Common ticketing systems: Case studies of Bangkok, Fukuoka, Singapore, and Sydney

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เมื่อมีบริการการเดินทางและระบบชำระเงินใหม่ ๆ เกิดขึ้นมากมายในระบบการขนส่งสาธารณะ หลายเมืองทั่วโลกจึงหันมาเลือกใช้ระบบบัตรโดยสารร่วมเพื่อรับมือกับความซับซ้อนที่เกิดขึ้น เนื่องจากระบบบัตรโดยสารร่วมสามารถช่วยวางโครงสร้างและกำหนดแผนจัดเก็บอัตราค่าโดยสารที่หลากหลายตามเวลาและพื้นที่ ตัวระบบจึงมีความคุ้มค่าในแง่ของต้นทุนและเป็นแรงจูงใจสำคัญให้กับกลุ่มเป้าหมาย อย่างไรก็ตาม แม้จะมีข้อดีเช่นว่า แต่ไม่ใช่ทุกเมืองหรือทุกระบบการคมนาคมขนส่งจะสามารถรับนำ ใช้งาน และให้บริการระบบบัตรโดยสารร่วมดังกล่าวได้อย่างราบรื่น กล่าวคือ มีทั้งที่ประสบความสำเร็จและล้มเหลว ซึ่งมีสาเหตุมาจากปัจจัยสำคัญหลายประการ งานวิจัยฉบับนี้ได้ใช้กรณีศึกษาและพิจารณาถึงเมืองต่าง ๆ ในฐานะหน่วยหลักของการวิเคราะห์ โดยพยายามตอบคำถามพื้นฐานที่ว่า “สิ่งใดคือปัจจัยสำคัญที่ทำให้ระบบบัตรโดยสารร่วมประสบความสำเร็จหรือล้มเหลว” การศึกษานี้มีวัตถุประสงค์ในการสร้างความเข้าใจที่เพิ่มขึ้นเกี่ยวกับหลุมพรางที่แต่ละเมืองเผชิญร่วมกัน และหมุดหมายสำคัญที่ต้องบรรลุเพื่อนำไปสู่การใช้ระบบบัตรโดยสารร่วม โดยเริ่มศึกษาจากการขนส่งระบบราง/รถไฟ และมุ่งเน้นประเทศเศรษฐกิจเกิดใหม่ (Emerging Countries) ที่กำลังพิจารณาแผนก่อสร้างระบบขนส่งมวลชนเร็ว (Mass Rapid Transit Transport Systems) หรืออยู่ในระหว่างการก่อสร้างโครงการดังกล่าว งานวิจัยฉบับนี้เรียนรู้จากการถอดบทเรียนของแต่ละเมือง ผ่านการทบทวนกรณีศึกษาเกี่ยวกับการจำหน่ายบัตรโดยสารร่วมในกรุงเทพมหานคร ประเทศไทย ฟุกุโอกะ ประเทศญี่ปุ่น ประเทศสิงคโปร์ และซิดนีย์ ประเทศออสเตรเลีย โดยพิจารณาปัจจัยต่าง ๆ เพื่อให้ได้แพลตฟอร์มการจำหน่ายบัตรโดยสารอิเล็กทรอนิกส์ (e-Ticket) ที่บูรณาการระบบเชื่อมต่ออย่างราบรื่นในอนาคต ผลลัพธ์ที่ได้จากการศึกษา ซึ่งพิจารณาปัจจัยความล้มเหลวและความสำเร็จผ่านมุมมองของรัฐบาล ธุรกิจ และผู้บริโภค ชี้ให้เห็นว่า ระบบบัตรโดยสารร่วมจำเป็นต้องใช้งานได้อย่างไม่ซับซ้อนและยึดถือลูกค้าเป็นหัวใจของการพัฒนามาเป็นอันดับแรก โดยมุ่งสร้างผลประโยชน์ให้กับผู้มีส่วนได้เสียทุกฝ่ายอย่างเท่าเทียม เมื่อพิจารณาถึงความสะดวกของการขนส่ง ต้นทุนทางการเงิน ความปลอดภัยและความมั่นคง การศึกษาพบว่า ความล้มเหลวและความสำเร็จนั้นมีหลายแง่มุม อันเนื่องมาจากอิทธิพลของปัจจัยต่าง ๆ อาทิ ข้อมูลประชากร เศรษฐศาสตร์ เทคโนโลยีที่มีอยู่ กรอบกฎหมายและกฎระเบียบ และประการอื่น ๆ อีกมากมาย

สาขาวิชา	ยุทธศาสตร์เมือง	ลายมือชื่อนิสิต ....
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With a plethora of new mobility services and payments systems found across public transportation systems, several cities globally have turned to common ticketing systems to help navigate this complexity. Helping to create time and space differentiated fare structures and tariff schemes, common ticketing systems can optimize transport utilization rates, achieve cost-efficiencies, and provide key incentives to specific target groups. However, not all cities and transportation systems have enjoyed a smooth journey towards the adoption, roll-out and servicing of common ticketing systems with both the experiences of success and failure being attributed to a wide variety of critical factors. Using case study research and cities as the main unit of analysis, this research seeks to address the fundamental question of "what are the critical factors for success of common ticketing systems?" By using rail/train systems as the entry-point, the study serves to facilitate improved understanding on common pitfalls and essential milestones towards the roll-out of a common ticketing system, especially for emerging countries, where mass rapid transit transport systems are being considered or in the process of construction. By reviewing case studies of common ticketing implementation in Bangkok, Thailand; Fukuoka, Japan; Singapore; and Sydney, Australia the research will explore lessons learned from each of the cities, eliciting factors to ensure seamless connectivity integrated e-ticketing platforms into the future. Viewing failure and success through the lens of government, business, and consumers, outcomes of the study recognize a common ticketing system must first and foremost be easy-to-use and customer centric, striving for a win-win-win situation between these stakeholders. While considering all of transport convenience, financial costs, safety and security, the study establishes that failure and success is multi-faceted, influenced by dimensions including demographics, economics, existing technologies, legal and regulatory frameworks and many more.

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CHAPTER 1: INTRODUCTION

As it has been previously imparted by Chinese philosopher, Lao Tzu, "a journey of a thousand miles, begins with a single step". Such is a befitting introduction to this paper and following this vein of thinking, then a seamless, efficient, and pain-free public transport journey, should start with access to the right ticket, supported by clear information on the fares and local transportation routes. Without question, buying a ticket whether for bus, train, metro, or ferry, can be both a time-consuming and even frustrating process, especially when encountering a new system. Common ticketing which is intended to integrate access to different modes or networks of transport via the use of a stored value transit card not only serves to make the process of navigating public transport easier, but it also helps to avoid long queuing times for passengers and potential congestion at ticketing booths for operators.

In this first chapter of the paper, the importance of common ticketing systems is established in the context of public transport, while breaking down the concept of common ticketing systems at-large. Conducting the first-ever research of its kind on the chronology of common ticketing systems, an overview of the evolution of transport ticketing is provided, leading us to the present day, where ticketing may no longer even require a ticket. Significant efforts are undertaken to elaborate on key considerations for common ticketing, which help to form the rationale for the problem statement, taking into account previous studies, reports and analysis thereof concerning common ticketing, especially in Bangkok, later influencing the identification of variables assessed. Presenting the overall research question to be addressed, several research objectives are offered, supported by an outline of the scope of the study which helps to identify the broad contours of research, especially the delimiters outside the scope the paper. Towards the end, the overall research outcomes are presented.

1.1 COMMON TICKETING SYSTEMS AT-LARGE

By 2023, it is estimated that 1 in 4 transport ticketing will be contactless reaching over 468 million users (up from 180 million in 2019) and with metro/bus ticketing being forecast to account for 86% of all contactless ticketing (Juniper-Research, 2019). Shifting away from plain paper-based tickets, punch hole tickets, and magnetic stripe tickets, modern public transport systems are now embracing a plethora of new mobility services and payment modalities (Ferreira et al., 2020; Kamargianni et al., 2016; UITP, 2020). To help navigate this complexity, several cities globally have successfully turned to common ticketing systems (Douglas, 2009; Ellison et al., 2016; Iwanowicz & Szczuraszek, 2019; Puhe, 2014), often integrating different modes of public transport. In some cases, this has extended further to open-loop systems (Soehnchen, 2022), capable of handling discrete transactions even external to the public transport network such as for grocery payments (APTA, 2019; Nishi et al., 2021).

Underlying our appreciation of what belies a common ticketing system is the fundamental acknowledgement of what inherently makes traditional ticketing systems to be “common”. The articulation of commonality in the context of transport ticketing is used to refer to the interoperability of networking systems being the foundation for information data exchange (Verity, 2014). While, other researchers adopt the view of commonality as requiring a universal modality for ticketing, most conventionally in the form of a smart card (NTT, 2001). Whereas others have taken this a step further to suggest that the commonality of ticketing systems is best achieved when administered by single transport operator (CLC, 2013).

In reality, much of each holds a degree of merit and common ticketing systems are indeed significantly optimized, when built upon interoperable networks, a single form of ticketing and standalone operator. Different layers of integration should be considered, ranging from 0) zero integration 1) integration of information 2) ticketing media integration 3) integration of payment 4) contractual integration to 5) policy integration, including concerning fare policies (Sochor et al., 2018). Related to this, it is also important to consider the transition period between delving into each of the layers of integration to ensure a smooth facilitation.

1.2 EVOLUTION OF TRANSPORT TICKETING

In natural order, the first forms of payment for ticketing on mass public transport has closely mirrored the dominant forms of currency of the time and the modes of transport available. As detailed in the Henry Ford Archive of Innovation, the advent of the horse-drawn carriage from the late 17th century, often being referred to by transport historians as the "Carriage Era", were perhaps among the first examples multi-passenger transport. Although the roads were poor, suspension systems primitive, riding rather uncomfortable and while initially exclusively available to the aristocratic elite, ingenuity in the diversity of carriages made possible long-distance travel with greater numbers of people and therefore at a more affordable price (Casey, 2021). All the way until the 20th century, horse-drawn vehicles have played a key role in linking urban and rural areas, contributing to the movement of goods and people, fostering the creation of wealth and the rise of consumer culture. While the first commercial coaches for hire had only appeared around the early 1600's in London, prior to that low-income transport via wagon was often brokered simply by means of bartering of goods and services (ExhibitsUSA, 2007).

Considered to be the first true transit service originated by the Parisian professor of philosophy, Blaise Pascal (1623-1662), the Latin-named omnibus or "for all" was intended as allowing travel for everyone, although in actual fact licensing and charters limiting use to "people of merit", had prohibited many common folks such as servants and laborers from travelling. With weakening of the monarchy in France and progressive democracy in the United States, by 1840 over one hundred omnibuses rattled along the streets of New York with fares set at a shilling (12 1/2 cents) and later dropped to six cents. The driver sitting on the roof and collecting fares through a small opening just under his seat and passengers paying upon entry (White Jr., 2007).

It was around this same time with the progressive transition from stagecoaches to omnibuses, coupled with the invention of the cast iron industrial printing press by Lord Stanhope in 1800 and subsequently steam-powered rotary printing press by Richard M. Hoe in 1843, that the Edmondson-style rail ticket was born in 1836. Removing the laborious need for a ticket clerk to hand write out each ticket for each passenger resulting in long queues at busy transit stations, the new rail tickets, named after their inventor, Thomas Edmondson, were typically pre-cut on stiff cardboard, 31mm by 57.2mm, with a nominal thickness of 0.79mm, individually numbered and stamped with different colours and patterns used to differentiate between different types of tickets and fare classes (Stead, 1936).

Over a century later, the introduction of the token came to New York in the early 1940s when a fare hike was being explored and collecting coins became impractical. At the time, the transit deficit was USD $84 million or over USD $1.1 trillion in today’s money adjusted for inflation, so the city had a huge financial problem at hand. In this way, tokens were considered as a convenient means of legislating a fare hike while adapting to the reality that the transport system turnstiles at then modern railway stations were not equipped to handle multiple coins (Kabak, 2014). Although novel in their approach when they were introduced, the process of exchanging a reusable indestructible token for train ticketing can be traced back to the brass octagonal checks, engraved by the Leicester and Swannington Railway in 1832, which were issued in a special leather pouch by the booking clerk and collected by the guard at the end of the journey becoming available for re-issue.

Even to this day, in cities including Bangkok with the Airport Rail Link, a form of tokens continues to be used with slot ticket issuing machines and turnstile-based “passimeters” accepting the tokens for transportation. However, the incessant problem of counterfeit tokens or fake tokens known as “slugs”, plagued the transport ticketing network for decades and acts such as “token sucking” when someone would seal their lips over the token slot to claim a free fare, demanded a new way address transport ticketing which could not be easily tampered (Carlson, 2022).

Welcoming magnetic stripe card, initially developed by IBM engineer Forrest Parry for use by the CIA in the early 1960s and later standardized around the world by the 1970s, the new cards used the same conventional magnetic recording technology used for audiotapes. Consisting of three magnetic tracks used to store the encoded data, these cards not only allowed the programming of information onto the cards to be processed by dedicated readers, but also the ability to create customized cards including for advertising and promotional purposes (Smith & Brooks, 2013). Quickly becoming ubiquitous as the primary mechanism for transactions, the original information standards pertaining to how the data is physically laid out have stood the test of time, surviving every migration of transaction media.

Half a decade on since mag-stripe technology was introduced, it was estimated in 2011 alone that 6 billion bank cards, along with transit tickets and other magnetic-strip media, went through card readers some 50 billion times (Svigals, 2012). Popularized by the airline and banking industry while being used by 80 per cent of the world, one of the first uses of the magnetic stripe card was by the London Transit Authority to make access to transportation more efficient. Nonetheless, with increasing concerns around criminal outfits using card skimmers to make a magnetic copy of the card, even more robust security measures were required (Laney, 2022).

Originating from the humble invention of French inventor Roland Moreno back in 1974, the first so-called “smart card” was nothing more than a memory storage device, what was later encapsulated into a hard epoxy shell, offering protection to the chip and durability to the card. Later integrated with a microprocessor which allowed information stored on the card to be modified, appended to, retrieved, or removed, although the chip was manufactured in the USA by Motorola, interest in smart cards at the time were non-existent (Chrabaszewski, 1999). Rather it was not until the concept of the smart card was embraced by French banking consortium, instrumental in creating the early operating standards for smart card technology, that the technology begun to take root in Europe, with the establishment of a governing body for micro-circuit card development, applications, and standards in 1981.

Thereafter deployed throughout France in 1988, the new chip card as opposed to magnetic strip card, allowed for greater manipulation and yet control of the data by the operators, then primarily banks, leading to a 9 per cent decrease in fraud (BNP-Paribas, 2022). Spurred by the surge in uptake by early adopters such as Carte Bancaire, now the leading French credit card network, and France Telecom, to identify users independently of their equipment, usage of the smart card rapidly took hold in Europe. As such, it was estimated by 1995, 342 out of the 484 million smart cards used worldwide were accounted by Europe, while the number of smart cards in USA (mainly for access control and corporate ID) was negligible numbered well under 1 million (McDermott et al., 1997).

Around this same time in the early 1990s, a group of transport authorities from Belgium, France, Germany, Italy, and Portugal, joined forces to explore a ticketing system that would offer passengers with convenience, while ensuring a high level of security, which resulted in an advanced Contactless Pass solution and specifically, contactless ISO 14443 and CEN 1545 ticketing data standard. Integrating a chip directly onto the card, capable of being read remotely by a radio frequency identification device (RFID), the technology allowed the first contactless ticketing systems for multimodal and multi-operator public transport, evolving to multiservice payment applications (Manon, 2022).

Launched in 1997, the “Octopus card” launched in Hong Kong, was the first stored value card of its kind to not only facilitate payment for public transport but also find utility in several applications outside the transport sector. So widespread is the usage of the Octopus card, that for a population of merely 7.4 million people it is estimated that there are over 26 million Octopus cards in circulation with approximately 13 million transactions each day. Yet today, with ever increasing market penetration of smartphones, near field communication (NFC), as well as, short-range wireless or beacon technology, we are seeing the next wave in contactless ticketing solutions, helping to minimize the time to purchase tickets, simplify the fare collection process and respond to dynamically changing fare policies and service plans while reducing fraud (ITDP, 2006).

Evidently, new open-loop, system-centric, beacon technologies and account-based ticketing (Bieler et al., 2022; Jain et al., 2019), present significant opportunities for cities to harness cutting-edge technologies enabling urban mobility to promote more seamless transportation experiences. These can be realized through the reduction of transaction time both for the user and operator, promoting service efficiencies (TTF-Australia, 2010) or time avoidance and automated inspection technologies (Alhassan et al., 2022). However, as the case of Portugal (Balaban, 2021) and Thailand (Carlisle, 2020) clearly demonstrates, implementation of these integrated ticketing systems has not been without challenges and pitfalls.

Similarly, digital identity, platform interoperability and data privacy concerns, remain key issues (Palfrey & Gasser, 2009), both from a traveller and service provider perspective (Evans et al., 2015) to be addressed to ensure safe and affordable public transport for all. Meanwhile, new blockchain, radio frequency ID (RFID) and Near Field Communication (NFC) technologies, are offering new transformational opportunities to re-envision our human-machine interaction with Mobility as a Service (MaaS) and transport ticketing systems (Gudymenko, 2015; Querido, 2020). Shared in Figure 1 on the following page, we attempt to offer an illustration of the chronology of milestone events leading to the adoption and roll-out of common ticketing systems in the four cities part of this case study, namely Bangkok, Thailand; Fukuoka, Japan; Singapore; and Sydney, Australia. Through this portrayal, we can see how each of the ticketing systems in each country have played out in comparison to each other, providing some insights into the development of transport in each city overall.

1.3 KEY CONSIDERATIONS FOR COMMON TICKETING

Clearly, as disparate transport systems apply different payment modalities, this poses a significant inconvenience when switching between payment types and oftentimes heavy transactional costs as a result (Guo & Wilson, 2011). A more streamlined common ticketing system would help to alleviate any undue stress (Litman, 2022; Tirachini et al., 2013), while providing a more holistic picture of ridership for transport operators (Hadj-Chikh et al., 2019). In such a high-transaction environment, the transport sector needs to do everything possible to reduce crowding, passenger anxiety and stress on the transport infrastructure, which various researchers have evidenced can impact on the psychological feelings of commuters (Haywood et al., 2017; Rezapour & Ferraro, 2021). Meanwhile, planners must seek to optimize at least four dimensions or factors to help improve transit services, namely, i) ease; ii) effectiveness; iii) comfort; and (iv) aesthetics (Levinger & McGehee, 2008). This research will seek to examine common ticketing systems, drawing comparisons from 4 case studies and taking account of both historical and cultural influences which may have also contributed to what has made their systems succeed or fail.

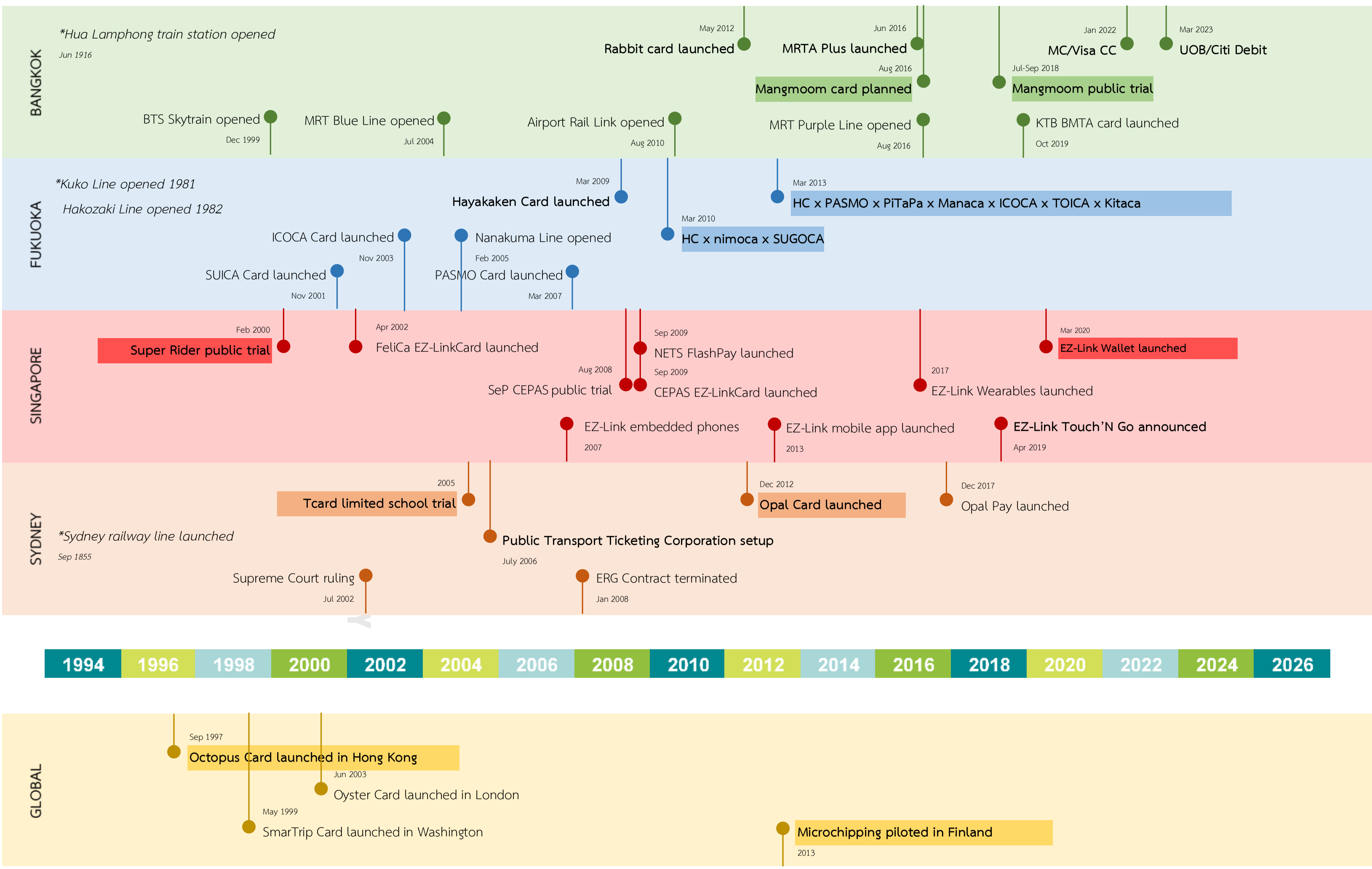

Figure 1: Chronological timeline of transport ticketing interventions in Bangkok, Fukuoka, Singapore, and Sydney

Indeed, the successes and failures of common ticketing systems can be attributed to a wide variety of factors, as examined by numerous researchers. For instance, some have placed the root cause for the failure of adopting a common ticketing system to the cost of fares which are not commensurate with the Thailand's minimum wage, suggesting the "cost to travel per kilometre" to be a determining factor while highlighting the issue of affordability of public transport (Ongkittikul & Charoen, 2021). Clearly, the rate is not balanced if a significant portion of the population are not able to afford the fare leading to transport inequality. With studies showing that longest time spent by Thai workers are associated with obtaining their ticket and emphasizing the average monthly income as an important variable to consider (Satranarakun & Kraiwanit, 2023). While data collected by the Thailand Development Research Institute (TDRI) on electronic fares in Bangkok, have suggested that the average ticketing price in Thailand is 20 percent higher than in Singapore (Hongthong, 2019). In fact, even for cases outside of Asia, using the example of regulated rail fares in the UK and building on a 2011 report from the "Rail Value for Money Study", it is evident that ticket pricing can greatly determine the attractiveness of the public transport and overall ridership with important economic issues regarding fare pricing and empirical studies being conducted on the psychology of how passengers respond to fare changes rolled out (Oxera, 2011).

Taking the position of the transport operator, smart card ticketing systems are assessed using the example of Trondheim, Norway, in terms of their profitability (Welde, 2012). Although profitability can also be a loaded factor, considering the capital investment in ticketing infrastructure which may be required (DfT, 2013); inherent operational and maintenance costs (Gattuso & Restuccia, 2014); which in turn are influenced by National Purchasing Power Parity (PPP) (Fraser & Thompson, 1994); being unique in the case of each country and city and important variables to consider when assessing respective ticketing systems. Meanwhile, although it is true that public transport is often subsidized, any private transport operator would be closely concerned with maintaining sustainability of profits and corporate bottom line. In this regard, factors such as historical ticketing and trip counts equivalent to sales revenue are of particular interest (Srivastava & Purohit, 2021). However, any analysis of the annual ticketing for a particular city, should also be complemented with a thorough understanding of the maturity of the public transport system itself and foundation year in which the common ticketing system was introduced to the city.

As usage of ticketing systems is fundamentally based on availability and accessibility of public transport, dimensions on spatial coverage as examined in the case of China, offer useful insights such as the ratio of number of stations within a particular size or area (ADB, 2008). Of course, besides being correlated with the population of the city under consideration, other variables could include the actual number of railway stations and availability of ticketing offices (Almech & Roanes-Lozano, 2021) and the length of passenger train kilometres, especially in cases where the train network is managed by multiple different transport operators (UK-R&R, 2022). Closely connected with the concept of first and last mile connectivity, transport users would be more reluctant to avail public transport, if the cost both in terms of time and effort to go to and return form their nearest train station outweighed that of driving a personal car, hailing a ride-share or other transport modality. At the same time, direct public transport utilization and rail usage rates are clearly important factors to consider, helping to establish the significance of adoption rates and perceived value (Arnone et al., 2016). Such metrics also serving to provide a good quantitative measure of varying degrees of implementation.

1.4 PROBLEM STATEMENT

In an increasingly digital age and where cities are now coming online, this paper seeks to unpack these critical factors, undertaking case study research drawing from literature and lived experiences. Offering a better overall understanding of the enabling environment and ideal mixture of ingredients to facilitate the successful roll-out of a common ticketing system, interviews will be conducted with transport operators from several selected cities to better appreciate the challenges and strategies employed to overcome those challenges in relation to common ticketing systems. Meanwhile, as we begin to see the introduction of new mobile applications and user interfaces to facilitate the ticketing and payment as part of the transport journey, we take stock of numerous policy challenges ahead and implications on city-wide and system-wide urban planning. It is hoped that this study will help to identify the critical factors for success and failure of common ticketing systems for cities set to embark on their implementation, while serving to fine-tune processes in those cities where common ticketing systems are already in place. Outcomes from the study will help to facilitate improved understanding on common pitfalls and essential milestones towards the roll-out of a common ticketing system for railway systems, especially for emerging countries, where mass rapid transit transport systems are being considered or in the process of construction.

1.5 RESEARCH QUESTION

The primary research question addressed by this study is "What are the critical factors for success of common ticketing systems?", while also learning from previous failures. According to the Cambridge Dictionary, factors are defined as 'a fact or situation that influences the result of something', highlighted as major/crucial contributing systems of measurement, which are considered decisive/key to achieving a particular result. Relatedly, success is defined as 'achieving of results wanted or hoped for' being typically associated with a positive outcome, while failure is defined as the 'fact of someone or something not succeeding', commonly having implications of something not working or that should have been done (Cambridge-Dictionary, 2023). Hence, the research seeks to identify both supporting factors, as well as, mitigating factors, for the roll-out of common ticketing systems.

1.6 RESEARCH OBJECTIVES

This research intends to address what are the critical factors for the success common ticketing systems, learning from previous failures, looking into key operational aspects such as the delivery, social acceptance, and profitability for a ticketing system focusing on rail/train settings. Spotlighting the evolution of the ticketing system in Bangkok, numerous failed attempts at launching a common ticketing system in Bangkok prompt questions concerning the root causes for why such a system remains elusive even today. This research will also be an opportunity to explore those lessons learned from cities in other countries who were seemingly able to overcome their initial stumbling blocks to successfully launch a unified system for rail/train ticketing in their city. On the whole, the study aims to help elicit factors to ensure seamless connectivity integrated e-ticketing platforms, offering us a better understanding of the enabling environment and ideal mixture of ingredients to facilitate the successful roll-out of a common ticketing system, which can be summarized below:

Objective 1: Reveal the importance of ticketing systems in our everyday lives.

Objective 2: Compare the ticketing systems of key cities part of the case study analysis to identify lessons learned for future implementations.

Objective 3: Summary of the critical factors for success for common ticketing systems and thereby helping to draw some useful conclusions.

In undertaking this research, it should be noted the study of common ticketing system in Bangkok is certainly not new, with comprehensive analysis previously led by the Office of Transport and Traffic Policy Planning (OTP), under the Ministry of Transport. As early as 2007, a fact-finding mission was conducted by ADB to consult with government, leading to a Bangkok Mass Rapid Transit Integrated Ticketing project with support from the Japan Special Fund. While in 2020, a governance plan was explored, building on earlier studies on a clearing house in 2009; common fare system in 2010; along with data connection system and revenue management system. Also in 2020, a commission was launched by the Mass Rapid Transit Authority of Thailand

(MRTA) to examine the long-term management and maintenance plan of the rail network to support the efficiency of the common ticketing system.

However, while the development of common ticketing system in Thailand and trends in automatic fare collection are very well captured in the study conducted by OTP, a common ticketing remains elusive, and the depth of analysis in comparing the experience of other cities is arguably superficial at best, looking predominantly at governance structures and only reviewing London, Hong Kong, Seoul, and Singapore in more detail. Looking at the selected cities, along with their underlying governance and regulatory processes, this research will seek to elicit learning from successes and failures in the four selected cities, supporting to establish how platform interoperability is essential to common ticketing systems.

1.7 SCOPE OF THE STUDY

This research will examine primarily metropolitan rail/train systems only, recognizing that common ticketing systems could also be leveraged for bus and ferry transport modes as well, which indeed are successfully implemented in several countries (Scărisoreanu, 2020). By using rail/train systems as the primary entry-point for this study and understanding where interconnected rail/train systems have stumbled in rolling-out common ticketing systems, it is believed will also support any future endeavours striving towards a multi-modal common ticketing system (Pasquale et. al, 2022). While reviewing implementation costs of common ticketing systems, the study will not delve into the economics of fare pricing, for which a good account is articulated on models for fare planning and optimization (Borndörfer et al., 2012). Similarly, to avoid going too deeply into the mechanics of common ticketing systems, this study will not assess the technological standards which are constantly evolving. As multiple modes of public transport exist, the scope of the study will primarily examine train or railway transportation systems and network services essentially evolving from the railway systems.

While interoperability will be examined at the city scale, the analysis of public transport ridership will focus entirely on train networks. Due to limited availability of transport data on user mobility patterns and behaviours, the scope of the study will not extend so far as to provide an analysis of data generated and obtained via origin-destination matrices (Arnone et al., 2016). While covering a broader gamut of transport metrics with detailed benchmarking methodologies and use of geo-analytical tools, one of the most detailed accounts of the elements of success for urban transportation systems was recently conducted examining 25 global cities on the basis of five criteria, namely 1) size 2) economic development 3) transport system features 4) data availability and quality and 5) expert assessment, referring to Table 1 on the following page. Extrapolating from this study also including Bangkok, several important metrics pertaining to rail transport are highlighted in the table below. Although not examining the experiences of cities directly, a good overview of framework conditions for the success of ticketing can be readily found (CIVITAS, 2010); the main drivers that serve as precursors to success; and strategies for successful implementing covering key aspects such as political support, acceptance, financial management, technical aspects, legal framework condition and organizational factors.

Table 1: Key identified metrics (McKinsey & Company, 2021)

No.	Key factors	Variables being assessed
1	Availability	Share of population living <1km from a train station
2		Share of workplaces located <1km from a train station
3	Public transport affordability	Cost of monthly travel card vs average monthly income
4	Efficiency	Average effective public transport travel speed during morning rush hour in kilometres per hour
5	Convenience of ticketing system	Possibility to use remote top-up and/or remote ticketing
6		Possibility to top-up travel card using a bank card
7		Possibility to use contactless bank cards and/or Apple Pay, Samsung Pay or Android Pay mobile applications directly (as an alternative) at pay gates
8		Possibility to use an electronic travel card to pay for non-transport services

Declared by the European Union (EU) in 2018 as the 'Year of Multimodality' common ticketing and payment systems have been a centrepiece of debate among regulators, transport operators and industry representatives, leading to key legislative and policy initiatives relating to better infrastructure, connections, incentives, and digital solutions (Finger et. al, 2019). While even transboundary integration of ticketing is discussed enabling passengers to travel using different modes of transport, provided by numerous operators and between countries, the scope of this study will be limited common ticketing systems in a single country context.

A good account of the benefits of integrated ticketing drawing case studies from across Europe and the Americas (Booz-&-Co, 2009), although lacking any representation of cities in Asia. While experiences are well articulated of integrating urban e-ticketing for public transport and touristic sites drawing from global case studies (Puhe, 2014), this research will focus on critical factors for success of common ticketing systems, learning from previous failures, in Asia-Pacific region, while avoid extending to in-depth sectoral analysis.

1.8 OVERALL RESEARCH OUTCOMES

This research will explore how common ticketing systems can be successfully rolled-out, especially in Bangkok, Thailand, to ensure a more streamlined process for transport users to aid stress reduction and the likelihood of congestion at rail/train stations. Leveraging operational efficiencies this could drive down capital works and investment costs for transport operators with savings in turn passed on to transport users. For cities looking to embark on common ticketing systems, this study can help identify the critical factors for success from other selected cities, while at the same time, learning from previous failures. Meanwhile, for those where common ticketing are already employed, the study can help to further fine-tune their processes. Outcomes from the study will help to facilitate improved understanding on common pitfalls and essential milestones towards the roll-out of a common ticketing system for railway systems, especially for emerging countries, where mass rapid transit transport systems are being considered or in the process of construction. It is further hoped that the research will help to consider the differences in transportation ticketing systems in different cities at different levels of development.

CHAPTER 2: LITERATURE REVIEW

As a key element of any public transport system, ticketing and payment systems for a local transport service provider must be flexible, open, expandable, and economical. Adapting to future market demands, flexibility is an essential feature to help shorten the time-to-market for new fare products, while being economical will ensure that service delivery can modulate against dynamic changes to operating expenses and capital expenditures required. Being open and expandable in this context, such as in relation to business models, media, services, vendors, and sales channels, will avoid any lock-in dependencies and support ease of integration in expansionary phases. While it is further recognized that successful migration of existing ticketing systems to newer advanced common ticketing scenarios requires in-depth planning (UITP, 2020). Yet to date, there does not appear to be any studies bringing these elements together to elicit the critical factors for the success of common ticketing implementation, learning from previous failures.

This second chapter serves foremost to offer an overview of relevant literature which has helped to shape our understanding of common ticketing systems, going back to the roots of the discourse in academia around multi-modal access, at a time where the different forms of public transport were converging. Reviewing both English and Chinese language literature which are documented in a chronological table format, several conceptual frameworks are also elaborated upon which underpin the thinking which later ensues in designing the research methodology considering methodologies employed elsewhere. A summary of the literature reviewed is provided, in addition to an elicitation of the significance of the research and identified gaps. Considering the varied and important stakeholders being involved in facilitating a transport journey, value propositions are assessed for different stakeholder categories.

2.1 STUDIES ON COMMON TICKETING SYSTEMS

Despite the launch of the Octopus Card in Hong Kong in September 1997 and Shanghai Metro Card in 1999, it is not until the early 2000's we see a significant increase in English journal articles on integrated smart ticketing systems using contactless cards, presumably spurred by the introduction of the New York MetroCard in 1997 and SmarTrip Card in Washington in May 1999 (Newman, 1998). Around this same time, common ticketing was being put to trial in Trondheim, Norway and Paris, France, prompted by investigations into the usage of smart cards by Paris Metro employees and initial passenger pilots (Paris-Project, 1998).

Perhaps one of the earliest accounts of common ticketing was the proposition of Multi-modal Access and Payment Systems (MAPS) for New Jersey tabled in the 1993 National Telesystems Conference (Cunningham, 1993). Prompting research by US Federal Transportation Authority, a project was developed to explore plans for common standard card-based fare payment system for various public transit modes (Bushnell, 1995), followed by an analysis of smart cards on transit operators for the Journal of Transportation Research Record (Chira-Chavala & Coifman, 1996).

A cursory review of Chinese literature with the aid of translation tools, surprisingly details the first mention of the 'Octopus card' on Zhangqiao online literature database as a dual English Chinese entry in the Journal of Public Transport International, apparently motivated by a reflection of the political handover of Hong Kong occurring in the same year as the launch of the Octopus card on Mass Transit Railway (MTR) and Kowloon Canton Railway (KCR) (Wildermuth, 1997). Meanwhile, the first Chinese language entry on common ticketing seemingly did not appear on the Wanfang online literature database until a mention in the Shanghai-Hong Kong Economy industry journal, the first example of case study research into common ticketing in China, a comparison of Hong Kong Octopus card, Shanghai Metrocard, Hualian card and Lianhua card (Wen, 2001). Notably, we see a small surge in Chinese literature related to common ticketing in 2004-2005, potentially triggered by discussions between Hong Kong and Shenzhen Metro on fare alignment and possibility of one-ticket transfer between the two cities (Chun, 2004; Shugang, 2005; Songsen, 2004; Yingjun, 2004), by which point it was recorded over 11 million Octopus cards had been issued and some referring to the Octopus card as "weight loss for wallets", "miracle transformation" and the "golden card".

Even among these early English articles, we see that case study research was being employed to compare cities such as Hong Kong and Paris (McDonald, 2000), which makes sense as comparison of technologies are often widely applied for bleeding-edge technologies with cities benefitting from the lessons learned from other cities elsewhere. With common ticketing at the time representing the intersection of the electronic smart cards and digitalization in the public transport sector, operators were faced with questions such as to what extent could the cards be used between different vendors and transport agencies and how to phase out existing cash, tokens and passes, based on the introduction of the new fare payment media. While comparisons mainly focussed on lessons learned, there was elaboration on the benefits of smart card technologies, including 1) cost reduction 2) service improvements 3) fare policy 4) increased revenues leading to success, while examining implementation barriers such as 1) institutional 2) technical 3) user and 4) equity, being similar to factors contributing to failure. Here case study research was employed to inform the ticketing systems in the San Francisco Bay Area.

Despite being seen as a model for common ticking for many other cities and its tremendous success today, the Oyster Card in London which clocks more than 38 million journeys each week on the buses, tubes, trams, Docklands Light Railway, London overground and National Rail Services, was only launched in June 2003. With the application of smart ticketing sprouting in areas outside of London, it was evident that government intervention was required to bring harmonisation to the sector in a way that would help revolutionize ticketing arrangements and allow seamless travel around the country (DfT, 2009). With an estimated net annual benefit of over £1 billion per year to passengers from the roll-out of a smart and integrated ticketing system across England, we see validation of smart cards gaining traction leading to recognition in the Transport Cooperative Research Program (TCRP) Report 94 with a seminal chapter on “Fare Payment Technology Developments” including “Smart Cards” and examining 13 case studies in terms of fare policies and trends, however, entirely based on the experience of cities in USA at the time (TCRP, 2003).

In London, we again see case study research employed to examine improvements in public transport ticketing through smart cards (Blythe, 2004) using the Oyster Card as a focus while highlighting several early trials in the United Kingdom such as in Milton Keynes, Mersey Travel, Harrow, and Hertfordshire, to name a few. In the US, a follow-up TCRP Report 115 in 2006, titled “Smartcard Interoperability Issues for the Transit Industry”, applied case study research of 12 different smart card systems, for the first time having a section on “Asian contactless Smartcard Trends” featuring Hong Kong and Singapore as case studies (TCRP, 2006).

Relatedly, case study research was also used by the Federal Bank of Boston to examine transit payments in 2008, highlighting 1) cost considerations 2) consumer inertia and 3) security concerns as key barriers and 1) convenience 2) consumer cost savings and lower operating costs 3) fraud risk reduction 4) improved customer relationship management and 5) operational efficiency as key benefits (Quibria, 2008).

Perhaps acting as a precursor to the launch of Rabbit Card in May 2012, A Transport Sector Assessment, Strategy conducted recognizing the need for an integrated ticketing system (ADB, 2011). Capturing all of these seminal articles which have helped to shape the authors understanding of common ticketing systems, Table 2 has been prepared providing an overview in the order in which the research was published and detailing the cities examined, as well as, the methodology employed.

Table 2: List of studies addressing common ticketing and their research methodology approach employed to compare the ticketing systems

Author/s	Title	Year	Countries /Cities	Methodology
Cunningham, R.F.	Smart card applications in integrated transit fare, parking fee and automated toll payment systems-the MAPS concept	1993	New Jersey	Introducing concept of Multi-modal Access and Payment System (MAPS), primarily through the lens of information management.
Bushnell, W. R.	Smart cards for transit: Multi-use remote interrogated stored data	1995	Washington	Examination of current and planned applications in relevant transit modes, and in-person interviews with public transit personnel

	cards for fare and toll payment			
Chira-Chavala, T. & Coifman, B.	Effect of smart cards on transit operators	1996	California	Evaluation of cost and productivity implications of smart cards based on interviews with transit personnel and onboard passengers.
Wildermuth, B.	The Hong Kong 'Octopus'	1997	Hong Kong	Social commentary on the handover of Hong Kong and the introduction of the Octopus card in 1997
Newman, A.	Incentives Lured Bus and Subway Riders in January	1998	New York, Washington	Examination of the impacts from introducing free transfer and other fare bonuses on smart cards.
Meland. S.	Impacts and Accessibility of an Integrated Payment System	1998	Trondheim	Two-wave interview survey and review of monthly system transaction data, evaluating the effect of "TRON card" on bus use among 500 households which took part in the test.
Paris Project		1998	Paris	Evaluation of passenger trials with 1,000 users to ascertain the viability of launching common ticketing.

McDonald, N.	Multipurpose Smart Cards in Transportation: Benefits and Barriers to Use	2000	Hong Kong; Paris, Phoenix; San Francisco; Seoul	Analysis of benefits including cost reduction, service improvements, increased revenues and barriers including institutional, technical, physical, user and equity-related concerns.
Wen, Z.	There is an "e-wallet" in Hong Kong	2001	Hong Kong, Shanghai, Hualian, Lianhua	Case study research of the newly introduced smart cards and common ticketing systems in China.
TCRP	Fare Policies, Structures and Technologies: Update	2003	Akron, Chapel Hill, Chicago, Connecticut, King County, Maryland, San Francisco, New Jersey, Orange County, New York, Portland, Ventura, Washington, London, Hong Kong, Paris, Pusan, and Curitiba.	Selective comparison on nature of the program, customer impacts and benefits including usage rates, attitudes towards the program, cost of travel, benefits (and disadvantages) to the agency such, as well as, constraints to the implementation including economic and political concerns, technical issues.
Blythe, P. T.	Improving public transport ticketing	2004	London (although other cards mentioned such as, Cornish, West	Mainly focused on payment mechanisms and information flow for smart cards, along with the technology issues associated with the early trials of the smart cards in United Kingdom.

	through smart cards		Yorkshire, Nottingham, North East Regional and North West	
Yingjun, C.	Technical implementation of interoperability between Hong Kong Octopus card and Shenzhen Metro stored value card	2004	Hong Kong, Shenzhen	Technical analysis of the hardware environment and inter-operability between Hong Kong Octopus card and Shenzhen Metro card.
Songsen, L.	Promotion of Hong Kong's Octopus smart card system and its application in the subway system	2004	Hong Kong	Overview of the roll-out of the Hong Kong Octopus card by the Revenue Affairs Manager, Hong Kong MTR Corporation Limited
Chun, K. L.	The Octopus in Hong Kong: The	2004	Hong Kong, Belgium, Singapore,	Comparison of top smart-card based e-payment systems in 6 countries and analysis of the Hong Kong Octopus

	Success of a Smart Card-based E-payment System and Beyond		Germany, Netherlands, Switzerland	card using Simmel's framework looking at 11 attributes.
Shuguang, L.; Liu; Dinggeng, L.	Research on one-ticket transfer between Shenzhen Metro and Hong Kong Octopus Card	2005	Hong Kong, Shenzhen	Study on the possible operation and viability of one-ticket transfer between the Shenzhen Metro and Hong Kong Octopus card.
TCRP	Smartcard Interoperability Issues for the Transit Industry	2006	Chicago, Central Puget, Orlando, Hong Kong, London, Singapore.	Peer review of interoperable smart cards examining ISO compliance, fare policies, transit benefits and loyalty programs.
Quibria, N.	The Contactless Wave: A Case Study in Transit Payments	2008	Utah, New York, Ohio,	Overview of challenges including standardization, cost and risks associated, along with barriers such as, security concerns, privacy and switching costs. Benefits included convenience, flexibility, consumer cost savings, security, operating efficiency, speed, lower operating costs,

				reliability, fraud risk reduction, CRM and accountability.
Szuc, D.	A Really Smart Card: How Hong Kong's Octopus Card moves people	2008	Hong Kong, London, Melbourne	Unpacking of features which make the Octopus card a success, along with comparison with London Oyster card and Melbourne myki.
Department of Transport (United Kingdom)	Smart and Integrated Ticketing Strategy	2009	London, Hong Kong, Chicago, Lyon	Government strategy for smart and integrated ticketing, based on a consultation paper which received 122 replies, being annexed. Case study research of several cities and outline of commitments by senior management and stakeholders.
Turner, M.; & Wilson, R.	Smart and integrated ticketing in the UK: Piecing together the jigsaw	2010	London, Chicago, Lyon, Melbourne, Nigeria, Tokyo, Hong Kong	Focus on interoperable smartcard ticketing standard (ITSO) and comparison of ticketing technologies and framework agreements.
ADB	Thailand: Transport Sector Assessment, Strategy and Road Map	2011	Bangkok	Sector analysis of strategic issues, constraints, and development needs, informing government policies, plans and ADB partner strategy.

Privacy International	Oyster, Octopus and Metro cards: what happens to our data?	2012	London, San Francisco, Hong Kong	Private inquiry of 48 transport authorities and companies operating common ticketing, requesting for information, and examining the openness to data availability.
Prayoonphan, F., & Xu, X.	Factors Influencing the Intention to Use the Common Ticketing System (Spider Card) in Thailand	2019	Bangkok	Survey of public transit users based on unified theory of acceptance and use of technology (UTAUT) and using Partial Least Square-Structure Equation Modelling (PLS-SEM) employed to examine the data.
Carlisle, P.	Bangkok's Rail Network Common Ticketing System Vows Fall Flat. Engineering News	2020	Bangkok	Social commentary on delays on introduction of common ticketing and failure of the Mangmoom card attributed to issues such as cost, ownership and governance.
Shetye, Y.; Singh, M.; Gupta, J.; Jeyachandran, A.; & Jain, A.	The changing face of transit: Emergence of a multimodal integrated ticketing system	2020	Australia, India, Singapore	Taking a unique view from the perspective of acquiring banks or financial institutions involved in the setup and establishment of the common ticketing modality.
UITP	Demystifying Ticketing and Payment in	2020	London, Talinn, Klaipeda,	Report on common ticketing comparing card-centric versus media-based ticketing (MBT) and account-

	Public Transport		Lisbon, Paris, Stockholm,	based ticketing, along with possible migration scenarios.
Mondal, Md. Ashifuddin ; & Rehena, Z.	Common Ticketing Service in Multimodal Transportation System	2021	None specified	Development of a strategy for the measurement of effectiveness in the delivery of transportation services within multimodal systems.
Bieler, M., Skretting, A., Budinger, P., & Grønli, T-M	Survey of Automated Fare Collection Solutions in Public Transportation	2022	None specified	Adopting primarily a focus on technology applications and common ticketing implementations, ranging from IoT, mobile apps and machine learning use-cases

2.2 REVIEW OF METHODOLOGIES EMPLOYED ELSEWHERE

2.2.1 Train and Passenger Experience Monitor

When considering those factors deemed essential for common ticketing systems, the psychology of transport with provision of services is conceptualized a pyramid of customer needs, whereupon aspects such as reliability and safety form the very base of the pyramid, hence reflecting those underlying and perhaps basic needs passengers place trust in the transport operators to be able to adequately provide (Hagen & Oort, 2018). As we see depicted in Figure 2 on the following page, reliability can be associated with the desire for passengers to have a hassle-free journey without service disruptions and issues when interfacing their smart card with ticketing readers and for the lifespan and durability of the ticketing media form.

Whereas, safety can relate not only to the ability to avoid overcrowded ticketing booths or vending machines, but also the assurances that the data contained on their smart cards are being maintained in a confidential manner, preserving their privacy and personal information. While reliability and safety can be seen as general assumptions of service, the suggestion is that common ticketing provides for enhanced speed of ticketing both in terms of entering and exiting ticketing barriers, but also the time taken to purchase the ticket due to the stored value in the card.

Using the very same concepts put forward, common ticketing can be seen as facilitating greater ease in catching public transport, but reducing the mental effort or figuring out which cards to use and inevitable situation where certain cards are left at home and the incorrect cards are being carried. Meanwhile, additional quality-of-life functionality made possible by common ticketing can help to ensure more predictable pricing and the ability to purchase products or services which are external to the transportation network.

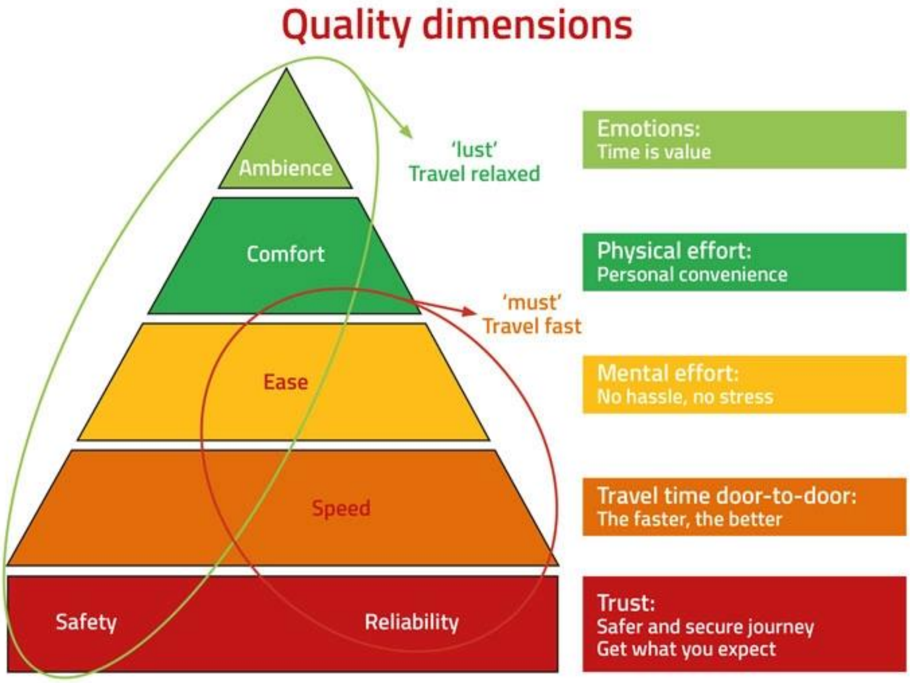

Figure 2: Pyramid depicting the different dimensions of quality (Hagen & Bron, 2013)

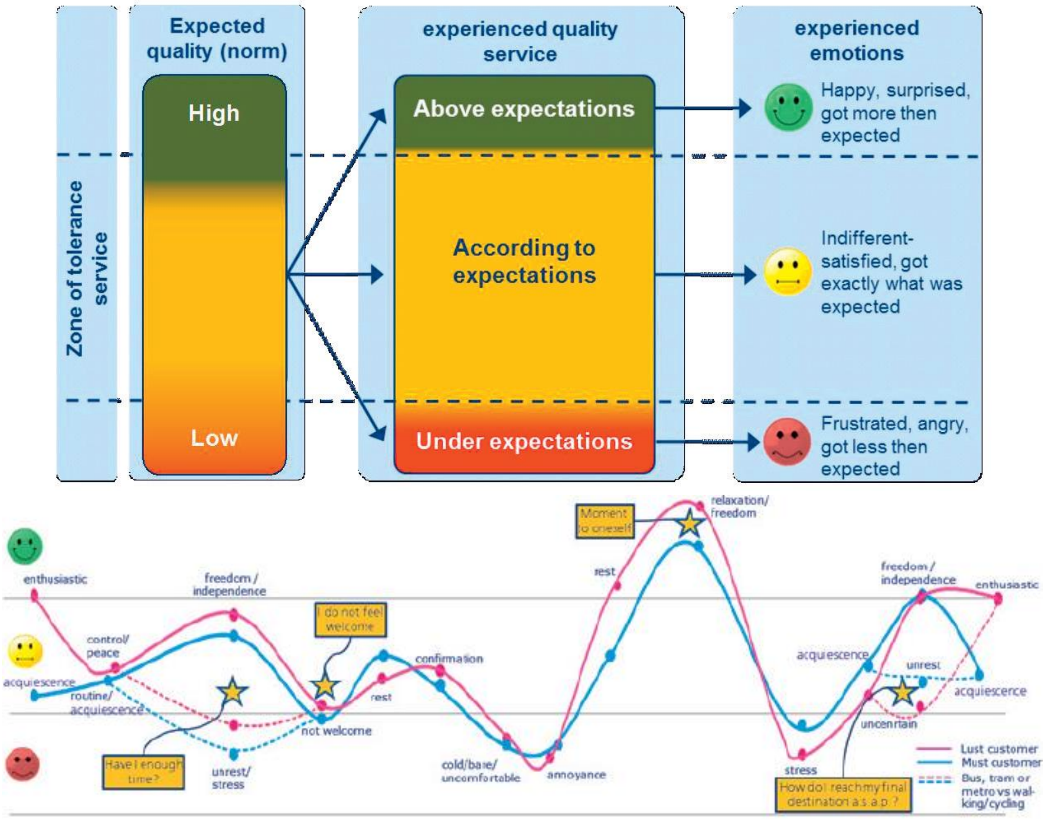

Figure 3: Visual illustration of customer needs/experience (Hagen & Bron, 2013)

At the upper-end of the passenger satisfaction pyramid and train experience monitor, passengers are suggested to be seeking comfort, which could be realized in terms of common ticketing systems from the perspective of contactless travel which is free of any impediments, along with reduced levels of stress and anxiety which are typically associated with standing in long queues for ticketing, especially in hot, humid or frosty environments or adverse weather conditions. While at the apex, when all other previous factors forming the foundation of the pyramid are already met, is the concept that passengers are desiring a level of ambience or experience, such as the perceived sophistication of using a modern and technologically-advanced form of ticketing along with its added services. The study continues to suggest that important elements to consider as part of the overall customer journey include but limited to trip time determination; vehicle holding times; terminal design; line coordination; and line length design, referring to Figure 3 on previous page. These concepts are expanded in further studies which posit that transit service quality is a combined function of travel, speed, comfort and affordability and the development of a "Level-of-Service" rating to compare transit across different modes (Levinger & McGehee, 2008).

2.2.2 Indices to evaluate transit service quality

Systematically reviewing several indices for transit service quality in studies conducted by myriad authors in Fu et. al (2005), these various transportation indices are represented in Table 3 on following page and ranging from issues of accessibility, mobility to service quality, a number of key performance factors are evolved which may be relevant to the writing of this paper. These include frequency and coverage, which in the context of common ticketing systems could relate to how often individuals may need to switch between different ticketing platforms.

For example, if a passenger only anticipates to catch public transport once a month or lives in a particular where service coverage is limited and public transport is not readily available, concerns around common ticketing would be significantly different from a passenger who utilizes public transport on a daily basis or even multiple times throughout the day. Other performance factors assessed of note include cost efficiency and travel time, which would be of high importance to common ticketing systems, which at their core are seeking to ensure a more seamless transport experience resulting in operational cost savings and swifter transactions for passengers at the gates.

Table 3: Comparison of train-related indices (Fu et. al, 2005)

Indices	Studies	Performance Factors	Transit Availability?	Comfort and Convenience?	Travel Demand?
Local Index of Transit Availability	Rood 1997	Frequency; capacity; route coverage	Yes	No	No
Public Transport Accessibility	Hillman,	Frequency; service coverage	Yes	No	No
Mass Transit Indicators	Hale, 2011	Transit supply, travel impacts, land use, cost efficiency	Yes	No	Yes
Transit Level of Service Indicator	Kittelson & Ass. and URS 2001	Coverage; frequency; span; population; jobs	Yes	No	Yes
Transit Service Accessibility Index	Polzin et al. 2002	Coverage; span; frequency; travel demand	Yes	No	Total trips
Mobility Index	Galindez and Mireles-Cordov 1999	Travel speed; average vehicle occupancy	No	Yes	No
Service Quality Index	Hensher et al. 2001	13 variables (travel time; frequency, etc.)	Yes	No	Yes
Transit Service Indicator (TSI)	Fu, Saccomanno and Xin 2005	Frequency; coverage; walk, wait, transfer, and ride travel time.	Yes	Yes	Yes

This table compares indices used to evaluate transit service quality and predict service change impacts.

2.2.3 Perceived value, convenience, and sacrifice

In (Prayoonphan & Xu, 2019), the Unified Theory of Acceptance and Use of Technology (UTAUT) formulated by (Venkatesh et al., 2012), is utilized to investigate commonly accepted influence factors on behavioural intention and adoption such as perceived convenience versus perceived sacrifice. Thereafter, employing UTAUT model, 7 key constructs are examined, namely performance expectancy, effort expectancy, facilitating conditions, social influence, perceived convenience, perceived sacrifice, and perceived value to assess 8 proposed hypotheses, which are summarized here below and illustrated in Figure 6 on the following page:

- H1: Performance expectancy will have a positive effect on intention to use Spider Card
- H2: Effort expectancy will have a positive effect on intention to use the Spider Card
- H3: Effort expectancy will have a positive effect on performance expectancy
- H4: Facilitating conditions will have a positive effect on intention to use the Spider Card
- H5: Social influence will have a positive effect on intention to use the Spider Card
- H6: Perceived convenience will have a positive effect on perceived value
- H7: Perceived sacrifice will have a negative effect on perceived value
- H8: Perceived value will have a positive effect on intention to use the Spider card

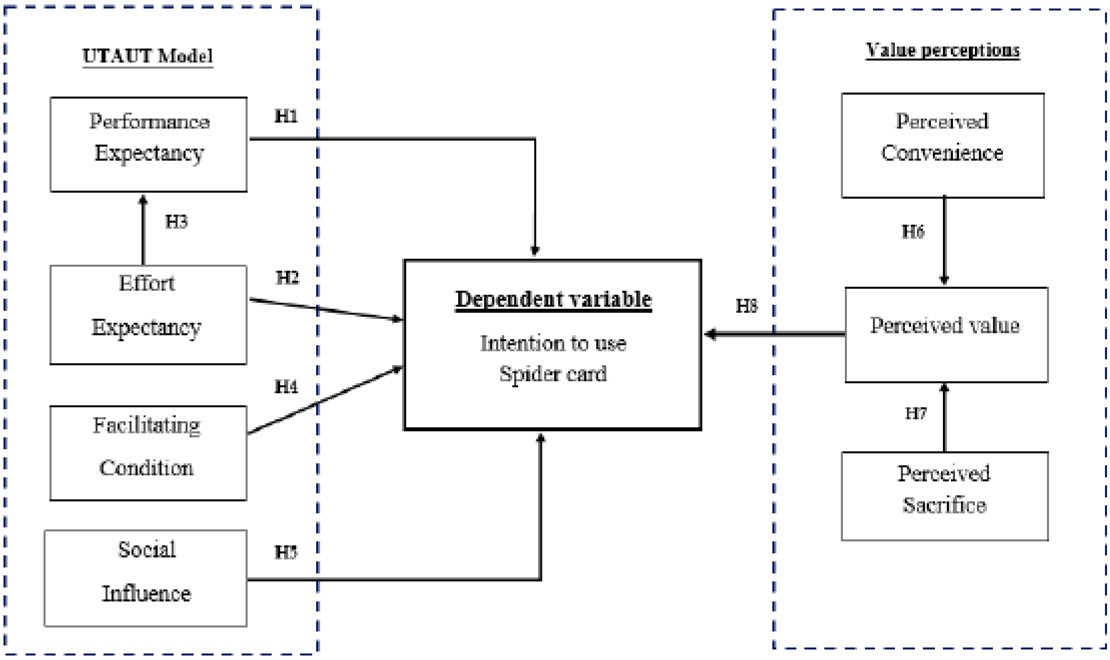

Figure 4: Proposed research model in Prayoonphan & Xu (2019)

Using a five-point Likert scale to test the 8 hypotheses, 408 respondents were canvassed, the Partial Least Square-Structural Equation Modelling (PLS-SEM) technique was performed on Smart PLS. At the conclusion of the study, it was reported that perceived value, performance expectancy and facilitating conditions indeed had a positive influence on passengers' intention to use the Spider Card for public transportation in Thailand, along with confirming that perceived value is positive influenced by perceived convenience but negatively influenced by perceived sacrifice. Moreover, the study identified that social influence was not deemed to be a substantial predictor of intention, while effort expectancy is the most important factor affecting performance expectancy, but insignificant on behavioural intention to use the Spider Card.

In ADB (2009) being a final report commissioned on the Bangkok Mass Rapid Transit Integrated Ticketing Project, a detailed account of the existing fare policy in

Bangkok is provided, looking into the fare structure, different fare models and evaluation of fare products. Examining the procurement for back-end system, an appraisal mechanism is put forward to ensure that the common ticketing system implemented meets the necessary requirements across each of the Central Clearing House (CCH), Card Issuing Machines (CIM), and the Key Management Systems (KMS), along with offering recommendations for system specifications, cost estimates and process for technology transfer.

The report then continues to propose possible financing requirements for implementation of the common ticketing system, potential funding strategies, value for money assessment, and investment recovery plan. Recognizing the importance of a clear governance structure accompanied by sound laws and regulations, the report shared guidance on forming a common ticketing company, supervision of said company and even terms of reference which could be used for the establishment of required program management services.

Through the report, the total back-end system cost is estimated to be 120,000,000 THB (approx. USD $3.46 million) the total front-end system cost is estimated to be 69,800,000 THB (approx. USD $2 million). Taking into account inflation, contingency costs, and financial charges during implementation, the overall investment costs are estimated to 216,533,000 THB (approx. USD $6.24 million), with funding proposed through a 10-year government bond, 5.5% expected return on equity for the government and 1.5 year construction period.

2.3 SUMMARY OF LITERATURE REVIEW AND CASE STUDIES

Examining both English and Chinese literature databases, the first journal articles related to common ticketing systems appeared emerging from the Americas 1993, some years even before the launch of the Hong Kong Octopus card in 1997. By and large, a significant number of articles published, compared cities as a methodology. First referred to as “Multi-modal Access Payment Systems or MAPS” in 1993, like many innovations, the discourse on common ticketing started as a discussion among academia and practitioners driving towards technology standards. Seeing the economic opportunity for this, a project was commissioned by the US Federal Transportation Authority, with a significant surge in literature in 2004, when looking at fare alignment between Hong Kong and neighbouring Shenzhen.

Appreciating the propensity for cost reductions, service improvements and revenue, in themselves being success factors, cities like San Francisco pioneered by leading their own projects and fare harmonization undertaken in the UK and elsewhere. With increasingly complex train systems, rapid urbanization and population growth, in more recent research we start to see issues around interoperability and technology introduced, as well as, social studies on consumer inertia, privacy and convenience. Today, topics such as multi-modality are now widespread and new topics like open loop payment systems surfacing. Indeed, the effective roll-out of common ticketing often depends on a complex, system-interdependent ecosystem of stakeholders whose success also depends on the joint action of all players simultaneously. Proven possible in only a few countries such as Japan and South Korea, where national payment strategies are legislated, this is on contrast to many countries in Europe and the United States, still lagging in mobile payments (Ezell, 2009).

This is clearly demonstrative of the need for a strong enabling environment with close cooperation among stakeholders, financing of pilot projects and subsidized installation (Yoh et al., 2006), often backed by centralized government control and institutional coordination, such as in Hong Kong and Singapore, but also the roll-out of common ticketing schemes in Netherlands and United Kingdom (ITF, 2012). Conversely, a frequent stumbling block in the quest for common ticketing systems is the inability of the ecosystem of stakeholders which often have conflicting interests to reach agreement on key areas, often related to level of control, revenue capture, equipment acquisition, serving and maintenance, and vendor selection process.

Spurred by the success of open loop payment systems in cities such as London in 2012, there is also now a noticeable trend in the adoption of systems which relieve public transport operators with the need to issue, stock and replace smart cards, while placing the burden on issuing institutions (Soehnchen, 2022). Examples of this include the ability to utilize Mastercard and Visa credit and debit cards on the MRTA, Google Pay as an alternative to SmarTrip card in Washington DC, and use of EZ-Link wearables such as smart watches in Singapore. Despite removing the concept of a ticket out of the equation entirely, general principles of common ticketing systems still apply, ensuring platform interoperability, agreed standards of usage, and a rational transparent pricing structure which is clearly communicated.

On the whole, it is evident that public transport systems must adapt or perish, while maintaining the status quo may seem like the comfortable solution, this risks falling behind other cities globally and failing to take advantage of technological progress. With operational trials of smartcards exhibiting time savings during boarding and more convenience versus cash-based transactions (Chira-Chavala & Coifman, 1996), common ticketing has the potential to offer a faster, better, and cheaper travel interaction, improving operational service efficiencies along with minimizing transactional costs (Guo & Wilson, 2011), by improving the speed of boarding and more seamless payments in cashless economy (Hadj-Chikh et al., 2019).

Meanwhile, new "mobility as a service" (or MaaS) systems are now providing a combination of an intermodal journey planner, booking system, easy-payment, and real-time information on a single platform. Offering integrated and seamless mobility, MaaS is founded upon the three main elements, namely (i) ticket and payment integration or the ability to access and pay for multiple modes of transport using a single card or ticket (ii) mobility package allowing pre-payment for diverse modes of travel and (iii) ICT integration facilitating a single interface to obtain data and information about the different transport modes (Kamargianni et al., 2016).

2.4 SIGNIFICANCE OF THE RESEARCH AND GAPS

Combined, the research undertaken by (Prayoonphan & Xu, 2019) and report prepared by (ADB, 2009), along with a plethora of other studies on related subject matter, should have provided the essential blueprint for a common ticketing system in Bangkok, examining not only the fare policy, governance mechanisms, and financing requirements, but also socio-behavioural intention to use the Mangmoom (or Spider Card) itself. Nonetheless, almost 15 years on from the production of the report and 5 years on from the research carried out, an integrated common ticket remains elusive. As elaborated by (Clark, 2022), an official unified transit map may still be lacking and what would have been possible on one ticket without having to exit the station in London or Tokyo, travelling between Thong Lor BTS to Don Mueang Airport SRT required three separate tickets on board the SRT, MRT and BTS.

Besides the fact that such a disjointed system does not allow a cap on daily spending, passengers must also pay a separate fee each time they use a different network. While as shared in (South-East-Asia-Infrastructure, 2022), technical and infrastructural difficulties, as well as, the cost and complexity of the scheme, have hampered progress despite recognition an open-loop system would substantially lower procurement, ticketing, and transaction costs for transit operators. Meanwhile, passengers continued to be charged multiple flag fall rates, as a result leading the average ticket price in Thailand to be 20% higher than Singapore. As of May 2022, despite the establishment of the Common Ticketing Management Consultant Commission (CTMC) by the MRTA, formal business negotiations between government agencies and mass transit operators to agreeing on and promulgate a common fare structure for all mass transit operators that participate in the common ticketing system were still yet to begin.

This thesis paper is therefore proposed as an opportunity to consider further these gaps both in terms of research and implementation. By reviewing the experiences of other cities, particularly those might have also experienced challenges initially in rolling-out their integrated ticketing system, as well as, those perhaps considered to be best practices in their field, it is hoped will shed more light on critical factors for success, learning from previous failures, which should be taken into account for the introduction of common ticketing in Bangkok.

Building upon (ADB, 2009) which had established two kinds of objectives for an integrated ticketing system, defined as social objectives such as increased ridership and occupancy, equitable fares, and ease of use, along with financial objectives, such as increased fare revenue, ridership, more fare options and reduced fare collection costs, the study will also benefit from previous analysis conducted by the Office of Transport and Traffic Policy and Planning (OTP). In (OTP, 2020), for instance, a study of the governance plan for management of a common ticketing system is examined, along with a rudimentary analysis of lessons learned from other cities, limited to Taipei Easycard; London Oyster Card; Singapore EZ-link; Shanghai Traffic Card; Hong Kong Octopus Card; and Tokyo, Suica Card, a source of inspiration for this case study research.

Thereafter, criteria related to ticketing systems as an aspect of convenience identified in (McKinsey-&-Company, 2021) assessment of urban transportation systems of 25 global cities, which had used the metrics of 1) availability 2) affordability 3) efficiency 4) convenience 5) safety and sustainable development, upon which a snapshot is shared from the research in Figure 7 directly below, helping to offer thinking on the development of suitable variables and areas to be assessed when considering critical factors for success and failure.

Ticketing system

- Availability of a universal travel card to pay fares while using multiple modes of public transport
- Possibility to use remote top-up and/or remote ticketing
- Possibility to use an electronic travel card available on mobile devices
- Possibility to top up travel card and/or buy a ticket using a bank card
- Possibility to use contactless bank cards and/or Apple Pay, Samsung Pay, or Android Pay mobile applications directly at pay gates
- Possibility to use an electronic travel card to pay for nontransport services
- Possibility to pay fares using biometric data
- Need for registration following travel card top-up

Figure 5: List of criteria considered important to evaluate ticketing systems

2.5 VALUE PROPOSITION OF COMMON TICKETING FOR DIFFERENT STAKEHOLDERS

As the case in Europe demonstrates, which for over a decade has been promoting integrated ticketing as part of intelligent transport systems (ITS), as a priority agenda of its European Union transport policy, ensuring sustainable mobility, while increasing passenger inter-modality and attractiveness of public transport (Commission-of-the-European-Communities, 2011), implementation of an integrated e-ticketing system is a complex process that requires the synchronized activity of heterogenous actors, each with their own set of drivers, motivations and interrelations which can also be conflicting.

The balance between revenue-seeking objectives of private sector, cost-saving interests of passengers, and efficiency-agenda of governments being a classic example, the different preferences, expectations, and priorities of those involved in the use and provision of integrated ticketing must be carefully understood in order to ensure that specific needs and objectives are met, and where necessary for compromise in service offerings to be achieved (Puhe, 2014). To this end, we examine here in this section the actual value which is perceived by different stakeholder groups in relation to common ticketing systems.

2.5.1 Government and state-owned enterprises

Although standalone, the profitability of a transport system would be considered ideal, the function of public transport must be understood in terms of the eco-system of services within the city and ability of public transport to offset other forms of transport especially road personal road transport having both environmental and social externalities. When fully integrated across all transport modalities, common ticketing can lead to procurement efficiencies, such as the capture of revenue not only for rail transit networks but also bus, ferry and even tollway systems, as is the case in Singapore and currently being explored in Thailand.

Common ticketing can be of value to government and state-owned enterprises, in its ability to provide a more comprehensive systems-oriented view of the transport network, facilitating the possibility of tailored products and service offerings, as well as, adjusting planning policies to cater for shifting demand at different periods of the day or week (Rehema, 2021). Enhanced data asymmetry and cross-comparability of ticketing information based upon a more harmonized set of data, can also assist to make available up-to-the-minute information to improve decision-making and support operational efficiencies. Politically, common ticketing beyond creating the basis for a more seamless passenger journey across transport networks and predictable pricing, can also help to foster an image of a unified and coherent policy direction and governance capacities improving popularity (Mezghani, 2008).

2.5.2 Business and private sector

Introducing cost savings due to reduced floats times for train station operators and reduced dwell time for passengers, common ticketing systems help to increase the overall throughput of people catching public transport while minimize delays due to personal fumbling and denials to entry. Lowering the barrier to introducing new value-added services, common ticketing can increase the stickiness factor, simply by integrating the use of the card to a point-of-sale system, thereby facilitating an open-loop system of secondary purchases and new opportunities for revenue generation.

As common ticketing relies upon a shared IT backbone, observances of anomalies across transport networks such as related to fare evasion can be more easily identified and regulated, while making more difficult for criminal syndicates or opportunistic individuals to emulate the technology and information contained the smart cards and engage in ticket forgery, falsification, or fraud (Fürst & Herold, 2018). Except where there is a monopoly or dominant market player, common ticketing generally serves to create more level playing field, facilitating the sharing of information across the private sector and allowing more reliable decisions to be made toward medium-term operating profit and customer service, while incentivizing the entry of new technological offerings and transport innovations, capturing more customers through loyalty schemes and promotional campaigns.

2.5.3 Consumers and transport users

As users and the ultimate beneficiaries of common ticketing systems, passengers benefit from the convenience of having to only carry one single card making for lighter wallets and purses, but also the time avoidance and speed of transiting different transport networks without changing cards. When merged with travel and expense management software, common ticketing can support individuals to conduct expense tracking and monitor their history of journeys across multiple transport networks, to explore those services considered to be the most reliably, frequent, fast, comfortable, accessible, convenient, affordable, and safe, based on their own personal experience.

Real-time information across multiple transit modes and capable of taking in information from different transport operators and digital sources, can mean that passengers can quickly adapt to dynamic congestion scenarios. While targeted ticketing strategies as implemented by government can also help facilitate subsidized public transport especially for marginalized, low-income, or vulnerable parts of society, thereby improving equality and access to transport for everyone (C40, 2019). Common ticketing offers the advantage to passengers of easier or more numerous ways to reload the stored credit value in the cards in more diverse locations including digital payment and top-up regimes at the click of a button or directly using handheld mobiles and specialized applications.

2.6 DIMENSIONS FOR THE ASSESSMENT OF COMMON TICKETING

2.6.1 Dimensions of convenience

When assessing the effectiveness of common ticketing, it necessary to consider the relative convenience of the ticketing format and usage, which can also be interpreted differently for government, private sector, and passengers, respectively. Indeed, there is no universal definition of which service attributes come under the definition of convenience (Anderson et al., 2013), which in itself can be rather ambiguous, showing a high degree of overlap with other service attributes (Crockett & Hounsell, 2005), related to all stages of the journey, from initial planning to arrival at the destination, perhaps more easily conceptualized as an end-to-end series of touchpoints upon which passengers might interact with the public transport and ticketing system (Zalar et al., 2018). Convenience in this regard is also closely linked to the concept of reliability, as positive user experiences generally help to promote trust and continued loyalty creating a virtuous cycle of ridership, whereas systems which are deemed to be unreliable and inconvenient tend to be avoided by potential customers (González et al., 2021).

From the point-of-view of governments, transport convenience can be examined through the lens of operational efficiency with interests to ensure maximum utility of the public transport network. This can also relate to the improvement of traffic congestion by reducing the number vehicles on the street. Businesses may be interested in transport convenience in the ability of common ticketing to open new online and offline revenue streams, such as through added services and digital content, as well as, support to the ease of doing business. While passengers will be mostly be concerned with whether the common ticketing system implemented, leads to time savings and potential alleviation of the stresses associated with public transport during peak hour.

2.6.2 Financial costs of the system

Fundamentally, common ticketing must be affordable and delivering value for the person utilizing transport, while at the same time, balancing the cost of capital works, infrastructure, servicing, and maintenance associated with the implementation borne by the government and operator. Despite an often widely held assumption, especially in the United States that public transport is not profit-making industry (Hannan, 2012; Jaffe, 2015), the cases of Hong Kong, Japan and Singapore would suggest otherwise. According to a study by Brookings referred to as the Hamilton project, the immediate if unsurprising takeaway is that every single metro rail system whether subways, elevated trains or light rail is losing money, with only 2 percent of America's 1,800-plus mass transit operations (metro trains, buses and other modes combined) generating more fare revenue than costs (Burke, 2015). Yet "rail plus property" models such as Hong Kong which have fused railway expansion with land value capture processes and real estate development, have ensured its Mass Transit Railway (MTR) Corporation is self-financing, making just as much profit above ground, from property development, as it does from its rail operations, making it one of the most profitable metro operators in the world (Keegan, 2019).

Continuing to deliver operating profits, the case of Singapore may be considered unique with a dominant public transport operator in the context of a city-state. While the case of Japan flips the model on its head, with all public transport services now operated by private firms, no tram or metro operator that is state-owned and only a few directly and independently operated by the city. Allowing operators to run advertisements on the system, lease out kiosks in the station premises and operate stores in the vicinity have helped to ensure profitability (BLK, 2022).

Financially, the cost of implementation of common ticketing for government can be considered a fairly loaded concept and difficult to estimate, however, this should include at a minimum the actual cost of manufacturing the ticketing medium, the management of receiving devices and ticketing infrastructure, and average ridership representing the revenue potential. Calculating the cost for private sector operators often concerns the licensing arrangements, taxation rebates, land acquisition and other preferential financing terms. While the cost for consumers is strongly linked to affordability with equitable transport relying on subsidies for low-income groups (Bondemark et al., 2020).

2.6.3 Risks, safety and security concerns

From the perspective of government or local authorities, there is a genuine need to address the sense of fear that may be associated with public transport when considering the roll-out of any ticketing system and how the proposed system might serve to quell or reinforce those perceptions. This also introduces the question, whether public transport and the ability to move freely within society should be considered to be either a community right or communal responsibility (Carr & Spring, 2006) with varying levels of accountability depending on the form of governance and values held by the passenger.

In this sense, a high prevalence of crime is most certainly going to be a key determinant for users when considering whether to use public transport. While other considerations such as a common ticketing system being easier to understand and manage, helping to promote operational efficiency, prevent loitering, and fare evasion, being other important incentives for government. For businesses or operators engaged in the provision of common ticketing systems, the concerns related to security can often arise associated with the potential for litigation and disputes arising from perceived cases of negligence or misconduct.

This could include the more obvious example of potential injuries or accidents resulting from the application of common ticketing systems to mitigating the possibility of fraud which could be associated with ticketing financial controls. Finally, as common ticketing systems imply the harmonization of information and exchange of data between systems and operators, many consumers will be alert to the way in which privacy of their personal data is managed and the potential for misuse (Milutinovic et al., 2015), along with general concerns about risks, safety, and security, such as related to accessibility to stations (Hamid et al., 2015).

2.7 CONCEPTUAL FRAMEWORK

In this way, the primary categories of stakeholders described, 1) Government and state-owned enterprises 2) Business and private sector 3) Consumers and transport users can be seen to be 3 complementary parts of the overall picture. Elaborated in a report by Visa on "cashless cities", up to USD $28 billion of consumer net benefits; USD $312 billion in business net benefits; and USD $130 billion in government net benefits can be derived from cashless economies, calculated across 100 cities per year for payments industry stakeholders, which in turn have the potential to foster up to USD $12 trillion in additional economic activity (Norton, 2017).

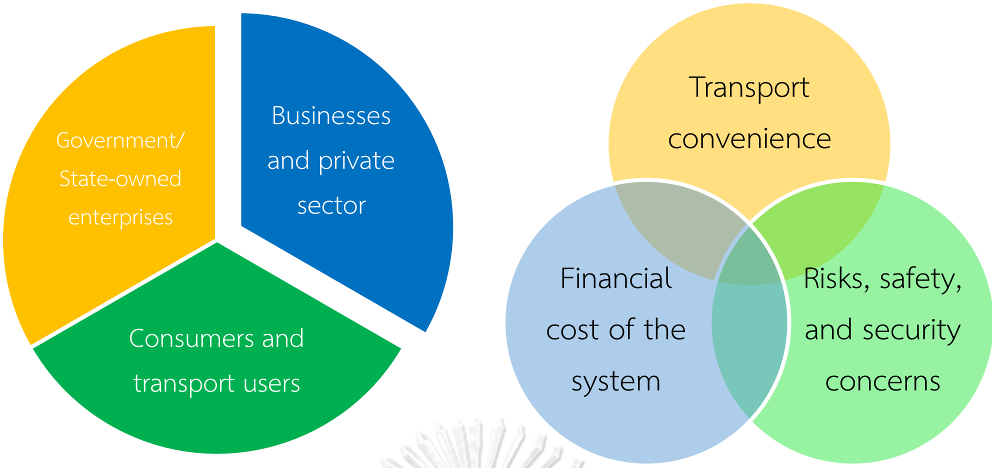

Figure 6: Key stakeholder categories and their primary considerations

While the three dimensions for the assessment of common ticketing systems described in the preceding section comprising 1) transport convenience; 2) financial cost of the system; and 3) risks, safety, and security concerns, can be perceived as 3 parts of an intersecting diagram, being competing needs for the roll-out and implementation of a common ticketing system and transport journey itself. Combining these two concepts, the 3 stakeholders being 1) government and state-owned enterprises; 2) businesses and private sector; and 3) consumers and transport users, are therefore continuously striving to satisfy each of the 3 dimensions.

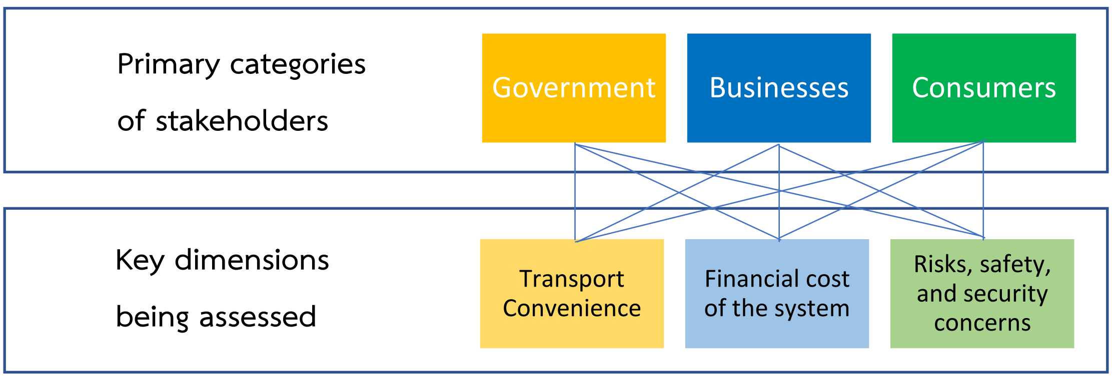

Figure 7: Sandwich of concerns for common ticketing system

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

The third chapter of this paper presents the research methodology employed, namely case study analysis, while elaborating on the approach adopted with specific reference to the 'Yin Approach' (Yin, 2002). Here some of the primary tools used for the data collection are shared, including desk review, establishment of a checklist, followed by interviews using structured questionnaire. In helping to design the overall framework for the research, three key proposed dimensions of common ticketing are assessed relating to 1) convenience, 2) financial cost, and 3) safety and security, which results in the development of a matrix for further assessment. For each of the variables assessed in the matrix, elaboration is provided on the rationale for identifying each of the respective variables. Finally, the sole unit of analysis being "cities" is established, followed by overview of the structure of the interview questions, and process for the identification of experts who had eventually kindly supported with their time and experience to addressing common ticketing in each of their cities.

3.1 RESEARCH DESIGN

The overall design of the research employed will be based upon case study analysis, inherently qualitative in nature, examining a group of 4 cities from Asia and the Pacific region, namely Bangkok, Thailand; Fukuoka, Japan; Singapore; and Sydney, Australia in-depth related to their common ticketing systems, drawing from peer-reviewed literature, global discourse and new approaches which are emerging. Distilling the unique characteristics underpinning these cases, city transport systems will be compared against each other to elicit patterns or trends. This approach is considered suitable, as case study analysis is recognized as being able to help facilitate in-depth, multi-faceted explorations of complex issues in their real-life settings, allowing for a much deeper appreciation of an issue, event, or phenomenon of interest, in its natural context (Crowe et al., 2011). This is ideal, as it perfectly mirrors the challenge at hand of reviewing common ticketing systems across several cities.

As elicited through the literature review in the preceding chapter, case study analysis is also applicable, having been widely used throughout the corpus of literature to date, as it pertains to common ticketing systems. Hence, whether comparing the cases of common ticketing as applied in individual cases in New Jersey (Cunningham, 1993), Trondheim (Welde, 2012), or Hong Kong (Wildermuth, 1997) or across multiple country contexts such as across the US continent (TCRP, 2003), Europe (Chun, 2004) and abroad or perhaps comparing several cities in China (Wen, 2001), the use of case study analysis, is similarly appropriate for this thesis paper. Partly, it is assumed this is because the analysis of case studies, especially across different cities, lends naturally to new and intricate developments such as fare policy, technological and social determinants which are associated with common ticketing. On the other hand, it can further be rationalized the more that case study analysis is applied across a wider range of diverse cities, the greater the learning gained in terms of opportunities, challenges encountered, and shared experiences.

It is important to recognize here that case study analysis as a research design framework, relies upon a “fenced in” approach (Merriam, 1998) concerning a defined space and further anchored in some sort of bounded context. According to critical theory and interpretivist paradigms, case study analysis can help to make a substantial connection to each of the cases being examined. While adopting a more postpositivist paradigm, case study analysis is understood to imply the existence of “an ultimate reality that we can only approximate – not completely – understand” (Schoch, 2020). Fundamentally, case study analysis offers the opportunity to collect different kinds of data, such as through interviews, documents, surveys and observations, with regards to the process, while also facilitating a more comprehensive understanding of the fenced-in unit, leading itself to transferability to other studies.

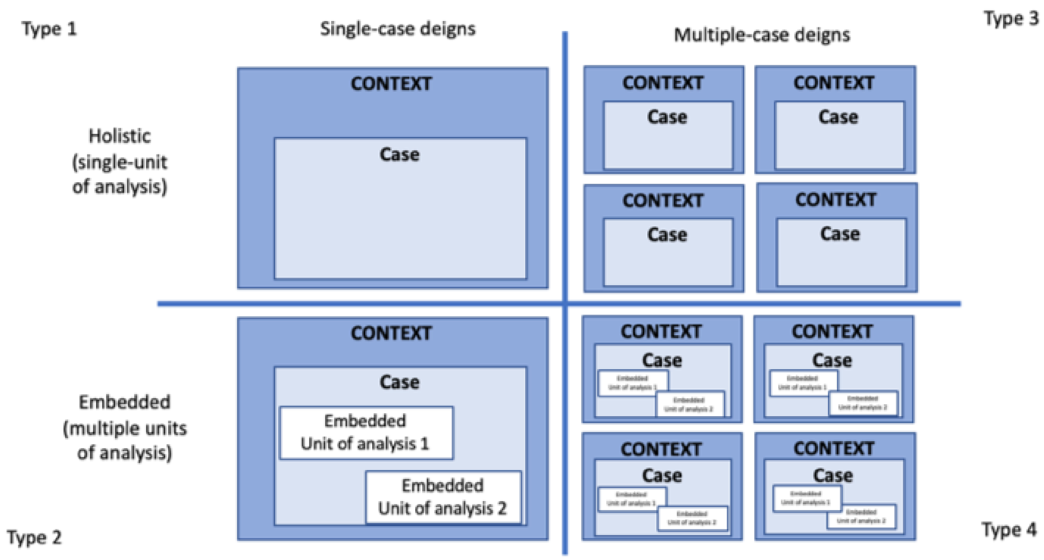

Figure 8: Basic types of design for case study research (Hollweck, 2016)

Employing the 'Yin Approach' to case study research design to select the cases as depicted above, the 2x2 matrix helps to describe how every type of design includes the desire to analyse contextual conditions in relation to the cases. Here in this paper, "multiple-case design" represented by the upper-left quadrant is adopted whereby common ticketing systems are the broader context being examined and the individual cases in each of the cities observed help result in a higher learning particularly with regards to the critical success factors across the cities.

3.2 UNIT OF ANALYSIS

Evidently, in the application of case study analysis in the design of the research as outlined in the preceding section, "cities" being representative of local government administrations are identified as the primary unit of analysis. Indeed, as previously established, “cities” are often cited in case study research related to common ticketing and transportation systems more broadly (McKinsey-&-Company, 2021; OTP, 2020; Turner & Wilson, 2010), perhaps largely on account of the comparability across cities. By further narrowing the scope of the study to rail/train network systems as described in Section 1.7, a richer examination of transport connectivity within the cities being examined is made possible, and moreover, better understanding of the decentralization of public transport services achieved. Only a single unit of analysis will be examined, namely “Cities”, which in turn form the basis for data collection and the development of policy recommendations at the summation of the analysis.

3.3 RESEARCH FRAMEWORK

Referring to the conceptual framework of the sandwich of concerns depicted in Figure 7 at the end of the preceding chapter, and the justification for case study analysis presented as aforementioned, the variables assessed are categorized across two primary axes. Firstly, from the perspective of 3 main stakeholder groups, namely “government and state-owned enterprises” in Section 2.5.1; “businesses and private sector” in Section 2.5.2; and “consumers and transport users” in Section 2.5.3. This is reasoned on the underlying recognition that when considering the concepts of success and failure, these are significantly influenced by the origin of where perception is founded (Crouch, 2021). Indeed, what could be attributed as a success in the case of common ticketing for government and state-owned enterprises could be viewed in a very different manner for businesses and private sector.

Similarly, what may be constituted as a failed endeavour for consumer and transport users, may simply be part of a broader strategy by businesses and private sector to test the relevant suitability of a particular line of services before full implementation. As such, one can conceive this becomes a natural extension of the win-win philosophy, striving towards a win-win-win outcome which balances the needs of the three stakeholder groups assessed in this study. True success in this sense is therefore described as the result of mutual gains and reaching an agreement which distinct stakeholders can work together to meet diverse interests and at the same time maximize the creation of value (Wertheim, 2002).

As a secondary axis, three lenses are adopted from which these stakeholder groups may view the success or failure of common ticketing systems, founded in literature and earlier discussed in Section 2.6.1 associated with transport convenience, Section 2.6.2 related to cost implications of implementation; and Section 2.6.3 regarding safety and security. Significantly building upon the “Train Experience Monitor” in Section 2.2.1, the adoption of these three dimensions of common ticketing recognizes that the assessment of success or failure is not grounded solely in one domain, but rather reflective of the entire journey for the passenger which takes into account different aspects. More explicitly, just because a passenger may deem common ticketing systems to be functional in delivering transport convenience does not necessarily mean that they are effective if they do not meet other criteria which are important to the passenger such as ensuring affordability.

Similarly, despite the roll-out of common ticketing systems imposing significant upfront capital investment costs and inconvenience to transport users especially in the transitionary phases, this may be justified on the basis of increased ridership of public transport in the longer term, which can facilitate secondary effects such as reduced congestion and improved safety conditions especially on the roads, as well as, access to transport behaviour data and mobility patterns which can help to shape transport planning and city-wide development. Articulating success and failure through these three dimensions is also meaningful, as a passenger may be assessing the value of common ticketing well before even arriving at any station in terms of “transport convenience", taking into account "safety and security" throughout the journey" and only reflecting on "financial cost" of travel when considering the cost of travel compared to their relative personal income received monthly.

Table 4: Proposed matrix to review each stakeholder-dimension

	A Government and state-owned enterprises	B Business and private sector	C Consumers and transport users
1 Transport convenience	A1	B1	C1
2 Financial cost	A2	B2	C2
3 Risk, safety and security	A3	B3	C3

Therefore, the proposed matrix above is established to define the boundaries for the case study analysis and offer a logical framework for evolving the variables which should be considered in the context of common ticketing systems. Here, A1 would refer to variables having relevance to stakeholder "A" being "government and state-owned enterprises", in respect of dimension "1", related to the matter of "transport convenience". Similarly, C3 would refer to variables having relevance to stakeholder "C" being "consumers and transport users", in respect of dimension "3", related to the matter of "safety and security". Such a research framework also helps to incorporate the principle of replication, which allows the assessment of reliability and validity of findings, consistent with the 'Yin Approach' articulated in Section 3.1, supporting the analysis of cities through a unified framework.

3.4 PROPOSED VARIABLES

3.4.1 Operational service efficiency

Pertaining to stakeholder-dimension "A1" of research framework in Section 3.3, when taking the view of "government and state-owned enterprises" and from the lens of "transport convenience", operational efficiency is considered as the key variable to be assessed, which can be calculated as the number of passenger trips per day versus the hours of operation, otherwise referred to as service efficiency reflecting on the transport system as a whole (TTF-Australia, 2010). This is important, since by better understanding how efficient a transportation service is operating, we can assess if there are any potential bottlenecks to performance, which could in turn allude to issues at the ticketing booth or machines due to overcrowding or staffing. On the other hand, a well-functioning system with integrated and common ticketing system in place, should help serve to improve the service efficiency as-a-whole.

$$\textbf{Operational service efficiency} = \frac{\text{Number of passenger trips per day}}{\text{Total hours of operation per day}}$$

For instance, if 100,000 trips are operated over a 10 hour period equivalent to 600 minutes, this would lead to an operational service efficiency of 166.7. In other words, for every minute of the day taking into account both peak and off-peak periods, an average of 166.7 boardings are taking place across the transport network. For the purposes of this study, a figure below 500 is considered as benefitting improvement, between 500 to 1,500 as being a well-functioning system, and figures above 1,500 as being a highly optimised system. Needless to say, governments which are looking to ease traffic congestion by incentivizing public transport, are also looking to optimize the boardings which are taking place throughout the day, which is demonstrative of a public transport system that is essentially well-functioning.

Guide used to make the assessment	Scoring
Operational service efficiency ≤ 500	Benefitting improvement
500 < Operational service efficiency > 1,500	Well-functioning
Operational service efficiency ≥ 1,500	Highly optimized

3.4.2 Availability of related services and eco-system

Pertaining to stakeholder-dimension "B1" of research framework in Section 3.3, for "businesses and private sector" who are concerned about mitigating losses and generating revenue from a common ticketing system, "transport convenience" can be articulated as the availability of related services that can be value-added to the existing ticketing medium and an opportunity to cultivate new streams of revenue such as through the purchase of goods and services. In this regard, the ability of ecosystems of connected digital services utilizing a single platform such as common ticketing system to create economic value is well documented (Sengupta et al., 2019), building partnerships to help extend services and increase the stickiness factor, while enlarging their platforms and activating multi-level marketing (Garrod, 2023).

Here we adopt several indicators to assess the availability of services, such as 1) the possibility of using the smart card to purchase goods and services; 2) the ability to perform an online top-up of the stored value; 3) the availability of a personal mobile application for the smart card; and 4) whether or not individuals can access a history of their boardings and transportation journey. Clearly, the more easy-to-use, access information, and multi-purpose a ticketing system is by nature, the greater the overall acceptance of the card should be, if other prevailing conditions are well functioning and stable. Meanwhile, assessment of the transport eco-system is simply made upon the basis of whether the smart card in operation, can also be used for bus, ferry, and tollway services, beyond train services being the focus of this study.

3.4.3 Population density and spatial coverage

Pertaining to stakeholder-dimension "C1" of research framework in Section 3.3, of utmost priority for "consumers and transport users" when assessing the value of common ticketing and relative success or failure of implementation in lieu of "transport convenience", would be the time avoidance achieved by virtue of common ticketing (Alhassan et al., 2022) as compared to the existing ticketing medium, coupled with the alleviation of psycho-social stressors which may be associated with the need to have to carry multiple contactless cards, and delays in locating the cards in time-sensitive environments, such as during peak hour on a busy sub-urban railway network. However, since it is difficult to calculate this time avoidance, particularly if a common ticketing system is not already in place, such as the case of the train network in Bangkok to adequately compare, population density is adopted along with spatial coverage of train stations along the track length relative to the area in size of cities is used to help approximate the level of convenience of transportation based upon an understanding of the pressures exerted on public transport due to population size.

$$\textbf{Average population density} = \frac{\text{Total existing population of the city}}{\text{Land area covered by the population}}$$

$$\textbf{Spatial coverage (on line)} = \frac{\text{Number of existing train stations}}{\text{Total network length of the track}}$$

Here the calculation of population density is simply included to help build a picture of the potential for public transport usage and consider whether a critical mass is generally achieved to help warrant an effective system. As a crucial metric in helping us understand the distribution of people within a given region, the level of crowding or spaciousness in an area, an appreciation of population density also facilitates improved urban planning and resource allocation, while also being the focus of studies examining its correlation with transport viability (Cooke & Behrens, 2017). Here any figures below 500 persons/sq km are considered as low population density, between 500-1,500 persons/sq km as being medium population density, and figures exceeding 1,500 persons/sq km, considered as being high population density.

Guide used to make the assessment	Scoring
Average population density ≤ 500 persons/sq km	Low population density
500 persons/sq km < Average population density > 1,500 persons/sq km	Medium population density
Average population density ≥ 1,500 persons/sq km	Highly population density

In terms of spatial coverage along the line or track length, for instance, if there are 10 stations along 100 km of track length, then we can estimate an average of 1 train station every 10 km. In general, and related to the concept of transportation convenience, this variable helps to enhance our understanding of the level of public transport accessibility related to the railway network. For the purposes of this study, any figures indicating that a train station is present every 1 km is considered exceptional accessibility, between 1-3 km as exhibiting good accessibility and those figures beyond 3km, demonstrating lower accessibility. Of course, accessibility here is exclusively considering the level of accessibility for the population living within close proximity to the railway network itself, while a significant percentage of the population may live in underserved areas with low transport connectivity. For this reason, both population density and spatial coverage are considered together.

Guide used to make the assessment	Scoring
Spatial coverage (on line) ≤ 1km	Exceptional accessibility
1km < Spatial coverage (on line) > 3km	Good accessibility
Spatial coverage (on line) ≥ 3km	Lower accessibility

3.4.4 Estimated cost of initial roll-out

Pertaining to stakeholder-dimension "A2" of research framework in Section 3.3, adjusting to the lens of "financial cost", government is most concerned with the relative implementation costs incorporating key aspects such as the operational and maintenance costs (Gattuso & Restuccia, 2014). For the purposes of this study, we consider the estimated cost of initial roll-out for the common ticketing system, as a benchmark for what might be the estimate financial outlay for a city which might be considering implementing a common ticketing system. Admittedly, while other factors such as currency exchange, cost of labour, and even access to high-speed internet to facilitate transactional data, can significantly influence the overall cost of the initial roll-out, we attempt to use USD as a common currency calculation and meanwhile, focus on initial cost of roll-out here in this paper, as opposed to ongoing maintenance costs, which could be the topic of entirely different paper.

$$\textbf{Estimated initial cost ratio} = \frac{\text{Initial estimated cost of the roll-out}}{\text{Number of train stations at launch}}$$

For instance, if the initial estimated cost of the roll-out was USD $1 million, and there were 100 train stations at launch, then the initial cost ratio would be 10,000:1. The higher the overall ratio, the more expensive it is estimated that the cost of implementing the common ticketing system was in respect of the number of train stations present at the time of the launch. For the purposes of this paper, we consider estimated initial cost ratios under 250,000:1 as being low; between 250,000-500,000:1 as being medium; and above 500,000:1 as being high. In other words, when calculating the initial cost across the entire network, a cost of USD $250,000 per station is seen as low cost and above USD $500,000 per station as high cost. These figures are further adopted, being easy to appreciate and rationalize economically.

Guide used to make the assessment	Scoring
Estimated initial cost ratio ≤ 250,000:1	Low-cost ratio
250,000:1 < Estimated initial cost ratio > 500,000:1	Medium-cost ratio
Estimated initial cost ratio ≥ 500,000:1	High-cost ratio

3.4.5 Annual ridership and revenue levels

Pertaining to stakeholder-dimension "B2" of research framework in Section 3.3, at the core for any business in the context of "financial cost" would be public transport utilization and rail usage (Arnone et al., 2016) being calculated based on historical ticketing or trip counts, which in turn directly correlates with the annual revenue being generated, particularly for railway operations. With the effects from the Coronavirus or Covid-19 pandemic withstanding, which many economies are still recovering and which it was recognized had significant impacts on public transport ridership including directly here in Bangkok (Siewwuttanagul & Jittrapirom, 2023; Thaithatkul et al., 2023), datasets and financial year-end results from 2022 can offer a reasonable level of confidence.

Meanwhile, it should also be noted that return on investment and profitability of the common ticketing system as-a-whole (Welde, 2012) could be considered an even more robust measure, such proprietary information is difficult to source. At the same time, as capital investment for common ticketing may be high upfront with returns on investment not evolving until several years into operation, it is not uncommon for build-transfer-operate (BTO) models of private sector financing to take place, where businesses will be incentivized to invest in infrastructure development through the facilitation of tax rebates, subsidies, preferential financing, or licensing concessions made available by government (Nikomborirakm, 2004).

Concerning the calculation of annual ridership, for the purposes of this study, figures under 250,000 boardings per year are considered as low annual ridership, between 250,000 to 500,000 as medium annual ridership, and above 500,000 as high annual ridership. Regarding the assessment of annual revenue, converted to USD as a common currency, figures below USD $250,000 per year are considered as low annual revenue, between USD $250,000 to $500,000 per year are considered as medium annual revenue and above USD $500,000 per year are considered as high annual revenue. Of course, as these figures are absolute values based on each country context, it would also be important to consider how these figures fare in relation to other socio-economic dimensions and operational factors.

Guide used to make the assessment	Scoring
Annual ridership (boardings) ≤ 250,000	Low annual ridership
250,000 < Annual ridership (boardings) > 500,000	Medium annual ridership
Annual ridership (boardings) ≥ 500,000	High annual ridership

Guide used to make the assessment	Scoring
Annual revenue (USD) ≤ $250 million	Low annual revenue
$250 million < Annual revenue (USD) > $500 million	Medium annual revenue
Annual revenue (USD) ≥ $500 million	High annual revenue

3.4.6 Relative affordability of fares

Pertaining to stakeholder-dimension "C2" of research framework in Section 3.3, as a passenger when considering the "financial cost" of travel, it is evident this must be connected with the concept of affordability based upon the cost to travel per kilometre (TDRI, 2021), along with the variable of purchasing potential being the cost of travel relative to the income level (Satranarakun & Kraiwanit, 2023). This is because affordability is naturally linked to the earnings power of individuals, which determines their personal capacity for taking one form of transport over another. While it can be reasonably debated that any estimation of the average cost of passenger travel, should also take into account the overall length of the journey, the fare cap in most cities will already account for this. As such, we opt to use the maximum cost of travel less the minimum cost of travel, as a suitable proxy for estimation of this variable.

$$\textbf{Relative affordability of fares} = \frac{\text{Maximum} - \text{Minimum cost of travel}}{\text{Averaging income level per month}}$$

For instance, if maximum cost of travel in a fictitious city was USD $10 and the minimum cost of travel was USD $1, and the average income level was USD $1,000, based upon a 30-day calendar month, then the relative affordability of fares would be 0.27. In other words, based on this example, it would therefore be estimated that the total expenditures by a passenger in this fictitious city would constitute around 27% of their average monthly income, which would be very high.

In this case and for the purposes of this study, any figures below 1% would be considered as a high relative affordability, between 1-2% would be considered medium relative affordability and above 2% would be considered as low relative affordability. At the same time, it should also be recognized that this calculation does not account for income disparity within cities, which can oftentimes suggest significant inequality with the most marginalized populations struggling to afford basic food and shelter, much less availing potentially costly public transport as opposed to other modes of transport.

Guide used to make the assessment	Scoring
Relative affordability of fares ≤ 1%	High affordability
1% < Relative affordability of fares > 2%	Medium affordability
Relative affordability of fares ≥ 2%	Low affordability

3.4.7 Public safety and crime rating

Pertaining to stakeholder-dimension “A3” of research framework in Section 3.3, from the lens of “safety and security” any city would place importance on the rating of safety and crime, having a strong influence on user perceptions and the propensity to catch public transport (Ceccato et al., 2022). Needless to say, if the level of crime is high or perception of public safety is low, these would be significant factors driving potential public transport users away from adopting public transport offerings and instead taking advantage of personal motorized vehicles. While it is true the level of crime in a city has a direct correlation with the perceived safety and inversely related, it should also be noted that the level of crime in a city is an immutable fact influenced by varying concerns, whereas the perceived level of safety is a socially-oriented and a product of behavioural theory and deeply rooted in social anthropology.

For the purposes of this study, the indexes of public safety rating and level of crime in the city provided by Numbeo are utilized, the world’s largest cost of living database. In this respect, a public safety rating below 60 could be considered to be low public safety rating, between 60-80 could be considered as medium public safety rating and above 80 considered as a high public safety rating. Meanwhile, with regards to the level of crime in the city, a figure below 20 could be considered as very low level of crime, between 20-40 as a low level of crime and above 40 being considered as having a relative concern pertaining to the level of crime. Of course, while these denominations theoretical only, they are however based upon an ordinal scale which unto itself offers a perspective as the scale or magnitude of concern.

Guide used to make the assessment	Scoring
Public safety rating ≤ 60	Moderate public safety rating
60 < Public safety rating > 80	High public safety rating
Public safety rating ≥ 80	Very high public safety rating

Guide used to make the assessment	Scoring
Crime level rating ≤ 20	Very low level of crime
20 < Crime level rating > 40	Low level of crime
Crime level rating ≥ 40	Moderate level of crime

3.4.8 Corruption perception and fraud propensity

Pertaining to stakeholder-dimension "B3" of research framework in Section 3.3, any ticketing systems can only be as effective as the way they are governed and operated in an environment which is free of fraud, the perception of corruption will be a key variable being closely examined by businesses when considering the level of financial risk and the transport sector often being targeted and at high risk of being associated with corruption (Fazekas & Tóth, 2018). Like any capital works intensive or large infrastructure project with large financial outlays, there is always a concern around the potential for abuse of power and corruption at the upper levels of governance, as well as, propensity for fraud at the lower levels. Even with these factors withstanding, evidently a city which is perceived free of corruption, has a greater chance of attracting investments stemming from increased trust and confidence.

Adopting the estimates provided at the national level through the Transparency International Corruption Perceptions Index, for the purposes of this study, a figure below 40 could be considered as having a low level of trust in relation to corruption, between 40-80 as having a medium level of trust in relation to corruption, and figures above 80 as having a high level of trust in relation to corruption. As various examples have demonstrated, the presence of corruption within transit agencies and associated with public transport projects can have a significant impact on curb the attractiveness of public transport by commuters, further investments into public transport and in the worst-case scenarios, extensive delays in construction and complete closure of public transport operations and amenities (Bertram, 2019; Gordan, 2006).

Guide used to make the assessment	Scoring
Corruption Perceptions Index ≤ 40	Low level of trust
40 < Corruption Perceptions Index > 80	Medium level of trust
Corruption Perceptions Index ≥ 80	High level of trust

3.4.9 Data privacy and cybersecurity

Pertaining to stakeholder-dimension “C3” of research framework in Section 3.3, when considering aspects of “safety and security”, key variables which consumers and transport users would be evaluating especially when it comes to common ticketing would be the existence of data national privacy legislation to ensure their personal data is safeguarded and relatedly, robust cybersecurity readiness to prevent misuse of data and exploitative tracking of passenger information for unintended or unauthorized commercial purposes (Avoine et al., 2014). Only a few months ago and earlier this year, a ransomware attach on the Auckland Transport (AT) HOP cards, being electronic smart cards designed for seamless fare payment and common ticketing on buses, trains, and ferries, threw the entire public transport network in disarray (Pandagle, 2023). While according to the Mineta Transportation Institute in 2022, weekly ransomware attacks on transit systems were up 186% since June 2020 (Katsarov, 2023).

In preventing the potential for data breaches and misuse of data, this study proposes recognition on the existence of any national data privacy legislation as one measure of the capabilities of a city to adequately safeguard its public transport users. Given that the first transport smart card was only launched in Hong Kong in 1997, namely the ‘Octopus card’, for the purposes of this study, where national data privacy legislation is enacted in Year 2000 or prior, this is considered as an early adopter, where national privacy legislation is enacted between Years 2000 to 2015, this is considered as the general period of adoption, and where national privacy legislation is enacted after Year 2015, this is considered to be a late incomer.

Guide used to make the assessment	Scoring
Data privacy legislation ≤ Year 2000	Early adopter
Year 2000 < Data privacy legislation > Year 2015	General period
Data privacy legislation ≥ Year 2015	Late incomer

Moreover, the study further adopts the Global Cybersecurity Readiness Index which is developed by the United Nations International Telecommunications Union (ITU) and considered as a trusted reference now in its 5th edition, measuring the commitment of countries to cybersecurity at the global level. Taking into account 5 pillars including 1) legal measures, 2) technical measures, 3) organizational measures, 4) capacity development, and 5) cooperation, the Index has the goal of fostering a global culture of cybersecurity. For the purposes of this study, any figure below 70 is considered to be having a low cybersecurity readiness, between 70-90 as having a medium cybersecurity readiness and figures above 90, as high cybersecurity readiness. Meanwhile, assessment of national data privacy legislation can be based upon the year which the legislation was enacted or put into force.

Guide used to make the assessment	Scoring
Cybersecurity Readiness Index ≤ 70	Low cybersecurity readiness
70 < Cybersecurity Readiness Index > 90	Medium cybersecurity readiness
Cybersecurity Readiness Index ≥ 90	High cybersecurity readiness

Table 5: Filled-out matrix used to depict the key variables to be assessed

	A Government and state-owned enterprises	B Business and private sector	C Consumers and transport users
1 Transport convenience	- Operational service efficiency (number of trips/day vs operational hours/day)	- Availability of related services and integrated transport eco-system	- Population density and spatial coverage of railway transport networks
2 Financial cost	- Estimated cost of initial roll-out - Number of train stations	- Annual ridership - Annual revenue (railway operations)	- Relative affordability of fares based (i.e. cost of fares relative to average income)
3 Safety and security	- Public safety rating and level of crime in the city	- Corruption perception and the propensity for fraud	- Existence of national data privacy legislation and cybersecurity readiness (at the national level)

3.5 DATA COLLECTION METHODS

Research will employ analytical tools such as semi-structured interviews, content analysis, along with word clouds to support. In the case of semi-structured interviews, stakeholders engaged, and the seniority of informants will be carefully calibrated, as far as possible, to ensure a level of consistency and comparability. In the case of Thailand, as a common ticketing system is not yet fully implemented, the research will build upon existing discourse related to Mangmoom (or Spider) card

(Clark, 2022; Prayoonphan & Xu, 2019) (South-East-Asia-Infrastructure, 2022), along with prevailing technical analysis conducted (ADB, 2009). For this particular study, “multiple-case designs” consistent with Type 3 of Yin’s approach to case study research will be employed, which in turn will reflect on the unique contexts of each city part of the study, while the unit of analysis will the cities themselves, namely being Bangkok, Thailand; Fukuoka, Japan; Singapore; and Sydney, Australia.

The research will commence with a review of some key methodologies employed and innovative approaches in related research on the use of common ticketing systems, especially in Bangkok. Analysing the proposed variables detailed in the research framework in the preceding sections, through both primary and secondary research, several areas will be put forward to assist with the assessment of common ticketing systems. Initially through a desk review of available data, a checklist will be prepared to be verified by local authorities and/or transport operators, forming the baseline for comparison across the 4 cities being examined.

Through the preparation of a standardized questionnaire, being translated into the relevant local language, respondents will be assisted through a semi-structured interview helping to establish the basis for the critical factors for the success of common ticketing systems. Finally, an overview of the background to each of the 4 cities being examined, along with the establishment of their existing ticketing systems, will help to unpack aspects such as their ticketing types and costs, relative spatial coverage, and other important dimensions. Analysis of the data will be used to explore urban strategies and opportunities, while coming up with a series of potential policy recommendations for cities considering common ticketing.

3.6 SAMPLING STRATEGY AND CASE STUDY SELECTION

As case study research is applied, the sampling strategy is inherently "non-probable" in nature. Identifying Bangkok, Thailand, as the primary point of interest, this is established as the "baseline" for the overall study, an unto which the associated case studies examined will further help to inform. Given the research intends to learn from previous failures of common ticketing systems, at least one of the selected cities should help to demonstrate how failure has occurred. Towards this end, Sydney, Australia, is considered as a relevant case study, having previously experienced a significant failure in the roll-out of the previous common ticketing system, leading to expensive legal court disputes and over a decade of delays.

Given the research intends to elicit some of the factors for success of common ticketing systems, at least one of the selected cities should help to demonstrate how success has resulted. Towards this end, Fukuoka, Japan, is considered as a suitable case study, whereby roll-out of the 'Hayakaken card' which is fully integrated with 10 other IC card systems in Japan, is considered to be a benchmark for common ticketing systems globally. Looking to one of Bangkok's nearest neighbours and the first country in South-East Asia region to successfully implement a common ticketing system, the case of Singapore is included in the case study analysis. Therefore, this is considered to be a form of "purposive sampling" with clear criteria. Moreover, this may be considered a form of "extreme deviant sampling" for selection.

3.7 QUESTIONNAIRE AND INTERVIEWS

To supplement data collected on the variables specified in the proposed matrix in Table 5, based on secondary data obtained and justification of the rationale through desk review of existing literature, it is considered important to ground the study of common ticketing systems in the real-world perspectives of those individuals who are engaged in the operation of public transport on a daily basis, especially from the cities part of this case study research endeavour. For this purpose, a specially designed questionnaire is developed to facilitate the process of semi-structured interviews, subsequently translated into Thai, as well as, Japanese, to ensure the concepts contained are accurately reflected for respondents.

Starting first with a warm-up question, this also offers the opportunity to set the frame of thinking and obtain an immediate understanding of the views held on common ticketing systems, as well as, to clarify any questions from the outset. To a better picture of the respondent themselves, but also to help build rapport, a personal question follows, to hear more about the respondent, which is followed by a question concerning their work environment. Subsequent questions are intended to directly elicit information and perspectives required to assess the critical factors for success of common ticketing systems, covering both issues and challenges encountered, as well as, the most critical and immediate needs.

A simple ranking of the most critical factors for success is included to prioritize responses in a logical sequence and ranking of key stakeholders establishes the most important entities to the respective city. Finally, probing questions which are included provide a chance to looking back in hindsight with a degree of neutrality, while also looking forward into the horizon, in terms of the potential for new innovations and opportunities for common ticketing. Here the measurement focussed on the frequency of messaging, particular the number of times a phrase or concept was brought up the respondent as part of the semi-structured interview (Mills et al., 2010).

3.8 IMPORTANT STAKEHOLDERS RELEVANT TO THE STUDY

Key stakeholders considered to have the most relevance to the research include the ministries of transport and respective departments of rail as part of the institutional government architecture. Given that public transportation is often delivered through a mixture of public and private enterprises, the activity of these transport providers along with their ability to align with and adequately deliver upon rail-related legislation is essential. As the ultimate end-users of the public transport system, passengers themselves and their corresponding needs should drive the demand and functionality of the system.

In relation to ticketing systems, the three phases of user interaction with the transport system occur at the point-of-sale or purchase of the ticket, entry to and exit from the transport network and ridership of the mode of transport itself. Whether facilitated by a booking agent or ticket vending machine, ticket collection officer or automated turnstile, the vendors of the ticketing system are important stakeholders in the design of an integrated common ticketing system. Due to the need for capital investment and infrastructure works, city departments responsible for finance or treasury functions are vital to secure the necessary funds for the installation and overall implementation, which is especially the case where loans or other financing mechanisms are involved. While the management of data processed by smart card readers and mobile applications requires a thorough grounding in software development and system integration, contract developers which are either in-house or outsourced are key to ensuring the effective functioning of the ticketing system and the privacy of data is maintained.

In consideration of the raw materials necessary to produce the various forms of ticketing themselves, these could range from mining enterprises being engaged in the collection of precious metals or alloys for the electronic chipset and component parts for RFID circuit board to the plastic manufacturers being involved in the production of the cards used for ticketing. While the cost of any smart card is inherently dependent on the type of material used, manufacturing process employed, scale of production, and digital capacity of the card, among other factors, the approximate cost of a smart card today incorporating EMV chips or NFC proximity technology can start as low as USD ten cents and going as high as USD $10 for more sophisticated production.

Needless to say, that having an uninterrupted supply chain for the production of smart cards is vital and any possibility of a global chip shortage or disruptions in the supply chain, as was evidenced by the COVID-19 pandemic, can have an immediate impact on the lead times for raw materials, extending the time to delivery of payment cards and delays in freight handling capacities (Phillips, 2022). Given the long-life cycle (3 to 10 years), light carbon footprint (about 150 grams of CO^2), and low electric consumption, the environmental impact of producing smart cards is considered to be relatively low (Thales, 2023).

With a significant portion of the passengers taking advantage of smart cards on public transport networks being international tourists on transient businesspersons who only may be visiting a city for several days, the need to consider personal data and identify issues is paramount. Attracting over 21.2 million predominantly foreign visitors in 2023, Bangkok ranked as the second most visited city in the world according to Mastercard’s Global Destinations City Index, only trumped by Hong Kong at 26.6 million visitors, although largely on account of the influx of Chinese themselves to the bustling metropolis, who comprised the lion’s share of visitors (Reeler, 2023).

Other important stakeholders in the smart card and public transport ticketing eco-system include telecommunication carriers and digital payment systems helping to facilitate the exchange data and currency, along with the manufacturers of mobile phones, computers, and related devices, acting as the interface for payment transactions. Finally, as car ridership and shared mobility services may be considered as a competitor to public transport, they may be indirect stakeholders. In an effort to breakdown and highlight those important stakeholders unique to the common ticketing systems in Bangkok, along with the supporting government structures, we include as a reference the Venn diagram developed by OTP in 2015 in Figure 6 below, along with their visualization of the account-based ticketing system.

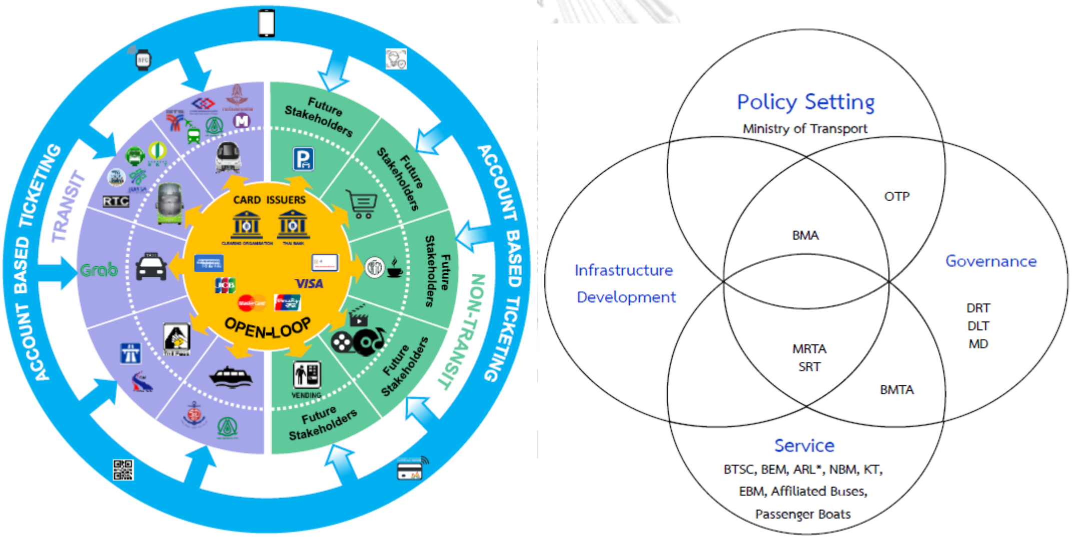

Figure 9: Key industry players for account-based ticketing and important stakeholders for common ticketing systems in Bangkok (OTP, 2015)

3.9 IDENTIFICATION OF EXPERTS FOR INTERVIEWS

First and foremost, in identifying the experts to contribute to this paper, it was considered essential to gain trust from the relevant city authorities and establish the legitimacy of research. To this end, correspondence was initiated with each of the local authorities where the common ticketing systems being examined were based, which in the case of Singapore, referred directly to the Ministry of National Development. Upon establishing contact with the authorities, it was then important to determine, if management of transport ticketing was a function being served by the respective city authority or who they might recommend to be interviewed. In this way, it was ensured that the identification of experts was founded in a recognition in the capacities of those individuals to share their experiences on transport ticketing.

Notably, while transport experts able to speak to the area of common ticketing were immediately available in the case of Bangkok Metropolitan Administration, this was not the case for the City of Sydney, which kindly deferred to experts in Transport for NSW, being more directly responsible for transport ticketing and eventually the team being responsible for management of the common ticketing system directly. In Fukuoka, the overall management of IC card system was directly hosted by the Fukuoka City Transportation Bureau, with experts interviewed drawn through dedicated in-house team. Meanwhile, in the case of Singapore, an incorporated entity named MSI Global had been setup as a wholly-owned subsidiary of the Land Transport Authority, identified as being the most suitable to advise on the study.

Sharing below in warm recognition, the experts who kindly contributed to this paper both through the support to verifying the information provided in the checklist and support to responding to questions shared in the interviews:

Bangkok, Thailand

- **Mr. Apichart Suphachitsawas**, Director of the Rail Transport Division, Bangkok Metropolitan Administration (BMA)
- **Mr. Jakrapon Wannagul**, Chief of Operations, Transportation System Office, Bangkok Metropolitan Administration (BMA)

Fukuoka, Japan

- **Mr. Hidetaka Urae**, Chief, IC Card Section at Fukuoka City Transportation Bureau (FCBT)
- **Mr. Fumiyasu Ichinaga**, UN-Habitat Regional Office (seconded by Fukuoka Prefecture)

Singapore

- **Mr. Silvester Prakasam,** Senior Advisor, Digital Mobility Solutions, MSI Global
- **Mr. Looi Teik Soon,** Advisor to the LTA Academy and Singapore Rail Academy

Sydney, Australia

- **Mr. Lewis Clark**, Head, Customer Systems and Operations, Transport for NSW
- **Ms. Sharon Harrison**, Business Coordinator, Customer Strategy and Technology, Transport for NSW

CHAPTER 4: DATA AND STUDY AREA

Adopting case study research as the main research methodology, this chapter offers a comprehensive background to each of the cities part of the case study, namely Bangkok, Thailand; Fukuoka, Japan; Singapore; and Sydney, Australia. Covering areas including an overview of the city railway network, existing fare pricing policy, common ticketing implementation and legal/regulatory framework, the chapter will help readers who are unfamiliar with the context of each city to gain a better appreciation of the dynamics which may concern socio-economic and other factors which might influence the failure or success of common ticketing in each city. Results from the pre-verification is shared as a context, while responses from the semi-structured interviews conducted with the experts are also provided. Finally, outputs using the research framework for each city are presented with accompanying analysis.

4.1 MAP ILLUSTRATING CASE STUDIES

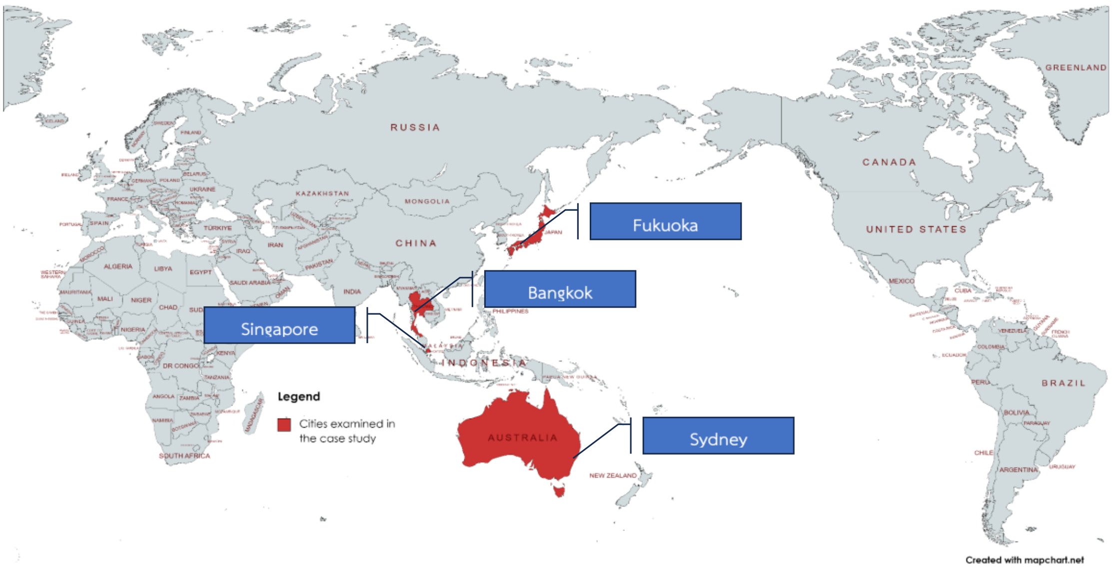

Figure 10: Map depicting cities examined in Bangkok, Fukuoka, Singapore, and Sydney

4.2 BACKGROUND TO EACH OF THE CITIES

4.2.1 Bangkok, Thailand

Overview of the railway network

Comprising 3 primary train networks, namely 1) BTS Skytrain being privately operated and stretching 68.5 km in length and comprising a total 60 stations, through a government concession; 2) MRT operated by the Bangkok Expressway and Metro Company Ltd. (BEM) and under a concession granted by Mass Rapid Transit Authority of Thailand (MRTA) incorporating 35 stations; and 3) Airport Rail Link (ARL), as well as, new Red Line operated by State Rail of Thailand (SRT) Electrified Company Limited (SRTET); an old locomotive is still operated by SRT for destinations outside of the Bangkok Metropolitan region. In 2022, and even despite the pandemic, 74.17 million passengers used the BTS Skytrain, while 470,000 passengers are estimated to use the MRT and 20,000 passengers the SRT daily across Purple, Blue, and Red lines. Having a population of 11,069,982, this suggests that the public transportation by either BTS or MRT is only availed by approximately 6-8 per cent of the overall population daily, while the vast majority of commuters turn to personal vehicles, motorcycles, buses, minivans, taxis, or other forms of transportation.

Existing fare pricing policy

With fares ranging from 17-47 THB (USD $0.48-1.32) on the BTS and 16-70 THB (USD $0.45-1.97) on the MRT, a One-Day Pass is also available on the BTS and MRT, at the cost of 150 THB (USD $4.22) and 120 THB (USD $3.38) respectively. The standard fare for ARL ranges between 15-45 THB (USD $0.42-1.27) and 12-42 THB for SRT (USD $0.34-1.18), although a 20 THB (USD $0.56) flat fare has been proposed and given the greenlight by SRT Board, which would span extent of the 13 stations on SRT Red Line and 16 stations on MRT Purple Line. According to studies conducted by SRT, while it estimated that SRT would lose revenue and require compensation of about 80 million

THB per year (USD $2.25 million) if the flat fare policy is implemented, the fare reduction is expected to increase the number of passengers by 5-20 per cent annually and eventually boost SRT's revenue. While a 30-day multi-trip package was previously available for BTS bringing the effective cost down to 28 THB per trip (USD $0.79), this was scrapped in September 2021 citing uncertainties around the pandemic, receiving customer complaints and call for a ban on BTS services by the Foundation for Consumers (FFC) (Onthaworn, 2021). Meanwhile, 30-day multi-trip packages continue to be available on MRT, however, not without some level of complexity. 60-trip passes are available on Purple Line bringing the cost down to 20 THB (USD $0.56) per trip and 50-trip passes are available on Blue Line bringing the cost down to 25 THB (USD $0.70) per trip, however, these passes can only be topped up and used at the respective Purple or Blue lines. Instead, a 50-trip Multi-line pass is available bringing down the cost to 45 THB (USD $1.27) allowing usage on both the Purple and Blue Lines, being valid for 60 days from the first use.

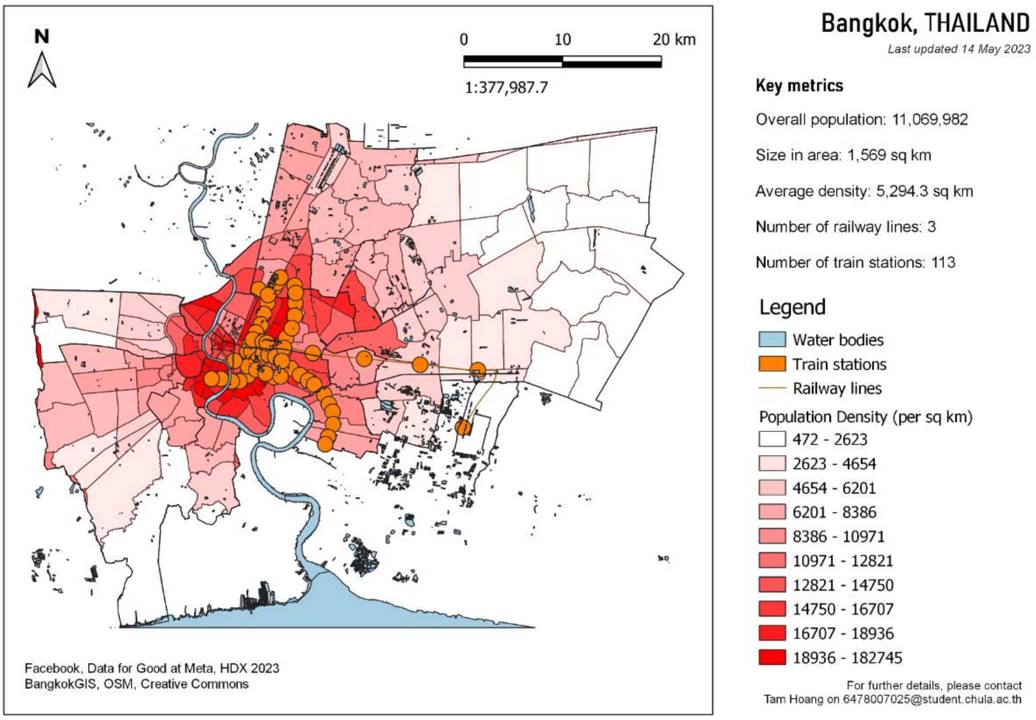

Figure 11: Overlay of Bangkok railway system on spatial map of Bangkok

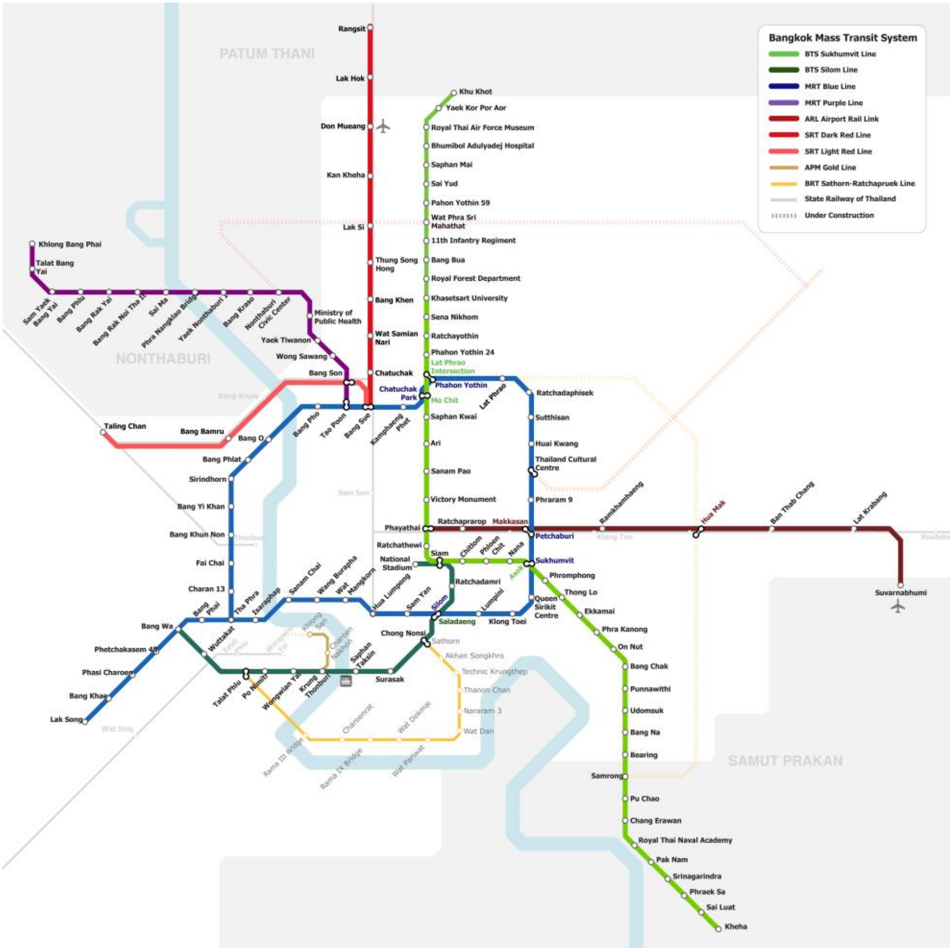

Figure 12: Map of the railway system network in Bangkok, Thailand

Common ticketing implementation

A Rabbit card was launched by BTS in May 2012, while MRTA Plus card launched by MRT in June 2016. Although a 'Mangmoom card' was planned to be launched in August 2016, later postponed to November 2016, a common ticketing platform remains elusive despite several concerted efforts. In April 2017, a central clearinghouse was intended to be setup at MRTA, later delayed to October 2017 and thereafter mid-2018. While public trials based on 200,000 Mangmoom cards took place between July-September 2018, critics have pointed to a number of policy and pricing challenges which have led to the vow of common ticketing in Thailand falling flat (Carlisle, 2020).

Among these policy challenges, it is understood that agreement was not able to be reached among the transport operators on the licensing and enforcement of proposed common ticketing system, with existing systems being incompatible, leading to lack of consensus on the governance and ownership of card data, as well as, the servicing and maintenance of associated platforms. With railway transport in Bangkok being a mixture of public-private regimes, disagreement on the level of capital investment and cost recovery for the card infrastructure has seemingly hampered progress towards a common ticketing system.

It should be noted that under Thai law, any fare adjustment must comply with Section 27 of Financial Disciple Act, which states that if any government agency has a measure of project that will affect its revenue, the measures must be accompanied by a budget and expenditure plan, including a timeframe for implementation and estimation of benefits received (Online-Reporters, 2023). Nonetheless, as evidenced by pricing information shared in the previous section, an increasingly complex fare policy which was never setup with harmonization in mind, amidst an expanding train network has further complicated matters. Passengers navigating through the network, alighting from one independently operated line to another are subject to multiple flag-fall rates, which makes the journey not only cumbersome but costly. At the same time, operators are faced with a “catch-22” dilemma, with some city train lines being over-capacitated especially during peak hours and yet others failing to reach the critical mass required, rendering any fare standardization difficult.

Legal and regulatory framework

Already partly discussed in the previous sub-section, legal and governance arrangements between both public and private operators have possibly contributed to the delays in implementation of a common ticketing system in Bangkok. Presently, 2 main service providers operate the metro under concessions granted, the first being Bangkok Metro Company Limited (BMCL), servicing the MRT, supervised by the Ministry of Transport (MOT), and second being Bangkok Mass Transit System Public Company Limited (BTSC), regulated by Bangkok Metropolitan Administration (BMA), under the supervision of the Ministry of Interior (MOI). Stemming from an *Announcement to the National Executives Council No. 58* dated 26 January 1972, these are arrangements are founded on the authorization provided to MOT at the time to monitor train operations and MOI to monitor tram operations. This is further complicated by the State Rail of Thailand (SRT), setup as its own State-Owned Enterprise, operating all the Airport Rail Link (ARL), inter-provincial trains, and new SRT Red Line.

Regrettably, the integration of mass rapid transit or common ticketing is not governed by any single law in Thailand. Under *MRTA Act B.E. 2543*, MRT are afforded the rights to push for integration among operators and authorizes MRTA to access to other metro lines. However, "access" here is considered to relate primarily to physical connection and multi-modality between metro lines, rather than taking into account serious consideration of common ticketing. Separate from the transportation sector, greater promise holds through the *Electronic Transaction Act B.E. 2544*, requiring for business operators engaged in multi-purposes e-money to be registered with the Bank of Thailand (BOT) and Ministerial Regulation of the Ministry of Finance (MOF), regulating any business which issues e-money cards. Currently, a Committee for the Management of Land Traffic is setup by an Act dated B.E. 2521, whose duties and responsibilities are to setup the standards of management of land transportation to the Cabinet, while a new Mass Transit Committee is proposed under a draft regulation under the *MRT Act B.E. 2543*, which would have the ability to advise the Ministry of Transport on the integration of MRT, structure of fares, service fees, collection systems and the standard of services, answerable to a single regulatory body (ADB, 2009).

4.2.2 Fukuoka, Japan

Overview of the railway network

Commencing construction in 1995 and opened in 2005, the Fukuoka City railway system covers 35 stations, all converging at Tenjin Station, stretching across 29.9 km and incorporate the Kuko Line, Nanakuma Line and Hakozaki Line. Being operated by Fukuoka City Transportation Bureau (FCTB), it is estimated over 430,000 passengers use the subway network daily with trains passing every 3-6 minutes during rush hour and around 4-8 minutes during the rest of the day. Serving an overall population of 1,539,000 people, it is therefore estimated that public transport via rail is availed by approximately 28 per cent of the population on a daily basis. As the largest city in Kyushu, Fukuoka is not only one of the fastest growing cities in Japan, but also one of the few cities in Japan which is continuing to grow amidst a society with a declining population. Having a high ratio of young people and women, 96.2 per cent of citizens had answered that the city was "easy to live in" through the 2022 Citizen's Opinion Survey, giving it a reputation as a liveable city (Digitimes-Asia, 2023). Earlier this year extending the Nanakuma Line a further 1.4 kilometres to new Kushida Shrine providing riders the perfect way to access the thriving centre of Hakata, once Japan's largest trade hub, it is also one of the few cities in Japan actively expanding is urban rail provision (Zelki, 2019).

Existing fare pricing policy

Dividing the Fukuoka City Subway network spanning the 3 separate train lines into 6 distinct zones, a base fare for an adult in Zone 1 would cost 210 yen (USD $1.41), meanwhile a Zone 6 adult fare being the highest possible for travel between Meinohama station on the Kuko line and Hashimoto station on the Nanakuma line would cost 380 yen (USD $2.54). In this way, a passenger would be able to traverse the entire extent of the Fukuoka City Subway, getting on and off along different train lines based on an overarching fare policy and utilizing the same electronic transportation card. For taking multiple journeys in the same day, a one day pass with unlimited travel costs 640 yen (USD $4.28), while a “Fukuoka Tourist City Pass” ranging between 1,700-2,000 yen (USD $11.38-13.39), offers additional unique perks and discounts at selected outlets, such as free soft drinks, Asahi beer, post card and even 2 fillets of sardine on pollack roe (with the purchase of Yuyake Mentaiko) (GoFukuoka, 2023).

For regular commuters travelling in a limited area, a “Commuter Pass” is available for periods of 1, 3 and 6 months, while a “Chika Pass” is available for same periods, allowing unlimited travel on all subway lines, resulting in substantial savings for those who travel daily. Introducing another layer of innovation by incentivizing loyalty and good travel behaviour, riders can also earn points with 1 point equivalent to 1 yen. 60 points added per ride when using the Hayakaken card for one station area beyond the Commuter Pass area, and maximum of points being added 10 times a month (Fukuoka-City-Transportation-Bureau, 2023).

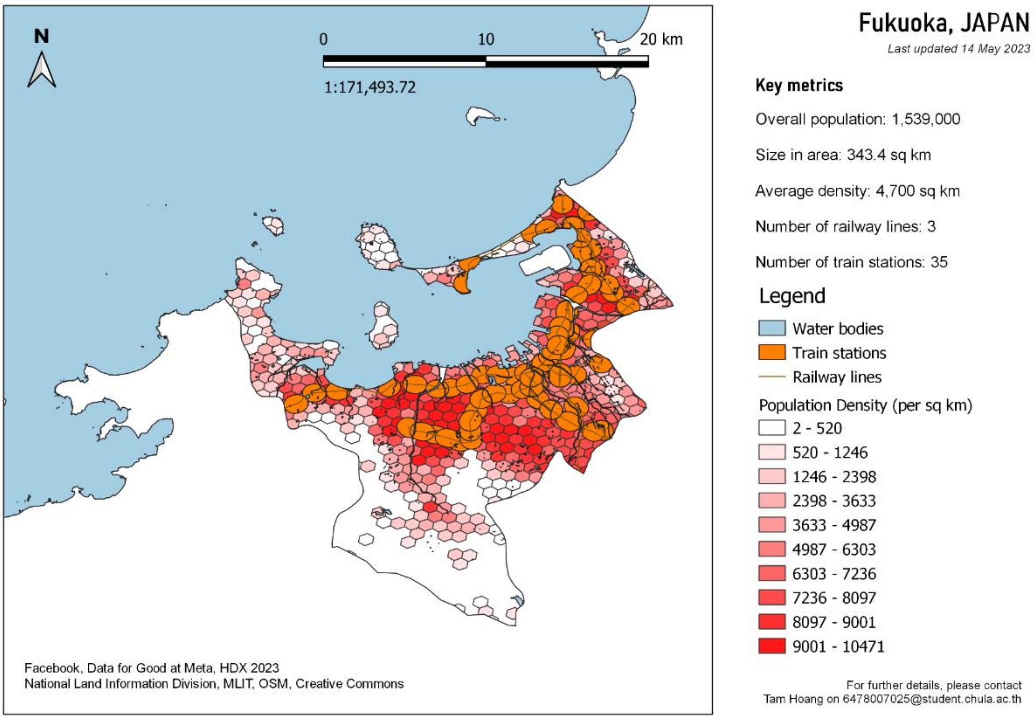

Figure 13: Overlay of Fukuoka railway system on spatial map of Fukuoka

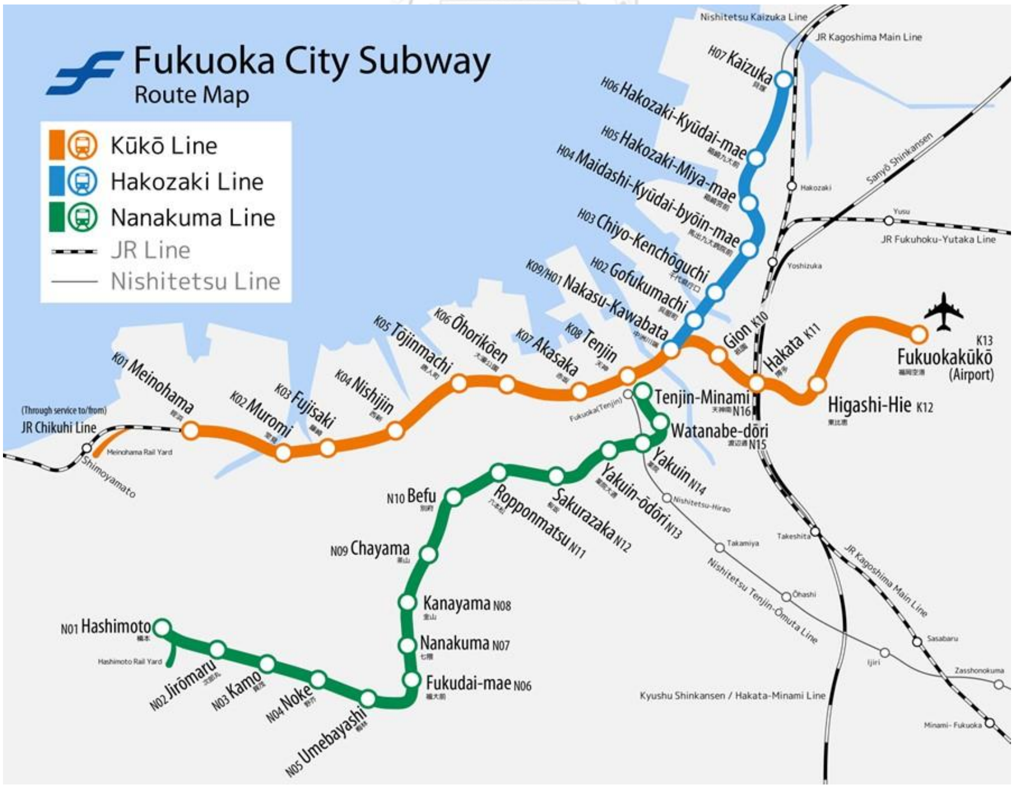

Figure 14: Map of the railway system network in Fukuoka, Japan

Common ticketing implementation

Having the opportunity to benefit and learn from the launch of the Suica card in 2001, ICOCA card in 2003 and Pasmo card in 2007, along with other transportation smart cards globally, the Hayakaken card used in Fukuoka was launched in March 2009. As such, despite possessing over 10 different types of integrated circuit (IC) cards in Japan, which can only be purchased from their respective region, perhaps the most revolutionary feature of these IC cards is their ability to be used inter-changeably across regions. By simply scanning the cars at the appropriate machine, prepaid stored value cards will automatically deduct the necessary fee. For many tourists familiar with the Suica and Pasmo cards in Tokyo, the only difference is that these IC cards are issued by different companies, so if you want to return the card at the end of your trip and receive a refund, it would only be possible to do so at any JR East Office for Suica card and any ticket office that is not JR for Pasmo card (Takamura, 2020). In the case of a Hayakaken card, IC card purchases prices are available starting from 1,000 yen (USD $6.69) which includes a 500 yen deposit (USD $3.35). Meanwhile, not only can the Hayakaken card in Fukuoka be used for trains and buses in Japan with an IC mark, but as an open-loop system, they can also be used as electronic money in stores having the IC mark on them.

IC cards in Japan have also benefitted from FeliCa technology used in smart cards being developed by homegrown Sony. The same technology as applied in the Hong Kong Octopus card, FeliCa was first adopted in 1997 and the world's first contactless smart card certified by ISO/IEC 15408 EAL4, assuring security and reliability of the system (Sony, 2023). Fully compliant with near-field communication (NFC) standards which use a short-range 13.56 megahertz high-frequency wireless signal to enable data exchange between devices over a distance of about 10 centimetres, the FeliCa smart chip comes with a microprocessor and has no power source of its own, but rather uses power supplied wirelessly by the card reader used to complete the transaction. While one of the most notable features is its speed, taking only 0.1 seconds to read and write data (Takei, 2016). Through a combination of technological ingenuity and rationalization of fare policies taking over a decade to mature, Japan now offers one of the most integrated common ticketing systems.

Legal and regulatory framework

Combining seven public companies in 1987, each being responsible for public transport in different areas of Japan, Japan Railways (JR) is a public company which is also registered in the Tokyo Stock Exchange, meaning that it is accountable to a wide variety of shareholders the 5 largest being Japan Trustee Services (5.06%); The Master Trust Bank of Japan (4.17%); The JR East Employees Shareholding (3.29%); The Bank of Tokyo-Mitsubishi (3.13%); and Sumitomo Mitsui Banking (2.63%), while also including 2 life insurance providers, Nippon Life and Dai-ichi Life. This is important to take note, as diversification of holdings means that JR Group is less susceptible to overall market volatility, while also ensuring that the company is accountable to ensuring sustained profits and operational productivity. Helping to facilitate interoperability, JR Group and Central Japan Railway cooperated in 2008 to expand card services interoperability across 10 transport cards including the 'Hayakaken card' in 2011. Nonetheless, it is recognized that despite the success of the 1987 railway reform, new measures must be considered to retain the profitability of local lines (Kurosaki & Alexandersson, 2018).

A *Basic Act on Transportation Policy (Act No. 92 of 2013)* exists which covers general provisions such as under Article 5 on efficient coordination among modes of transportation, as well as, under Article 18 towards the improvement of convenience, smoothness, and efficiency of transportation, however, it should be highlighted that ticketing is not mentioned in the context of the Act in any place. Perhaps interestingly, cross-modal transportation with railway is captured even dating back to the Railway Operation Act of 1900, under Article 18.2, including revisions of Act No. 19 of 31 March 2006, including between railway and other railway services, by means of the Ordinance by the Ministry of Land, Infrastructure, Transport, and Tourism (MLIT). Similar to the case of Bangkok, 2 regulations regulate the operation of rail and transportation systems in Japan, separated into railways by the *Railway Business Act No. 92 of 1986* and trams by the *Tram Act No. 76 of 1921*. By allowing private corporations to develop their own mass transit systems and compete with national rail lines, the government has limited its role to the regulation of fares and service quality standards, while facilitating private corporations to promote transit-oriented developments, planned communities, and vertically integrated businesses, along with retail integration.

4.2.3 Singapore, Singapore

Overview of the railway network

Occupying a landmass of 728.6 sq km, roughly half the size of Bangkok and double that of Fukuoka, public transport has for long been the predominant mobility for many in Singapore, known for its strong interventionist measures, due to space constraints and vehicle-light society targeting the reduction of car dependency. Two private/public companies operate the MRT and LRT across 8 distinct train lines, 175 train stations and 260 km of track, with plans to increase the track length to 360 km by 2030, surpassing the networks of Tokyo and Hong Kong. This is part of the Green Plan 2030 which aims to have 75 per cent of trips during peak periods done through mass transport, along with the Land Transport Masterplan, putting 80 per cent of households within a 10-minute walk of their nearest train station (Diao, 2018). With over 3.2 million riders daily out of a population of 5,454,000, close to 60 per cent of the population currently uses either the MRT and LRT for their daily commute. Despite experience rapid population growth and immigration rates, Singapore’s rail network has not been able to keep up, prompting deep investments by the government into railway infrastructure, which is expected to account for the vast majority of infrastructure industry value in Singapore.

Existing fare pricing policy

With both train operators, SMRT Corporation and SBS Transit being regulated by government, commuters are charged a fare according to the total distance travelled on each mode of transport, ranging between $0.99-2.26 SGD (USD $0.73-1.67) for distances of up to 3.2 km at lower end and over 40.2 km at upper end. To help alleviate congestion during the morning peak hours, the cost is discounted for tapping in before 7:45am on weekdays (excluding public holidays) with fares ranging from $0.49-1.76 SGD (USD $0.36-1.30). Recently undergoing a Fare Review in December 2022, the introduction of distance fares allows fares to be calculated on the shortest travel path, limited up to 5 transfers within a single journey and up to 2 hours to complete the journey. In this case, multiple rail transfers are allowed with no additional boarding charges, with up to 45 minutes allowed for each transfer between rail and bus services, while a maximum of 15 minutes allowed for transfers between rail stations. Besides discounts to both senior citizens and students, which are commonplace across ticketing systems, discounts are further provided in Singapore to Persons with Disabilities (PwDs), as well as, providing a Workfare Transport Concession (WTC) Scheme, for low-income individuals between ages of 30-60 years old and receiving Workfare Income Supplement (WIS) Payments, in possession of a WTC card. While a hybrid adult monthly travel pass is available at $128 SGD (USD $94.53), this is not available for standalone bus or train users, besides students and full-time national servicemen. As an interesting fare innovation, fares for feeder bus services are capped at 3.2 km.

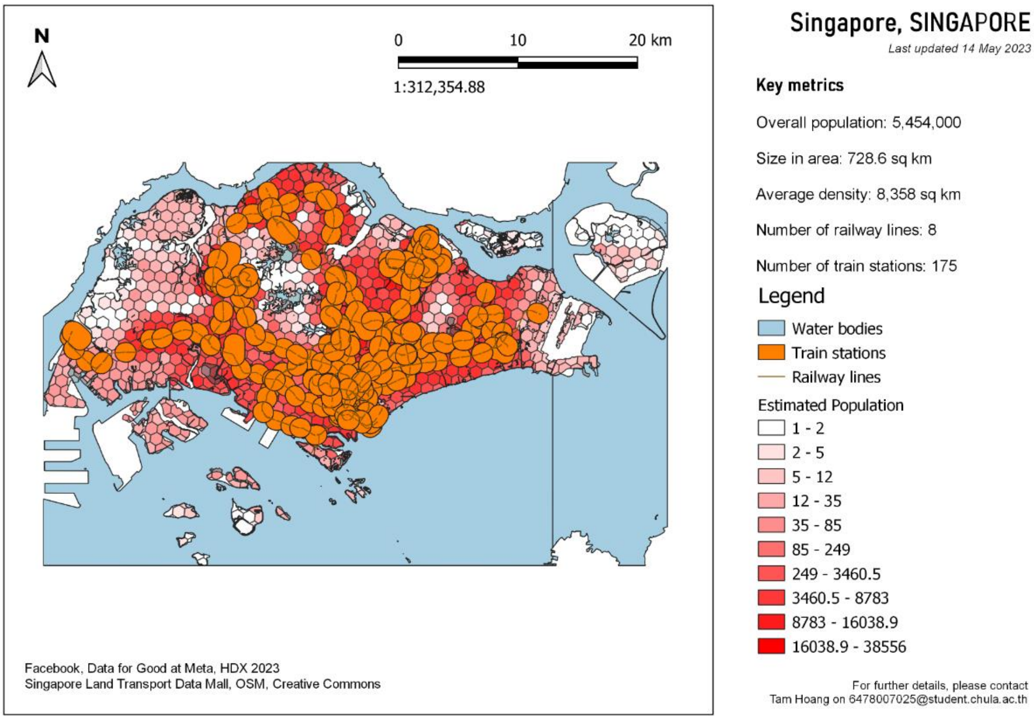

Figure 15: Overlay of Singapore railway system on spatial map of Singapore

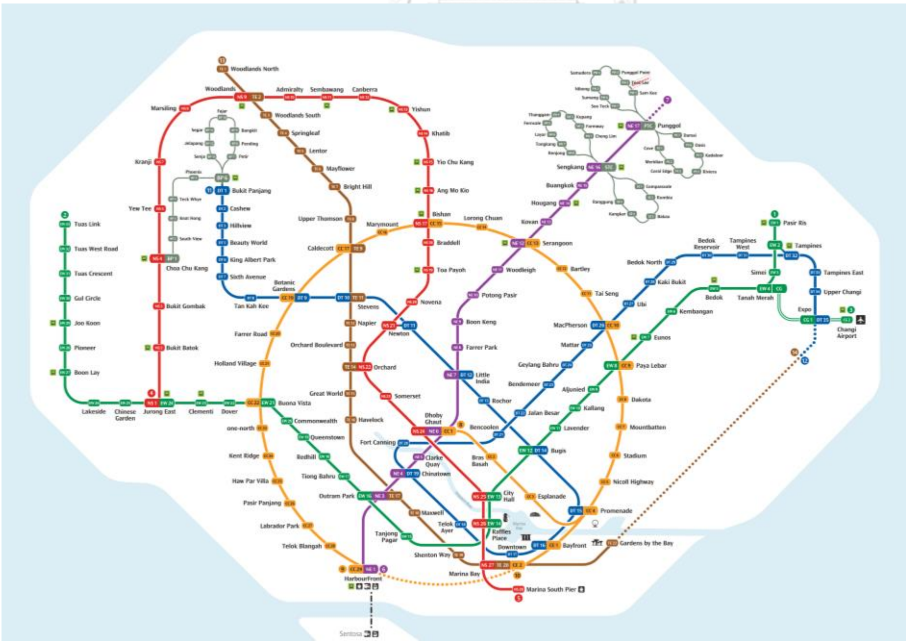

Figure 16: Map of the railway system network in Singapore

Common ticketing implementation

Launching the ez-Link card in 2002, allowing common ticketing across MRT, LRT and buses, the card is operated by two state-owned subsidiaries, both of which were established by the Land Transport Authority (LTA), namely 'EZ-Link', the issuer of the ez-Link card, and 'Transit Link', the acquirer which processes transit transactions and apportions revenue to the concerned public transit operators (PTOs). A second IC card, NETS, was further launched in 2009 by a subsidiary bank in Singapore providing integration with motor tollways and parking, including Singapore's Electronic Road Pricing (ERP), a system used to manage road congestion in the country (Kurosaki & Higashino, 2019). Recognizing the opportunity with smart cards to help enable a cashless society, the Specification for Contactless e-Purse Application (CEPAS), a Singaporean specification for electronic money was developed and put to public trial in 2008 and becoming effective in 2009. Allowing the inter-operability of multi-purpose stored value (MPSV) card payment schemes from different card issuers and system operators, this has since enabled innovations such as ez-Link embedded phones, ez-Link wearables, and ez-Link wallet. Despite this, at least in the retail space dominated by NETS, card readers cannot interoperate forcing consumers to hold different cards for different goods and services.

Reflecting on this fragmented e-payments landscape in 2017 during his National Day Rally Speech, Prime Minister Lee Hsien Loong issued a call to action to unify and integrate Singapore's e-payment systems, highlighting the significance of the matter in a country widely recognized for its pervasive use of digital technology and innovation to boost liveability. Passing the '*Payments Services Act*' in response, mandating common standards for payments services, this provides a backbone infrastructure upon which industry players can offer differentiated products. For e-payment companies, this has facilitated increased merchant adoption, consumer choice, and greater interoperability (Sim, 2019). However, as history has shown through the Electronic Commerce Plan in 1998, infrastructure and policy alone are seldom sufficient. In implementing common ticketing systems, it would be prudent to consider Singapore’s experience with spearheading account-based ticketing standards, influencing consumer behaviour, and ensuring institutional political leadership (Ng, 2018).

Legal and regulatory framework

Established by the LTA in 2002, EZ-Link is responsible for the issuing of smart cards, as well as, managing the central clearing house for regulating both transit and non-transit service providers who use EZ-Link. Holding 100 per cent of shares, it is in turn regulated by the Monetary Authority of Singapore (MAS) and Public Transport Council (PTC). The latter in particular, being responsible for the regulation of public transport fares and ticket payment services, being established in 1987 under the *Public Transport Council Act (Cap 259B)* and operating within the overall ambit of the *Public Transport Act 1987*. Specifically established with the key statutory powers to regulate bus and train fares, as well as, facilitate the integration of bus and train fares for more efficient public passenger transport services and facilities, along with ticket payment services and fare structures, the PTC are a good example of dedicated government institution, helping to make public transport the preferred choice of travel for all by keeping fares affordable while improving the commuting experience. Applying a fare review formula, feedback from commuters, and data analysis, fare adjustments are capped each year taking into account external factors, such as inflation, wages, energy prices, network capacity, and productivity extraction.

Accordingly, the licencing of ticket payment services is covered by the *Public Transport Council Act 1987 (2020 Revised edition)* under Article 28, whereby any application for the grant or renewal of a ticket payment service licence must be made to the PTC, exercising the discretion to grant, renew or refuse a licence under Article 29, based on the financial standing of the applicant and ability to maintain adequate, satisfactory, secure, and efficient ticket payment service. Under Article 30, the PTC may also impose conditions relating to the provision or operation of any ticket payment service under Clause (d) or standards of performance under Clause (e). A *Rapid Transit Systems Act (Chapter 263A, Section 42) (1997 Revised edition)*, stipulates under Article 32 that all tickets are granted subject to Section 24C of the *Public Transport Council Act (Cap. 259B)*, although details are not expanded to the area of common ticketing. Liberalization of the 'stored value facility' (SVF) market contributed to the emergence of NETS in 1996, which is now accepted on public transport, regulated by *Payment Systems (Oversight) Act 2006 (Chapter 222A)*, which provides the legal framework for SVFs, accompanied by the *Electronic Transactions Act (Chapter 88)*.

4.2.4 Sydney, Australia

Overview of the railway network

Operating as a hybrid urban-suburban rail system with underground core covering 369 km over 813 km of track and across 170 stations, the Sydney train network is operated by Sydney Trains which became a standalone entity from Transport NSW (TfNSW) in July 2017. Between 2018-19, it was estimated that over 377.1 million passenger journeys were facilitated, making it the most used rail network in Australia with metro-equivalent frequencies every 3 minutes in the underground core and 5-10 minutes for most inner-city and major stations, while around 15 minutes for minor stations. On average, each day across 3,200 timetabled services, it is estimated that Sydney Trains delivers around 720,000 passenger journeys, which based on a population of 5,297,089 in the Sydney metropolitan region, means approximately 13.6 per cent of the population are availing themselves of public transport by rail.

Responsible for the management of more than $46 billion AUD (USD $29.96 billion) including maintenance of almost 2,000 km of track, 2,134 electric and diesel cars, and 1,536 km of electric wiring, a review is underway of the mission and priorities for Sydney Trains, initially focused on governance and accountability, asset management and planning, reliability, and resilience (TfNSW, 2023).

Existing fare pricing policy

Pricing for the standard fare is based on peak and off-peak periods with incentives for contactless smart cards versus cash or other monetary transactions. While an adult peak fare ranges between $4.00-9.84 AUD (USD $2.60-6.41), an adult off-peak fare would be between $2.80-6.88 AUD (USD $1.82-4.48). With the base fare calculated on distances between 0-10 km, the most expensive fare is for distances beyond 65 km. Passengers receive a 30 per cent discount on metro/train, bus and light rail services when travelling on Fridays, weekends, public holidays, and outside of peak times (i.e. 6:30-10:00am and 3:00-7:00pm). Whereas these same adult “single trip tickets” cost between $4.80-11.80 AUD (USD $3.13-7.68) irrespective of peak and off-peak periods.

Daily and weekly caps are implemented allowing unlimited travel on metro, train, bus, ferry, and light rail services, being capped at $17.80 AUD a day (USD $11.59) (Monday to Thursday); $8.90 AUD a day (USD $5.80) (Friday, Saturday, Sunday, and public holidays); and $50 AUD per week (USD $32.56), with the exception of Sydney Airport, privately owned by Airport Link Company, where a station access fee of $16.68 AUD (USD $10.86) applies. For adult Opal card users who switch between metro/train, ferry, bus, or light rail services within 60 minutes of the last tap-off as part of one journey, an additional $2 AUD (USD $1.30) discount is applied (except at Circular Quay station).

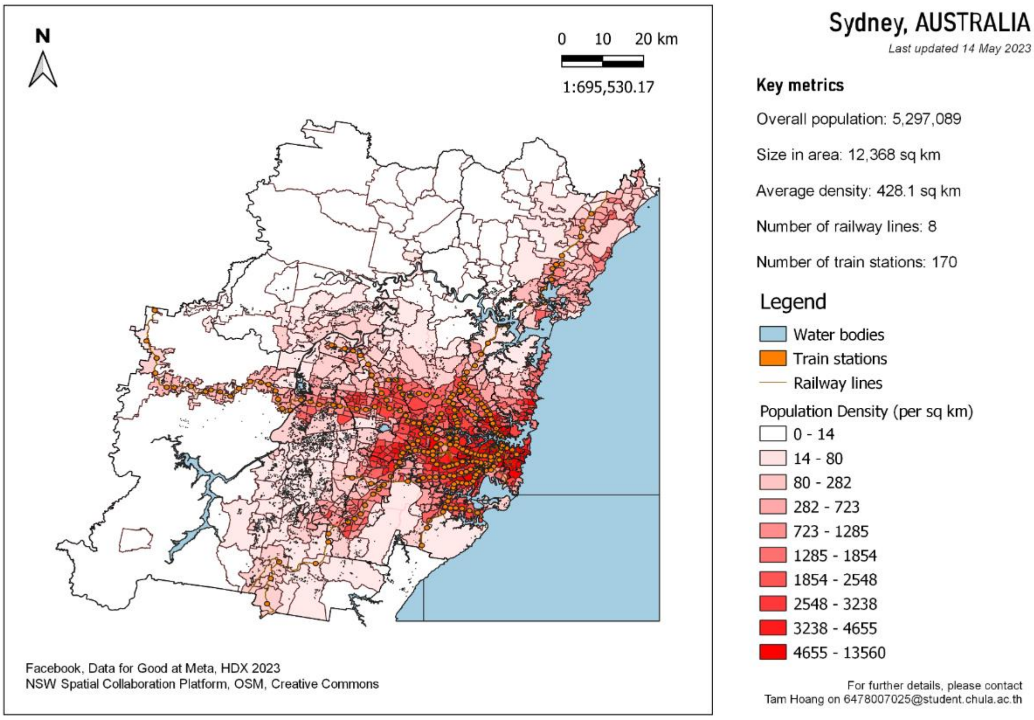

Figure 17: Overlay of Sydney railway system on spatial map of Sydney

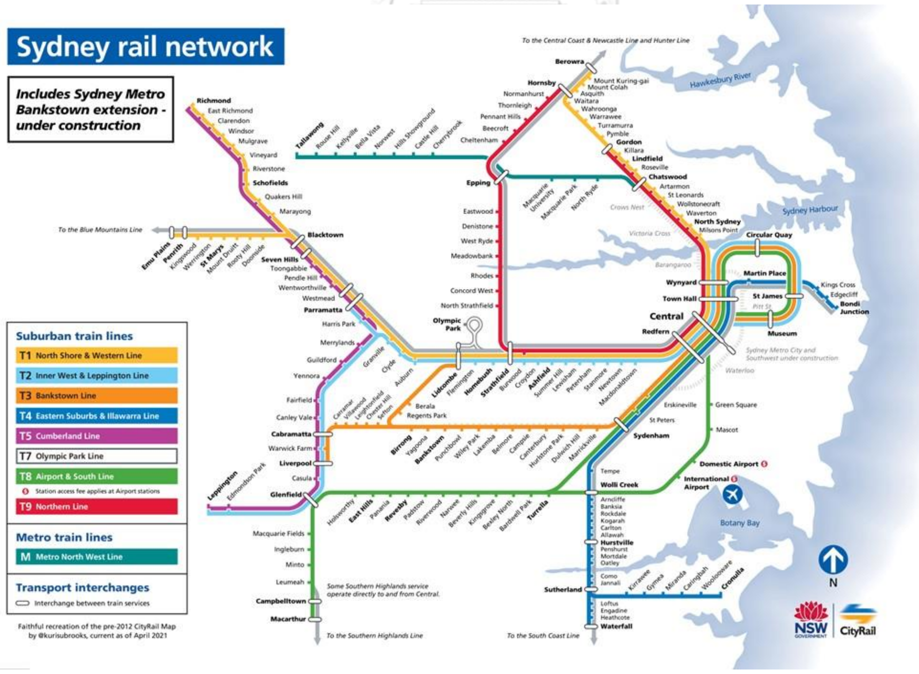

Figure 18: Map of the railway system network in Sydney, Australia

Common ticketing implementation

Experiencing a rocky start with “Tcard” first announced in 1997 and a limited trial commencing with schools in 2005, a Public Transport Ticketing Corporation (PTTC) was setup in 2006 to administer the roll-out, although the contract with vendor ERG was terminated in 2008, following long drawn-out legal Supreme Court disputes dating back to 2002. Despite having implemented smart cards in cities including Hong Kong, Melbourne, Rome, San Francisco and Singapore, ongoing delays, failures, and “appalling” project management were cited by then Transport Minister, John Watkins, as justification for the termination of the contract with ERG, at exorbitant cost of $95 million AUD (USD $61.86 million) to NSW taxpayers (Smith, 2008). Originally planned for launch at 2000 Sydney Olympic Games, the Pearl Consortium comprising of Commonwealth Bank, Cubic Transportation Systems Australia, and Downer EDI Engineering Power, was eventually appointed in 2010 to deliver upon an integrated electronic ticketing system (LeMay, 2010). With the matter resolved sparing taxpayers a potential loss of $200 million AUD (USD $130.2 million), the Opal card was finally launched in 2012 (Mallya, 2012).

Evidently, lessons drawn from the failed Tcard are pivotal to informing a common ticketing system in Bangkok or elsewhere. Through the theoretical framework posited by Eric Patashnik, who argues for successful public policy to be implemented, former political structures such as iron triangles, opposing parties and pre-existing markets must be destroyed, it is suggested the presence of complex legal pre-reform fare structures resulting in 120 different fare policies and segregated transport operators, ultimately led to the demise of the Tcard (Patashnik, 2008). Different transportation operators, STA, Railcorp, and Sydney Ferries, maintained the same structure, powers and functions as before, while old and complex fare systems were not reformed.

On paper, Sydney should have been a clone of Hong Kong, contracting the same company, ERG, and setting up the PTTC to deliver upon the promise. Beyond the absence of actual powers by PTTC to make decisions over fares and a streamlined single transport operator, the failure of key actors to reform due to electoral interests and fear of losing votes, causing policy myopia are cited as key factors leading to the downfall of the Tcard (Lee, 2011). Fortunately, over two decades later, key NSW rail products are set to receive a boost as part of the $72.3 billion AUD (USD $47.1 billion) 2023-24 Budget over 4 years, towards city-shaping transport infrastructure projects (Skatssoon, 2023).

Legal and regulatory framework

While several Acts govern passenger transport in NSW, the main legislation is the *Passenger Transport Act 1990 (PT Act)*, which regulates the operation of buses, trains, ferries, taxis and hire cars, including setting fares, while supported by specific regulations setting out the operational information such as about ticketing and fines. An overarching *Transport Administration Act 1988 (No. 109)*, sets out the functions for Transport for NSW, which include the general functions of planning, oversight and delivery of transport infrastructure in accordance with integrated transport and land use strategies, including specifically under Schedule 1, Article 1, Clause (j) the provision of integrated ticketing arrangements for transport services, and regulating the types of tickets and other ticketing arrangements for the setting of fares for transport services. While the meaning of a "smart card" is even covered in the *Passenger Transport (General) Regulation 2017*, under Article 70, Subsection 3(1), while ticketing more generally is covered under Part 6 of the same Regulation.

Following a 2012 review of the NSW Passenger Transport legislation, reforms were proposed aimed at developing an integrated, coherent transport system across all modes that consider the passenger's entire journey wherever possible, they way in which transport services are purchased, contract conditions, along with performance standards (Transport-for-NSW, 2012). This was also done in recognition of new modes of transport including 'light rail' being introduced and the removal of licencing for buses and ferries. Maximum fares for passenger transport services are set out through 3 different Acts, namely the *PT Act*, the *Transport Administration Act 1988 (TA Act)*, and *Independent Pricing and Regulatory Tribunal Act 1992 (IPART Act)*. Whereas the *Passenger Transport Regulation 2007* was established to pave the way for the launch of the 'Opal card' in 2012 and Privacy Personal Information Protection Act 1998 (NSW) (PPIPA) covers personal information collected by the ticketing system.

4.3 RESULTS FROM PRE-VERIFICATION

Table 6: Responses from the pre-verification with Singapore

1. General operations									**Singapore, SINGAPORE**
a. Number of stations and lines are currently operated by the city train network									8 lines, 175 stations
b. Estimated length of the city train network which is currently being managed									259.6km
c. When the city train network was established and how many years of operation									1987
d. How many operators are involved in the provision of the city train network									2
e. Is provision of railway transportation in your city primarily publicly operated or privately managed									
☐	Fully public	☒	Mainly public	☐	Balanced	☐	Mainly private	☐	Fully private
f. Estimated number of passengers who caught the train in the previous year									1.6 billion
g. Average frequency of the trains operating during the peak hour period									
2-3 mins (peak); 5-7 mins (off-peak)									
h. Hours during the day and night in which the city train network operational									
5:30am-12 midnight									
2. Pricing structure									
a. Purchase price of a train card					c. Minimum trip cost of travel				
SGD $10 (including SGD $5 non-refundable credit)					SGD $0.77 (0-3.2 km) - SGD $1.37 (Express)				
b. Validity of the card in duration			5 years		d. Maximum trip cost of travel				SGD $2.02 - SGD $2.62
e. Pricing structure for transportation and how it is presently calculated for the city train network									
☐	Number of stations	☐	Duration of travel	☐	Zone-based	☒	Other *(please specify)* Based on distance		
f. Availability of a weekly or monthly or annual card allowing unlimited trips									
☐	Weekly	☒	Monthly	☐	Yearly	☐	Other *(please specify)*		
g. Is the cost of travel subsidized in any way for the below categories of transport users?									
☒	Elderly	☒	Students	☒	Persons with disabilities	☒	Low-income groups	☐	Faith bearers
3. Payment and ticketing									
a. Year in which the existing transport card currently in operation was launched									April 2002
b. How many transport cards are currently known and believed to be in circulation									24.9 million
c. Is a mobile application available?			Yes		f. Can users have personal accounts?				Yes
d. Is a history of trips available?			Yes		g. Can the transport card be used to pay for other purchases or services?				Yes
e. Is the card linked to personal ID?			No		h. Can credit top-up be done online?				Yes
i. Estimated cost of rolling-out the common ticketing system present in your city									
j. Months required for the common ticketing system to be completely rolled out									**24 months**
k. Please indicate which aspects were carried out for the roll-out (tick all that apply).									
☒	Local/Public consultations	☒	Technical assessment	☒	Limited trial or testing period	☐	City-to-city exchanges	☒	Phased migration

NOTE: For the results from the pre-verification for Bangkok, Fukuoka, and Sydney, please kindly refer to ANNEX A: RESULTS FROM PRE-VERIFICATION.

4.4 RESPONSES FROM THE INTERVIEWS

4.4.1 Bangkok, Thailand

Table 7: Responses to interview questions with Bangkok

Respondents:

- **Mr. Apichart Suphachitsawas,** Director of the Rail Transport Division, Bangkok Metropolitan Administration (BMA)
- **Mr. Jakrapon Wannagul**, Chief of Operations, Transportation System Office, Bangkok Metropolitan Administration (BMA)

No.	Question	Response
1	In your own opinion, do you feel that a common ticketing system is/can be effective? (Yes/No/Other)	Yes - *"Let me offer a background. OTP and MOT are planning for common ticketing but the common fare is not yet implemented. Since they need to be independent for now so they are looking at first how to integrate the systems on rail transport for common ticketing and the common fare."* - *"For now, they are developing common ticket for rail and road separately, then they will merge in the next step."* - *"Presently, the Blue and Purple line can share the ticket. With regards to road transport, they have the Mfloor system for motorway and Easy Pass for expressway, using the same thing."* - *"It is the goal of OTP to roll-out the EMV payment system, allowing for*

		payment by Mastercard or Visa credit cards. At the same time, the chipset can also be used to pay for everything." - *"Concerning rail transportation, the Bangkok Governor is focusing on the people, and how it will be convenient for people for most part, to ensure their easy access to the rail transport. Fare discussions are also underway with the ministry to help resolve issues."* - *"One of the challenges has been having contractors do the train network. While both BTS and MRT have fixed price for each line to reduce the price, these lines are independent of each other."* - *"BMA has fund subsidise the cost for this, but this is still being negotiated."* - *"Now the government is working on the Common Ticketing Act and when this is established, the cost of MRT and SRT will be reduced, meaning people will get lower price, but the contractor will still get same price due to subsidies."*
2	Please help to share about little bit about yourself, in particular helping to touch upon your (i) position; (ii) role in operations, in relation to ticketing	- *"Having joined the rail department since 2011, I have worked with the Bangkok Metropolitan Administration since 2003."* - *"Presently, my duty is as a regulator of all the contractors for rail transport, as*

	systems; and (iii) number of years in the organization.	*well as, matters pertaining to the facilities for persons with disabilities, skywalks, and all aspects which connect to rail transport. A significant part of my work has been the implementation of the new Gold line to Icon Siam."* - *"Other areas I have been involved are environmental impact assessments of feeder lines to the grey line and engaging in public-private-partnership initiatives for network expansion."* - *"I am also involved in the study of 2 new lines, being Silver line connecting to Bang Na and Green line, connecting the Gold, Grey and Silver line."*
3	Please help to share about little bit about the work environment, in particular helping to touch upon the (i) number of personnel in your team; (ii) background of personnel; and (iii) areas of work covered.	- *"Within the Office of Transport, presently there are 2 divisions, leading on rail and road transport collectively, and another on water transport."* - *"The roles which I am leading are mainly concerning sectors that are associated with operations and project implementation."* - *"Many of the personnel in the team come from construction background."* - *"Some had also transferred to the operations team from another team."*

		- *"On average, there are around 5-6 people employed per sector."* - *"My role is to oversee the division, as head of project implementation team."* - *"Among those in the Division, around 2-3 personnel out of 5-6, will be typically be focussed on research and study, while the others are more often than not civil engineering technicians."*
4	With regards to roll-out of the common ticketing system in your city, what did you perceive were the main issues encountered and challenges faced during the design, installation, or implementation? These may be at national, or sub-national level; related to capacity or resource constraints; or external factors.	- *"In the case of Bangkok, there are a lot of regulators, such as BMA and Ministry of Transport (MOT), while it is difficult to use the same price and negotiate upon an agreed price. Yet another challenge is having to integrate the systems while continuing to operate the transport system. I also find that technology is rapidly changing and the systems used for money collection are evolving so fast, which is making it hard for to keep up with latest technology."* - *"Agreeing up on the price of fares has been quite difficult, taking the Green line, there are 3 operators, 2 of which as hired and 1 being owned by BTS."* - *"Because of the many operators, it has been difficult to have the same price structure in the past. Looking back, when Bangkok was starting to build the BTS rail transport, at the time Bangkok*

		did not have much money, and so BTS had invested heavily for everything. By owning all the infrastructure, this helped to drive down costs, but has made it more difficult to integrate the system with other operators."
5	In terms of your most critical and immediate needs due to effective roll-out of common ticket systems, what factors do you feel contributed most to the success of the roll-out or are considered to be the most important? These may relate to population; ridership; ticketing costs; data management; or other factors.	- *"Presently, a challenge is MOT holds everything. If they want to implement common ticketing, they would have to enact a law which is still being debated and it is quite complex to have to go through government and get approval."* - *"Fortunately, now they are working on common ticketing. OTP is working on the law and then the Department of Transport is working on the pricing structure. Contracting the project to contractor will be another challenge. Even though pricing is issued already, but common ticketing is not there yet. Meanwhile, there still be more work even after the price is negotiated."* - *"OTP is working on the lines which are beneath their own supervision. They cannot work on others, which has also been a limiting factor as they are not able to work cross-function. In this regard, I would say the number of passengers is not or less important."*

		- *"Right now, the priority is to connect he Pink line and Green line connect, while BTS is contracted to help connect both the Yellow line and Pink line."* - *"In these cases, users can still use their existing Rabbit cards, but will plan to be enabled to used EMV card as well."* - *"OTP helps to oversee 4 primary lines, with the Purple line and Blue line operated by MRT, while the Yellow line and Pink link operated by BTS."*
6	In order of ranking, what do you consider to be the 5 most critical factors to ensure the success of a common ticketing system?	1. Subsidy from public sector 2. Need to be the middle person 3. Win-win situation 4. Contract pattern (should mention common ticketing in the contract) 5. No regulation on common ticketing, hence, different operators use different systems – need to study the system
7	In order of ranking, which stakeholders do you feel to be the 5 most important to ensure success of a common ticketing system?	1. MOT – issue a policy to cover everything 2. OTP – every transport, road, rail etc. 3. Department of Rail 4. BMA – cooperate on everything
8	Reflecting upon the roll-out of the existing ticketing system, is there anything else that you feel could have been done in the	- *"Looking back, each authority needs to develop their own system separately, but there should have been more communication between each of the operators in setting up the system."*

	early stages to help facilitate a smoother adoption of the ticketing system in general?	- *"The Rabbit card which belongs to BTS, has helped increase the adoption of smart cards on public transport."* - *"By implementing marketing strategies, such as to support the earning of points and redeeming of points for other trips, food items, or gifts, could have also been considered to increase uptake of public transport within society."* - *"Further research could also be done by the Ministry of Transport to ensure EMV can be used across MRT and other existing railway systems in Bangkok."* - *"Discussions have also suggested the possibility of maybe connecting the new red line with the Airport Rail Link."* - *"Adding for the MOT, it would be very important to consider how to also integrate the EMV for road transport, especially tollways using credit cards."* - *"While efforts should also be made to help develop integrated common ticketing for other modes of public transport to also connect, for example, ferries, which are now separate."*
9	Looking forward to the future of ticketing systems, what might you consider to be the opportunities that may lie on the	- *"Overall, the highest goal is to have a common fare for the common ticket."* - *"For now, pending to pay the starting price, when you go to the green line, first 16 baht when boarding and then*

	horizon, which may eventually influence or revolutionize public transport as a whole?	*subsequently fees will need to be paid upon boarding upon each new line.”* - *“Ideally, it should be the case you would only need to pay for the rest of the trip, you pay remainder, rather than a new boarding fee for each line.”* - *“Having a common fare is certainly the first step towards common ticketing.”* - *“Eventually, every mode of public transport should be able to connect with each other without problems.”*

4.4.2 Fukuoka, Japan

Table 8: Responses to interview questions with Fukuoka

Respondents:

- **Mr. Hidetaka Urae**, Chief, IC Card Section at Fukuoka City Transportation Bureau (FCBT)
- **Mr. Fumiyasu Ichinaga**, UN-Habitat Regional Office (seconded by Fukuoka Prefecture)

No.	Question	Response
1	In your own opinion, do you feel that a common ticketing system is/can be effective? (Yes/No/Other)	*Yes* - *“Common ticketing helps to improve the efficiency of operations, as the touch speed is very fast, this ensures that it is not so crowded around ticket gates.”* - *“Interoperability is also very important. For instance, it is very convenient for the Hayakaken card to also be used in other public transportation in Japan.”*

2	Please help to share about little bit about yourself, in particular helping to touch upon your (i) position; (ii) role in operations, in relation to ticketing systems; and (iii) number of years in the organization.	- *"Presently, I am the Chief official of the IC card section, which stands for "integrated circuit", in the Transportation Bureau of Fukuoka City. Here I am responsible for the management and operations of the Hayakaken card usage and functions."* - *"As part of my role, I help to consider introducing new technology and improving transportation service."* - *"Approximately, I have been working with the Fukuoka City Transportation Bureau for around 10 years."*
3	Please help to share about little bit about the work environment, in particular helping to touch upon the (i) number of personnel in your team; (ii) background of personnel; and (iii) areas of work covered.	- *"The IC Card team comprises 6 personnel for which I am the Chief officer."* - *"Our responsibilities are to consider the specification of the transportation system and ensure the functionality of the Hayakaken card in Fukuoka City."* - *"We also support the consideration and operation of the additional services regarding of IC card such as for the purchases of goods and services using electronic money. Here two personnel are responsible for these services."* - *"Overall, we support the development and maintenance of the system of IC card, for which 4 personnel in the team are in charge and help to deliver."*

4	With regards to roll-out of the common ticketing system in your city, what did you perceive were the main issues encountered and challenges faced during the design, installation, or implementation? These may be at national, or sub-national level; related to capacity or resource constraints; or external factors.	- *"Primarily, the biggest challenge which we encountered was that it was difficult to implement the new system while operating the existing system. This meaning, that it was necessary to continue the functionality of both the existing and new system at the same time, while passengers were gaining familiarity with the new system, which might cause some confusion among passengers or resistance towards the adoption of the new system."*
5	In terms of your most critical and immediate needs due to effective roll-out of common ticket systems, what factors do you feel contributed most to the success of the roll-out or are considered to be the most important? These may relate to population; ridership; ticketing costs; data management; or other factors.	- *"Most importantly, when implementing common ticketing systems should be the consideration about how to coordinate with other transportation companies and administrations in advance in order to make the Hayakaken card available all over Japan. This includes both public and private public transport operators and should include administrations even beyond those in the nearby vicinity, extending to other regions to help and maximize the coverage."*

6	In order of ranking, what do you consider to be the 5 most critical factors to ensure the success of a common ticketing system?	1. The research of advanced cases 2. The consideration of being clear about what we want to achieve 3. The consideration of the specification of the system 4. The tests with other transportation administrations 5. The consideration of the way of switching the existing system to the new system
7	In order of ranking, which stakeholders do you feel to be the 5 most important to ensure success of a common ticketing system?	1. The manufacturing company which implemented the IC system in other areas 2. Co-workers (we trained them the change of the operation regarding the new system) 3. Finance sector in Transportation Bureau
8	Reflecting upon the roll-out of the existing ticketing system, is there anything else that you feel could have been done in the early stages to help facilitate a smoother adoption of the ticketing system in general?	- *"Something that we had done well during the launch of the ticketing system, was to provide easy-to-understand information to customers uniformally at all stations, responding to questions which they might have around the usage of the card. We also set up a help desk internally to teach our own co-workers about the operation of the new system."*
9	Looking forward to the future of ticketing systems, what might you consider to be the opportunities that may	- *"Perhaps in looking forward, it would be better to collaborate with the "My number system" in transportation systems. In this way, every individual passenger would have a digital account*

	lie on the horizon, which may eventually influence or revolutionize public transport as a whole?	*and ID, providing them with access to personalized services, while helping the city to better monitor trends in public transportation usage rates."*

4.4.3 Singapore, Singapore

Table 9: Responses to interview questions with Singapore

Respondents: • **Mr. Silvester Prakasam,** Senior Advisor, Digital Mobility Solutions, MSI Global • **Mr. Looi Teik Soon,** Advisor to the LTA Academy and Singapore Rail Academy		
No.	Question	Response
1	In your own opinion, do you feel that a common ticketing system is/can be effective? (Yes/No/Other)	Yes - *"Definitely. A common ticketing system is effective and beneficial, especially for passengers concerned, as it allows ease of transfers, while also facilitating lower fares due to single boarding charges."* - *"When integrated across different modes of transport, it also helps to ensure a common mode of payment being used across all modes of transport."* - *"Considering that it is common to take different modes of transport along a journey, common ticketing also helps to follow a journey from the very start until the finish, as a single journey."* - *"Increasingly, we are also seeing the adoption of "Mobility-as-a-service",*

		integrating not only the ticketing but also booking and other services, which Singapore has been doing since 2011."
2	Please help to share about little bit about yourself, in particular helping to touch upon your (i) position; (ii) role in operations, in relation to ticketing systems; and (iii) number of years in the organization.	- *"As Head of the Business Unit, responsible for fare systems, joining the organisation in 1989, I have led several ticketing initiatives, including Integrated Ticketing System which provided a common fare structure for the entire public transport network in Singapore."* - *"In 1998, as Project Director for the Enhanced Integrated Fare System project, I had helped to implement a common smart card system across the public transport network at a total cost of US$200m and completed in 2002, with over 10 million cards were issued."* - *"I have also been actively involved in various National Committees such as for the promotion of e-payments and related standards and also in overseas projects."*
3	Please help to share about little bit about the work environment, in particular helping to touch upon the (i) number of personnel in your team; (ii) background of personnel;	- *"As we undertake software development and system integration inhouse, we have team of around 200 personnel."* - *"On the whole, these personnel help to perform a whole range of project activities and functions from gathering user requirements, to project management and coordination."*

	and (iii) areas of work covered.	- *"Within this structure, there are various teams, such as those on software development, site supervision, testing, system rollout and maintenance."* - *"In conducting each activity, it is important personnel are equipped with well documented tasks. It is also equally vital in the public domain, you should be able to access this information."* - *"All personnel have at least 5 years of experience in their respective areas of profession, while the years of experience is on average about 12 years."*
4	With regards to roll-out of the common ticketing system in your city, what did you perceive were the main issues encountered and challenges faced during the design, installation, or implementation? These may be at national, or sub-national level; related to capacity or resource constraints; or external factors.	- *"Getting the right skill sets is always a problem but we were able to fill gaps in expertise by recruiting expertise internationally from abroad."* - *"Have been able to develop a robust project organisation over the past 20 years, we did not face any significant problems in design, installation and implementation of the common ticketing system when it was launched."* - *"However, it should be noted that we also put in significant efforts for public education to get public acceptance, which was vital for the uptake."* - *"Something to consider when rolling out common ticketing systems, is that why aren't taxes part of the journey?"*

		- *"As a much bigger ticket item, private sector does not see public transport as lucrative and there needs to be ways to incentivize these operations."* - *"While not necessarily a technical reason, but road pricing is seen as premium service in Singapore, and as such can compete with public transport."*
5	In terms of your most critical and immediate needs due to effective roll-out of common ticket systems, what factors do you feel contributed most to the success of the roll-out or are considered to be the most important? These may relate to population; ridership; ticketing costs; data management; or other factors.	- *"Fundamentally, there must be good partnership between government, system provider and Public Transport Operators."* - *"An experienced project management core team, is also essential with at least 10 years in performing similar roles."* - *"Well defined requirements established at the outset will minimize scope creep."* - *"Meanwhile, thorough testing of the common ticketing system in the lab as well in the field, will be important to minimize inconvenience to commuters."* - *"To save time, the use of test automation can be applied to observe results."* - *"Considering cities where common ticketing systems are deployed, it is critical the population size exists so there is sufficient ridership."* - *"For passengers themselves, ensuring affordable fares is the most important."*

		- *"In this way, passengers should only be charged one boarding charge, for the entire length of their journey."* - *"Payment of fares should be based upon the total distance, plus the boarding charge with a fare cap per journey."*
6	In order of ranking, what do you consider to be the 5 most critical factors to ensure the success of a common ticketing system?	1. Political will and budget 2. Experienced project management team 3. Well defined requirements 4. Stringent selection of contractor 5. Exhaustive testing
7	In order of ranking, which stakeholders do you feel to be the 5 most important to ensure success of a common ticketing system?	1. Buy-in from the public 2. Good client support 3. Public transport operators 4. Contractor 5. Interfacing of system owners such as banks
8	Reflecting upon the roll-out of the existing ticketing system, is there anything else that you feel could have been done in the early stages to help facilitate a smoother adoption of the ticketing system in general?	- *"As an organization, we are very well-versed in system rollout and our standard practice can be good enough."* - *"When rolling out the system, it is vital that it is designed to be multi-modal."* - *"Coefficients and comprehensive testing will help to decide, how much each fare will go into this and system roll-out."* - *"A significant big thing which occurred in Singapore was when the bank cards started to be introduced in 2008 allowing payments on their cards."*

		- *"Today, 50% of payments are now using bank cards instead of transport cards."*
9	Looking forward to the future of ticketing systems, what might you consider to be the opportunities that may lie on the horizon, which may eventually influence or revolutionize public transport as a whole?	- *"Considering the future, account-based ticketing, if properly executed can eliminate the need for top-up facilities."* - *"This would lead to significantly reducing the ticketing cost for passengers."* - *"In the long term, all payment providers may make ticketing part of their product and service offerings available."* - *"In the case of the Opal card – stitched "transfer rebate" has been promoted supporting multi-modality."* - *"Meanwhile, in Sydney - new ticketing services also now being explored."* - *"In Bangkok, MSI is working with BTS through the Rabbit card, along with MRT and BEM (Bangkok Expressway and Metro) for support on tollway systems."* - *"MSI is helping to put in additional software across a range of systems."* - *"In fact, the back office for BTS is functionally supported by MSI."* - *"Considering the original BTS system, we have 1 backend which is pure transit, and 1 backend supporting retail."*

4.4.4 Sydney, Australia

Table 10: Responses to interview questions with Sydney

Respondents:

- **Mr. Lewis Clark**, Head, Customer Systems and Operations, Transport for NSW
- **Ms. Sharon Harrison**, Business Coordinator, Customer Strategy and Technology, Transport for NSW

No.	Question	Response
1	In your own opinion, do you feel that a common ticketing system is/can be effective? (Yes/No/Other)	Yes - *"A common and simple ticketing platform makes public transport an easier to use choice for customers. Detailed tap on and tap off information also assists with transport planning."*
2	Please help to share about little bit about yourself, in particular helping to touch upon your (i) position; (ii) role in operations, in relation to ticketing systems; and (iii) number of years in the organization.	- *"As the Executive Director responsible for Opal, Customer Payment Services at Transport for New South Wales (TfNSW), and the benefits it brings for customers, I am also responsible for other customer and operational systems, possessing 14 years in the organization, while also currently being a Director at Intelligent Transport Systems (ITS) Australia."*
3	Please help to share about little bit about the work environment, in particular helping to touch upon the (i) number of personnel in your team; (ii)	- *"As part of the functions being carried out by the team, we currently provide a number of services including:* - *Opal card management* - *Tolling systems* - *Road and public transport operational systems*

	background of personnel; and (iii) areas of work covered.	- *Contact centres* - *Administration of public transport concession travel schemes."*
4	With regards to roll-out of the common ticketing system in your city, what did you perceive were the main issues encountered and challenges faced during the design, installation, or implementation? These may be at national, or sub-national level; related to capacity or resource constraints; or external factors.	- *"A particular challenge encountered was assisting customers to migrate from the legacy ticketing system to Opal. Previously, passengers were used to magnetic stripe card system, and so using a card system was relatively new."* - *"This was further made complicated by the large geographic footprint for Opal card system, which spanned over 40,000 sq KM across the state of NSW."* - *"Another factor to consider was how to design for the New South Wales environment. For example, taking into account heat effects which might impact upon the card, as well as, different weather conditions and waterproofing for use on NSW ferries and wharfs."*
5	In terms of your most critical and immediate needs due to effective roll-out of common ticket systems, what factors do you feel contributed most to the success of the roll-out or are considered to be the most important? These	- *"Most importantly, was to ensure a customer centred approach to the roll-out and management of the common ticketing system deployed."* - *"Change management also needs to take place across transport staff and not only being limited to passengers."* - *"As part of a phased migration to the new ticketing platform, gradual legacy ticketing retirement is also important."*

	may relate to population; ridership; ticketing costs; data management; or other factors.	- *"Phased rollout of the Opal card across products and modes, also helped to increase overall adoption."*
6	In order of ranking, what do you consider to be the 5 most critical factors to ensure the success of a common ticketing system?	1. Simple for customers to use 2. Meets the needs of diverse customer segments 3. Technical capability of the system 4. Considered and customer centric rollout
7	In order of ranking, which stakeholders do you feel to be the 5 most important to ensure success of a common ticketing system?	1. Customers 2. Peak bodies 3. Transport staff and operators
8	Reflecting upon the roll-out of the existing ticketing system, is there anything else that you feel could have been done in the early stages to help facilitate a smoother adoption of the ticketing system in general?	- Not applicable (not being directly involved in the roll-out of the initial roll-out of the common ticketing system being launched in 2012 and therefore not being able to comment on this).
9	Looking forward to the future of ticketing systems, what might you consider to be the	- *"Looking to the future, we can expect to see continuously more services along with more options being delivered for customers to pay. For example, this*

	opportunities that may lie on the horizon, which may eventually influence or revolutionize public transport as a whole?	*could include contactless payments and technologies designed to help simplify the customer experience.”* - *“It is likely that we will also witness a movement to account based ticketing, which will help to deliver frictionless access to public transport.”*

4.5 REVIEW OF DATA IN THE RESEARCH FRAMEWORK

4.5.1 Bangkok, Thailand

Table 11: Filled-out matrix for Bangkok, Thailand using research framework

Ref.	Variable Assessed	Output	Scoring
A1	Operational service efficiency	166.71	Benefitting improvement
B1	Availability of related services and eco-system	Good and services	Partially available
		Online top-up	Partially available
		Mobile application	Partially available
		History of trips	Partially available
		Train integration	Partially available
		Bus integration	Not available
		Ferry integration	Not available
		Tollway integration	Not available
C1	Population density and spatial coverage	Population density: 2,094/sq km	High population density
		Spatial coverage (on line): Every 1.36 km	Good accessibility
A2	Estimated cost of initial roll-out	730,000,000 THB (No. of stations: 135)	Low-cost ratio

		Ratio = 153,838:1	
B2	Annual ridership and revenue levels	Annual ridership: 266,559,500 boardings	Medium annual ridership
		Annual revenue (railway) 10,672 million THB (BTS) (USD $300,216,071)	Medium annual revenue
C2	Relative affordability of fares	1.71%	Medium affordability
A3	Public safety and crime rating	Public safety rating: 59.89	Moderate public safety rating
		Crime level rating: 40.11	Moderate crime concern
B3	Corruption perception and fraud propensity	36	Low level of trust
C3	Data privacy and cybersecurity	National data privacy legislation: Yes (2019)	Late incomer
		Cybersecurity readiness: 86.5	Medium cybersecurity readiness

4.5.2 Fukuoka, Japan

Table 12: Filled-out matrix for Fukuoka, Japan using research framework

Ref.	Variable Assessed	Output	Scoring
A1	Operational service efficiency	382.22	Benefitting improvement
B1	Availability of related services and eco-system	Good and services	Yes, available
		Online top-up	Not available
		Mobile application	Yes, available
		History of trips	Yes, available
		Train integration	Yes, available

		Bus integration	Yes, available
		Ferry integration	Not available
		Tollway integration	Not available
C1	Population density and spatial coverage	Population density: 1,058.8/sq km	Medium population density
		Spatial coverage (on line): Every 0.88 km	Exceptional accessibility
A2	Estimated cost of initial roll-out	1-2 billion JPY (No. of stations: 36) Ratio: 386,647:1	Medium-cost ratio
B2	Annual ridership and revenue levels	Annual ridership: 156,950,000 boardings	Low annual ridership
		Annual revenue (railway) 19.6 billion JPY (USD 135,205,595)	Low annual revenue
C2	Relative affordability of fares	0.97%	High affordability
A3	Public safety and crime rating	Public safety rating: 81.74	Very high public safety rating
		Crime level rating: 18.26	Very low level of crime
B3	Corruption perception and fraud propensity	73	Medium level of trust
C3	Data privacy and cybersecurity	National data privacy legislation: Yes (2003)	General period
		Cybersecurity readiness: 97.82	High level of trust

4.5.3 Singapore, Singapore

Table 13: Filled-out matrix for Singapore using research framework

Ref.	Variable Assessed	Output	Scoring
A1	Operational service efficiency	2,662.72	Highly optimized
B1	Availability of related services and eco-system	Good and services	Yes, available
		Online top-up	Yes, available
		Mobile application	Yes, available
		History of trips	Yes, available
		Train integration	Yes, available
		Bus integration	Yes, available
		Ferry integration	N/A
		Tollway integration	Partially available
C1	Population density and spatial coverage	Population density: 644.4/sq km	Medium population density
		Spatial coverage (on line): Every 1.48 km	Good accessibility
A2	Estimated cost of initial roll-out	134,600,000 SGD (ezLink) (No. of stations: 175) Ratio: 774,814:1	High-cost ratio
B2	Annual ridership and revenue levels	Annual ridership: 968,327,184 boardings	High annual ridership
		Annual revenue (railway) $813.2 million (SMRT) (USD $606,427,285)	High annual revenue
C2	Relative affordability of fares	0.66%	High affordability
A3	Public safety and crime rating	Public safety rating: 76.9	High public safety rating
		Crime level rating: 23.1	Low level of crime

B3	Corruption perception and fraud propensity	83	High level of trust
C3	Data privacy and cybersecurity	National data privacy legislation: Yes (2012)	General period
		Cybersecurity readiness: 98.52	High cybersecurity readiness

4.5.4 Sydney, Australia

Table 14: Filled-out matrix for Sydney, Australia using research framework

Ref.	Variable Assessed	Output	Scoring
A1	Operational service efficiency	1,111.11	Well-functioning
B1	Availability of related services and eco-system	Good and services	Not available
		Online top-up	Yes, available
		Mobile application	Yes, available
		History of trips	Yes, available
		Train integration	Yes, available
		Bus integration	Yes, available
		Ferry integration	Yes, available
		Tollway integration	Not available
C1	Population density and spatial coverage	Population density: 428.6/sq km	Low population density
		Spatial coverage (on line): Every 4.78 km	Lower accessibility
A2	Estimated cost of initial roll-out	$1,214,800,000 AUD (over 15 years) (No. of stations: 170) Ratio: 315,000:1	Medium-cost ratio

B2	Annual ridership and revenue levels	Annual ridership: 377,100,000 boardings	Medium annual ridership
		Annual revenue (railway) $347.7 million AUD (USD $228,700,285)	Medium annual revenue
C2	Relative affordability of fares	2.86%	Low affordability
A3	Public safety and crime rating	Public safety rating: 65.67	High public safety rating
		Crime level rating: 34.33	Low level of crime
B3	Corruption perception and fraud propensity	75	Medium level of trust
C3	Data privacy and cybersecurity	National data privacy legislation: Yes (1988)	Early adopter
		Cybersecurity readiness: 97.47	High cybersecurity readiness

CHAPTER 5: FINDINGS

By more acutely examining the compilation of data collected in the previous chapter and building upon the literature review earlier conducted, this chapter unpacks the underlying messages shared by experts interviewed, emerging themes from case studies, and shed light upon the meaning behind the figures being obtained through the research framework, especially when considered across the 4 cities part of the case study. Anchored in an understanding of the effectiveness of common ticketing systems, as interpreted by the experts themselves, the study synthesizes the lessons learned and experience shared to offer an overview of the challenges faced during the implementation and most immediate needs on the horizon. Equipped with this review, success factors are systematically considered along with key stakeholders, to reflect upon the critical components for a common ticketing system.

5.1 SEMI-STRUCTURED INTERVIEWS WITH THE CASE STUDIES

To help elicit understanding of the unique context and situation of each of the four cities part of the case study research, structured interviews were carried out with key individuals involved in the management or operation of ticketing systems in the city, as outlined in the methodology in Chapter 3.1. All the respondents held senior management positions establishing their credibility to support the research ranging from 8 years to 14 years of experience in their roles while directly overseeing teams as large as 200 personnel, while as low as 6 immediate personnel.

Further information on the structure of each of the organizations is provided below. While some of the respondents held roles exclusively focused on the IC card system itself, such as in the case of Fukuoka (Mr. Hidetaka Urae), others held wider roles extending to customer relationship management in Sydney (Mr. Lewis Clark) and even regulation of accessible facilities such as skywalks, elevators, mobility aids in the case of Bangkok (Mr. Jakrapon Wannagul) and other infrastructure associated with the rail network to support the elderly commuters and persons with disabilities.

According to Mr. Apichart Suphachitsawas from Bangkok, overall management of transportation was devolved into two sections, the first pertaining to rail transport and second combining road and water transport. Having around 5-6 personnel in each section overseen by project implementation team, typically 2-3 of these individuals would be considered key to the operations with civil engineering backgrounds, while the remaining personnel would be involved with conducting research. While the overall team size for Mr. Hidetaka Urae in Fukuoka was similar at around 6-7 personnel, functional responsibilities for at least 4 of these personnel were to directly develop and maintain the IC card system, with 2 personnel responsible for the operation and servicing of combined IC card and electronic money system. Finally, 1 personnel would have an overarching responsibility of the specifications of the IC card system, ensuring compliance with the rest of the transportation network.

Taking a different approach benefiting from the experience of Mr. Silvester Prakasam in Singapore, management of the ticketing system engaged a team of 200 personnel, undertaking activities ranging from software development, inhouse system integration, user requirements gathering and project management. In facilitating the system rollout and maintenance, each activity was considered to be well documented and available on the public domain, including site supervision and testing. While the responsibilities of the team under Mr. Lewis Clark including Ms. Sharon Harrison in Sydney, extended to the management of tolling, road, and public transport operational systems, contact centres and overall administration of travel concession schemes, such as for seniors above the age of 60 years and students.

5.1.1 Challenges faced and critical failure factors

A significant impediment being shared by Mr. Apichart Suphachitsawas from Bangkok was the "*number of regulators involved*" in administering a common ticketing system and lack of consensus having yet to be reached among the operators on a fair and viable fare pricing structure towards service integration. At the same time, with technology for money collection and payment systems rapidly evolving, there was also a concern that any technologies introduced could "*quickly become obsolete*" at a sizeable price tag for installation and maintenance.

"In the case of Bangkok, there are a lot of regulators, such as BMA and Ministry of Transport (MOT), while it is difficult to use the same price and negotiate upon an agreed price. Yet another challenge is having to integrate the systems while continuing to operate the transport system." (Mr. Suphachitsawas)

While the public and private ownership and management of ticketing systems added a further layer of complexity, it was elaborated that in the past when rail transportation in Bangkok (Respondents 1 & 2) was still nascent, "*BTS had invested heavily for everything*" and subsequently "*owning all of the infrastructure*" including for their dedicated 'Rabbit card' ticketing system. Hence, any transition over to new technologies or ticketing platform to be aligned with other operators, would also need to be justified with "*clear economic and operational rationale*".

"Looking back, when Bangkok was starting to build the BTS rail transport, at the time Bangkok did not have much money, and so BTS had invested heavily for everything... this helped to drive down costs, but has made it more difficult to integrate the system with other operators." (Mr. Suphachitsawas)

In Fukuoka according to Mr. Hidetaka Urae, the most important challenge to overcome was how to effectively implement the new common ticketing system "*while continuing to operate the existing system*". Therefore, migrating the ticketing system not only pertained to the change in technologies used by daily commuters for travel, but also adjustments in their purchasing behaviour, the "*training of customer service officers*" and public awareness campaigns.

"the biggest challenge (was) ...to continue the functionality of both the existing and new system at the same time, while passengers were gaining familiarity with the new system, which might cause some confusion among passengers or resistance towards the adoption of the new system." (Mr Urae)

Relatedly, "*obtaining the right skills sets*" for managing the common ticketing system was cited as a significant challenge in Singapore according to Mr. Silvester Prakasam with support from Mr. Looi Teik Soon, requiring "*expertise to be recruited from abroad*". In essence, this offers justification upon how case study research can offer tremendous value to examining the operation of common ticketing systems from one city to the next, with cities in the early stages of adopting such integrated ticketing platforms able to learn from the failures and successes of those cities at a more advanced stage, particularly at specific chokepoints such as in the design, installation, and implementation phases. Also highlighted was in what way government could help incentivize private sector investment in potentially less than lucrative public transport offerings, by means of taxes, subsidies, and rebate schemes.

"Something to consider when rolling out common ticketing systems, is that why aren't taxes part of the journey?" elaborating on this further *"As a much bigger ticket item,*

private sector does not see public transport as lucrative and there needs to be ways to incentivize these operations." (Mr Prakasam)

Finally, the "*migration between old and new legacy systems*" was also recognized as a challenge, as shared by Ms. Sharon Harrison in the case of Sydney, along with the "*large geographic footprint of the railway network*" extending over 40,000 km of track, as well as, the identification of environmental and climatic factors such as "*extreme heat effects*" in New South Wales, which might impact on the operation of ticketing systems, along with "*travel behaviour of passengers*" and their uptake of new ticketing systems and public transport. Given integrated common ticketing was quickly rolled-out with the launch of the 'Opal card' across rail, bus, and ferry networks, "*fare integration and the design of card readers*" and related technology was additionally shared as a challenge for common ticketing implementation for Sydney, as feedback from Mr. Lewis Clark.

"Previously, passengers were used to magnetic stripe card system, and so using a card system was relatively new." and *"Another factor to consider was how to design for the New South Wales environment. For example, taking into account heat effects which might impact upon the card, as well as, different weather conditions and waterproofing for use on NSW ferries and wharfs." (Mr. Clark)*

5.1.2 Immediate needs and critical success factors

As identified in the case of Bangkok, Mr. Apichart Suphachitsawas shared the enactment of "*legislation concerning common ticketing systems under the purview of Ministry of Transport*" was considered to be of utmost priority, although in full appreciation such processes were quite complex and would require several layers of government approvals. Presently, it was elaborated by Mr. Jakrapon Wannagul that the Office of Transport and Traffic Policy and Planning (OTP) was working on the law, while the Department of Transport was designing the fare policy and pricing structure. Previously, a contract had been issued to a contractor already and the price was issued, however, common ticketing was not yet implemented since the fare policy was not yet harmonized across the different operators.

"If they want to implement common ticketing, they would have to enact a law which is still being debated and it is quite complex to have to go through government and get approval." (Mr. Suphachitsawas) and *"OTP is working on the law and then the Department of Transport is working on the pricing structure. Contracting the project to contractor will be another challenge." (Mr. Wannagul)*

Given the limitations of OTP being only able to influence and work with departments within their direct remit and under their supervision, a key identified success factor was expanding this operational mandate to cross-functional roles allowing OTP to "*effectively negotiate fare policies and pricing structures*" across the different operators, or alternatively setting up a new administrative body and clearinghouse to facilitate such functions. An additional factor considered to be perceived positively contributing to a successful roll-out of common ticketing systems was the ability to continue to use the existing 'Rabbit card' for BTS and EMV technologies for MRT, as highlighted by Mr. Apichart Suphachitsawas, at least in the transitionary phases.

"OTP is working on the lines which are beneath their own supervision. They cannot work on others, which has also been a limiting factor as they are not able to work

cross-function". and "OTP helps to oversee 4 primary lines, with the Purple line and Blue line operated by MRT, while the Yellow line and Pink link operated by BTS." (Mr. Suphachitsawas)

Meanwhile, in the case of Fukuoka, Mr. Hidetaka Urae helped to provide the insights that "*interoperability across platforms*" and "*compatibility across different administrations*" were the most immediate needs. To ensure the 'Hayakaken card' could be used throughout Japan, a high level of coordination and negotiation was required with other transportation companies and administrations.

"This includes both public and private public transport operators and should include administrations even beyond those in the nearby vicinity, extending to other regions to help and maximize the coverage." (Mr. Urae)

First and foremost, a "*good partnership*" between the government, system providers, and public transport operators was underscored as being key to ensuring the success according to Mr. Silvester Prakasam in Singapore, complemented by an experienced core project management team of "*at least 10 years in similar roles*". Moreover, based on the complexity it was important to note that requirements should be "*well defined*" to "*minimize scope creep*". This pertained not only to technical specifications of the card reader, contactless cards, and communications protocol between the two devices, but also the back-end dashboard, cloud-based data repository, and functions allowing for reporting and planning on the common ticketing system. The experience of Singapore further suggested that as far as possible, "*rigorous testing*" should be conducted in the lab as well as in the field, including through the application of automated testing to foolproof the implementation.

"Thorough testing of the common ticketing system in the lab as well in the field, will be important to minimize inconvenience to commuters. To save time, the use of test automation can be applied to observe results." (Mr. Prakasam)

In turn, it was felt that this would help to minimize the potential of inconveniencing commuters, who would "*reward the ticketing system via increased ridership and thereby improving revenue*". However, in this context, it was recognized that a successful common ticketing system would also depend upon the cities concerned having a critical population size and density to ensure sufficient ridership, which in turn could facilitate more affordable fares.

"Considering cities where common ticketing systems are deployed, it is critical the population size exists so there is sufficient ridership." (Mr. Prakasam)

Mr. Lewis Clark from Sydney advised central to the overhaul and turnaround of the common ticketing leading to its success was characterized by a "*customer-centric approach*" applied by management to ensure the needs of passengers was prioritized, while at the same time, introducing a change management plan across all transport staff to enhance adoption internally and with the public. By applying this two-pronged approach, the previous legacy ticketing system was able to be gradually retired, while the new 'Opal card' was progressively rolled-out in phases, adding further products and services which each successive launch.

"Change management also needs to take place across transport staff and not only being limited to passengers. As part of phased migration to the new ticketing platform, gradual legacy ticketing retirement is also important." (Mr. Clark)

5.2 VISUALIZATION DERIVED FROM THE CONTENT ANALYSIS

To help obtain a more comprehensive overview of the feedback received and being derived from the content analysis, word clouds were further developed using WordClouds.com, visualizing point count of concepts referred to throughout the semi-structured interviews conducted. In this way, inputs from semi-structured interviews particularly relating to the challenges faced during the implementation and issues that were encountered in the roll-out were used to help visualize the critical failure factors, On the other hand, inputs relating to the immediate needs identified, lessons learned, and more directly the key success factors shared, was used to help visualize the critical success factors for implementing a common ticketing system. This visualization is an extension, building upon the analysis already conducted across all the entire research framework, as well as, responses from the interviews conducted.

Figure 19: Word cloud of failure factors captured during structured interviews and from feedback from experts in the selected cities using WordClouds.com

Referring to Figure 19 shared here above, where the failure factors are analyzed such aspects including the inability of operators to carefully consider the design of the system or that of the public to accept the new ticketing system, were perceived as particularly important inhibiting factors. Price determinants around fares along with the overall usability of the card, also appeared as significant challenges or stumbling blocks to be addressed or else leading to failure. It is also interesting to note that both entities BTS (or SkyTrain) and Bangkok Metropolitan Administration (BMA) were highlighted, suggesting the importance of ensuring cooperation between these 2 entities, as well as, their critical role in transportation in Bangkok. Additionally, elements such as gaps in customer education and ensuring sufficient expertise by developers, along with the three I's of implementation, installation, and integration, are seen to play an important role in mitigating failure in ticketing systems.

Figure 20: Word cloud of success factors captured during structured interviews and from feedback from experts in the selected cities using WordClouds.com

When analysing the success factors elaborated upon, it is clear that having well defined requirements for common ticketing systems and a strong project management team are essential to help minimize cost overlays and disruptions to service delivery. Needless to say, areas such as affordability, administration, and governance received strong attention in ensuring success. While it interesting to note that both the areas of "contracting" and "testing" scored among the most important considerations for success, recognizing the significance of carefully crafting the right terms and conditions to be stipulated in the service delivery contracts signed with transport operators and technology vendors, as well as, the additional responsibilities they should play, not only in eventually rolling-out, functional service and maintaining the ticketing system, but also at the feasibility stage to test the system for performance. In terms of institutions, the Office of Transport and Traffic Policy Planning (OTP) was identified as being critical to success, especially concerning their role in examining operational budgets, fare policy and overall pricing mechanisms.

5.3 SUCCESS FACTORS AND STAKEHOLDERS

Consolidating the ranking of the 5 most critical factors to ensuring the success of common ticketing systems undertaken by the respondents and across the 4 cities part of the case study research in this paper above and upon the subsequent page in Table 15, it becomes evident the role of public jurisprudence, particularly in relation to the political will of the local authorities, as well as, their ability to allocate and influence budgets, such as towards the implementation of public transport subsidies being among the most important concerns. Having a system that is both simple for customers to use, yet also strikes a win-win situation for passengers, that was able to meet the diverse needs of different customer segments, along with the interested of transport operators was considered paramount. In this respect, it was perceived that a lot could be learned from other advanced use cases, such as from other cities already implementing similar common ticketing systems.

Whether being a coincidence of characteristic of thinking patterns, more technical aspects such as the technical specifications of the system, definition of the requirements, understanding system technical capabilities and capturing these in the legal service contracts, ranked consistently as third place across all 4 of the cities being reviewed in Bangkok, Fukuoka, Singapore, and Sydney. Perceivably, this could be recognised that technical specifications in the context of successfully rolling out common ticketing systems, while evidently important were considered as being less important than other matters particularly those addressing political governance, project management experience and customer satisfaction.

Table 15: Ranking of success factors from city responses

	Bangkok	**Fukuoka**	**Singapore**	**Sydney**
1st	Subsidies from the public sector	Research of advanced cases	Political will and budget	Simple for customers to use
2nd	Seeking to achieve a win-win situation	Being clear about what we want to achieve	Experienced project management team	Meets the needs of diverse customer segments
3rd	Writing common ticketing directly into the contract	Specifications of the system	Well defined requirements	Technical capability of the system
4th	Regulations on common ticketing	Tests with other transportation administrations	Stringent selection of contractor	Considered and customer centric
5th	Study of the different	Way of switching the existing	Exhaustive testing	Change management

	operators and ticketing systems	system to the new system		across transport staff

On the whole, the most critical success factors for Sydney, revolved around customer centricity and change management processes, while cities such as Bangkok were focussed on addressing the legal and regulatory environment. For both Fukuoka and Singapore, there was a strong emphasis on exhaustive testing among users, testing with other transportation administrations, and testing based on the switching from the existing system to the new system, which perhaps underlies an overall attitude to performance monitoring and assessment.

Both of Bangkok and Singapore placed importance in the development of stringent criteria for the selection of the contractor, writing common ticket systems directly into the contract to ensure their fulfilment, and designing standards and regulations which would then ultimately govern the practical use, application, and implementation. Meanwhile, the study of different operators and their ticketing systems, and similarly research on advanced use cases were deemed critical for both the cases of Bangkok and Fukuoka.

Table 16: Ranking of the most important stakeholders to ensure success

	Bangkok	**Fukuoka**	**Singapore**	**Sydney**
1st	Ministry of Transport (policy enactment)	Manufacturing company which implemented the IC system in other areas	Buy-in from the public	Customers

2nd	OTP (policy integration)	Co-workers (training on the operation of the new system)	Good client support	Peak bodies
3rd	Department of Rail (overall operations)	Finance sector in Transportation Bureau	Public transport operators	Transport staff and operators
4th	Bangkok Metropolitan Administration (governance)	N/A	Contractor	N/A
5th	N/A	N/A	Interfacing of system owners such as banks	N/A

For both Singapore and Sydney, the buy-in and acceptance from customers was considered paramount to the success of the common ticketing system, while it is interesting to see in the case of Fukuoka, service level integration especially with those manufacturing companies of IC system outside of the system, were prioritized, which speaks to the focus on interoperability across the Japan rail network. In the case of Bangkok, it could be perceived that the stakeholders identified may be a reflection of the order of importance in administering processes, with the Ministry of Transport being responsible for policy enactment, the OTP being responsible for policy integration, the Department of Rail being responsible for overall operations, followed by BMA being responsible for governance, identified as the key stakeholders.

All of Fukuoka, Singapore, and Singapore, shared that public transport operators played a pivotal role, especially transport staff and workers themselves, who should be provided with adequate training and support, to be able to effectively assist others as part of the new common ticketing system and ensure good client support as being identified as being crucial for the case of Singapore. Interestingly, Sydney also helped to pinpoint peak bodies such as associations and regulatory authorities as being critical to the success of common ticketing systems. Meanwhile, both Fukuoka and Singapore underscored the role of the finance sector (particularly with the Transportation Bureau itself) and interface with banks, as being other key stakeholders.

5.4 ADDRESS OF THE RESEARCH QUESTION

Drawing upon the research undertaken and considering the research question of "what are the critical success factors for a common ticketing system", shared below are the key factors identified with further elaboration, split into two distinct categories of those success factors being more product-oriented often associated with technical interventions, as opposed to those success factors that are more strategy-oriented, typically associated with policy or regulatory interventions.

5.4.1 Product-oriented success factors

Simple for customers to use

Inherently, a common ticketing system, including its relevant fare and pricing structure must be simple to use and easy to understand. Given that users will be shifting to a new ticketing medium and platform, it is natural that there will be initial resistance which will take time to overcome. This needs to be addressed by a fully comprehensive public relations and educational campaign.

Well defined requirements/specifications

Given the extensive cost involved in a ticketing systems implementation and number of train stations implicated, ensuring agreement on very clearly defined requirements and specifications will help to ensure to containment of costs and avoid the potential for scope creep or implementation delays. In parallel, have consistent specifications can also help to facilitate an improved understanding for the potential of interoperability of one system between another prospect system.

Testing with other administrations

One proven factor which was catalytic in ensuring success in the case of Fukuoka was testing the system in advance with other administrations, to make sure that there was not only seamless transfer but also recognition of the benefits that could be obtained for neighbouring administrations as well. With many individuals travelling between cities for work or study, this was especially pertinent.

Exhaustive testing conducted

Regular and exhaustive testing, with different consumer groups, different times of day and during both on-peak and off-peak periods, can help to identify any critical bottlenecks which might impede on a successful implementation. This can also help to build a profile of users interacting with the public transport network throughout the day in order to design services better tailored to their needs.

Switching between existing and new system

Consistently shared as an area of feedback by experts and through literature review was how to effectively handle the transition between an existing legacy system and new common ticketing implementation. While this could also be aligned with a strategy-oriented success factor, because this relates to the actually roll-out of the ticketing system itself, it is maintained here as a product-oriented success factor and literature examined have also helped to offer a good overview of potential migration scenarios and approaches to managing this transition (UITP, 2020).

5.4.2 Strategy-oriented success factors

Subsidies from the public sector

As highlighted in the case of Fukuoka, a diversified holdings portfolio whereby a variety of financial shareholders may have a stake in the viability of the company can help to improve accountability. In this way, a company operator may function as a public transport in ensuring social welfare distribution but think like a private sector company to increase efficiency. Where this is not possible, inevitably, a key success factor for any common ticketing system implementation, must be a strong reliance on subsidies from the public sector to help ensure sustained operations.

Seeking to achieve a win-win situation

At the core of achieving success in roll-out of a common ticketing system, is balancing the competing needs of the various stakeholders as identified earlier in the previous section, recognizing the interests of each parties. This is necessary because system integration requires commitment from the whole for implementation and a common ticketing system is not possible with full endorsement.

Political will and budget

Evidently, without the political will to drive forward the implementation of a common ticketing system, which can take several years, and overcoming other political machinations which may influence the process are essential. At the same time, the project must have the necessary funding allocated for a sustained approach, especially in addressing the earlier period where critical mass is still gaining.

Training for employees and staff

Just as much as it is important for the consumers to be well-informed about the new product offering, staff and other railway personnel also need to briefed upon the changes, to help provide quality of service and inevitably respond to consumer needs. This training will need to be packaged into the implementation and suitably budgeted, with opportunities for on-the-ground training support.

Writing common ticketing directly into the contract

As highlighted in the case of Bangkok, it is essential that common ticketing is reflected within the contract of vendors who are engaged to deliver the services. If this is not explicitly accounted for, it may be very easy for vendors to baulk on these prior commitments. At the same time, having the specifications in writing helps to build accountability and supports monitoring on the implementation.

5.5 ASSESSING DIMENSIONS OF VARIABLES IDENTIFIED

5.5.1 Operational efficiency of the railway system (A1 - Section 3.4.1)

With trains running every 2-3 minutes during peak hours and 5-7 minutes during off-peak hours, Singapore is considered to have one of the most operationally efficient transport networks, at least among the four cities part of the case study. When taking into account the average number of trips serviced per day versus the operational hours per day, a figure of 2,662.72 results, which is close to 16 times higher than that of Bangkok and in fact greater than the figures for all of Bangkok, Fukuoka and Sydney combined. This means that on average, taken as a calculation over the entire course of the day, there are 16 times more boardings in Singapore than in Bangkok, speaking to the deep reliance of Singaporeans on public transport and demonstrative of the high utilization rates conducive to a common ticketing system.

By contrast in Bangkok, while relatively frequent services operating in the case of BTS and MRT services, ranging at 3 minutes and 2-4 minutes respectively during peak hours and 5-6 minutes and 5-12 minutes respectively during off-peak hours, there is a markedly decline in frequency of services in the case of ARL and SRT, reaching up to 10-11 minutes and 12 minutes respectively during peak hours and 12-13 minutes and 20 minutes respectively during off-peak hours. Meanwhile, Singapore maintaining frequency of 5-7 minutes, even during off-peak travel periods and Sydney have the least frequency of up to 15 minutes for minor train stations.

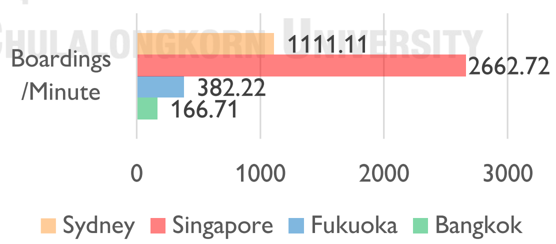

Figure 21: Operational service efficiency across 4 cities

Subsequently, a score of only 166.71 is attributed to Bangkok, based on an aggregate of the operational efficiency scores for ARL, BTS, MRT, and SRT combined. Whereas a somewhat higher score for Fukuoka at 382.22 results and significantly higher score for Sydney at 1,111.11. Largely, these resulting figures are strongly influenced by the number of trips per day serviced, for example, being exceptionally high in the case of Singapore at 2,929,000 trips per day, while as low as only a mere 14,200 trips per day in the case of the relatively new SRT in Bangkok. With BTS performing marginally better at 401,400 trips per day than MRT at 266,200 trips per day and ARL trailing behind at 48,500 trips per day. These same figures for Fukuoka were 430,000 trips per day and Sydney were 1,300,000 trips per day. By and large, the operational hours were quite similar generally commencing around 5:30am or 6:00am and then continuing service until around 11:00pm or 12:00 midnight.

5.5.2 Availability of services and transport eco-system (B1 - Section 3.4.2)

Across the four cities part of the case study, the only ticketing platform which was about to offer all of i) the ability to purchase goods and services ii) online top-up functionality iii) mobile application for account management and iv) history of trips, was the Singapore 'Ez-link card' and 'NETS card'. In the case of Sydney 'Opal card', everything was available with the exception of the ability to purchase goods and services using the smart card, whereas everything was available in the case of the Fukuoka 'Hayakaken card' except the ability for online top-up.

Available services varied in the case of Bangkok, for instance, with history of trips not available on the 'MRT card' and 'SRT card', mobile application not available for 'SRT card', online top-up not available on the 'ARL card' and 'SRT card'; while only the 'BTS card' and 'MRT card', permitting the purchase of goods and services. It should also be noted that the availability of these services, is also often considered to be a precursor to account-based ticketing and Mobility-as-a-Service (MaaS).

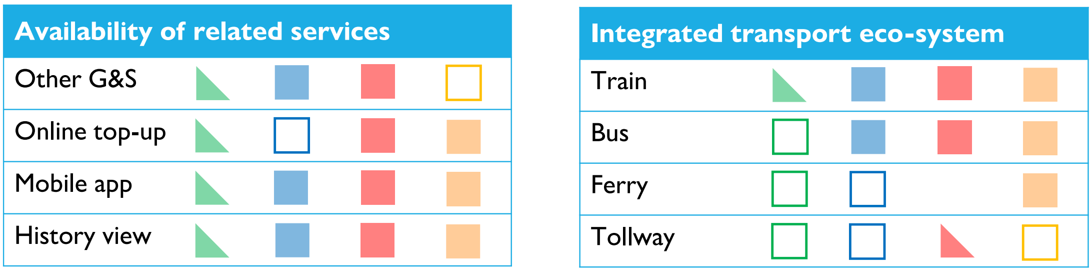

Figure 22: Availability of related services and integrated transport eco-system

In terms of integration across the transport eco-system, the 'Opal card' in Sydney was the most versatile in being able to be used seamlessly across bus, train, and ferry services. A card is not required for tollway payments, which instead are administered by RFID embedded devices attached to vehicles. In the case of Singapore, there is a split in terms of the two dominant smart cards, with tollway and parking station integration provided by the 'NETS card' but not so in the case of the 'Ez-link card'. While both cards can be used seamless across bus and train transport modes, Singapore does not operate a ferry service. In the case of the 'Hayakaken card' which could be used seamlessly across public transport modes in Fukuoka, usage on the card across ferry and tollway services is not possible. Even until now, common ticketing remains elusive in Bangkok, with challenges persisting even integrating fare policies and card usage on a singular train network with multiple lines. At present, each transport modality whether bus, train, ferry, or tollway, uses a different payment card, although some integration is being trialled for buses and tollways.

5.5.3 Population density and spatial coverage (C1 - Section 3.4.3)

Perhaps unsurprisingly being a primate city in Thailand and one of the world's megacities, the largest population density in the case of Bangkok at 2,094 persons/sq km, which also possesses the largest absolute population among the four cities part of the case study research at approximately 11,069,982 persons. This is important to consider, as established through the experience of Singapore, population size remains a key determinant in ensuring sufficient ridership and revenues, which in turn support reinvestment into infrastructure, maintenance, and network expansion. Nonetheless, population statistics must be backed by an analysis of the population density and even for a city such as Sydney with significantly less population density than Bangkok, we can see a 'well-functioning' operational service efficiency described in the previous section, as opposed to Bangkok, 'benefitting improvement'.

While it is evident from Figure 11 and the spatial map of Bangkok, that a large proportion of the city remains underserved by railway transport, connectivity within the city core and along the train line itself is quite good with a station located at every 1.36 km. By contrast, Sydney as exhibited in Figure 13 which possesses the largest size in area at 12,368 sq km, which is a whole 36 times greater than the size of Fukuoka at 343.3 sq km, has a train station on average every 4.78 km, speaking to the vastness of the Sydney metropolitan area and long stretches of track. Clearly, a high level of spatial coverage means that a greater proportion of the population especially along a railway line can have access to public transport. Nonetheless, with well-conceived feeder networks and park-and-ride solutions, even those cities with lower population density and spatial coverage, can still attract public transport users.

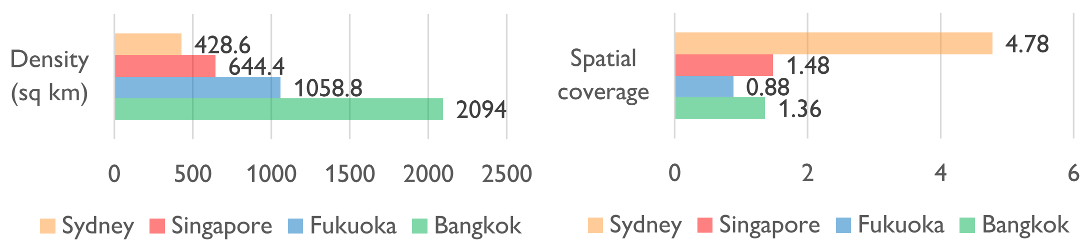

Figure 23: Population density and spatial coverage (on-line) across 4 cities

The respective size in area for Bangkok being 1,568 sq km and Singapore being 728.6 sq km. In all the cases of the four cities part of the case study research, a strong correlation is evident between population density and those areas I the city with high prevalence of railway and transport connectivity. While it may be debatable in some instances whether the introduction of train lines came first or the convergence of the population upon a certain area, planning adequate and efficient public transport is a means to not only reduce traffic congestion and carbon emissions, but also promoting greater connectivity and walkability, having several co-benefits. Among the four cities, Fukuoka had the highest spatial coverage, with a train station located every 0.88 km. Despite Fukuoka having the lowest absolute population at 1,539,000, being 7 times smaller than Bangkok, this spatial coverage is indicative of the commitment of Fukuoka to ensuring accessibility for transport for all, although it also apparent that operational service efficiency and utilization rates 'benefitting improvement'.

Table 17: Calculation of transport convenience dimensions for each city

	Bangkok	Fukuoka	Singapore	Sydney
Operational service efficiency	166.71	382.22	2662.72	1,111.11
Availability of related services	G&S: Partial Top-up: Partial Mobile: Partial History: Partial	G&S: Yes Top-up: No Mobile: Yes History: Yes	G&S: Yes Top-up: Yes Mobile: Yes History: Yes	G&S: No Top-up: Yes Mobile: Yes History: Yes
Integrated transport eco-system	Train: Partial Bus: No Ferry: No Tollway: No	Train: Yes Bus: Yes Ferry: No Tollway: No	Train: Yes Bus: Yes Ferry: N/A Tollway: Partial	Train: Yes Bus: Yes Ferry: Yes Tollway: No
Population density	2,094/sq km	1,058.8/sq km	644.4/sq km	428.6/sq km
Spatial coverage of railway	Every 1.36 km	Every 0.88 km	Every 1.48 km	Every 4.78 km

5.5.4 Estimated initial cost ratio

(A2 - Section 3.4.4)

As it was generally difficult to obtain accurate figures on the cost of servicing and maintenance of ticketing payment systems, which would not only entail the direct procurement and installation, back-end support, and personnel salaries, the figures associated with initial contracts were used to estimate the cost of initial roll-out of the common ticketing systems. It is important to take note here that this analysis did not consider the influence of inflation and cost of living, relative to the year of the launch, ranging from 2002 in Singapore to 2012 for Bangkok and Sydney, requiring a deeper analysis of the state of the economy in each city at the time.

At the same time, as some government concessions for the roll-out of a common ticketing system spanned several years, the average cost over the contract period is taken, appreciating upfront costs and more likely to outweigh the annual costs. For instance, in the case of Singapore, $134.6 million SGD was awarded to the ERG-Motorola alliance (USD $100.41 million) for the launch of the Ez-Link card back in 2002, including the supply of 5 million cards and readers. Whereas in the case of Sydney, payment by the NSW Government was awarded to Cubic Systems for $1,214.8 million AUD (USD $796.3 million), however, for a 15-year implementation period, working out to approximately AUD $80.99 million (USD $53.08 million) on average per year over the 15-year period of the government concession.

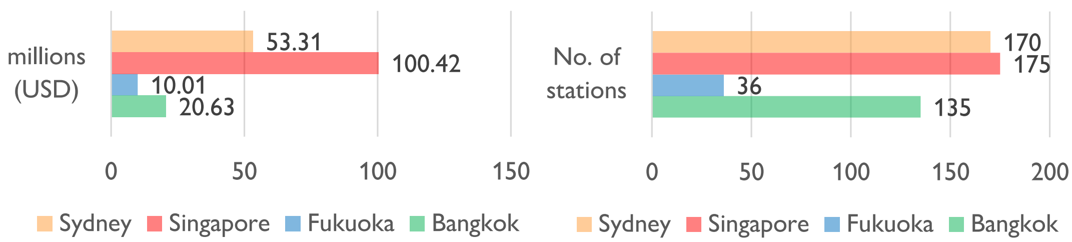

Figure 24: Estimated initial cost of roll-out and number of stations across 4 cities

In the case of Fukuoka, the initial roll-out was estimated by the Fukuoka City Transportation Bureau to be between 1-2 billion JPY (USD $6.7-13.4 million), although this was only attributed to the first 2 years of operations. Meanwhile, as a common ticketing system in Bangkok is still under research and not yet implemented, a report by OTP had estimated the cost to be 730 million THB (USD $20.71 million). Therefore, by absolute numbers, the initial cost of roll-out of the 'Ez-link card' in Singapore is would have been considered to be up to 10 times more expensive than the roll-out of the 'Hayakaken card' in Fukuoka, and almost twice as costly as roll-out of the 'Opal card' in Sydney. Such analysis helping to build an understanding of the financial costs of successfully implementing a common ticketing system.

However, any analysis of relative costs for common ticketing systems should be accompanied by a review of the number of train stations, which would be directly correlated with the number of ticketing reader machines and among the most intensive capital costs for procurement and installation. In other words, it would not really be a fair comparison of financial costs, where Singapore has 175 train stations and Fukuoka only has 36 train stations at the time of roll-out. Additionally, as the cost of personnel salaries is incidental to the operation of public transport and generally proportional or at least closely correlated to the number of train stations, any estimations should also consider the cost of recruiting and training transport personnel. For this purpose, the estimated initial cost ratio is developed and utilized as outlined in Section 3.4.4, to help account for these concerns as part of the analysis.

As such, here Fukuoka demonstrated a lower estimate initial cost ratio, when spread across the 36 stations in its subway network at approximately 0.186-0.372. Using this same rationale, Singapore which had the highest overall estimated initial cost ratio at 0.574 and coincidentally the largest number of train stations at 175 stations.

Meanwhile, the estimated initial cost ratio for Bangkok with 135 train stations and Sydney with 170 train stations was 0.153 and 0.312 respectively. Accordingly, based upon this proportional basis, these estimates help to establish that the cost per station implementation of common ticketing systems while remaining the most expensive in Singapore, when accounting for the number of stations, the financial cost of Singapore to Fukuoka might only be 1.5 times the cost per train station, as opposed to 10 times the financial cost when reviewing absolute figures. This analysis also suggests that if the report from OTP on the estimated cost of a common ticketing system holds true, that Bangkok might have the lowest estimated initial cost ratio.

5.5.5 Annual ridership and revenue for railway operations (B2 - Section 3.4.5)

Among the four cities part of the case study, the highest annual ridership (or boarding) was in Singapore at 968,327,184 and lowest in Fukuoka at 156,950,000 while Bangkok and Sydney were 266,559,500 and 377,100,000 respectively. However, when accounting for estimated population of each of the respective cities, annual ridership to population ratio is calculated as 24.079 in Bangkok; 101.982 in Fukuoka; 177.544 in Singapore; and 71.19 in Sydney. This would infer that although a larger number of passengers utilized the railway network in Bangkok and Sydney compared to Fukuoka in terms of absolute figures, the subscription rate to public transport was proportionally higher in Fukuoka than both Bangkok and Sydney. Overall, the highest subscription rate is observed in Singapore and lowest subscription rate in Bangkok.

In other words and what is important to note here, is even despite a larger uptake of railway ridership in Singapore versus Bangkok, when considering the overall proportion of the population in the city, according to this analysis it is estimated that the average Singaporean is taking advantage of railway transport services over 7 times more than the average Bangkokian or rather that the proportion of individuals availing railway transport in Singapore is over 7 times the proportion of individuals availing railway transport in Bangkok. Meanwhile, this proportion is approximately 2.5 times when comparing Singapore to Sydney. Evidently, the uptake of public transport should rely on the overall annual ridership, but perhaps more importantly, it should be especially concerned with the average subscription rate, that is, the proportion of the population who are utilizing railway transport services.

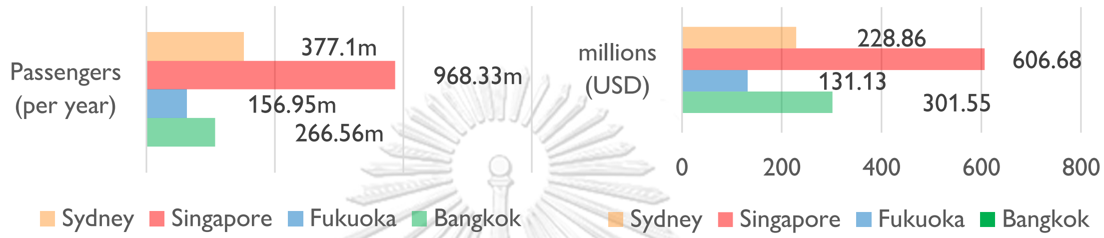

Figure 25: Estimated annual ridership and estimated annual revenue across 4 cities

Being difficult to estimate the exact revenue generated and directly attributable to common ticket systems, the annual operating revenue of transport operators is used as a proxy for the acceptance of associated payment systems and adoption of public transport. Here the highest operating revenues according to 2021-2022 annual reports, being posted by Singapore SMRT at $813.2 million SGD (USD $607.13 million) and about half that being posted by Bangkok BTS (for service and sales revenue only) at 10,672 million THB (USD $303 million).

While the farebox revenue posted for Sydney and Fukuoka (railway transport only) were $347.7 million AUD (USD $228.40 million) and at 19.6 billion JPY (USD $131.57 million) respectively. Notably, this does not take into account the annual operating revenue of MRTA or SRTET, as it was not possible to distinguish the farebox revenue from other revenue in the annual report, as well as, for SBS Transit Singapore, which also included bus fare revenue, which otherwise will have certainly increased the revenue for Bangkok and Singapore, assuming that the MRTA, SRTET, SBS Transit railway services are operating at a profit.

Unsurprisingly, the figures for annual revenue are visibly a close mirror of the figures for the annual ridership. Yet it should be noted that despite Sydney possessing 110 million more passengers per year than Bangkok, the annual revenue for Sydney is estimated to be USD $72.69 million less than Bangkok, likely attributable to the cost of maintenance, servicing, and staffing, of the train network. Similarly, when considering the estimated revenue recovered for each passenger based upon annual ridership levels, Sydney results in having the lowest figure of around USD 60 cents per passenger, as opposed to Bangkok, where the average passenger is estimated to net USD $1.13 in revenue, when abstracting the cost of the fare price itself.

5.5.6 Relatives affordability of fares for passengers (C2 - Section 3.4.6)

Calculation of the relative affordability of fares was performed on the basis of reviewing the difference between the maximum ticketing fare and minimum ticketing fare, divided by the average income level per month of individuals according to Salary Explorer. Based upon this, the highest relative cost of travel versus purchasing power is exhibited by Sydney at 2.86 with average income per month of $8,960 AUD (USD $5,886 USD) and lowest relative cost by Singapore at 0.66 and average income per month of $8,450 SGD (USD $6,309 USD). In this way, despite Bangkok having the lowest ticket fare at 12 THB (USD $0.33), when calculating the relative cost of travel as a factor of monthly income, the cost of train fares in Bangkok can be seen as more expensive than both Singapore and Fukuoka, but lower than that of Sydney.

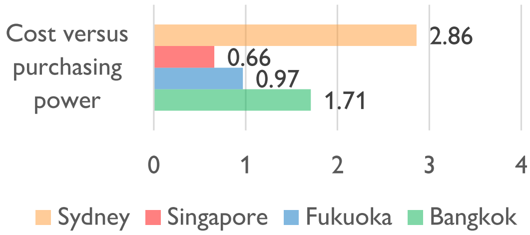

Figure 26: Relative affordability of fares across 4 cities

Table 18: Calculation of financial cost dimensions for each city

	Bangkok	Fukuoka	Singapore	Sydney
Estimated cost of initial roll-out	730,000,000 THB (initial estimated)	1-2 billion JPY (initial)	134,600,000 SGD (initial) (Ezlink only)	$1,214,800,000 AUD (15 year)
Number of train stations	135 stations	36 stations	175 stations	170 stations
Annual ridership	266,559,500	156,950,000	968,327,184	377,100,000
Annual revenue (railway operations)	(BTS) 10,672 million THB	(JR Kyushu) 19.6 billion JPY	(SMRT train) $813.2 million SGD	$347.7 million AUD
Relative cost of travel versus purchasing power	1.71	0.97	0.66	2.86

5.5.7 Public safety and the level of crime

(A3 - Section 3.4.7)

Underlying the acceptance and uptake of public transport systems at-large is the relative perception of public safety for passengers. As such, utilizing figures from the 2023 Numbeo Safety Index, a crowd-sourced global database and the world's largest cost of living database, the lowest scores among the four cities in the case study in the case of Bangkok with a score of 59.89, which may shed light on some of the challenges in obtaining a critical mass of public transport users. Here, perceived safety takes into account both day-time and night-time aspects, particularly regarding how residents and visitors feel walking around the city, and based upon worries such as mugging, robbery, harassment in public places and discrimination due to skin colour, ethnicity, gender, or religion. Meanwhile, the crime level rating is based upon the perception of crime levels, particularly property-related crimes and perpetration of more violent crimes including assault, homicide, and other offences.

Comparatively, Fukuoka and the Japanese transport system being reputed as having one of the most integrated common ticketing systems with the highest score of 81.74 in terms of the perception of safety in the city. When examined against the rest of the cities globally on Numbeo, the average score for public safety rating was 54.2, with Bangkok just above. Similarly, and perhaps by no mere coincidence, when evaluating in terms of the perceived level of crime in the city, having strong correlation with public safety, a similar trend is witnessed with Bangkok viewed as having a higher relative degree of crime which could ward people away from the city with a score of 40.11, whereas the Fukuoka, having the lowest score at 18.26. Here the global average was found to be 45.8, across the 334 cities being assessed.

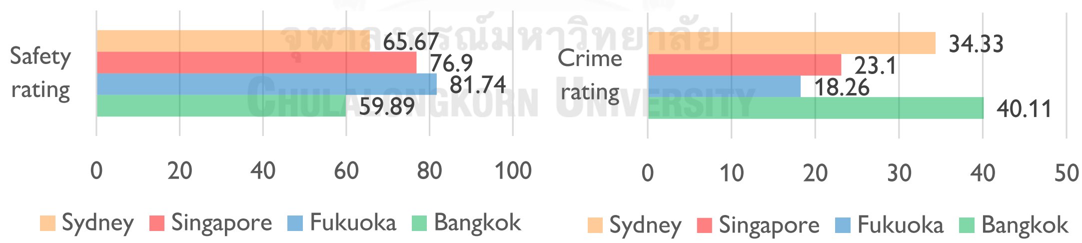

Figure 27: Perceived public safety rating and perceived crime rating across 4 cities

While it is certainly true that both one’s rating of public safety and the level of crime, may vary depending on the target group assessed, especially regarding such factors as age, gender, ethnicity, and other socio-economic considerations which may have a bearing on where individuals live and the distances which they may have to travel, it is nonetheless important to take note of these aspects in the broader planning for common ticketing systems. This is also a pointed reminder that even with the best and technically advanced ticketing systems, without addressing the underlying social and economic factors which drive public transport, while providing a sense of safety and security for commuters, will inevitably impact on the bottom line and overall ridership. Moreover, it could also be interpreted from the figures that ensuring safety and security may be inversely proportional to the number of stations.

5.5.8 Corruption perception and propensity for fraud

(B3 - Section 3.4.8)

While indicators such as public safety and the level of crime in the city being assessed in the previous section pertain more to the ability of local authorities and transport operators to maintain law and order, while enforcing legislation in order to provide a safe environment for public transport ridership, business and private sector who may be looking to invest in transport infrastructure schemes including common ticketing systems will be most interested in the inherent perception of corruption for cities they are considering and propensity for fraud to take place.

Adopting figures from the Transparency International Corruption Perception Index, the most faith is exhibited in the Singaporean political system with a score of 83 and the lowest core in the case of Bangkok at 36, while close to equal scores for Fukuoka and Sydney which scored 73 and 75 respectively. As a ranking of 180 countries and territories around the world globally based on their perceived levels of public sector corruption, the global average is 43 out of 100 and two-thirds of countries scoring below 50.

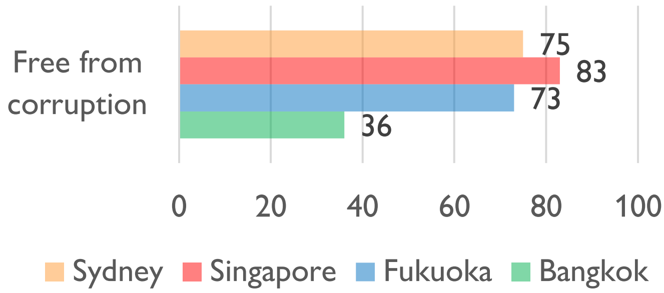

Figure 28: Perceived corruption across 4 cities

In this sense, perceptions of the vulnerability for specific cities to corruption will inevitably shape the investment decisions of potential developers, yet also speak to broader concerns around financial controls, governance, or other aspects such as institutional functions or accountability. While it is important to note here that a low score in terms of corruption perception does not necessarily point to a weakness in terms of governance, as even cities with robust financial controls may also be susceptible to violations of corruption measures. Rather, this indicator only seeks to highlight that reassuring business and the private sector that any of their investments will be well-spent not only in consideration of the return on investments but also adequately maintained to be free from corruption is generally seen favourably and meaningful to emphasize when rolling out public transport, especially related to integrated common ticketing systems, which not only interface directly with payment mechanisms and facilitate digital transactions, but also given the number of transport operators involved, each having their own financial protocols.

5.5.9 Data privacy legislation and cybersecurity (C3 - Section 3.4.9)

Finally, taken from the viewpoint of the consumers themselves and public transport users, trading off transport convenience for ease of transactions and a more seamless transportation journey, many will be concerned with what is being done with their personal information, who might have access to that information, and how it is being used. Without question, the advent of digital payment and public transport ticketing systems, enables operators and governments alike to amass vast volumes of data to improve their city and transportation planning. Yet any intentions to roll-out a common ticketing system, would be remiss without a consideration of the relative maturity of legislation protecting personal data, privacy, and security.

Here the city with the oldest privacy legislation being Sydney through the 1988 Privacy Act, being a Federal law, while State legislation varying and the Privacy and Personal Information Protection Act in NSW only being enacted 10 years later in 1998. Subsequently, a principal data protection act was introduced to Japan in 2004 referred to as “The Act on the Protection of Personal Information (Act No. 57 of 2003 as amended in 2020) ('APPI'), meanwhile, the Personal Data Protection Act was only introduced to Singapore in 2012. Most recent among the 4 cities part of the case study to enact personal data protection legislation aimed at preserving the privacy of individuals was Thailand, with its 2019 Personal Data Protection being the first consolidated law governing data protection in Thailand, taking effect in June 2022. Globally, it is estimated 133 countries have signed protection and privacy regulations into law, 15 are in the drafting process, 46 have no regulation in place.

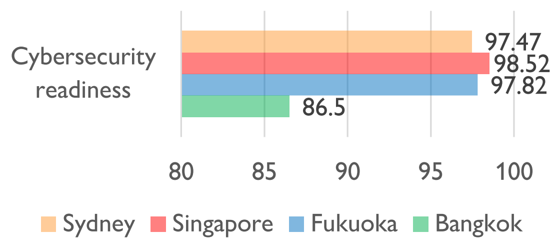

Figure 29: Cybersecurity readiness across 4 cities

While it is true that scoring against the ITU Global Cybersecurity Readiness Index, measuring 194 countries, over 82 questions, across 20 indicators, does exhibit some correlation to the maturity of data protection legislation, with Thailand receiving the lowest score among the four cities at 86.5, all of Japan, Singapore, and Australia have achieved a comparatively similar and high score for the aspect of cybersecurity readiness, ranging from 97.47 to 98.52. In this way, while personal data protection legislation facilitates the assurances that any personal data is managed in a systemized and anonymous manner, the level of cybersecurity readiness is a measure of the capacities and preparedness of countries to respond to infringements of national data privacy legislation, noting 102 countries have since introduced data breach and incident notification requirements into legislation and policies.

Table 19: Calculation of safety and security dimensions in each city

	Bangkok	Fukuoka	Singapore	Sydney
Public safety rating	59.89	81.74	76.9	65.67
Level of crime in the city	40.11	18.26	23.1	34.33
Corruption perception and the propensity for fraud	36	73	83	75
Existence of national data privacy legislation	Yes (2019)	Yes (2003)	Yes (2012)	Yes (1988)
Cybersecurity readiness at the national level	86.5	97.82	98.52	97.47

5.6 REFLECTING BACK AND MOVING FORWARDS

Overall, it was considered that a common ticketing system would offer value for money to passengers utilizing public transport while promoting other efficiencies and co-benefits. In the case of Bangkok according to Mr. Jakrapon Wannagul, where a fully integrated common ticketing system was not yet implemented, common ticketing had already been successfully implemented within single transport networks, such as between the Blue Line and Purple Line, allowing sharing of a single ticket, as well as, integration in another case for road transport, being connected with the M-Pass for motorways and Easy Pass for expressways. Starting from December 2021, through a collaboration between Europay, Mastercard and Visa (EMV), Mastercard and Visa debit and credit cards could also be used on the MRT.

"The Bangkok Governor is focusing on the people, and how it will be convenient for people for most part, to ensure their easy access to the rail transport. Fare discussions are also underway with the ministry to help resolve issues. BMA has fund subsidise the cost for this, but this is still being negotiated" (Mr. Wannagul)

In the view of Mr. Hidetaka Urae and with support from Mr. Fumiyasu Ichinaga in Fukuoka, common ticket systems were considered "*very convenient*" for railway passengers, especially in the fact that the cards could be used for other transportation throughout Japan, where rail continues to be a popular form of travel across over 30,000 km of track traversing the country. For instance, carrying over 9.1 billion passengers in the year 2013-2014, by comparison while Germany has over 40,000 km of track, only 2.2 billion passengers were carried during this same period, even when taking into account the population of Japan and Germany being 127.4 and 80 million people respectively. Recognizing the speed of interactions enabled by a common ticketing system, it was also perceived that it would contribute to easing the crowding experienced by daily commuters around the ticketing gates.

"Common ticketing helps to improve the efficiency of operations, as the touch speed is very fast, this ensures that it is not so crowded around ticket gates. Interoperability is also very important. For instance, it is very convenient for the Hayakaken card to also be used in other public transportation in Japan." (Mr. Urae)

Mr. Silvester Prakasam also cited the benefit of common ticketing systems as allowing "*ease of transfers*", while "*lowering the overall fare due to single boarding charges*". In Singapore, increasing adoption of "*Mobility-as-a-Service*" since 2011, was also fuelling the growth of "*booking and other services*". While Mr. Lewis Clark in Sydney helped to highlight a common and especially "*simple*" ticketing platform, could help to make public transport an easier to use choice for customers, helping potential commuters make the shift from personal motorized vehicles to public transport. Meanwhile, it could also provide passengers with detailed tap on and tap off information, details about their trip history, and perhaps even travel behaviour characteristics, which not only "*assist individuals with managing their travel*" but also support "*enhanced transport planning*" for operators.

"When integrated across different modes of transport, it (a common ticketing system) also helps to ensure a common mode of payment being used across all modes of transport. Considering that it is common to take different modes of transport along a journey, common ticketing also helps to follow a journey from the very start until the finish, as a single journey" (Mr. Prakasam)

In retrospect, there is always much which can be learned from both failures and successes, especially pertinent for transport ticketing having the characteristic of being able to be replicated for different cities. Indeed, even the current 'Opal card' in Sydney, is a licenced model of 'Oyster card' in London. Hearing from experts in each of the 4 cities part of this case study analysis it is made clear that possible actions adopted especially during the early stages may have certainly assisted to facilitate a smoother adoption. As shared by Mr. Apichart Suphachitsawas in the case of Bangkok, the advent of a "*marketing strategy*", enabling passengers to "*earn points and redeeming them for trips, food items, or gifts*", as in the case of Fukuoka, could have served to incentivize increased acceptance of the common ticketing system, while creating an additional revenue stream for transport operators.

"Looking back, each authority needs to develop their own system separately, but there should have been more communication between each of the operators in setting up the system. While efforts should also be made to help develop integrated common ticketing for other modes of public transport to also connect, for example, ferries, which are now separate." (Mr. Suphachitsawas)

Expanding the interoperability of the ticketing system to different transport modalities including buses, ferries, and tollways, as pointed out by Mr. Looi Teik Soon in Singapore, would also encourage more widespread adoption, recognizing that "*it is vital that it (a common ticketing system) is designed to be multi-modal*". Learning from the case of Mr. Hidetaka Urae in Fukuoka, help desks were setup both internally for co-workers to quickly familiarize with the new ticketing system, as well as, at all train stations, with such practices helping to communicate to customers in a uniform manner, reducing any anxiety, while informing about changes in an easy-to-understand way. With failure often being life's greatest teacher, learning from the cities part of this research and their challenges experienced will hopefully help to inform new cities embarking on their common ticketing systems journey.

"Something that we had done well during the launch of the ticketing system, was to provide easy-to-understand information to customers uniformally at all stations, responding to questions which they might have around the usage of the card. We also set up a help desk internally to teach our own co-workers about the operation of the new system." (Mr. Urae)

Presently, EMV payment technologies are already employed on MRT railway systems in Bangkok, while the ultimate goal remains to have a "*common fare*" as outlined by Mr. Jakrapon Wannagul, enabling commuters to seamlessly transfer to different railway networks, without having to pay an additional flag fall for each leg of the journey. Already implemented in Singapore, passengers are only charged one boarding fee with a fare cap per journey, irrespective of the transport mode. Taking this a step further in Sydney, "stitched" journeys now offer a "transfer rebate" promoting multi-modality, as shared by Mr. Silvester Prakasam.

"The highest goal is to have a common fare for the common ticket. Ideally, it should be the case you would only need to pay for the rest of the trip, you pay remainder, rather than a new boarding fee for each line." (Mr. Wannagul)

Indeed, if being properly executed, new account-based ticketing platforms as implemented in Singapore may remove entirely "the need for any top-up facilities" and "significantly reducing ticketing costs", as shared by Mr. Silvester Prakasam, where MSI Global have setup a backend for pure transit and yet another separate backend supporting retail, thereby allowing for operators and service providers to more easily facilitate fare harmonisation across a common back office software system. Having already been witnessed in Singapore, when the bank cards had introduced their own transport 'NETS card' in 2008 allowing payment on the cards, such new technologies could quickly revolutionize the market. "*Today, 50% of payments are now using bank cards instead of transport cards*", added Mr. Looi Teik Soon.

"Considering the future, account-based ticketing, if properly executed can eliminate the need for top-up facilities. This would lead to significantly reducing the ticketing cost for passengers. In the long term, all payment providers may make ticketing part of their product and service offerings available." (Mr Prakasam)

With technological advancements rapidly evolving, mobile payment are also increasingly gaining traction in the US using Apply Pay and Google Pay; integration with digital ID such as in Estonia; and even chip implants being piloted in Finland. In Fukuoka, as explained by Mr. Hidetaka Urae, transport cards are now possible to be fully integrated with digital accounts and personalized ID, providing more tailored services. Meanwhile, through the example of Sydney, shared by Ms. Sharon Harrison, one can also expect to see "*continuously more options being delivered for customers to pay*", more simplified customer experiences, and "*frictionless access to public transport*" by means of contactless payments and technologies.

It would be better to collaborate with the "My number system" in transportation systems. In this way, every individual passenger would have a digital account and ID, providing them with access to personalized services, while helping the city to better monitor trends in public transportation usage rates." (Mr. Urae)

CHAPTER 6: DISCUSSION AND CONCLUSION

In this final chapter of the paper, an analytical perspective is adopted to review the implications of the findings from the research towards enhancing common ticketing systems implementation and considering its significance to society. The contents of this chapter help to round out the analysis already conducted in the previous chapters by offering a view of other important considerations such as the phasing, piloting, and pricing of common ticketing systems. Presenting concluding policy recommendations, the paper seeks to delve deeper into socio-economic benefits of common ticketing, together with its economics and governance. Based upon the four case studies being analysed, four perceived urban strategies are interpreted, assessed against the axes of technology policy interventions and fare/pricing policy interventions. Finally, the delimiters being outside the scope being defined in Section 1.7 are offered and limitations of the paper, particularly those areas it was not possible to be covered in due to other constraints and benefitting from further research.

6.1 IMPLICATIONS OF THE FINDINGS

Among the significant findings is the recognition that standalone improvement of isolated factors pertaining to a common ticketing system is fraught with challenges and that in order to achieve optimal performance requires a comprehensive approach which addresses the needs of key stakeholder groups, especially, government and transport operators, whether they be public or private, while paying special attention to the passengers themselves, being the ultimate users. For instance, when evaluating the findings on transport convenience, the ability of common ticketing systems to offer multiple ancillary functions and/or services, such as i) the ability to purchase goods and services ii) online top-up functionality iii) mobile application for account management and iv) history of trips, may be a contributing factor in increasing the 'stickiness' factor of using the payment card and encourage more widespread use of the smart card in varied scenarios, making it part of every-day use.

Fundamentally, cities with existing common ticketing systems or with a view to roll-out a common ticketing system, a faced with the challenge of ensuring sufficient critical mass to provide the necessary capital to warrant further investments into public transport and common ticketing systems. At the same time, it is recognized that careful efforts must be applied with exhaustive testing to ensure a smooth transition from any existing payment mechanism to common ticketing platforms. In phasing the launch of the common ticketing system, public transport operators will need to consider when to add expanded services and inter-modality as part of the roll-out, as well as, even identifying suitable geographic areas or demographic groups to first pilot test, before going to a full-scale implementation. Most importantly, when designing equitable fare policies and accessible transport for all, it is critical to consider the needs of these currently underserved by public transport in areas of low transport coverage and how such commuters would not be penalized through the institution of multiple fare tariffs, but rather incentivised to travel through single stitched journeys, reminiscent of some of the earliest efforts around fare alignment between Hong Kong and Shenzhen, or across the US, discussed in the corpus of the literature review.

Evaluating the findings of the financial dimension of common ticketing systems, an important recognition is that concerted efforts are still lacking towards open and transparent availability of data concerning lifecycle costs. In other words, without a clearer breakdown of the associated costs such as those pertaining to servicing, maintenance, procurement, installation, back-end support, and personnel salaries, it is difficult to obtain a full picture of any areas prone to over expenditure, efficiency leakages, and non-competitive pricing. Through case study research such as conducted here and other contributors, it will be possible to compare the roll-out of different common ticketing systems in different cities, to assess their value for money, unique financing mechanisms, and period for return on investment. Such economic analysis of common ticketing systems should also account for other social and environmental co-benefits, including reduced traffic congestion, lower carbon emissions, individual productivity, enhanced connectivity, and community cohesion. This is further reflective of case for a strong enabling environment and close cooperation among stakeholders, being established in the paper earlier in Chapter 2 (Yoh et al., 2006).

Findings related to economies of scale suggest that greater public transport uptake through the acceptance of integrated common ticketing systems, can help lead to increase farebox revenue from ridership, which should be invested back into improved infrastructure and expanding services as far as possible, to attract even more public transport uptake and creating a virtuous cycle. As such, the growth of the railway system both in terms of spatial coverage, regularity, and reliability of services, needs to grow at pace with population shifts and consumer demands. From an economic point of view, this will require close monitoring with purchasing power for everyday passengers linked to inflation and earnings potential, so fare policies can be effectively structured to maximize public transport usage, addressing diverse customer segments, and ensure that fares remain at a reasonable rate for everyone.

It also vital to recognize that beyond convenience, if a public transport system is perceived to be dirty, unsafe, or financially corrupt, these factors will inevitably serve to significantly drive potential passengers away from public transport to other means of mobility, whether through their own private vehicles or ride sharing. Therefore, just as much as it is important to correctly address the socio-economic determinants of public transport usage, while tackling the technical specifications and ensuring sound project management, efforts must be led in parallel by public transport operators and local authorities alike to curb the incidence of crime, ensuring safety not within the immediate confines of the platform or train station, but also in the nearby vicinity and last mile of connectivity. Meanwhile, although it is evident in the findings on safety and security that the widespread adoption of digital payment through common ticketing systems can offer tremendous insights into passenger behaviour, which can in turn support improved transportation planning, by reassuring commuters that their personal identities and transport data will not be used towards malevolent ends and making a commitment to protecting that data and preserving their anonymity, will in turn help instil greater confidence in common ticketing systems.

6.2 CONCLUSION

Collectively through the analysis, this paper has had helped to reinforce the understanding of the benefits brought upon by common ticketing systems, not only from the dimensions of the consumers or public transport users, but also from the perspective of business and private-sector companies operating transport systems in several cities, as well as, for the government responsible for the overall management and coordination amongst other planning concerns, as well as, enacting legislation and policies related to transport management. Addressing Objective 1 of the research, being to reveal the importance of ticketing systems in our everyday lives, the paper establishes clearly in Section 5.6 on the effectiveness of common ticketing systems, directly from the view of experts and government officers, who are responsible for the operations of common ticketing systems in 4 different cities, recognizing for instance, that efficiencies and co-benefits promoted by common ticketing, convenience and cost reductions for the passengers, time saved and productivity increased for the city, and information gained through enhanced data analytics.

At the same time, as this paper was designed to employ case study research as the approach, a comprehensive review of the existing ticketing systems in the four cities part of this case study, namely, Bangkok, Thailand; Fukuoka, Japan; Singapore; and Sydney, Australia, formed the backbone of the data presented in Chapter 4, and addressing Objective 2 of the research, comparing the ticketing systems of key cities part of the case study analysis to identify lessons learned for future implementations. Taking into account aspects including the railway network itself, existing fare pricing policy, how the implementation of the common ticketing in the respective city took place, along with the legal and regulatory framework, a research framework was further developed based upon proposed variables identified through the literature review, upon which each of the cities in the case study were analysed.

Finally, drawing upon the analysis of the findings and data collected, together with the responses from several targeted semi-structured interviews with experts in each of the four cities, evaluation of the collective feedback is presented on the key challenges faced and critical failure factors in Section 5.1.2, along with the immediate needs and critical success factors in Section 5.1.3. Observing critical failure factors such as the over-abundance of regulators, lack of a fair and viable pricing structure, poor systems integration, competing public-private demands, and as often commented by experts, the challenge of rolling-out the new system while maintaining the old system and managing customer expectations and demands, were important chokepoint for any new city embarking on common ticketing to consider. Recognizing the high cost of capital investment needed for procurement of equipment, training of personnel, and management of the system, evidently lack of sufficient financial resources would inevitably lead to failure, but more importantly it was identified financial mechanisms were needed help ensure the long-term viability of the system.

Examining the critical success factors for common ticketing systems, being the focus of Objective 3 of the research, was further reviewed through the lens of three dimensions namely transport convenience, financial costs, and safety and security, as evolving from the literature review and conceptualized into the research framework being presented in Section 3.3. With experts highlighting such aspects as the need for enactment of legislation while designing the fare policy in parallel, harmonization of pricing among public transport operators, facilitation of a smooth transition period with both training for employees and information communicated to the public underscored by a strong customer-centric approach, broader interoperability of the system with other modes of transport, as well as, transport administrations through rigorous testing, being some of the important takeaways from the analysis. This was followed by the review of outputs from research framework based on the situation of each of the four cities and an exercise in looking forward across the case studies.

6.2 SOCIO-ECONOMIC BENEFITS

The provision of simple, affordable, and competitive integrated ticketing can yield numerous benefits such as increased patronage, passenger satisfaction, modal shift, more targeted incentives for marginalized or vulnerable social groups, and acquisition of data for network planning, among many other areas (Booz-&-Co, 2009). This is particularly the case in dense capital cities having high-transaction environments and hundreds of thousands, even in the millions of cashless payments and contactless transport taking place every day, requiring every possible effort to reduce dwell time on train station platforms, shorter queues for booking tickets, and the uninterrupted flow of people at check-in and check-out processes at ticketing turnstiles.

By helping to reduce the crowding phenomenon at accessways and ticketing booths is suggested to support a myriad of sensorial, psychological, and social benefits, related to perceptions of personal safety and security (Cox et al., 2006), the alleviation of feelings of stress and exhaustion, as well as, possible ill-health (Mohd Mahudin et al., 2011). For instance, with cash changing hands every couple of days, a reported 50% reduction in the use of cash was experienced during the COVID-19 pandemic in the United Kingdom, as many shop vendors and transport operators shifting to contactless payments, while some refusing to accept cash all together.

It is estimated transit authorities spend 3.5 times more on the physical collection of fares versus digital fares and common ticketing systems helping to shorten reconciliation times and accounting errors (Rolfe, 2020). While the desire to avoid crowded times and peak-hour periods can be a key determining factor for the choice of worker times and for firms to schedule working hours, it can also be argued that common ticketing systems which minimize this effect, facilitates a more productive economy on-the-whole (Henderson, 1981).

Besides the greater throughput achieved at rail/metro barriers, which in turn contribute to reduced boarding times, another important advantage of common ticketing systems is the simplification of fare tariffs and elimination of the need to memorize or understand complex fare structures, which otherwise there would be a multiplicity, especially where different travel conditions and competing transport operators are concerned. Of course, this relies on the ability of operators to agree on a common fare structure and travel conditions, while developing a methodology for the apportioning of revenue, which is more often than not the barrier to implementation of integrated ticketing, especially in those environments where there is fierce competition or dominance by a particular transport operator concerned with the potential loss of their market position or share of revenue (KonSULT, 2014).

In an examination of pricing and regulatory strategies and their effects on the welfare of society and profits of companies, it was concluded that firms almost always preferred integrated ticketing, but only where pricing is relatively inelastic and where a degree of collusion is allowed, whereas society demonstrated an increasing preference for integrated ticketing where the number of network operators was greater and a general preference at least for limited collusion over independent pricing, except where the integrated ticketing is introduced by a monopoly operator (McHardy et al., 2005), which could lead to pricing inequality distortions, deterioration in service quality, and a lack of control or regulation in terms of fare tariffs.

In several cases, decentralization and the devolution of decision-making and spending powers, can themselves contribute to the adoption of common ticketing systems, as public transport operators across different networks and administrative boundaries seek to rationalize the cost of travel and attract more businesses and families to their jurisdictions. In fact, despite differences in terms of political opinions, common ticketing systems is generally considered a popular political platform, as passengers do not really care or feel the need to know about the machinations political parties, as long as, they deliver upon the best-price ticket, with confidence, quickly and easily. More than 60% of rail passengers agree and support on the implementation of the South-East Flexible Ticketing Initiative (SEFT) creating an interoperable smart ticketing system among 12 different rail franchise operators, while a £620,000 funding package allowing the West Midlands to extend use of its Swift smartcard to local rail services run by London Midland, are demonstrative of the socio-economic benefits understood to be gained by local authorities (Wakeland, 2015).

Finally, the introduction of common ticket systems to public transport also possess clear environmental co-benefits, not least by the significant reduction in the need for multiple redundant plastic cards, promoting a more sustainable future for all and reducing the carbon footprint associated with both the manufacture and logistics for transportation of the raw materials for the cards. By providing passengers with a single card which can be used multiple times across different transport networks, also contributes to a modal shift, taking more cars off the roads and alleviating traffic congestion, gasoline consumption, carbon emissions, and consequently supporting cleaner air for everyone (Mees, 2000).

6.3 ECONOMICS AND GOVERNANCE

With significant upfront capital investment costs, complex legal and fare regulation, coupled with the challenges of ensuring technology inter-operability, it may be no surprise that there can be sense of apprehension or reluctance when initially considering common ticketing systems. This is additionally burdened by the fact that public transportation is often loss-operating without generating sufficient ticket revenue, while requiring further subsidies and concessions to even be effective. Hence, from a purely commercial perspective, it might be hard to find examples of public transport which are economically profitable, especially in the early years of societal uptake (Welde, 2012).

Adding to the chorus that root of failure of smart card schemes might be stem in the unviable business case for common ticketing systems, other proponents have highlighted the uncertainty of benefits for parties involved and the lack of comprehensive economic evaluations to properly appraise the costs and benefits as the main factors (Fearnley & Johansen, 2009; Iseki et al., 2008). On the other hand, when taking into consideration the relative scale economies and indirect benefits of a common ticketing system, the UK Department of Transport (DfT), evidenced by the $83 million of revenue per year generated by the Oyster card, estimated a high-value for money benefit-to-cost ratio of 1.8, and estimated net present value (NPV) of national smart ticketing infrastructure of $36.8 billion over a 10 year period, city large one-off costs, but low operating costs, and with benefits being derived from modal shifts, cost savings, fraud reduction, better service, improved access and enhanced integration (Detica, 2009).

While the economic costs of implementing a common ticketing system can generally be split into investment or capital costs, relating to purchases and planned acquisitions, along with operating or management costs, including servicing and maintenance, a suite of considerations can significantly skew how these costings play out, such as the sunk investment in existing technologies and both physical and technological impediments to upgrading them, capacities of train station operators to adapt to the new systems and the actual administration of the terminals, as well as, traffic density, being influenced by population and other demographic variables (Nash, 2000). Whereas for the passenger, the cost of travel may be distorted whether they live in a developed or developing country context, associated with the earnings potential and relative purchasing power of individuals from those respective countries.

Inherently, users of public transports and therefore its related ticketing systems make a judgement call when they choose their mode of transport, particularly with regard to whether the cost of undertaking the journey by train is more economical than other forms of transport available, in addition to the other positive social aspects which will be discussed further in the following section. At the same time, the introduction of common ticketing systems also introduces other economic co-benefits, such as the reduction in the number of train station operators to facilitate ticketing and inquiries, delay avoidance which contribute to a more efficient service, and perhaps most importantly, more accurate travel information and transportation statistics than previous paper-based and standalone ticketing systems, aiding transport policy planning, and paving the way for loyalty schemes based on customer needs and journey patterns (Blythe, 2004).

In whatever way we examine the costs, they cannot be done in isolation and numerous other factors are also vital to consider institutional governance arrangements that either facilitate or prohibit lending and expenditures. This is because the costs of rolling out a common ticketing system are not small, for example, EUR 712,500 for the purchase of 16 ticket vending machines together with back-office central management; EUR 13,000 for hardware and software which enabled the integrated ticketing; EUR 60,000 for maintenance along with EUR 10,000 for marketing, promotion and training activities for new ticketing system, shared here as a benchmark of the costs required (CIVITAS, 2010). In many countries, progressive and often competing nationalization, deregulation, and privatization reforms, have led diverse institutional arrangements across the transport system, evident in both the United Kingdom, Thailand and elsewhere, introducing additional governance challenges such as transport poverty for certain areas or pockets of society due to different social and spatial provision, fragmentation in terms of service delivery and pricing, and unplanned sprawl, particularly in the urban periphery and sub-urban centres. Regrettably, unlike the cases of London and Singapore, where a single governance structure exists to manage public transport, most cities are locked into to a multitude of transport providers, with often overlapping geographic boundary disputes. Optimization of these aspects demonstrating that simpler and more integrated structures, founded by good governance principles such as clear goals, leadership, alignment of stakeholders, long-term funding, and evidence of demand, being key ingredients to success (Marsden & Docherty, 2018).

6.4 POLICY RECOMMENDATIONS

Applying the same primary stakeholder groups as identified in the literature review and forming the basis for the stakeholder-operations matrix introduced earlier in Table 4, summarized below are key policy recommendations below.

For government and state-owned enterprises, it would be meaningful to consider,

- Subsidising public transport
- Writing common ticketing into contracts with vendors
- Regulating common ticketing
- Facilitating change management especially with transport staff
- Address first and last mile connectivity and accessibility
- Promote competition through the sharing of financial data
- Factor social-environmental co-benefits into city planning
- Promote clean, safe, and ethical transportation practices
- Make transport data available to foster operational efficiency

For businesses and the private sector, it will be important to consider below,

- Working together with clear specifications and well-defined requirements
- Exhaustive testing, especially with advanced cases and other cities
- Recruiting an experienced team
- Offer for a single stitched journey
- Developing a plan for the migration of existing system to new one
- Reinvesting in the ticketing system to improve its performance
- Pricing with a view of income levels and customer segments in mind
- Provide transfer rebate schemes

Related to consumers and transport users, the below considerations are vital,

- Simple to use and customer-centric design
- Look to improve the overall transportation journey
- Offer options to purchase local goods and ancillary services
- Develop an incentive scheme for loyal and regular customers
- Allow self-servicing and management
- Provide personal insights into trips
- Safeguard personal data from others
- Lower the barrier to card ownership
- Discounts for low-income, students, elderly, and persons with disabilities

6.5 PERCEIVED URBAN STRATEGIES

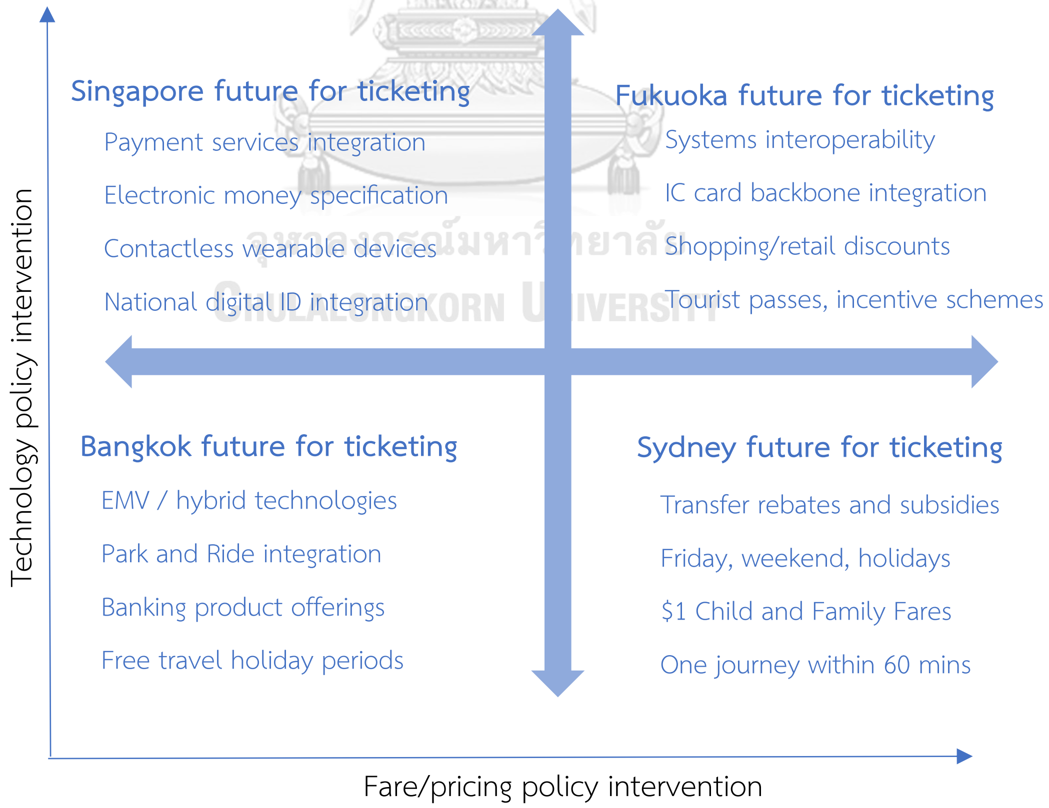

Figure 30: Perceived urban strategies from case studies

6.5.1 Bangkok future for ticketing

Considering a future where business continues as usual, a Bangkok future for ticketing essentially implies that the existing trajectory for common ticketing in Bangkok does not change very much or if so, marginally over time. For example, we can expect that existing roll-out of EMV or hybrid EMV technologies are deployed, as is currently the case in MRT, across the wider train network. Interventions such the introduction of Krungthai Bank BMTA card for buses, could also make the jump to trains, with more banks entering the space and providing new product offerings. While an ever-expanding train network may continue to see Park and Ride integration such as for BTS Sky Train introduced for more stations across different networks. An interesting scheme which is practiced in Thailand is also the advent of free travel especially during holiday periods, to encourage wider adoption of the public transport system.

6.5.2 Sydney future for ticketing

When reviewing the common ticketing interventions applied in Sydney, it is evident that significant care and effort has gone into the rational development of fare and pricing policy, targeted at different consumer segments, but also at the same time helping to promote multi-modality and increased usage. For instance, the introduction of transfer rebates, even if only at $2 AUD, encourages commuters to adopt public transport across the entire extent of their journey, while a one journey policy during 60 minute period, means that commuters can travel as much as they like in-between stations, as long as, it is within the defined time parameter. In viewing the travel behaviour of individuals in connection with the family unit, fares are offered in the NSW Regional train network including $1 Child fare and Family fares. Meanwhile, off-peak days are also considered including Fridays and weekends.

6.5.3 Singapore future for ticketing

While the Sydney future above was mainly focused on fare and pricing policy interventions, Singapore has adopted a technology-driven approach to its common ticketing system, by not only introducing an electronic money specification to ensure that transactional exchanges are largely retained within the domestic economy, but also facilitating payment services integration across different providers. This has further incentivized different service providers to come up with their line of ticketing products and merchandise, including wearable devices where payment readers are integrated into fashion and lifestyle products. Having already established a national digital ID 'SingPass', further exploration is underway to explore linking this with stored valued mediums such as transport ticketing and other use cases.

6.5.4 Fukuoka future for ticketing

Taking advantage of both fare and pricing policy interventions, as well as, technology policy interventions, the Fukuoka future for ticketing is one which already exists today in Japan, allowing for individuals to travel with relative ease using the same transport card across different regions of the country. This is further supported by constant research and development into IC card technology, in a quest to facilitate even faster transactions using larger sets of information. From a fare and pricing policy standpoint, Fukuoka is experimenting with interesting incentive schemes which take into account a person's place of residence and promoting travel outside of distinct zones, along with offering dedicated product offerings for tourists. A transport card loyalty scheme is also fascinating, along with individually negotiated arrangements for discounts with boutique shopping retailers promoting small business.

6.6 FURTHER STUDIES

6.6.1 Delimiters of the research

Given the solitary focus of this paper on railway systems, further research would be helpful to examine the relationship with other modes of public transport, whereby common ticketing systems could also be implemented, such as to explore the integration with buses, ferries, and tollway networks. Resulting from the analysis, there is also recognition that a much deeper review of fare and pricing policies should be undertaken, to achieve alignment between transport operators. Another practical implementation that will likely revolutionize ticketing systems, would also be the introduction of payment systems integration, especially using mobile phones and other wearable devices, along with biometric and facial scanning, as a replacement for any form of ticketing entirely, not within the scope of this paper.

6.6.2 Limitations of the research

Benefitting from the experience sharing that has already been facilitated, had funding been available to facilitate then city-to-city learning exchanges could have helped to drive cooperation between the 4 cities part of this case study, and promote the immediate sharing of best practices. During the course of writing this paper, it was not possible to engage significantly with technology providers and vendors of the system, which could have contributed towards the development of a technology maturity model, helping cities to understand whether the current eco-system of providers is conducive to implementing common ticketing. Finally, appreciating the difficulty in sourcing reliable, accurate, and current financial data on the operations of ticketing systems, due to the data being proprietary and potential language barriers, an analysis of this information remains another area to be explored.

ANNEX A: RESULTS FROM PRE-VERIFICATION

(BANGKOK, FUKUOKA, AND SYDNEY)

รายการตรวจสอบข้อมูลเบื้องต้นก่อนการสัมภาษณ์

1. การดำเนินการทั่วไป	**กรุงเทพฯ ประเทศไทย**
a. จำนวนสถานีและเส้นทางเดินรถในปัจจุบัน ซึ่งดำเนินการโดยเครือข่ายรถไฟของเมือง	3 สาย 113 สถานี
b. ความยาวเครือข่ายรถไฟของเมืองที่อยู่ภายใต้การจัดการในปัจจุบันโดยประมาณ	157.1 กม. [รถไฟฟ้า (68.5); MRT (60); ARL (28.6)]
c. วันที่ก่อตั้งและระยะเวลาดำเนินการของเครือข่ายรถไฟของเมือง	2459
d. จำนวนผู้ให้บริการเครือข่ายรถไฟของเมือง	4

e. บริการขนส่งทางรถไฟในเมืองของคุณดำเนินการโดยภาครัฐ หรือจัดการโดยภาคเอกชนเป็นหลัก

☐	ภาครัฐเท่านั้น	☐	ภาครัฐเป็นหลัก	☒	เท่า ๆ กัน	☐	เอกชนเป็นหลัก	☐	เอกชนเท่านั้น

f. จำนวนผู้โดยสารที่ใช้รถไฟปีที่แล้วโดยประมาณ

ทั้งหมด: ??? ล้าน [BTS (74.17 ล้าน); MRT (266.2k/วัน); ARL (48.5k/วัน)]

g. ความถี่ของการเดินรถไฟในชั่วโมงเร่งด่วนโดยเฉลี่ย

BTS (3 นาที (พีค), 5-6 นาที (ออฟพีค)); MRT (2-4 นาที (สูงสุด), 5-12 นาที (ไม่พีค), ARL (10-11 นาที (พีค)), 12-13 นาที (ไม่พีค)

h. ช่วงเวลาที่เครือข่ายรถไฟของเมืองเปิดให้บริการ

BTS (06:00-24:00 น.); MRT (05:30-24:00 น.); ARL (06:00-24:00 น.)

2. โครงสร้างราคา

a. ราคาบัตรโดยสารรถไฟ	BTS (100 บาท); MRT (80 บาท); ARL (???)	c. ราคาต่ำสุดต่อเที่ยวการเดินทาง	BTS (17 บาท); MRT (16 บาท); ARL (15 บาท)
b. ระยะเวลาที่สามารถเก็บบัตรไว้ใช้ได้	BTS (7 ปี); MRT (2 ปี); ARL (???)	d. ราคาสูงสุดต่อเที่ยวการเดินทาง	BTS (158 บาท); MRT (70 บาท); ARL (45 บาท)

e. โครงสร้างราคาสำหรับการขนส่งและวิธีการคำนวณในปัจจุบันสำหรับเครือข่ายรถไฟในเมือง

☒	จำนวนสถานี	☐	ระยะเวลาการเดินทาง	☐	ตามพื้นที่	☐	อื่น ๆ (โปรดระบุ)

รายการตรวจสอบข้อมูลเบื้องต้นก่อนการสัมภาษณ์

f. มีการจำหน่ายบัตรรายสัปดาห์ รายเดือน หรือรายปี ที่สามารถใช้เดินทางได้โดยไม่จำกัดเที่ยว				
☐ รายสัปดาห์	☐ รายเดือน	☐ รายปี	☒ อื่น ๆ (โปรดระบุ) Number of trips	
g. มีการอุดหนุนค่าเดินทางสำหรับผู้โดยสารในกลุ่มต่อไปนี้				
☒ ผู้สูงอายุ	☐ นักเรียน	☐ ผู้พิการ	☒ กลุ่มผู้มีรายได้น้อย	☐ พระสงฆ์/นักบวช
3. การชำระเงินและการออกบัตรโดยสาร				
a. ปีที่เริ่มใช้งานบัตรขนส่งที่มีอยู่ในปัจจุบัน				BTS (พฤษภาคม 2555); MRT (มิ.ย. 2559); ARL (???)
b. จำนวนบัตรขนส่งที่รู้จักในปัจจุบัน และเชื่อว่าหมุนเวียนอยู่ในระบบ				BTS (16.2 ล้าน); MRT (2 ล้าน); ARL (???)
c. มีแอปพลิเคชันบนมือถือหรือไม่	BTS (ใช่); MRT (มี); ARL (ใช่)	f. ผู้ใช้สามารถเปิดบัญชีส่วนตัวได้หรือไม่		BTS (ใช่); MRT (เลขที่); ARL (ใช่)
d. มีการแจ้งประวัติการเดินทางหรือไม่	BTS (ใช่); MRT (ไม่ใช่); ARL (ใช่)	g. สามารถใช้บัตรโดยสารเพื่อชำระค่าสินค้าหรือบริการอื่นๆ ได้หรือไม่		
e. ตรโดยสารเชื่อมโยงกับเลขประจำตัวประชาชนหรือไม่	No	h. สามารถเติมเครดิตออนไลน์ได้หรือไม่?		
i. ต้นทุนในการนำระบบจำหน่ายบัตรโดยสารร่วมมาใช้ในเมืองของคุณโดยประมาณ				
j. ระยะเวลาที่ต้องใช้สำหรับการวางระบบจำหน่ายบัตรโดยสารร่วม				
k. โปรดระบุสิ่งที่ได้ดำเนินการ เพื่อการนำระบบจำหน่ายบัตรโดยสารร่วมมาใช้ (ตอบได้มากกว่าหนึ่งข้อ)				
☒ รับฟังความคิดเห็นจากบุคคลในพื้นที่/ประชาชนทั่วไป	☒ การทดสอบแบบจำกัดกลุ่มหรือจำกัดระยะเวลา	☒ การประเมินทางเทคนิค		
☐ การแลกเปลี่ยนความรู้กับเมืองอื่น ๆ	☐ การปรับเปลี่ยนอย่างค่อยเป็นค่อยไป			

質問リスト（福岡市）

1. 一般的な運営	**バンコク、タイ**
a. 福岡市営地下鉄の路線数と駅数	3路線36駅
b. 福岡市営地下鉄の推定総延長距離	31.5キロ
c. 福岡市営地下鉄ができた時期と運行年数	1981年・41年
d. 福岡市営地下鉄を運営している事業者数	1
e. 福岡市営地下鉄は、公営または私営か	

☒	完全公営	☐	主に公営	☐	公私バランスよく	☐	主に私営	☐	完全私営

f. 前年の推定鉄道利用者数	399,000/日
g. ピーク時の平均運行本数	3 ～ 6 分 (ピーク時) 4 ～ 8 分 (オフピーク時)
h. 運行している時間帯	05:30-00:25

2. 料金体系			
a. 乗車券（はやかけん）購入代金 ※デポジット	500 JPY	c. 最低運賃	210 JPY
b. 乗車券（はやかけん）の有効期間	10年（最終利用から）	d. 最大運賃	380 JPY
e. 交通機関の料金体系と現在の都市鉄道網の計算方法			

☐	駅数	☒	区間	☐	ゾーンベース	☐	その他（具体的にご記入ください）

f. 定期券の期間							
☐	週間	☒	月間	☐	年間	☐	その他（具体的にご記入ください）

g. 以下のカテゴリーの交通機関利用者に対して、交通費は何らかの方法で補助されますか?									
☒	シニア	☐	学生	☒	障害者	☐	低所得層	☐	僧侶

3. 支払いと発券

a. 現在運用中の既存乗車券（はやかけん）の発売年	2009年3月
b. 現在流通していると考えられている乗車券（はやかけん）枚数	191万枚

c. モバイルアプリケーションの利用可否（Suicaなどの他の事業者アプリ利用可能）	はい	f. 利用者の個人アカウント所有の可否	いいえ
d. 利用履歴の有無	はい	g. 他の購入やサービスの支払いに交通カードを使用できますか?	はい
e. 乗車券と個人ID（マイナンバーカード）の連携可否	いいえ	h.オンラインでチャージできますか?	いいえ

i. はやかけんのシステムを運用開始するのにかかった費用（概算） Details are unknown.	1,000,000,000〜 00,000,000JPY
j. はやかけんのシステムが運用開始されるまでにかかった月数	約 2 年間
k. 運用開始のために実行したものをチェックしてください（該当するものすべてにチェックを入れてください）。	

☒	ローカル/公的協議	☒	技術評価	☐	限定トライアル/試験期間	☐	都市間交換	☐	段階的な移行

1. General operations	**Sydney, AUSTRALIA**
a. Number of stations and lines are currently operated by the city train network	8 lines, 170 stations
b. Estimated length of the city train network which is currently being managed	813km
c. When the city train network was established and how many years of operation	1855
d. How many operators are involved in the provision of the city train network	1

e. Is provision of railway transportation in your city primarily publicly operated or privately managed

☒	Fully public	☐	Mainly public	☐	Balanced	☐	Mainly private	☐	Fully private

f. Estimated number of passengers who caught the train in the previous year	135.5 million
g. Average frequency of the trains operating during the peak hour period	
Unsure	
h. Hours during the day and night in which the city train network operational	
6am-11pm (on Fridays to midnight)	

2. Pricing structure

a. Purchase price of a train card		c. Minimum trip cost of travel	
No charge (Min top up $10/$20 Adult depending on channel or $5/$10 depending on chancel for child)		AUD $2.65 - AUD $4.60 (0-10km; off-peak)	
b. Validity of the card in duration	11 years	d. Maximum trip cost of travel	AUD $6.51 - AUD $11.20

e. Pricing structure for transportation and how it is presently calculated for the city train network

☐	Number of stations	☐	Duration of travel	☐	Zone-based	☒	Other *(please specify)* Based on distance

f. Availability of a weekly or monthly or annual card allowing unlimited trips

☐	Weekly	☐	Monthly	☐	Yearly	☒	None however pricing structure provides daily and weekly caps as well as frequency of use discounts.

g. Is the cost of travel subsidized in any way for the below categories of transport users?

☒	Elderly	☒	Students	☒	Persons with disabilities	☐	Low-income groups	☐	Faith bearers

3. Payment and ticketing

a. Year in which the existing transport card currently in operation was launched	
Roll out commenced 2012 and completed 2014	
b. How many transport cards are currently known and believed to be in circulation	35.5m

c. Is a mobile application available?	Yes	f. Can users have personal accounts?	Yes
d. Is a history of trips available?	Yes	g. Can the transport card be used to pay for other purchases or services?	No
e. Is the card linked to personal ID?	No	h. Can credit top-up be done online?	Yes

i. Estimated cost of rolling-out the common ticketing system present in your city	**N/A**
j. Months required for the common ticketing system to be completely rolled out	**24**
k. Please indicate which aspects were carried out for the roll-out (tick all that apply).	

☐	Local/Public consultations	☒	Technical assessment	☒	Limited trial or testing period	☐	City-to-city exchanges	☒	Phased migration

ANNEX B: SUPPORTING MATERIALS

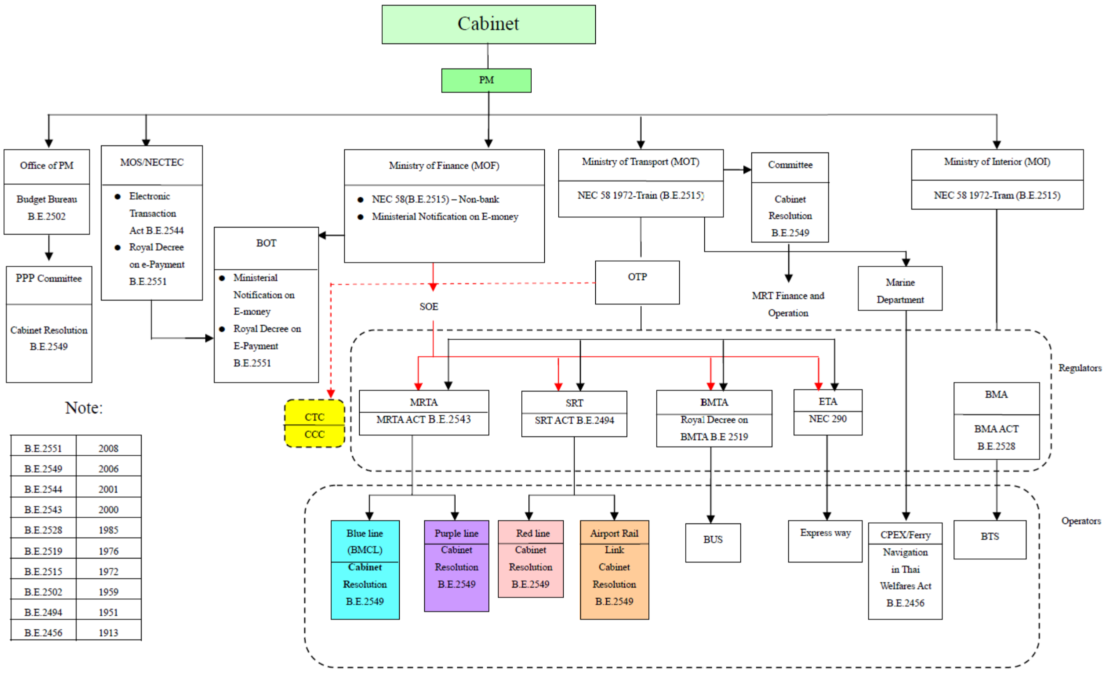

Figure 31: Governance structure and legislation of common ticketing in Thailand as illustrated in the final report prepared by ADB (2009)

Table 20: Governance structure and primary stakeholders for common ticketing in different countries globally prepared by OTP (2020)

Country	Common Ticket	Investor	Operator	Maintenance	Clearing House	Policy Maker	Governance
Hong Kong	Octopus Card	Octopus Cards Limited	Octopus Cards Limited	Octopus Cards Limited	Octopus Cards Limited	Octopus Holdings Limited	Hong Kong Monetary Authority (HKMA)
Singapore	EZ-Link Card	Ministry of Finance (MOF) (through LTA)	Transit Link Pte Ltd.	MSI and PTOs	Transit Link Pte Ltd.	Monetary Authority of Singapore (MAS)	Public Transport Council (PTC)
Japan	SUICA Card PASMO Card	SUICA Co.,Ltd. PASMO Co.,Ltd.	SUICA Co.,Ltd. PASMO Co.,Ltd.	SUICA Co.,Ltd. PASMO Co.,Ltd.	IC-Card Data Clearing Center	JR East/ Tokyo Metro	Ministry of Transport and Financial Services Authority
Taiwan	Easy Card	Taipei City Government	Easy Card Corporation	Easy Card Corporation	Hyweb (TSCC)	Taipei City Government	Taipei City Government
South Korea	T-money Card	Seoul Metropolitan Government	T-Money	T-Money	KSCC	Seoul Metropolitan Government	Seoul Metropolitan Government
Malaysia	Touch'n GO	TERAS	TNGSB	TNGSB	RTGS	TNGSB	TNGSB
London	Oyster Card	Mayor of London (through TfL)	TfL & TransSys (Cubic & EDS)	TransSys (Cubic & EDS)	Transport for London (TfL)	Mayor of London	Transport for London (TfL)
Australia	SmartRider Card	Rapid KL	Transperth	Transperth	Transperth	Public Transport Authority	Public Transport Authority
China	Yikatong Card	Yikatong Company	Beijing Municipal Administration and Communications Card Co., Ltd.	Beijing Municipal Administration and Communications Card Co., Ltd	Beijing Municipal Administration and Communications Card Co., Ltd	Ministry of Transport, China Transport Telecommunication & Information Center	Ministry of Transport, China Transport Telecommunication & Information Center

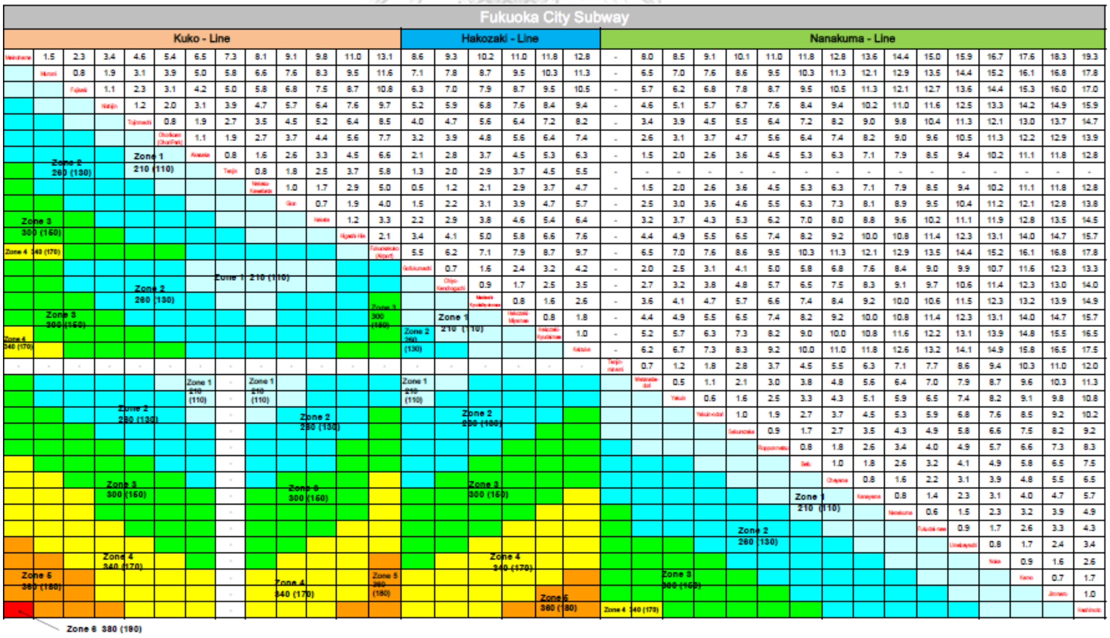

Figure 32: Consolidated fare table for travel on the Fukuoka City Subway

ANNEX C: INTERVIEW QUESTIONS
(ENGLISH, JAPANESE, AND THAI)

Open-ended questions to support semi-structured interviews

Warm-up question

1. In your own opinion, do you feel that a common ticketing system is/can be effective? (Yes/No/Other)

   a) If "Yes", how do you feel it contributes to improving operations of the transport network?
   b) If "No", what are your concerns related to the effectiveness of a common ticketing system?
   c) If "Other", please help share the related issues that led you to select "Other" as a response.

Personal background

(this information is used to better understand the profile of individuals responding)

2. Please help to share about little bit about yourself, in particular helping to touch upon your (i) position; (ii) role in operations, in relation to ticketing systems; and (iii) number of years in the organization.

Work environment

(these details are used to better understand the overall work environment situation)

3. Please help to share about little bit about the work environment, in particular helping to touch upon the (i) number of personnel in your team; (ii) background of personnel; and (iii) areas of work covered.

4. With regards to roll-out of the common ticketing system in your city, what did you perceive were the main issues encountered and challenges faced during the design, installation, or implementation? These may be at national, or sub-national level; related to capacity or resource constraints; or external factors.

5. In terms of your most critical and immediate needs due to effective roll-out of common ticket systems, what factors do you feel contributed most to the success of the roll-out or are considered to be the most important? These may relate to population; ridership; ticketing costs; data management; or other factors.

6. In order of ranking, what do you consider to be the 5 most critical factors to ensure the success of a common ticketing system?

7. In order of ranking, which stakeholders do you feel to be the 5 most important to ensure success of a common ticketing system?

Probing questions

(these questions can be used to go deeper, in case there is remaining time available)

8. Reflecting upon the roll-out of the existing ticketing system, is there anything else that you feel could have been done in the early stages to help facilitate a smoother adoption of the ticketing system in general?

9. Looking forward to the future of ticketing systems, what might you consider to be the opportunities that may lie on the horizon, which may eventually influence or revolutionize public transport as a whole?

根本原因分析をサポートする自由回答形式の質問

ウォームアップの質問 (正解、不正解もないことに注意してください。これは単にあなたの見解を聞くためのものです)

1. あなた自身の意見では、共通発券システムは有効だと思いますか? (はい/いいえ/その他)

a. 「はい」の場合、交通ネットワークの運用改善にどのように貢献していると思いますか?

b. 「いいえ」の場合、共通発券システムの有効性に関連する懸念は何ですか?

c. 「その他」の場合は、回答として「その他」を選択するに至った関連する問題を共有してください。

個人の経歴 (この情報は、回答者のプロフィールをよりよく理解するために使用します。)

2. あなた自身について、特に、あなたの (i) 職位 (ii) 発券システムに関連する業務の役割 (iii) 組織における在職年数について少し教えてください。

職場環境（この情報は、全体的な職場環境の状況をよりよく理解するために使用します。）

3. 職場環境について、特に、(i) チームの人員数 (ii) 人員の経歴 (iii)担当業務の領域について少し教えてください。

4. あなたの自治体での共通発券システムの運用開始に関して、設計、設置または実装中に直面した主な問題と課題は何だと思いましたか。これらは、国レベルまたは地域レベル、キャパシティ若しくはリソースの制約、または外部要因に関連する場合があります。

5. 共通発券システムの効果的な運用開始による最も重要かつ差し迫ったニーズに関して、運用開始の成功に最も貢献した、または最も重要であると考えられる要因は何ですか。これらは人口、乗車率、発券費用、データ管理または他の要因に関連している場合があります。/

6. 共通発券システムの成功を確実にするために最も重要な 5 つの要因は何だと思いますか?

7. 共通発券システムの成功を確実にするために、どの関係者が最も重要であると感じますか?

詳細な質問 (これらの質問は、利用可能な時間が残っている場合に、より深く掘り下げるために使用できます)

8. 既存の発券システムの運用開始を振り返って、共通発券システムのよりスムーズな採用を促進するために、初期段階に行うことができたと思われることは他にありますか?

9. 発券システムの将来に期待して、公共交通機関全体に影響を与える、または革命を起こし得る、兆しのある機会は何だと思いますか?

คำถามปลายเปิด เพื่อการวิเคราะห์ถึงสาเหตุที่แท้จริง

คำถามเบื้องต้น (โปรดทราบว่า คำถามทั้งหมดนี้มีไว้เพื่อรับฟังความคิดเห็นของคุณเท่านั้น ดังนั้นจึงไม่มีคำตอบที่ถูกหรือผิด)

1. ในความคิดเห็นของคุณ คุณคิดว่า ระบบจำหน่ายบัตรโดยสารร่วมจะมีประสิทธิภาพหรือไม่ (มี/ไม่มี/อื่น ๆ)
    a. ถ้าตอบ “มี”
    คุณคิดว่าระบบดังกล่าวจะมีส่วนช่วยยกระดับการดำเนินงานของเครือข่ายการขนส่งอย่างไร
    b. ถ้าตอบ “ไม่มี”
    สิ่งใดเป็นข้อกังวลของคุณเกี่ยวกับประสิทธิภาพของระบบจำหน่ายบัตรโดยสารร่วม
    c. ถ้าตอบ "อื่น ๆ" โปรดระบุถึงประเด็นที่ทำให้คุณเลือกตอบ “อื่น ๆ”

ประวัติส่วนตัว *(ข้อมูลในส่วนนี้จะนำไปใช้เพื่อทำความเข้าใจผู้ทำแบบสอบถามให้ดียิ่งขึ้น)*

2. โปรดระบุรายละเอียดเกี่ยวกับตัวคุณเล็กน้อย โดยเฉพาะในส่วนของ (i) ตำแหน่งงาน (ii) บทบาทในการดำเนินงานที่เกี่ยวข้องกับระบบจำหน่ายบัตรโดยสาร และ (iii) ระยะเวลาที่ทำงานกับองค์กร

สภาพแวดล้อมการทำงาน

(ข้อมูลในส่วนนี้จะนำไปใช้เพื่อทำความเข้าใจสภาพแวดล้อมการทำงานโดยรวมให้ดียิ่งขึ้น)

3. โปรดระบุรายละเอียดเกี่ยวกับสภาพแวดล้อมการทำงานของคุณเล็กน้อย โดยเฉพาะในส่วนของ (i) จำนวนบุคลากรในทีมของคุณ (ii) ประสบการณ์ของบุคลากร และ (iii) ส่วนงานที่รับผิดชอบ

4. เมื่อพิจารณาถึงการนำระบบจำหน่ายบัตรโดยสารร่วมมาใช้ในเมืองของคุณ อะไรคือสิ่งที่คุณมองว่าเป็นปัญหาและความท้าทายหลักที่ต้องเผชิญในระหว่างการออกแบบ การติดตั้ง หรือการนำไปใช้งาน *ซึ่งอาจเป็นได้ทั้งในระดับประเทศ หรือระดับภูมิภาค ไม่ว่าจะเป็นเรื่องของข้อจำกัดด้านกำลังการผลิตหรือทรัพยากร หรือปัจจัยภายนอก*

5. หากพิจารณาถึงความต้องการเร่งด่วนที่สุดจากการนำระบบจำหน่ายบัตรโดยสารร่วมมาใช้งานอย่างมีประสิทธิภาพ
ปัจจัยใดที่คุณคิดว่ามีส่วนทำให้การนำระบบดังกล่าวมาใช้ประสบความสำเร็จ
หรือเป็นปัจจัยที่สำคัญที่สุด *ซึ่งอาจเป็นเรื่องของประชากร จำนวนผู้โดยสาร ต้นทุนการจำหน่ายบัตรโดยสาร การจัดการข้อมูล หรือปัจจัยอื่น ๆ*

6. คุณคิดว่าปัจจัยสำคัญที่สุด 5 ประการ
ซึ่งรับประกันถึงความสำเร็จของระบบการจำหน่ายบัตรโดยสารร่วมได้แก่อะไรบ้าง

7. ผู้มีส่วนเกี่ยวข้องรายใดที่คุณคิดว่ามีความสำคัญในการรับรองถึงความสำเร็จของระบบจำหน่ายบัตรโดยสารร่วมมากที่สุด 5 อันดับแรก

คำถามแบบเจาะจง *(ใช้คำถามด้านล่างนี้เพื่อลงรายละเอียด ในกรณีที่มีเวลา)*

8. เมื่อพิจารณาจากการนำระบบจำหน่ายบัตรโดยสารนี้มาใช้
มีอะไรอีกบ้างที่คุณรู้สึกว่าน่าจะทำได้ในช่วงแรก
เพื่อช่วยให้การนำระบบจำหน่ายบัตรโดยสารมาใช้โดยทั่วไปมีความราบรื่นมากยิ่งขึ้น

9. หากพิจารณาถึงอนาคตของระบบจำหน่ายบัตรโดยสาร
สิ่งใดที่คุณคิดว่าน่าจะเป็นโอกาสที่รออยู่
ซึ่งอาจมีอิทธิพลหรือช่วยปฏิวัติวงการขนส่งสาธารณะโดยรวมในท้ายที่สุด

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