediating the impact of

TOSMD attractiveness on shopper passengers using nearby transit stations. The resultant conceptual framework for TOSMD attractiveness can assist in identifying TOSMD attractiveness factors and clarify their impact on shopper passenger ridership at stations near TOSMDs.

7.4 Contribution to the accuracy and comprehensiveness of existing PFMs models at a metro station

The research empirically identified TOSMD attractiveness factors as a modifying input to be considered for future passenger forecasting models at station level to ensure that it aligns the transit service level with the demand pattern of shopper passengers flowing from nearby TOSMDs.

The research developed correlational SEMs explaining resident and tourist shopper passenger ridership measured by preference to board at metro stations near TOSMDs, which can potentially enhance PFMs. This enhancement expands the knowledge base of mall attractiveness factors, contributing to malls' mix-use choices and their variation in growth.

7.5 Implications for Urban Planning and Shopping Mall Operations

The conceptual framework can assist urban planners and governments building transit stations by identifying attractiveness factors and clarifying their impact on shopper passenger ridership (resident and tourist) at stations near TOSMDs to 1) optimise TOD effectiveness, 2) motivate tourists to visit a city's shopping malls using its transit system, 3) maximise the shopping experience in a city and 4) improve its place marketing strategies.

Furthermore, the developed correlational models for resident and tourist shopper passenger ridership at metro stations near TOSMDs can potentially enhance passenger forecasting models by identifying TOSMD attractiveness factors as a modifying input to these models. This enhancement can guide planners in designing transit network stations while creating a balance between a station's future ridership growth and the area inside the station and around it for optimal TOD and sustainability of transit networks.

Also, considering TOSMD attractiveness factors can assist mall management in understanding the needs of customers and improve patronage within the shopping mall context (inside the mall and between the mall and its nearby transit station).

Cities with large numbers of shopping malls and cities growing their mall developments can also benefit from the research outcomes by identifying TOSMD attractiveness factors and directing investments to where the best effect will be achieved when developing metro stations. In the Dubai case, TOSMD context needs to include convenient walkways, short distances between a mall and its nearby transit station, directional signs inside and around malls, and a high number of retail and service facilities surrounding malls. Particular TOSMD context measures are needed to encourage Dubai Airport tourists to visit Dubai malls. These TOSMD attractiveness measures include less agglomeration, proximity to the airport, and having customer service inside the mall. In addition, less car park and traffic congestion in the mall area is expected to attract mall shoppers to use their nearby transit stations. Hence, TOSMD attractiveness factors should be an input considered for future PFMs at station level to ensure that they align the transit service level with the demand pattern of shopper passengers flowing from nearby TOSMDs.

7.6 Concluding remarks

This research provides an insight into TOSMD attractiveness factors impacting the ridership of shopper passengers at stations of the Dubai Metro Redline. It provides a framework that delivers a basis from which to identify and clarify the "pull" or attractiveness factors of the TOSMD context impacting the flow of shopper passengers boarding at stations near TOSMDs. The research was limited to the case of the Dubai Metro Redline's seven stations near TOSMDs. However, for a more comprehensive test of causality, the research could be repeated with other cities' transit networks. It is also noted that individual personality traits might impact shopper passengers' perception of TOSMD attractiveness factors. Therefore, future studies could incorporate socio-economic, demographic, and individual personality factors into the research design.

The research provides urban policymakers and urban transit planners with a basis to understand, identify and clarify the ridership of shopper passengers (resident and tourist) using a transit rail station near a TOSMD. Furthermore, it provides an opportunity for an enhancement to the existing PFMs at transit station level by identifying and clarifying the impact of TOSMD attractiveness factors on the ridership of shopper passengers who form part of the total ridership using transit stations near TOSMDs.

References

Aaker, D. A. (2004). *Marketing research* (8th ed.). New York: Wiley.

Abutaleb, A., McDougall, K., Basson, M., Hassan, R. and Mahmood, M. N. (2019). Towards a Conceptual Framework for Understanding the Attractiveness of Rail Transit-Oriented Shopping Mall Developments (TOSMDs). *Urban Rail Transit*. doi:10.1007/s40864-019-00112-4

Abutaleb, A., McDougall, K., Basson, M., Hassan, R. and Mahmood, M. N. (2020a). The Impact of Transit-Oriented Shopping Mall Developments (TOSMDs) on Metro Station Ridership: Dubai Metro Redline. *Urban Rail Transit*. doi:10.1007/s40864-020-00129-0

Abutaleb, A., McDougall, K., Basson, M., Hassan, R. and mahmood, M. N. (2020b). Understanding Contextual Attractiveness Factors of Transit Orientated Shopping Mall Developments (Tosmds) for Shopping Mall Passengers on the Dubai Metro Red Line. *Planning Practice & Research*, 1-22. doi:10.1080/02697459.2020.1829282

Acheampong, R. A. and Silva, E. (2015). Land use–transport interaction modeling: A review of the literature and future research directions. *Journal of Transport and Land Use, 8*(3). doi:doi:10.5198/jtlu.2015.806

Aimran, A. N., Ahmad, S. and Afthanorhan, A. (2016). Confirming the mediation effect of a structural model by using bootstrap approach: a case study of Malaysian 8th grade students' mathematics achievement. *International Journal of Business, Economics and Management, 3*(4), 44-51.

Albalate, D. and Bel, G. (2010). Tourism and urban public transport: Holding demand pressure under supply constraints. *Tourism Management, 31*(3), 425-433. doi:http://dx.doi.org/10.1016/j.tourman.2009.04.011

Anselmsson, J. (2006). Sources of customer satisfaction with shopping malls: A comparative study of different customer segments. *The International Review of Retail, Distribution and Consumer Research, 16*(1), 115-138. doi:10.1080/09593960500453641

Arjun, K. (2012). *Key factors impacting on response time of software vendors in releasing patches for software vulnerabilities.* (Unpublished master's thesis), University of Southern Queensland.

Arslan, T. V., Sezer, F. S. and Isigicok, E. (2010). Magnetism of shopping malls on young Turkish consumers. *Young Consumers, 11*(3), 178-188. doi:10.1108/17473611011074250

Awang, Z. (2012a). A handbook on SEM *Structural equation modeling* (4th ed., pp. 18-44). Kota Bharu, Malaysia: UiTM Kelantan.

Awang, Z. (2012b). A handbook on SEM: Structural equation modelling. *Shah Alam, Selangor Darul Ehsan: UiTM*.

Bernick, M. and Cervero, R. (1997). *Transit villages in the 21st century*. New York: McGraw-Hill.

Bogdan, R. (1992). *Qualitative research for education : an introduction to theory and methods* (2nd ed. ed.). Boston: Allyn and Bacon.

Boyle, D. K. (2006). *Fixed-route transit ridership forecasting and service planning methods*. (66). Washington, D.C.: Transportation Research Board.

Brès, A. (2014). Train stations in areas of low density and scattered urbanisation: towards a specific form of rail oriented development. *TPR: Town Planning Review, 85*(2), 261-272. doi:10.3828/tpr.2014.16

Canepa, B. (2007). Bursting the bubble: Determining the transit-oriented development's walkable limits. *Transportation Research Record: Journal of the Transportation Research Board*(1992), 28-34.

Cao, X. J., Mokhtarian, P. L. and Handy, S. L. (2009). The relationship between the built environment and nonwork travel: A case study of Northern California. *Transportation Research Part A: Policy and Practice, 43*(5), 548-559.

Cardozo, O. D., García-Palomares, J. C. and Gutiérrez, J. (2012). Application of geographically weighted regression to the direct forecasting of transit ridership at station-level. *Applied Geography, 34*, 548-558.

Castillo-Manzano, J. I. and López-Valpuesta, L. (2009). Urban retail fabric and the metro: A complex relationship. Lessons from middle-sized Spanish cities. *Cities, 26*(3), 141-147. doi:10.1016/j.cities.2009.02.007

Cervero, R. (1994). Transit-based housing in California: evidence on ridership impacts. *Transport Policy, 1*(3), 174-183. doi:http://dx.doi.org/10.1016/0967-070X(94)90013-2

Cervero, R. (2004). *Transit-oriented development in the United States: Experiences, challenges, and prospects* (102). Retrieved from

Cervero, R. (2006). Alternative approaches to modeling the travel-demand impacts of smart growth. *Journal of the American Planning Association, 72*(3), 285-295.

Cervero, R. and Duncan, M. (2002). Transit's Value-Added Effects: Light and Commuter Rail Services and Commercial Land Values. *Transportation Research Record: Journal of the Transportation Research Board, 1805*, 8-15. doi:doi:10.3141/1805-02

Cervero, R. and Murakami, J. (2008). Rail+ Property Development: A model of sustainable transit finance and urbanism. Retrieved from https://escholarship.org/uc/item/6jx3k35x

Chakour, V. and Eluru, N. (2014). Analyzing commuter train user behavior: a decision framework for access mode and station choice. *Transportation, 41*(1), 211-228. doi:10.1007/s11116-013-9509-y

Chan, S. and Miranda-Moreno, L. (2013). A station-level ridership model for the metro network in Montreal, Quebec. *Canadian Journal of Civil Engineering, 40*(3), 254-262. doi:10.1139/cjce-2011-0432

Chen, C., Varley, D. and Chen, J. (2011). What affects transit ridership? A dynamic analysis involving multiple factors, lags and asymmetric behaviour. *Urban Studies, 48*(9), 1893-1908.

Child, D. (2006). *Essentials of factor analysis* (3rd ed. ed.). New York: Continuum.

Choi, J., Lee, Y. J., Kim, T. and Sohn, K. (2012). An analysis of Metro ridership at the station-to-station level in Seoul. *Transportation, 39*(3), 705-722. doi:10.1007/s11116-011-9368-3

Chu, X. (2004). Ridership models at the stop level National Center of Transit Research. *University of South Florida, Tampa*.

Colomb, C. (2012). *Planning, History and Environment: Staging the New Berlin : Place Marketing and the Politics of Urban Reinvention Post-1989*: Taylor and Francis.

Cooper, D. R. (2011). *Business research methods* (11th ed. ed.). New York: McGraw-Hill/Irwin.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*: Sage publications.

Cushman & Wakefield. (2014). Global shopping center development report: Springs 2014. Springs 2014. Retrieved from http://cwrussia.ru/documents/20181/64819/%D0%A2%D0%BE%D1%80%D0%B3%D0%BE%D0%B2%D0%B0%D1%8F+%D0%BD%D0%B5%D0%B4%D0%B2%D0

%B8%D0%B6%D0%B8%D0%BC%D0%BE%D1%81%D1%82%D1%8C+%D0%BC%D0%B8%D1%80%D0%B0+2014/99ae17ef-1445-470b-9b96-2cb698095dcb/
Cushman & Wakefield. (2016). European shopping centre development report: November 2016. November 2016. Retrieved from http://bpcc.org.pl/uploads/ckeditor/attachments/10749/european_shopping_centre_development_report_nov_2016.pdf
Cushman & Wakefield. (2017). U.S. Shopping center marketbeat: Q2 2017. Q2 2017. Retrieved from http://www.cushmanwakefield.com/~/media/reports/corporate/MarketBeat%20Reports/2017/Q2%20US%20MarketBeat/CW_US_ShoppingCenter_MarketBeat_Q2_17.pdf
Dahsh, M. and Dasa, P. (2014). Shopping mall preferences in easten region: implications for retail strategy. *Prestige International Journal of Management and Research, 7/8*(2/1), 19.
De Juan, M. D. (2004). Why Do People Choose the Shopping Malls? The Attraction Theory Revisited: A Spanish Case. *Journal of International Consumer Marketing, 17*(1), 71-96. doi:10.1300/J046v17n01_05
De Vaus, D. (2013). *Surveys in social research* (6th ed.): Routledge.
Doi, M. and Allen, W. B. (1986). A time series analysis of monthly ridership for an urban rail rapid transit line. *Transportation, 13*(3), 257-269.
Du, H. and Mulley, C. (2007). The short-term land value impacts of urban rail transit: Quantitative evidence from Sunderland, UK. *Land Use Policy, 24*(1), 223-233. doi:http://dx.doi.org/10.1016/j.landusepol.2005.12.003
Dubai Economic Department. (2019). *Dubai Economic report 2019*. Dubai Economic Department Retrieved from http://dubaided.ae/StudiesAndResearchDocument/DER2019_EN_Report_f4.pdf.
Dubai Statistics Center. (2020). Population. Retrieved from https://www.dsc.gov.ae/en-us/Pages/default.aspx#
El-Adly, M. I. and Eid, R. (2016). An empirical study of the relationship between shopping environment, customer perceived value, satisfaction, and loyalty in the UAE malls context. *Journal of Retailing and Consumer Services, 31*, 217-227. doi:10.1016/j.jretconser.2016.04.002
El-Adly, M. (2007). Shopping malls attractiveness: a segmentation approach. *International Journal of Retail & Distribution Management, 35*(11), 936-950. doi:doi:10.1108/09590550710828245
Eriksson, P. and Kovalainen, A. (2008). Qualitative research materials. *SR Methods, Qualitative Methods in Business Research*, 78-97.
Erkip, F. (2005). The rise of the shopping mall in Turkey: the use and appeal of a mall in Ankara. *Cities, 22*(2), 89-108. doi:10.1016/j.cities.2004.10.001
Eshuis, J., Braun, E. and Klijn, E.-H. (2012). Bottlenecks in place marketing and their effects on attracting target groups. *Permanent Study Group: Public and Nonprofit Marketing*, 28.
Estupiñán, N. and Rodríguez, D. A. (2008). The relationship between urban form and station boardings for Bogota's BRT. *Transportation Research Part A: Policy and Practice, 42*(2), 296-306.
Farrag, D. A., El Sayed, I. M. and Belk, R. W. (2010). Mall Shopping Motives and Activities: A Multimethod Approach. *Journal of International Consumer Marketing, 22*(2), 95-115. doi:10.1080/08961530903476113
Finn, A. and Louviere, J. (1990). Shopping-center patronage models: Fashioning a consideration set segmentation solution. *Journal of Business Research, 21*(3), 259-275. doi:http://doi.org/10.1016/0148-2963(90)90032-9

Flyvbjerg, B. (2001). *Making social science matter: Why social inquiry fails and how it can succeed again*: Cambridge university press.

Fowler, F. J. (2013). *Survey research methods* (5th ed.). Thousand Oaks, California: Sage publications.

Gertner, D. (2011). Unfolding and configuring two decades of research and publications on place marketing and place branding. *Place Branding and Public Diplomacy, 7*(2), 91-106.

González-Hernández, E. M. and Orozco-Gómez, M. (2012). A segmentation study of Mexican consumers based on shopping centre attractiveness. *International Journal of Retail & Distribution Management, 40*(10), 759-777.

Guarte, J. M. and Barrios, E. B. (2006). Estimation Under Purposive Sampling. *Communications in Statistics - Simulation and Computation, 35*(2), 277-284. doi:10.1080/03610910600591610

Guba, E. and Lincoln, Y. (1988). *Do inquiry paradigms imply inquiry methodologies?. DM Fetterman (Ed.), Qualitative approaches to evaluation in education*: New York: Praeger.

Gutiérrez, J., Cardozo, O. D. and García-Palomares, J. C. (2011). Transit ridership forecasting at station level: an approach based on distance-decay weighted regression. *Journal of transport geography, 19*(6), 1081-1092. doi:10.1016/j.jtrangeo.2011.05.004

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E. and Tatham, R. L. (2006). Multivariate data analysis 6th Edition. *Pearson Prentice Hall. New Jersey. humans: Critique and reformulation. Journal of Abnormal Psychology, 87*, 49-74.

Hall, D. R. (1999). Conceptualising tourism transport: inequality and externality issues. *Journal of transport geography, 7*(3), 181-188.

Handy, S. (2005). Smart growth and the transportation-land use connection: What does the research tell us? *International Regional Science Review, 28*(2), 146-167.

Hospers, G. j. (2011). Place marketing in shrinking Europe: some geographical notes. *Tijdschrift voor economische en sociale geografie, 102*(3), 369-375.

Huang, R., Grigolon, A., Madureira, M. and Brussel, M. (2018). Measuring transit-oriented development (TOD) network complementarity based on TOD node typology. *Journal of Transport and Land Use, 11*(1), 305-324.

Huff, D. L. (1962). *Determination of intra-urban retail trade areas*: Real Estate Research Program, Graduate Schools of Business Administration, University of California.

Jacobs, H. (2018). Why Dubai has so many malls. Retrieved from https://www.businessinsider.com/why-dubai-has-so-many-malls-2018-11

Jacobson, J. and Forsyth, A. (2008). Seven American TODs: Good practices for urban design in transit-oriented development projects. *Journal of Transport and Land Use, 1*(2), 51-88.

Kamruzzaman, Md., Baker, D., Washington, S. and Turrell, G. (2014). Advance transit oriented development typology: Case study in brisbane, australia. *Journal of transport geography, 34*, 54-70. doi:10.1016/j.jtrangeo.2013.11.002

Kamruzzaman, Md., Baker, D., Washington, S. and Turrell, G. (2016). Determinants of residential dissonance: Implications for transit-oriented development in Brisbane. *International Journal of Sustainable Transportation, 10*(10), 960-974. doi:10.1080/15568318.2016.1191094

Kamruzzaman, Md., Shatu, F. M., Hine, J. and Turrell, G. (2015). Commuting mode choice in transit oriented development: Disentangling the effects of competitive neighbourhoods, travel attitudes, and self-selection. *Transport Policy, 42*, 187-196. doi:10.1016/j.tranpol.2015.06.003

Kashfi, S. A., Bunker, J. M. and Yigitcanlar, T. (2016). Modelling and analysing effects of complex seasonality and weather on an area's daily transit ridership rate. *Journal of transport geography, 54*, 310-324.
Kavaratzis, M. (2007). City marketing: the past, the present and some unresolved issues. *Geography compass, 1*(3), 695-712.
Khare, A. (2011). Mall shopping behaviour of Indian small town consumers. *Journal of Retailing and Consumer Services, 18*(1), 110-118. doi:10.1016/j.jretconser.2010.10.005
Khattak, A. J. and Rodriguez, D. (2005). Travel behavior in neo-traditional neighborhood developments: A case study in USA. *Transportation Research Part A: Policy and Practice, 39*(6), 481-500.
Kim, S., Ulfarsson, G. F. and Hennessy, J. T. (2007). Analysis of light rail rider travel behavior: impacts of individual, built environment, and crime characteristics on transit access. *Transportation Research Part A: Policy and Practice, 41*(6), 511-522.
Kivunja, C. and Kuyini, A. B. (2017). Understanding and applying research paradigms in educational contexts. *International Journal of Higher Education, 6*(5), 26-41.
Kok, H. J. (2007). Restructuring retail property markets in Central Europe: impacts on urban space. *Journal of Housing and the Built Environment, 22*(1), 107-126. doi:10.1007/s10901-006-9068-z
Kotler, P. and Gertner, D. (2011). A place marketing and place branding perspective revisited *Destination brands: Managing place reputation* (3 ed., pp. 33-53): Elsevier Ltd.
Kotler, P., Hamlin, M. A., Rein, I. and Haider, D. H. (2002). *Marketing Asian places: attracting investment, industry, and tourism to cities, states, and nations*: John Wiley & Sons.
Kuby, M., Barranda, A. and Upchurch, C. (2004). Factors influencing light-rail station boardings in the United States. *Transportation Research Part A: Policy and Practice, 38*(3), 223-247.
Kushwaha, T., Ubeja, S. and Chatterjee, A. S. (2017). Factors Influencing Selection of Shopping Malls: An Exploratory Study of Consumer Perception. *Vision: The Journal of Business Perspective, 21*(3), 274-283. doi:10.1177/0972262917716761
Kwoka, G. J., Boschmann, E. E. and Goetz, A. R. (2015). The impact of transit station areas on the travel behaviors of workers in Denver, Colorado. *Transportation Research Part A: Policy and Practice, 80*, 277-287. doi:10.1016/j.tra.2015.08.004
Lai, W.-T. and Chen, C.-F. (2011). Behavioral intentions of public transit passengers—The roles of service quality, perceived value, satisfaction and involvement. *Transport Policy, 18*(2), 318-325.
Larsen, V., Shelton, R. and Wright, N. D. (2015). Shopping center attitudes: an empirical test of predictive attributes. *Academy of Marketing Studies Journal, 19*(2), 93.
Lawton, L. J. and Weaver, D. (2014). *Tourism management*: John Wiley & Sons Australia, Ltd.
Lee, S. (2013). Does Context Matter?: Understanding the Urban Design Requirements of Successful Neighborhood Parks (Doctoral dissertation). from Arizona State University, USA https://repository.asu.edu/attachments/110491/content/Lee_asu_0010E_12898.pdf
Lee, S., Yi, C. and Hong, S.-P. (2013). Urban structural hierarchy and the relationship between the ridership of the Seoul Metropolitan Subway and the land-use pattern of the station areas. *Cities, 35*, 69-77. doi:https://doi.org/10.1016/j.cities.2013.06.010
Leedy, P. D. and Ormrod, J. E. (2005). *Practical research*: Pearson Custom.
LeHew, M. L. and Wesley, S. C. (2007). Tourist shoppers' satisfaction with regional shopping mall experiences. *International Journal of Culture, Tourism and Hospitality Research*.

Lin, J.-J. and Shin, T.-Y. (2008). Does transit-oriented development affect metro ridership?: Evidence from Taipei, Taiwan. *Transportation Research Record: Journal of the Transportation Research Board*(2063), 149-158.

Loo, B. P. Y., Chen, C. and Chan, E. T. H. (2010). Rail-based transit-oriented development: Lessons from New York City and Hong Kong. *Landscape and Urban Planning, 97*(3), 202-212. doi:https://doi.org/10.1016/j.landurbplan.2010.06.002

Malhotra, N. K. (2008). *Marketing research: An applied orientation, 5/e*: Pearson Education India.

Masoumi, H. E. and Mirmoghtadaee, M. (2016). Editorial Preface. Transit-Oriented Development in Iran: Challenges and Solutions. *TeMA: Journal of Land Use*, 2-4. doi:10.6092/1970-9870/4028

McNally, M. G. (2000). The Four Step Model Institute of Transportation Studies, Center for activity Systems Analysis, University of California, Irvine.

McNally, M. G. (2007). The four-step model *Handbook of Transport Modelling: 2nd Edition* (pp. 35-53): Emerald Group Publishing Limited.

Mejia, L. C. and Eppli, M. J. (1999). The effect of merchandise space allocation on retail sales in enclosed shopping centers. *Journal of Shopping Center Research, 6*(1), 23-40.

Mertens, D. M. (2005). *Research and evaluation in education and psychology : integrating diversity with quantitative, qualitative, and mixed methods* (2nd ed. ed.). Thousand Oaks, CA: Sage Publications.

Mertens, D. M. (2014). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods* (4th ed.). Los Angeles: Sage publications.

Michon, R., Chebat, J.-C., Yu, H. and Lemarié, L. (2015). Fashion orientation, shopping mall environment, and patronage intentions. *Journal of Fashion Marketing and Management, 19*(1), 3.

Mingqiao, Z., Xi, L., Chao, M. and Ke Zhang, M. L. (2014). *Review on the Theory and Planning Principle of Transit-Oriented Development*. Paper presented at the 14th COTA International Conference of Transportation Professionals, Changsha, China. http://ascelibrary.org.ezproxy.usq.edu.au/doi/abs/10.1061/9780784413623.338

Mundell, M. (2013). Shopping Centre Choice: A Behavioural Perspective (Doctoral dissertation). from Durham University, UK http://etheses.dur.ac.uk/7282/1/MLMFinalThesis.pdf?DDD2+

Murray, A. T., Davis, R., Stimson, R. J. and Ferreira, L. (1998). Public transportation access. *Transportation Research Part D: Transport and Environment, 3*(5), 319-328.

Neuman, W. L. (2011). *Social research methods: qualitative and quantitative approaches* (7th ed.). Boston, Mass;London;: Allyn and Bacon.

Newman, P. (2009). Planning for Transit-Oriented Development: Strategic Principles. Chapter 2 in Curtis C, Renne JL, Bertolini L (2009, Eds) Transit-Oriented Development–Making it Happen (pp. 13-22). Cornwall, UK: Ashgate Publishing Limited.

O'Neill, W. A., Ramsey, R. D. and Chou, J. (1992). Analysis of transit service areas using geographic information systems. *Transportation Research Record, 1364*, 131-138.

O'Sullivan, S. and Morrall, J. (1996). Walking distances to and from light-rail transit stations. *Transportation Research Record: Journal of the Transportation Research Board*(1538), 19-26.

Olaru, Smith and Taplin. (2011). Residential location and transit-oriented development in a new rail corridor. *Transportation Research Part A, 45*(3), 219-237. doi:10.1016/j.tra.2010.12.007

Pacheco-Raguz, J. F. (2010). Assessing the impacts of Light Rail Transit on urban land in Manila. *Journal of Transport and Land Use, 3*(1). doi:10.5198/jtlu.v3i1.13

Peng, Y., Li, Z. and Choi, K. (2017). Transit-oriented development in an urban rail transportation corridor. *Transportation Research Part B, 103*, 269-290. doi:10.1016/j.trb.2017.03.011

Perry, C. (1998). Processes of a case study methodology for postgraduate research in marketing. *European Journal of marketing, 32*(9/10), 785-802.

Phillips, D. C. and Burbules, N. C. (2000). *Postpositivism and educational research*. USA: Rowman & Littlefield.

Pike, S. (2002). ToMA as a measure of competitive advantage for short break holiday destinations. *Journal of Tourism Studies, 13*(1), 9.

Quade, P. B. (1996). Douglas, Inc: Transit and Urban Form: National Academy Press, Washington, DC.

Rafiq, M. and Ahmed, P. K. (1995). Using the 7Ps as a generic marketing mix: an exploratory survey of UK and European marketing academics. *Marketing Intelligence & Planning, 13*(9), 4-15. doi:10.1108/02634509510097793

Rajagopal. (2009). Growing shopping malls and behaviour of urban shoppers. *Journal of Retail & Leisure Property, 8*(2), 99-118. doi:10.1057/rlp.2009.3

Rajagopal. (2010). Coexistence and conflicts between shopping malls and street markets in growing cities: Analysis of shoppers' behaviour. *Journal of Retail and Leisure Property, 9*(4), 277-301. doi:10.1057/rlp.2010.17

Rajagopal. (2011). Determinants of Shopping Behavior of Urban Consumers. *Journal of International Consumer Marketing, 23*(2), 83-104. doi:10.1080/08961530.2011.543051

Rantanen, P.-L., Mellin, I., Keinänen-Toivola, M. M., Ahonen, M. and Vahala, R. (2018). The seasonality of nitrite concentrations in a chloraminated drinking water distribution system. *International journal of environmental research and public health, 15*(8), 1756.

RTA-Dubai. (2016). Roads and Transport Authority - Dubai.

Salant, P. and Dillman, D. A. (1994). *How to conduct your own survey*: Wiley.

Salleh, S. H. M. (2005). *An examination of factors influencing Bruneian secondary teachers' use of information and communication technology in teaching : a survey exploration.* Thesis (PhD) -- USQ, 2005.

Schofield, J. W. (2002). Increasing the generalizability of qualitative research. *The qualitative researcher's companion*, 171-203.

Sides, P. C. (2012). *Regression model ridership forecasts for Houston light rail.* (Master of Community and Regional Planning and Master of Public Affairs), The University of Texas at Austin. Retrieved from https://repositories.lib.utexas.edu/bitstream/handle/2152/19978/Sides_ProfessionalReport_20129.pdf?sequence=1

Singh, Lukman, A., Flacke, J., Zuidgeest, M. and Van Maarseveen, M. (2017a). Measuring TOD around transit nodes - Towards TOD policy. *Transport Policy, 56*, 96-111. doi:10.1016/j.tranpol.2017.03.013

Singh and Sahay. (2012). Determinants of shopping experience. *International Journal of Retail & Distribution Management, 40*(3), 235-248. doi:10.1108/09590551211207184

Singh, H. and Prashar, S. (2013). Factors defining shopping experience: an analytical study of Dubai. *Asian Journal of Business Research, 3*(1), 36.

Singh, Y. J., Lukman, A., Flacke, J., Zuidgeest, M. and Van Maarseveen, M. F. A. M. (2017b). Measuring TOD around transit nodes - Towards TOD policy. *Transport Policy, 56*, 96-111. doi:10.1016/j.tranpol.2017.03.013

Sohn, K. and Shim, H. (2010). Factors generating boardings at Metro stations in the Seoul metropolitan area. *Cities, 27*(5), 358-368. doi:10.1016/j.cities.2010.05.001

Strauss, A. L. (1990). *Basics of qualitative research : grounded theory procedures and techniques*. Newbury Park, Calif: Sage Publications.

Suhr, D. D. (2006). *Exploratory or confirmatory factor analysis?* Paper presented at the SAS Users Group International Conference Cary, NC. file:///D:/C%20Drive%20DATA/Downloads/EFACFAmateralinSAS%20(1).pdf

Sung, H. and Oh, J.-T. (2011). Transit-oriented development in a high-density city: Identifying its association with transit ridership in Seoul, Korea. *Cities, 28*(1), 70-82. doi:http://dx.doi.org/10.1016/j.cities.2010.09.004

Taehyun, K., Dong-Wook, S. and Sangho, C. (2016). An analysis of the relationship between pedestrian traffic volumes and built environment around metro stations in Seoul. *KSCE Journal of Civil Engineering*. doi:10.1007/s12205-016-0915-5

Tandon, A., Gupta, A. and Tripathi, V. (2016). Managing shopping experience through mall attractiveness dimensions: An experience of Indian metro cities. *Asia Pacific Journal of Marketing and Logistics, 28*(4), 634-649. doi:10.1108/APJML-08-2015-0127

Taylor, B. D. and Fink, C. N. (2003). The factors influencing transit ridership: A review and analysis of the ridership literature (UCLA Department of Urban Planning working paper). from University of California Transportation Center https://escholarship.org/uc/item/3xk9j8m2

Telci, E. E. (2013). High shopping mall patronage: is there a dark side? *Quality & Quantity, 47*(5), 2517-2528. doi:10.1007/s11135-012-9668-5

Teller, C. (2008). Shopping streets versus shopping malls - determinants of agglomeration format attractiveness from the consumers' point of view. *The International Review of Retail, Distribution and Consumer Research, 18*(4), 381-403. doi:10.1080/09593960802299452

Teller, C. and Reutterer, T. (2008). The evolving concept of retail attractiveness: what makes retail agglomerations attractive when customers shop at them? *Journal of Retailing and Consumer Services, 15*(3), 127-143.

Thang, D. C. L. and Tan, B. L. B. (2003). Linking consumer perception to preference of retail stores: an empirical assessment of the multi-attributes of store image. *Journal of Retailing and Consumer Services, 10*(4), 193-200. doi:http://dx.doi.org/10.1016/S0969-6989(02)00006-1

Thomas, R. and Bertolini, L. (2014). Beyond the case study dilemma in urban planning: using a meta-matrix to distil critical success factors in transit-oriented development. *Urban Policy and Research, 32*(2), 219-237. doi:10.1080/08111146.2014.882256

Tkaczynski, A., Rundle-Thiele, S. and Beaumont, N. (2010). Destination segmentation: A recommended two-step approach. *Journal of Travel Research, 49*(2), 139-152. doi:10.1177/0047287509336470

Tsai, S. (2010). Shopping mall management and entertainment experience: a cross-regional investigation. *The Service Industries Journal, 30*(3), 321-337. doi:10.1080/02642060802123376

Veal, A. J. (2006). *Research methods for leisure and tourism: A practical guide*: Pearson Education.

Vessali, K. V. (1996). Land use impacts of rapid transit: A review of the empirical literature. *Berkeley Planning Journal, 11*(1).

Yao, X. (2007). Where are public transit needed–Examining potential demand for public transit for commuting trips. *Computers, Environment and Urban Systems, 31*(5), 535-550.

Yap, J. B. H. and Goh, S. V. (2017). Determining the potential and requirements of transit-oriented development (TOD): The case of Malaysia. *Property Management, 35*(4), 394.

Yin, R. K. (1981). The case study crisis: Some answers. *Administrative science quarterly, 26*(1), 58-65.

Yin, R. K. (1994). Case study research: Design and methods. 2d ed. Applied Social Methods Research Series: Thousand Oaks (California): Sage Publications, Inc.

Yin, R. K. (2009). Case study research: Design and methods fourth edition. *Los Angeles and London: SAGE*.

Zemp, Stauffacher, Lang and Scholz. (2011). Classifying railway stations for strategic transport and land use planning: Context matters! *Journal of transport geography, 19*(4), 670-679.

Zhao, F., Chow, L.-F., Li, M.-T., Ubaka, I. and Gan, A. (2003). Forecasting transit walk accessibility: Regression model alternative to buffer method. *Transportation Research Record: Journal of the Transportation Research Board, 1835*, 34-41.

Zhao, J., Deng, W., Song, Y. and Zhu, Y. (2013a). Analysis of Metro ridership at station level and station-to-station level in Nanjing: an approach based on direct demand models. *Transportation, 41*(1), 133-155. doi:10.1007/s11116-013-9492-3

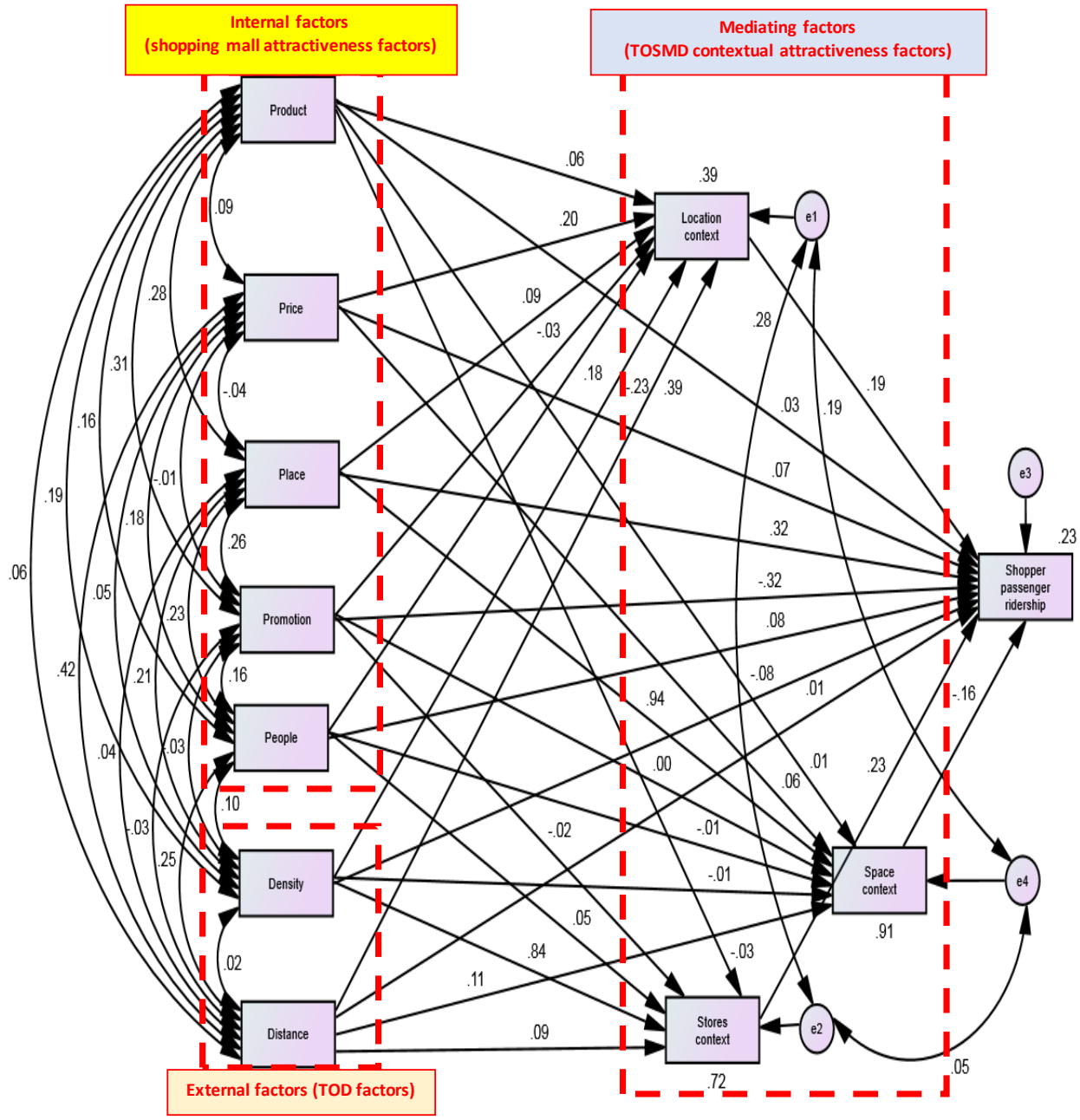
Zhao, J., Deng, W., Song, Y. and Zhu, Y. (2013b). What influences Metro station ridership in China? Insights from Nanjing. *Cities, 35*, 114-124. doi:10.1016/j.cities.2013.07.002

Zhao, J., Rahbee, A. and Wilson, N. H. M. (2007). Estimating a Rail Passenger Trip Origin-Destination Matrix Using Automatic Data Collection Systems. *Computer-Aided Civil and Infrastructure Engineering, 22*(5), 376-387. doi:10.1111/j.1467-8667.2007.00494.x

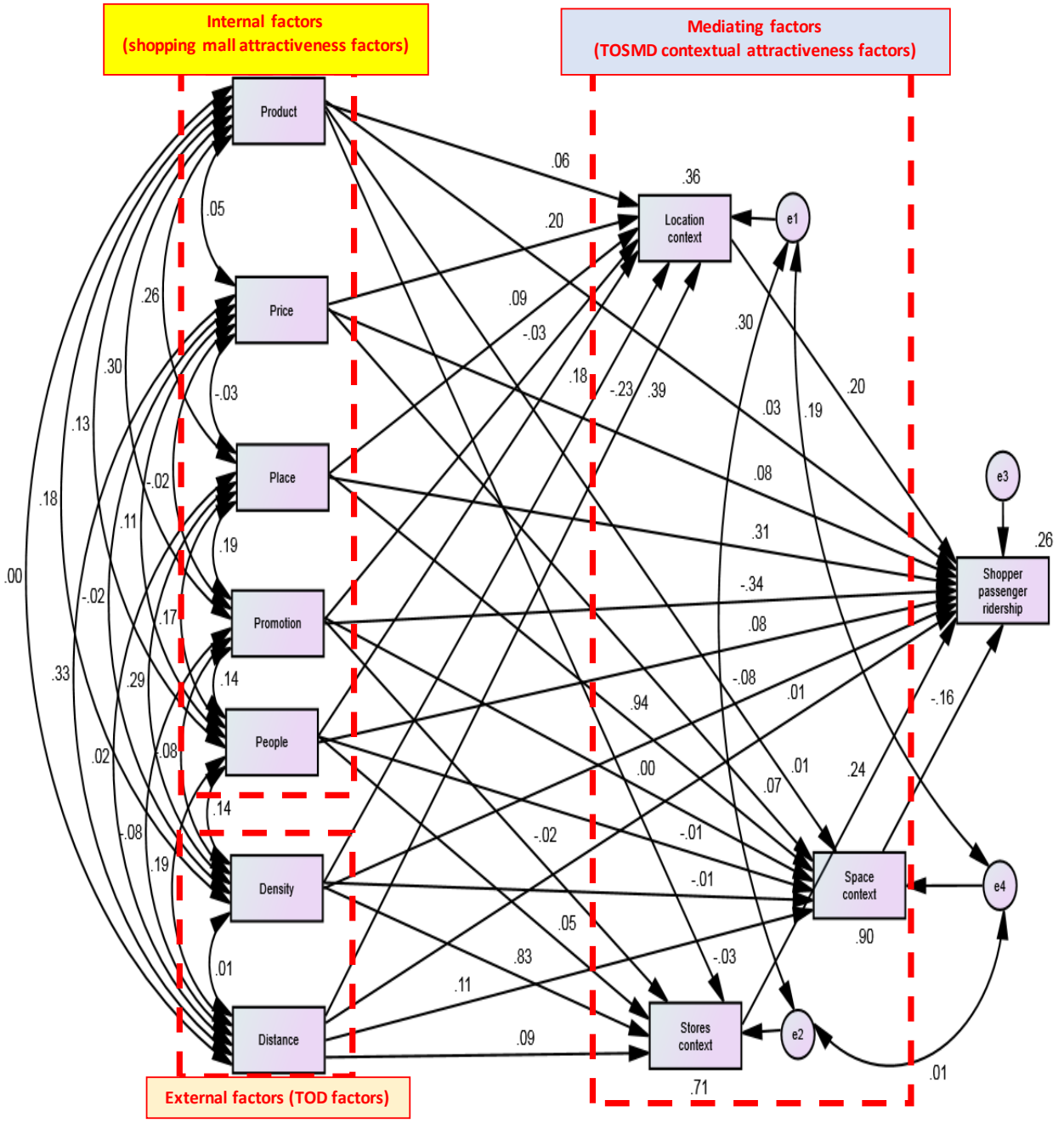
Zikmund, W. G., Carr, J. C. and Griffin, M. (2013). *Business Research Methods (Book Only)*: Cengage Learning.

Appendices

Appendix 1 Relationships between TOSMD attractiveness factors impacting **all shopper passenger** ridership at transit stations near TOSMDs



Appendix 2 Relationships between TOSMD attractiveness factors explaining **Resident Shopper Passenger (RSP)** ridership at transit stations near TOSMDs



Appendix 3 Relationships between TOSMD attractiveness factors explaining **Tourist Shopper Passenger (TSP)** ridership at transit stations near TOSMDs