

Space utilisation strategy for Thailand underground transit station.

A case study of Thailand cultural centre underground station



Miss Wirasinee Tongsoo

บทคัดย่อและแฟ้มข้อมูลฉบับเต็มของวิทยานิพนธ์ตั้งแต่ปีการศึกษา 2554 ที่ให้บริการในคลังปัญญาจุฬาฯ (CUIR)
เป็นแฟ้มข้อมูลของนิสิตเจ้าของวิทยานิพนธ์ ที่ส่งผ่านทางบัณฑิตวิทยาลัย

The abstract and full text of theses from the academic year 2011 in Chulalongkorn University Intellectual Repository (CUIR)
are the thesis authors' files submitted through the University Graduate School.

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering Program in Engineering Management
Regional Centre for Manufacturing Systems Engineering

Faculty of Engineering
Chulalongkorn University

Academic Year 2017

Copyright of Chulalongkorn University

ยุทธศาสตร์ในการใช้พื้นที่สำหรับสถานีรถไฟใต้ดินของประเทศไทย
กรณีศึกษาสถานีรถไฟใต้ดินศูนย์ประชุมแห่งประเทศไทย



วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
สาขาวิชาการจัดการทางวิศวกรรม ภาควิชาศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต
คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

ปีการศึกษา 2560

ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

Thesis Title	Space utilisation strategy for Thailand underground transit station.A case study of Thailand cultural centre underground station
By	Miss Wirasinee Tongsoo
Field of Study	Engineering Management
Thesis Advisor	Professor Parames Chutima, Ph.D.
Thesis Co-Advisor	Dr. Dhunyanon Ratanakuakangwan

Accepted by the Faculty of Engineering, Chulalongkorn University in Partial Fulfillment of the Requirements for the Master's Degree

..... Dean of the Faculty of Engineering
(Assistant Professor Supot Teachavorasinskun, Ph.D.)

THESIS COMMITTEE

..... Chairman
(Assistant Professor Jeerapat Ngaoprasertwong, Ph.D.)

..... Thesis Advisor
(Professor Parames Chutima, Ph.D.)

..... Thesis Co-Advisor
(Dr. Dhunyanon Ratanakuakangwan)

..... External Examiner
(Assistant Professor Vanchai Rijiravanich, Ph.D.)

วิชาคือ : ยุทธศาสตร์ในการใช้พื้นที่สำหรับสถานีรถไฟฟ้าใต้ดินของประเทศไทยกรณีศึกษาสถานีรถไฟฟ้าใต้ดินศูนย์ประชุมแห่งประเทศไทย (Space utilisation strategy for Thailand underground transit station.A case study of Thailand cultural centre underground station) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: ศ. ดร. ปารเมศ ชูติมา, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: ดร. ธัญชนก รัตนเกื้อกั้วาน, หน้า.

ปัจจุบันสถานีรถไฟฟ้าใต้ดินในกรุงเทพมหานคร มีจำนวนผู้โดยสารสูงขึ้นต่อเนื่อง ทุกๆปี แต่ในทางกลับกัน การบริหารจัดการพื้นที่บริเวณอาคารผู้โดยสารกลับไม่ประสบความสำเร็จเท่าที่ควร เนื่องจากไม่มีการจัดสรรพื้นที่ให้เกิดความเหมาะสม และยังมีผู้ค้าจำนวนมากยกเลิกสัญญาเช่าก่อนกำหนด ดังนั้นเพื่อพัฒนาแผนการจัดสรรพื้นที่สำหรับอาคารผู้โดยสารสถานีรถไฟฟ้าใต้ดินในประเทศไทยในปี 2566 สถานีจึงต้องการกลยุทธ์และการจัดสรรพื้นที่ให้เหมาะสมและเกิดประโยชน์สูงสุด ทั้งนี้ เพื่อดึงดูดให้มีการสัญจรเพิ่มขึ้นและยังช่วยให้เกิดการตัดสินใจเลือกใช้การเดินทางโดยรถไฟฟ้าใต้ดินอีกด้วย

สถานีรถไฟฟ้าใต้ดินกรณีศึกษาในงานวิจัยนี้เป็นสถานีจุดเชื่อมต่อระหว่างรถไฟฟ้าใต้ดินสายสีน้ำเงิน และรถไฟฟ้าใต้ดินสายสีส้ม ซึ่งในขณะนี้รถไฟฟ้าใต้ดินสายสีส้มอยู่ระหว่างดำเนินการก่อสร้าง นอกจากนี้สถานีนี้ยังตั้งอยู่ใจกลางย่านธุรกิจสำคัญแห่งใหม่ และยังมีรายล้อมไปด้วยที่พักอาศัย อาคารสำนักงานจำนวนมาก ดังนั้นจึงคาดว่าในอนาคตสถานีนี้มีศักยภาพที่จะสามารถพัฒนาพื้นที่ อาคารผู้โดยสารให้เกิดประสิทธิภาพได้

งานวิจัยชิ้นนี้จึงได้ทำการศึกษาพื้นที่อาคารผู้โดยสาร โดยได้นำหลักการ Space syntax เข้ามาใช้ และนำหลักการTOD มาร่วมศึกษาวิเคราะห์โดยรอบสถานีรถไฟฟ้าใต้ดินแห่งนี้ นอกจากนี้เพื่อให้

เข้าถึงความต้องการของผู้โดยสาร การสัมภาษณ์และวิเคราะห์ตลาดยังได้นำมาร่วมในงานวิจัยชิ้นนี้อีกด้วย

หลังจากที่ข้อมูลได้ถูกวิเคราะห์และเก็บอย่างครบถ้วนแล้ว ได้นำมาต่อยอดพัฒนาข้อบกพร่องที่เกิดขึ้นในปัจจุบัน และออกแบบ layout ขึ้นมาใหม่สองแบบ ภายใต้คอนเซ็ปต์ อาศัย ทำงานและเล่น และนำเสนอต่อผู้บริหาร MRT เพื่อคัดเลือก master plan และนำมาประเมินผล โดยเปรียบเทียบกับ layout ปัจจุบัน และ economic impact พบว่า ได้มีการใช้พื้นที่ให้เกิดประโยชน์ เพิ่มขึ้นและคาดว่าจะทำให้เกิดรายได้เพิ่มขึ้นต่อสถานีมากขึ้นถึง 200% อีกด้วย นอกจากนี้คาดว่า สถานีนี้จะเป็นสถานีสำคัญอีกแห่งหนึ่งในอนาคต

ภาควิชา ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการ ลายมือชื่อนิสิต
 ผลิต ลายมือชื่อ อ.ที่ปรึกษาหลัก
 สาขาวิชา การจัดการทางวิศวกรรม ลายมือชื่อ อ.ที่ปรึกษาร่วม
 ปีการศึกษา 2560

5771239421 : MAJOR ENGINEERING MANAGEMENT

KEYWORDS:

WIRASINEE TONGSOO: Space utilisation strategy for Thailand underground transit station. A case study of Thailand cultural centre underground station. ADVISOR: PROF. PARAMES CHUTIMA, Ph.D., CO-ADVISOR: DR. DHUNYANON RATANAKUAKANGWAN, pp.

The ridership of Thailand underground station continuously increases every year. On the other hand, space management of terminal of underground station does not success as expected. The main reason is space does not have strategy to handle. majority of renter rarely stay until the completion of the rental contract, and they prefer to break the contract, pay the fine and move business elsewhere. According to research, there is no research study about this for Thailand underground station. In order to create appreciate plan for Thailand underground station in 2022. The strategy is core to integrate plan. Passengers would be attracted to increase traffic in that space. Besides, it is factor for passengers to make decision to use underground station more.

The case studied underground station will be connected station between 2 lines; blue line and orange line. Orange line is under construction now. Moreover, this station has been located at new central business district (CBD) and surrounding by residence and office buildings. Therefore, there will be potential here to develop and increase efficiency of space.

Space syntax has been applied to study and explain terminal's space of study station and integrated TOD to study surrounding area. To understand need of passengers, interview was applied to this research.

Subsequently, data and information were collected, floor plan was configured to improve weak area. 2 layouts were created under concept of live, work and play and present to director of area development and acting director of business development and area management and then choose the master plane.

Department:	Regional Centre for Manufacturing Systems Engineering	Student's Signature
		Advisor's Signature
		Co-Advisor's Signature

Field of Study: Engineering Management

Academic Year: 2017

ACKNOWLEDGEMENTS

Acknowledgement

First of all, I would like to express my deepest gratitude to my dissertation advisors, Prof. Parames Chutima, Ph.D. and Dr. Dhunyanon Ratanakuakangwan for their helpful advice, support, motivation and comments during the review process over the years. Moreover, I do appreciate all suggestions from all dissertation examiners.

I would like to thank Mr. Anawin Juntaruthai for sharing all necessary data and suggestions.

I take this opportunity to record sincere thanks to Miss Natravee Deewattanarkul and Mr. Prach Arporniem who to dedicate their time to advise and support with architectural skills and knowledge.

It is my privilege to thank Mr. Muhamad Azim bin Abdul Aziz Al Akbar, for his helpful, support, motivation and constant encouragement throughout my dissertation period.

Finally, I would like to thank my family and friends, especially Mr. Chavanant Roongchao and Miss Panita Suthiwongsing. I also place on record, my sense of gratitude to one and all who directly or indirectly, have lent their helping hand in this adventure. I would not come this far without them.

CONTENTS

	Page
THAI ABSTRACT	iv
ENGLISH ABSTRACT	v
ACKNOWLEDGEMENTS.....	vi
CONTENTS.....	vii
List of Figures	xii
List of Tables	xv
List of Equations	xviii
ABBREVIATIONS.....	xix
General abbreviations.....	xix
Underground station code.....	xix
Chapter 1 :Introduction	1
1.1 Background Information.....	1
1.2 Statement of Problem.....	3
1.2.1 Bangkok Mass-Transit Trends	5
1.2.2 Underground Space Development Project.....	5
1.4 Limitation of Research	6
1.5 Research Objective	6
1.6 Scope of the project.....	6
1.6 Expectation Benefits	7
1.7 Dissertation overview	8
Chapter 2: Literature review	9
2.1 Introduction	9

	Page
2.2 Transit Oriented Development (TOD)	9
2.2.1 Benefit of TOD	10
2.2.2 key success point of TOD	12
2.2.2.1 Function and Role of intermodal facilities.....	13
2.2.3 Case study 1: Japan's railway station as urban place	14
2.3 Porter's value chain.....	16
2.3.1 the advantage of Porter's value chain	18
2.3.2 the disadvantage of Porter's value chain.....	18
2.4 SWOT Analysis.....	19
2.4.1 Advantage of SWOT analysis.....	20
2.4.2 Disadvantage of SWOT analysis.....	20
2.5 Marketing Opportunity Analysis.....	21
2.5.1 Advantage of marketing opportunity analysis	23
2.5.2. Disadvantage of marketing opportunity analysis	25
2.6 Space Syntax.....	25
2.7.1 Advantages of the Space Syntax.....	27
2.7.2 Limitations of the Space Syntax	28
2.7 Activity System	28
2.8 Interview and questionnaire.....	32
Chapter 3: Research Modelling	34
3.1 Introduction	34
3.2 Task 1	37

	Page
3.2.1 Objective	37
3.2.2 Input Information	37
3.2.3 Information gathering and understanding of study station	37
3.2.4 Bangkok MRT information gathering	38
3.2.4.1 Interview 1	39
3.2.5 The Porter's value chain	39
3.2.6 Interview 2	39
3.2.7 SWOT analysis	40
3.2.8 Marketing opportunity analysis	40
3.2.9 Output Information.....	40
3.3 Task 2.....	40
3.3.1 Objective	40
3.3.2 Input information.....	40
3.3.3 Space syntax.....	40
3.3.4 Output Information	41
3.4 Task 3.....	41
3.4.1 Objective	41
3.4.2 Input Information	41
3.4.3 Evaluation of surrounding area	41
3.4.4 Reconfigure the floor plan configure the floor plan to improve the weak areas.....	42
3.4.5 Creating layout plan	43
3.4.6 Getting master plan.....	44

	Page
3.4.7 Output Information.....	44
3.5 Task 4.....	44
3.5.1 Objective	44
3.5.2 Input information.....	44
3.5.3 Evaluation the master plan base on.....	44
3.5.4 Output information	44
Chapter 4: Results and analysis	45
4.1 Task 1	45
4.1.1 Information Gathering and Understanding the Study Station	45
4.1.2 MRT station information gathering	49
4.1.3 Interview with ridership.....	50
4.1.4 Interview with MRT staff.....	50
4.1.5 Porter's Value Chain	51
4.1.6 SWOT analysis	54
4.1.7 Marketing Opportunity.....	56
4.2 Task 2: Space syntax.....	58
4.3 Task 3: Mapping Underground Urban Space and Making Distinction Between Areas.....	60
4.3.1 Evaluation of surrounding area	61
4.3.2 Mapping the new floor plan	67
4.3.3 The Master Plan.....	72
4.3.3.1 Customer Attraction	75
4.4 Task 4: Master Plan Evaluation	76

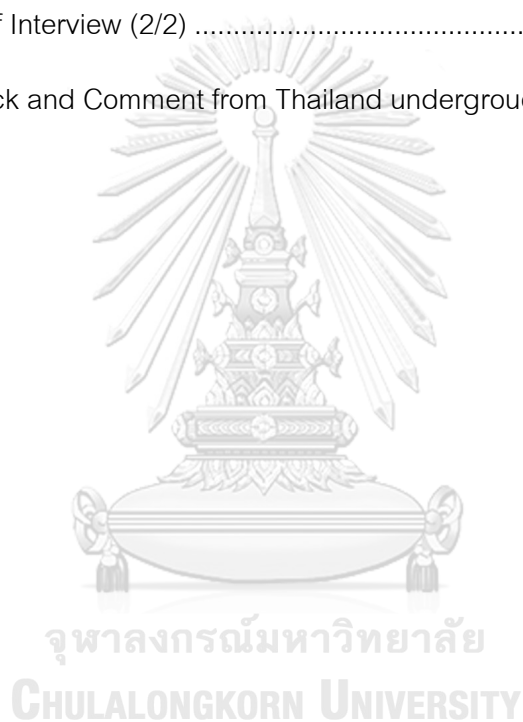
	Page
Chapter 5: Discussion	77
5.1 Research Overview	77
5.2 Consideration of potential underground transit station	78
Chapter 6: Conclusion.....	80
6.1 Conclusion and summary	80
6.2 Recommendation for future research	80
6.3 MRT feedback and comment	81
REFERENCES.....	82
Appendix 1: Thailand Cultural Centre's floor plans	96
APPENDIX 2 – Given Data from MRT.....	99
APPENDIX 3– Comparing Data.....	117
APPENDIX 4: Interview form	119
APPENDIX 5: Feedback and Comment from Thailand underground station.....	136
VITA	137

List of Figures

Figure 1: Traffic flow of each underground station (Bangkok Expressway and Metro, 2017).....	2
Figure 2: Layout of current use of Thai Cultural station	4
Figure 3: Average Daily Passenger of Thailand Cultural Center in 2011-2016.....	7
Figure 4: “Transit Oriented Development in America” survey polled a random nationwide sample of 1,002 Americans between April 6 and April 13, 2016 (HBTB, 2016).....	12
Figure 5: Layout of Osaka UMRT station (WEST JAPAN RAILWAY COMPANY, 2017)...	15
Figure 6: Porter's Value Chain structure (Kannegiesser, 2010)	18
Figure 7: Framework for Market Opportunity (Rayport and Jaworski, 2005)	22
Figure 8 Example of axial lines, convex space and isovist field (VAN NES, 2011).	27
Figure 9: Activity mediated by artifacts (Bali, n.d.).....	29
Figure 10 : Three levels of an activity.....	30
Figure 11: The structure of human activity (Engeström, 2015)	30
Figure 12: Flowchart of research modelling (Part 1 of 3)	35
Figure 13: Flowchart of research modelling (Part 2 of 3)	36
Figure 14: Flowchart of research modelling (Part 3 of 3)	37
Figure 15: Activity Agents and Activity Systems.....	43
Figure 16: Maps showing Huai Kwang District and Thailand cultural centre underground station (Maps of Huai Kwang District, 2017)	45
Figure 17: Side view of Thailand cultural centre underground station	47
Figure 18: General arrangement plans with door indication of Thailand cultural centre underground station.....	48

Figure 19: Porter's value chain of MRT	51
Figure 20: the data set of average daily passengers from the year 2011 to 2016 over the entire blue line	53
Figure 21: Picture showing the first view commuters will see entering from exit 4.	59
Figure 22: Picture showing the corridors after turning from the corner from Figure 21(above)	60
Figure 23: Area around north entrances in 500 meters radius (Google Maps, 2017)	66
Figure 24: Area around south entrances in 500 meters radius (Google Maps, 2017)	66
Figure 25: Drawing of Plan 1	69
Figure 26: Drawing of Plan 2	71
Figure 27: Station layout of Thailand Cultural Center Station (Th.wikipedia.org, 2017) ...	96
Figure 28: Thailand Cultural Centre Station General Arrangement Plan (Sheet 1 of 2) ...	97
Figure 29: Thailand Cultural Centre Station General Arrangement Plan (Sheet 2 of 2) ...	98
Figure 30: Graph of total passenger in 2011-2016.....	117
Figure 31: The result of Interview 1 (1/15)	119
Figure 32: The result of Interview 1 (2/15)	120
Figure 33: The result of Interview 1 (3/15)	121
Figure 34: The result of Interview 1 (4/15)	122
Figure 35: The result of Interview 1 (5/15)	123
Figure 36: The result of Interview 1 (6/15)	124
Figure 37: The result of Interview 1 (7/15)	125
Figure 38: The result of Interview 1 (8/15)	126
Figure 39: The result of Interview 1 (9/15)	127
Figure 40: The result of Interview 1 (10/15)	128

Figure 41: The result of Interview 1 (11/15)	129
Figure 42: The result of Interview 1 (12/15)	130
Figure 43: The result of Interview 1 (13/15)	131
Figure 44: The result of Interview 1 (14/15)	132
Figure 45: The result of Interview 1 (15/15)	133
Figure 46: Result of Interview 2 (1/2)	134
Figure 47: Result of Interview (2/2)	135
Figure 48: Feedback and Comment from Thailand underground station	136



List of Tables

Table 1: Description of primary activities and secondary activities.	17
Table 2: Walk distance to Transit of TOD (ITDP, 2017).....	42
Table 3: the average daily passengers from the year 2011 to 2016 over the entire blue line	53
Table 4: SWOT analysis of MRT station Thailand cultural centre	55
Table 5: List of shops and stores in the Culture Centre Station	58
Table 6: List of surrounding buildings.....	62
Table 7: List showing connectivity of the context to the station	63
Table 8: Passengers and their motives; divisions of labour.	64
Table 9: Functions to serve each motive	64
Table 10: Walk distance to Transit (ITDP, 2017).....	65
Table 11: List of function for improved design of plan 1	70
Table 12: List of function for improved design of plan 2	72
Table 13: Accumulated Passengers in 2011 (Bangkok Metro Public Company Limited, 2012).....	99
Table 14: Average Daily Passengers in 2011 (Bangkok Metro Public Company Limited, 2012).....	99
Table 15: Average Daily Arrival Passenger of each station in 2011	100
Table 16: Average Daily Departure Passenger of each station in 2011	101
Table 17: Accumulated Passengers in 2012 (Bangkok Metro Public Company Limited, 2013).....	102
Table 18: Average Daily Passengers in 2012 (Bangkok Metro Public Company Limited, 2013).....	102

Table 19: Average Daily Arrival Passenger of each station in 2012	103
Table 20: Average Daily Departure Passenger of each station in 2012	104
Table 21: Accumulated Passengers in 2013 (Bangkok Metro Public Company Limited, 2014).....	105
Table 22: Average Daily Passengers in 2013 (Bangkok Metro Public Company Limited, 2014).....	105
Table 23: Average Daily Arrival Passenger of each station in 2013	106
Table 24: Average Daily Departure Passenger of each station in 2013	107
Table 25: Accumulated Passengers in 2014 (Bangkok Metro Public Company Limited, 2015).....	108
Table 26: Average Daily Passengers in 2014 (Bangkok Metro Public Company Limited, 2015).....	108
Table 27: Average Daily Arrival Passenger of each station in 2014	109
Table 28: Average Daily Departure Passenger of each station in 2014	110
Table 29: Accumulated Passengers in 2015 (Bangkok Metro Public Company Limited, 2016).....	111
Table 30: Average Daily Passengers in 2015 (Bangkok Metro Public Company Limited, 2016).....	111
Table 31: Average Daily Arrival Passenger of each station in 2015	112
Table 32: Average Daily Departure Passenger of each station in 2015	113
Table 33: Accumulated Passengers in 2016 (Bangkok Metro Public Company Limited, 2017).....	114
Table 34: Average Daily Passengers in 2016 (Bangkok Metro Public Company Limited, 2017).....	114
Table 35: Average Daily Arrival Passenger of each station in 2016	115

Table 36: Average Daily Departure Passenger of each station in 2016	116
Table 37: Table: Accumulated Passengers 2011-2016	117
Table 38: Average Daily Passenger 2011-2016 for overall stations of blue line	118
Table 39: Average Daily Passenger of Thailand Cultural Center in 2011-2016	118



List of Equations

Equation 1: Growth difference	38
Equation 2: Growth percentage	39



ABBREVIATIONS

General abbreviations

MRTA	Mass Rapid Transit Authority of Thailand
TOD	Transit Oriented Development
UMRT	Underground mass rapid transit
MRT	Mass rapid transit

Underground station code

HUA	Hua Lum Pong station
BAN	Bang Sue
CHA	Chatuchak Park
CUL	Thailand Cultural Center station
HUI	Huai Khwang Station
KAM	Kamphaeng Phet
KHO	Khong Toei Station
LAT	Lat Phrao Station
LUM	Lumpini Station
PET	Phetchaburi Station
PHA	Phahon Yothin Station
RAM	Rama 9 Station
RAT	Ratchadaphisek Station
SAM	Sam Yan Station
SIL	Silom Station
SIR	Queen Sirikit National Convention Centre Station
SUK	Sukhumvit Station
SUT	Sutthisan Station

Chapter 1 :Introduction

This paper is to interpret the space development and management within the underground station in Bangkok as well as a guideline for the appropriate maximum utilisation of the underground station space .This chapter will introduce the preliminary information and the intention of this dissertation.

1.1 Background Information

Bangkok has the biggest urban area in Thailand with a population of 9.3 million (Un.or.th, 2017). There are three types of mass transportation in Bangkok consisting of public bus, rail-based transit, and bus rapid transit (Assavavipapan and Opasanon, 2016). The rail-based mass transportation in Bangkok however is divided into two; an over-ground system consisting of both the Bangkok Mass Transit System or more commonly known as BTS as well as the purple line in Metropolitan Rapid Transport or MRT and underground system called blue line in MRT with 18 stations (BEM, 2017).

Bangkok Expressway and Metro or BEM is an operator of MRT .It has a right to manage and develop the space within underground station .BEM has a business plan that includes the gathering revenue from the space management within the station (BEM, 2017). BEM created subsidiary firm named Bangkok Metro Network and it has developed 11 underground stations' space. However, only some of them are fully organised and called Metro Mall such as Chatuchak station, Kamphaeng Phet station, Phra Ram 9 station, Sukhumvit station and Phahon Yothin station (MRTA, 2017). The development and management of the certain space is, however, not depended on traffic flow alone. The data in Appendix 2 shows that the most traffic station is Sukhumvit station, but the stores are available in limited area due to the scarcity of space and station design.

แผนที่เส้นทางรถไฟฟ้า MRT สายสีน้ำเงินและสายสีม่วง

Route Map of MRT Blue Line and MRT Purple Line

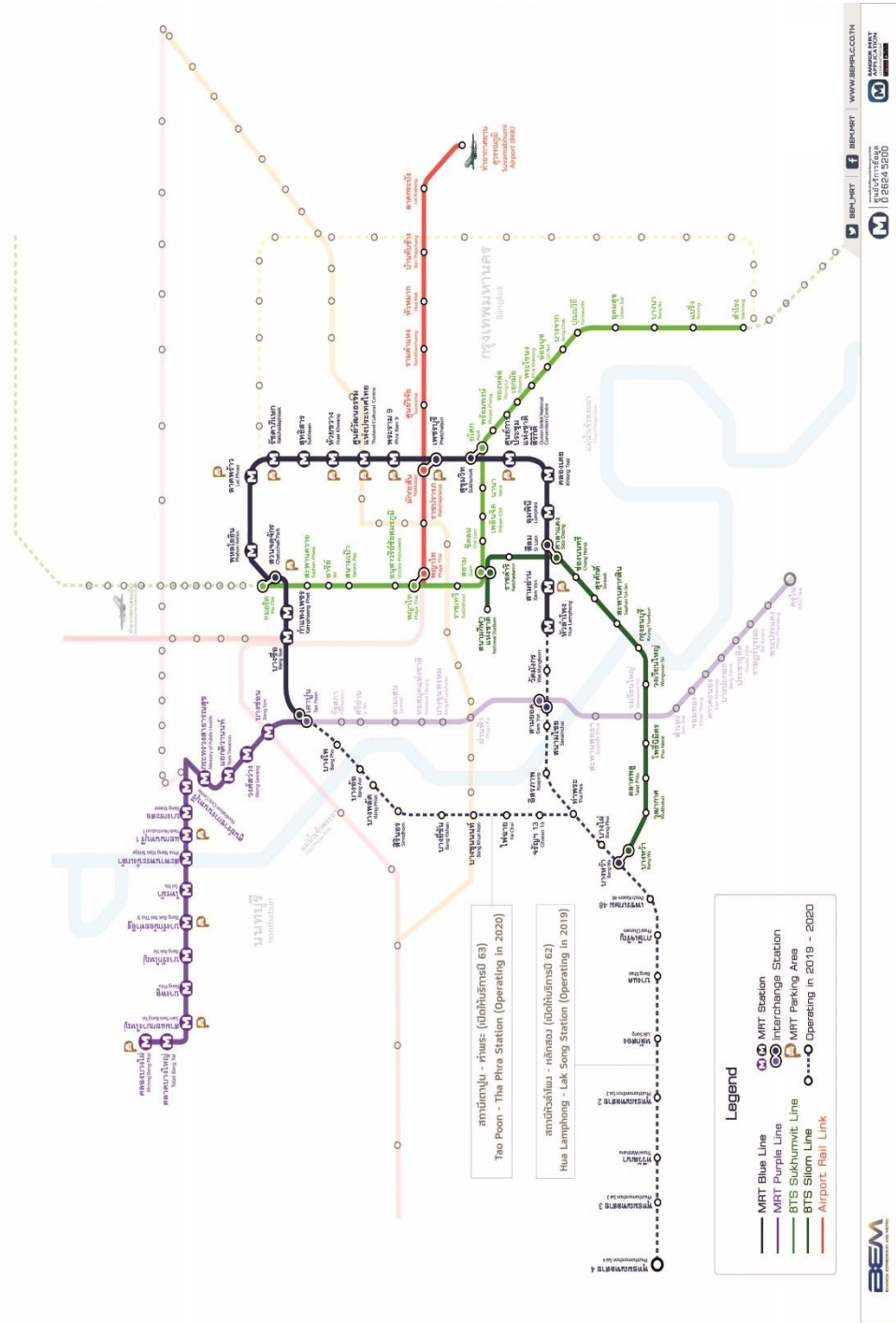


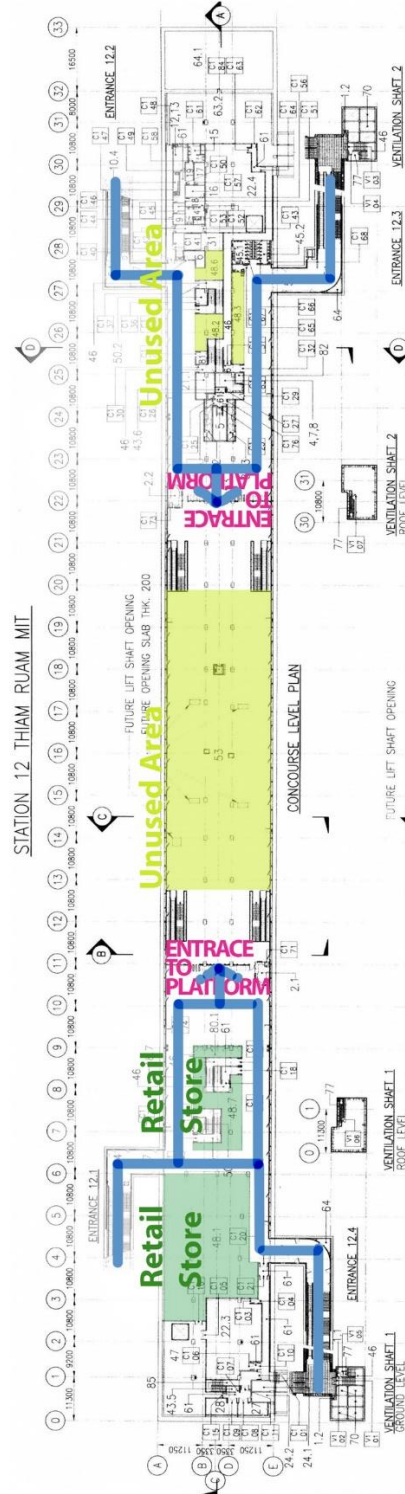
Figure 1: Traffic flow of each underground station (Bangkok Expressway and Metro, 2017)

1.2 Statement of Problem

Spaces in underground are a profitable asset .This asset is particularly costly in urban area where spaces possess a premium value stated that city master plan and underground space use have affected by urbanisation .This includes the underground space uses of railway, buildings 'basement, and pipeline infrastructure .Space management within the underground station is extensive than ever to maximise the utility of unused spaces .

However, the space management in Bangkok underground station was suffered from an insufficient flow creating the dead area, none zoning, none attractive infrastructure and whatnot .Even the data of traffic flow, illustrated previously, shows that there is a dense in the junction stations, such as Sukhumvit station, and parking building station, such as Huai Khwang station .Space development inside the station where has been developed may not be paid off because of station's characteristic and improper management.

Thailand cultural centre was chosen as study station. According to Figure 1, it is obviously that the space didn't have good management, because all the stores have been located only one side. In another side, space has not been rented out. Moreover, the ticket gates block the passenger flow from north wing to south wing. So, Passenger cannot circulate all over the area.



**CURRENT USE
OF THE STATION**

Figure 2: Layout of current use of Thai Cultural station

1.2.1 Bangkok Mass-Transit Trends

Bangkok mass-transit development plan is focused on rail-based transit system which will extend the network of MRT (BEM, 2017). The passengers are forecast to be increased. The junction station with the exist underground station will be added as show on Figure 1 The spaces in station and the passenger flows also will be enlarged (BEM, 2017). Hence, the space of underground transit station needs to maximise used space as much as possible. However, this need to integrate science knowledge in term of analysing and architectural knowledge in term of designing.

1.2.2 Underground Space Development Project

BEM has recognised the latent value of station's space. They have a plan to develop the area by setting up the project plan. In 2016, Bangkok Metro Network proposed the space development project to 11 stations of Bangkok underground transit station. Total area is more than 14,000 m². In present, they are operating 7 stations, and another 2 stations will be opened soon. This project is under name "Metro Mall". First metro mall was opened at Sukumvit station in 2005. The main purposes are

1. To utilize space
2. To facilitate to underground transit station's passengers
3. People around station such as office buildings and condominium

At that time, retail at underground transit station is new dimension for Thailand retail market. There were so many known brands interested at metro mall. For example, convenient stores, banks, book stores and restaurants. They all expected to gain huge number of passengers because Sukumvit station is transfer station between underground station and sky train station (Brand Buffet, 2017).

However, the result was reverse. Metro mall didn't not respond from the customers. To follow plan, after that metro all still opened up at other underground stations.

1.4 Limitation of Research

1. Developing plan will not be able to change ticket offices and staff zone
2. Fire exit must be clear for safety for emergency case
3. Area of current shop will be equal or more than present contact
4. Underground station must get higher or equal income from space rental than current situation.
5. In case of after development, if exiting stores need to be moved, the space area will be greater or equal to current number

1.5 Research Objective

The object of research is to develop a model for increasing utilization of underground space in Bangkok mass transit.

1.6 Scope of the project

The analysis of the underground space management in this paper focuses on the spaces within Thailand Cultural centre underground station. This station has located in new central business district area (CBD), which is surrounding with office buildings and residence areas. According to appendix 3, there is demand of passengers of both overall stations and Thailand cultural center. Especially, in 2015-2016 the number of passengers sharply grew up as show in Figure 3. Moreover, this station will be connecting station between blue line (current line) and orange line.

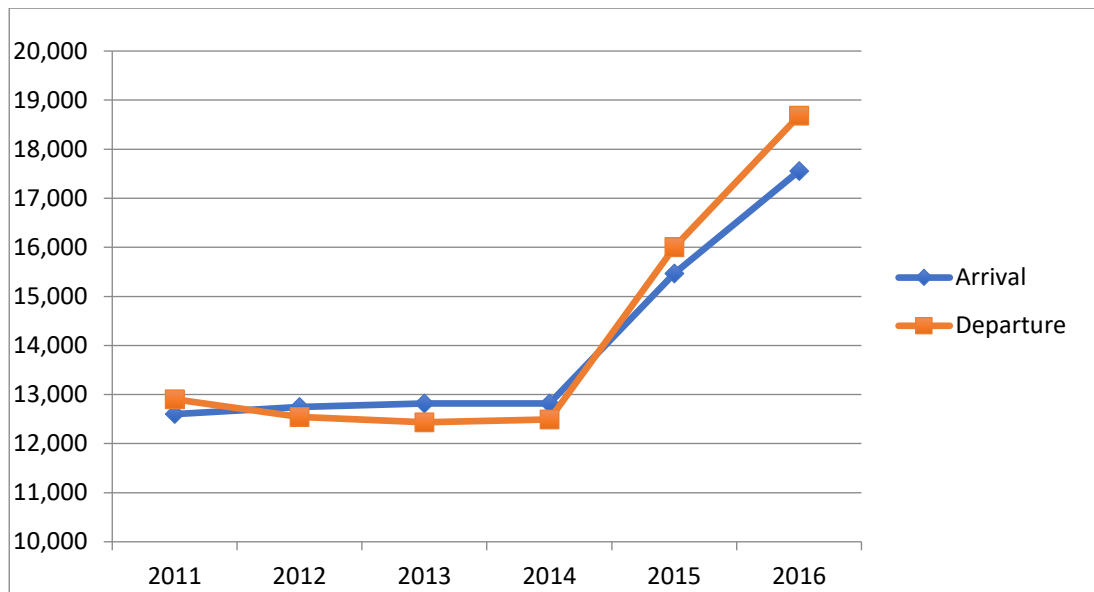


Figure 3: Average Daily Passenger of Thailand Cultural Center in 2011-2016

The underground spaces include the entrance on the ground floor, the junction pathway to over-ground system in possession of MRT, the space before the ticket gate including ticket machine, the space after the ticket gate, the facilities such as restroom, lift, and escalator, and staff only area. All of these functions are on basement 1 floor. However, developing plan will not include platform floors, which are B2 (orange line) and B3 (blue line).

1.6 Expectation Benefits

1. To increase used space
2. To increase underground station profitability
3. To increase passenger flow within study station
4. To increase ridership and better satisfaction among UMRT users

1.7 Dissertation overview

This dissertation has consisted of 6 chapters, including this introductory chapter. The remainder of this dissertation has been organized in this following way. Chapter 2 is literature review, which review of theories, literatures and associated case studies with this topic such as transit oriented development and underground development, space analysis and designing, and economic analysis. Chapter 3 is research modeling, which illustrates and structures of method and process in this dissertation including Porter's value chain, SWOT analysis, Marketing opportunity, space syntax methodology and economic impact. Chapter 4 is result and analysis. This chapter uses the model from Chapter 3 to get result and analyze. Before getting master plan, there would be 2 designed plans. The master plan would be selected later. Afterwards, economic impact will be analyzed. Chapter 5 is discussion. The author discusses about the result regarding to the objective of this dissertation. This chapter explains how to apply models to study station and investigate the master plan. There are some limitations of designing. Finally, Chapter 6 is conclusion. It includes summary and conclusion of research contribution of this dissertation. This chapter also includes recommendation for future research.

Chapter 2: Literature review

2.1 Introduction

This chapter defines Transit Oriented Development (TOD) and its implementation. Section 2.2 explains the need for the study of transit oriented development in understanding its importance and their implementation in current public transport systems. Section 2.3 investigates Porter's Value Chain as a validation method of railway station developments. Section 2.4 examines the attributes of railway stations and highlights the importance of considering transit oriented development. Section 2.5 analyses the marketing opportunity of a railway station planning that includes the implementation of transit oriented development.

2.2 Transit Oriented Development (TOD)

Transit Oriented Development, also known as TOD, is a model used in planning sustainable urban communities with high population densities, various land uses, and large public spaces. In this context however, TOD is used to determine the feasibility of creating compact, pedestrian-friendly and mixed-use communities focusing around high-quality transit stations which in turn would also decrease their dependence on driving.

According to Calthorpe (1993), TOD is commonly quoted as a choice in producing the capability for regional and urban sustainability transitions (Calthorpe, 1993; Cervero and Sullivan, 2011; Dorsey and Mulder, 2013). In other words, TOD method is believed to have the ability to improve both return on development and passenger volume for public transport system by achieving a lower pressure in life without depend on motor vehicles alone for mobility and survival.

In Thailand, where urbanization is the third-largest in East Asia in terms of area (United Division, 2017) and with the Capital being the 9th largest in terms of its population (The World Bank, 2017), transit oriented development could stand as an

ideal solution to accommodate such dense population. However, there are many international example of successful frameworks, which developed and utilized area around transport hub planner. Thailand has widely applied this method.

The challenges of demographic growth, economic competition (both within Thailand and internationally) and social equity mean that a cultural shift in government's planning and transport, provided with adequate funding, is essential to bring transit oriented development to the forefront of the urban policy agenda.

2.2.1 Benefit of TOD

The density of the Thai population in cities is among the highest in East Asia – with population number approaching a total of 10 million soon (The World Bank, 2017). In a recent study by the Fiscal Policy Office, it is found that the proportion of population above 60 years set to increase from 14% to 17.5% by 2020, 21.2 percent in 2025, and 25.2 percent in 2030 (Paweewun and Sirimai, 2016). This signals a need for significant change in priority.

Out of the total population number, Bangkok Metro Public Company Limited (2011) reported that the average number of passengers who uses the MRT on weekdays is more than 220,000 people whereas on weekends the number exceeds 129,000. This amounts to more than 180,000 people using the services of MRT on a daily basis. In the 2016 report however, Bangkok Metro Public Limited states that the average number of passengers (daily) is more than 270,000 people. This shows that the number of people using the services of Underground Rail Transit has increased by at least 50%. However, reports show that businesses operating in the MRT underground stations are suffering from losses, year after year due to poor development and planning of the station.

The most effective response to such problems is to revise the current plan on how the development is most appropriate and plan for growth along the rail transit stations' corridors. Transit oriented development is a main important key of strategy. TOD creates a pedestrian-oriented medium to high-density mixed-se spaces around the underground rail transit stations, possibility of underutilizing spaces under the MRT

would be much lower. With that, passenger volume would also increase as better passenger flow is created. This enables potential business owners to generate better income flow as more strategic hubs would have been allocated for proper commercial use. Thus, encouraging potential business owners/ investors to rent more of the areas in stations and in turn generate more income for the station owners.

On a side note, implementation of walk-friendly platforms promotes healthier lifestyle for passengers as more walking activities is believed to contribute to the reduction of stress. This however, increases the amount of transit 'ridership' as it enables pedestrians with ease of access around the mass transit systems. This would increase the income generated by potential business owners as better opportunities are offered when pedestrians are able to view the services and products more, which then provides higher number of viewership or brand awareness.

One other major outcome from the adoption of TOD method is reduced amount of traffic congestion, car accidents and even injuries. With the focus to shift the usage from private vehicles to public transport, lower household spending on transportation would be expected hence giving an expense relief for regular users to invest in other assets such as affordable housing. Following this, property values around areas affected would increase and become more stable investments for potential investors.

A recent study was conducted in America to analyze the effects of TOD. This can be viewed using Figure 4, whereby Americans believe transit oriented development provides an array of benefits ranging from lifestyle to environmental to economic. With reduced dependence on foreign oil, pedestrians are able to experience reduced amount of pollution together with minimal environmental damage. In 2014, Thailand had a record of 4.622 metric tons per capita in CO₂ emission (The World Bank, 2017) being the country's highest record and was speculated to increase further. Other than that, TOD creates more incentive for compact development and at the same time reducing the possibility of passengers to sprawl. This approach is relatively inexpensive as compared building more roads to tackle sprawling problems.

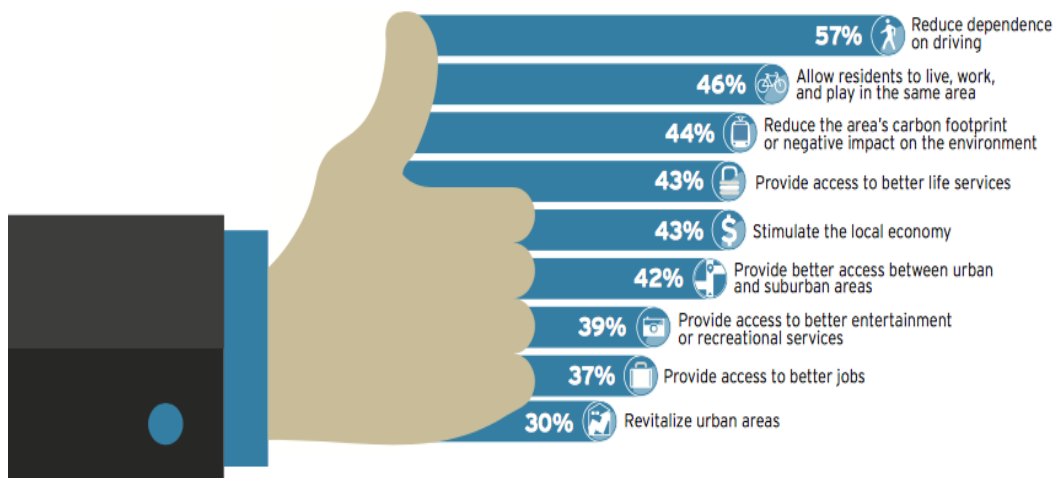


Figure 4: “Transit Oriented Development in America” survey polled a random nationwide sample of 1,002 Americans between April 6 and April 13, 2016 (HBTB, 2016).

In conclusion, TOD is a key method when planning and developing a public transport system; namely the rail transit stations; thus, enhancing the capabilities of Thailand in maintaining an economic competitiveness both within East Asia and throughout the world.

2.2.2 key success point of TOD

TOD has been widely accepted across the world and each of these implementations have become the focal point of successful TOD integration. The following examples states key success points of implementing TOD policies. Firstly, by emulating the station's development capability to the Mass transit capability. Pairing the housing development and jobs capability inside the stations, to the transit systems' carrying capacity reflects to a balanced system, avoiding expansions in crowding by over-aggravating certain locations.

Secondly, by specifying mix space use aims. Diverse space use is the foundation for transit-oriented societies and pedestrians. A criterion for a beneficial mix considers operated transit-supported single-use neighborhoods and help them in

adjusting over time to achieve a beneficial mix without certainly aggravating beyond an optimum density.

Thirdly, setting benchmarks for expanding cycling infrastructure. Setting goals to build non-motorized modes would reflect more efficient in shifting travel routines rather than aiming on mode-switch from a private transport to public transport. In many cities, for instance; Bogota, Copenhagen, Curitiba, and Portland, where a large investment is made in bicycle and pedestrian infrastructure, non-motorized travel skyrockets noticeably.

Lastly, determine TOD ready areas. Traditional, old and re-settlement neighborhoods may already possess good elements for TOD, including mixed-use, good street accessibility and density. They are more likely to become transit-oriented communities by building transit accessibility and essential infrastructure interventions.

These strategies are important in succeeding urban Thailand transit-oriented development. Specifying criterion leads the targets for city planners when assessing projects or policies. Quantitative and periodic evaluation of TOD process will assist to guarantee that the city's transformation will be an equitable multi-modal environment.

2.2.2.1 Function and Role of intermodal facilities

Implementing TOD requires intermodal facilities to adapt accordingly. To do so, an important strategy such as door-to-door travelling is needed. Existing underground rail transit stations are lacking this strategy whereby passengers are able to access and exit using the door-to-door method in an area. This enables passengers to roam all over the area. Another benefit of this strategy is the increasing numbers of passengers who will shift from private transportation to public transportation. With the current model and developments, not all areas have a door-to-door access, which creates the discouragement for passengers to park their cars at the station and use the rail transit instead. Lastly, TOD strategy leads to minimize change between intermodals (ALMEC Corporation, Oriental Consultants Global Co, Ltd., 2015).

2.2.3 Case study 1: Japan's railway station as urban place

This case study illustrates the urban planning and design strategy by transformation. After the Second World War, underground mass transit has become the most important method in Japan. At that time, there was weak planning, which need to transform.

One of the largest railway station complexes in the world can be found in Japan. Since 2000, Japan's railway station re-development is one of the most significant urban conversion scheme underway. The stations and bordering railway area that are subjected to physical change was affected to serve new urban operations and to intensify traveler experience. Operations such as media, information, leisure, commerce, and other advanced industries are consolidated into the city making the rail stations crucial places for innovation. This implementation enables the railways stations to not only be considered as a transport hub, but as a cultural symbol, social communication hub as well as a business centre (Zacharias, Zhang and Nakajima, 2011).

Tokyo Station re-development is a prime demonstrating the investigation of consolidating modern conveniences into a current spatial operation. The concept of the station is renovated as a crucial metropolitan hub in Tokyo to illustrate a mix of shopping, entertainment and business venues. The walk-way network is reconstructed with extra spaces and new complex land uses, introducing to modern spatial patterns and configurations of behaviour. The new function of the station is developed from these transformations. The station renovation, besides surrounding area's investments present an obvious Japanese method to transit-oriented development (Tod.org, 2017).

Another main example would be the Osaka underground mass rapid transit (UMRT) station as it follows the same principle strategy to re-develop the station. The station occupies the 1st, 2nd and 3rd floor of the Osaka Station City whereby the two buildings are connected through the North and South entrances. Within these buildings are department stores, restaurants and other leisure stores. The building also has booths for tourists and travel information. The Osaka Station City also has other facilities such as a film cinema, a fitness club and a farm, designed to drive traffic towards the

underground MRT station. The layout of the Osaka UMRT station is illustrated in Figure 5.

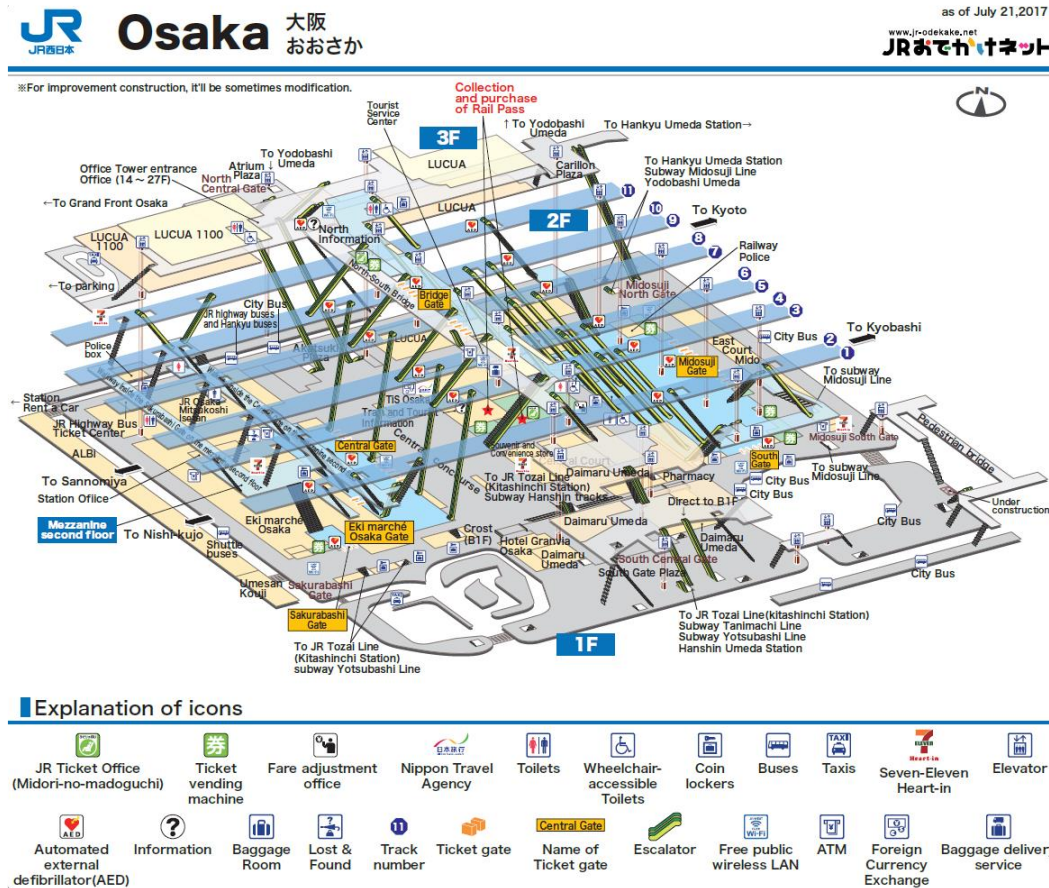


Figure 5: Layout of Osaka UMRT station (WEST JAPAN RAILWAY COMPANY, 2017)

CHULALONGKORN UNIVERSITY

In summary, Japan's railway stations are a prime example of successful development with high influence of TOD in both planning and development. This shows the importance to capture the full concept of approaches to maximising mixed-use areas in public transport hubs; in this case underground rail transit stations; where the re-development programmes create an integration of compact, pedestrian-friendly and mixed-use communities centered around high-quality train systems. From the literature review and case study, the transport oriented development method is used to emphasize the urban centre in showcasing a mix of prestige business, shopping and

unique entertainment venues leading to new spatial configurations and patterns of behavior in rider

2.3 Porter's value chain

A value chain illustrates a combination of activities within an organization intended to increase the value of a service or product. These activities include identifying consumer needs, production, distribution, marketing, and after-sales service. The value of the service or product curated then translates into a profit margin. The higher the value of the service or product compared to the cost of the materials, the higher the profit margin. A higher profit margin not only translates into a more profitable business, but also allows the organization to gain a competitive advantage over its competitors in capturing new consumers and retaining present consumers. The profitability of a company relies on how efficient of its management including the value chain's procedure; willing to pay price of the consumers for its products and services is over the related expenditure of the value chain procedures (Kumar and P. V., 2016).

Porter's value chain analysis was developed to identify the curation of value at each individual activity and how these activities interact with each other to maximize profit margin (Porter, 2008). The value chain framework consists of 2 categories; namely, primary activities and secondary activities as shown in Figure 6 (Kannegiesser, 2010). Basic activities are involved in the physical creation, maintenance, support and sales of products or services. Secondary, or support activities are activities that increase the efficiency and performance of the primary activities. The description of primary activities and secondary activities are shown on Table 1 below:

Table 1: Description of primary activities and secondary activities.

	Type of activity	Description
Primary	Inbound logistics	Receiving, storing and distributing of goods.
	Operation	Transformation activities which change goods into product/service, therefore creating value to the consumers.
	Outbound logistics	Storing and distributing of the product/service to a consumer.
	Marketing & Sales	Consumer interaction activities that translate into sales, including benefits and how these benefits are communicated to the consumer.
	Service	Activities related to maintaining the value of a product or service after consumer purchase.
Secondary	Firm Infrastructure	The organization of a business and its support systems integral to its daily operations.
	Human Resource Management	Activities related to finding the most suitable person for the required tasks, training them for said tasks and rewarding them based on their performance.
	Technological Development	Managing and processing of information to optimize efficiency and protecting knowledge base.
	Procurement	Activities related to finding the resources necessary for the operations of the organization.

Porter's Value Chain

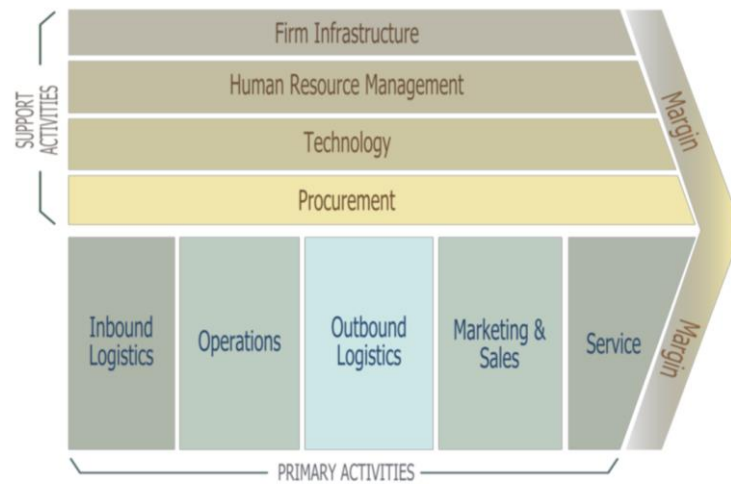


Figure 6: Porter's Value Chain structure (Kannegiesser, 2010)

2.3.1 the advantage of Porter's value chain

Porter's value chain model is commonly used as a flexible strategy tool that is inexpensive for looking at business/ development on a larger scale. This includes the analysis of a company's competitors as well as respective places in the industry's value system. Although Porter's competitive forces model is a similarly used tool, it can only be used to identify general strategies. The model of value chain however, identifies specific activities, which can use competitive strategies to create the best impact. This gives organisations a much deeper understanding of strengths and weaknesses when making a SWOT analysis. The model also shows points at which organisations can use information technology to achieve greater competitive advantage. One other advantage of adopting the model is that it can be adapted for all types of businesses and that includes manufacturing, retail or service etc.

2.3.2 the disadvantage of Porter's value chain

While Porter's value chain analysis allows an organization's optimization of its activities to gain a competitive advantage over its competitors, the segmentation into separate activities may result in a loss of flow between the different segments. This results in a strategy that focuses solely on higher profitable activities and neglects the less profitable activities. For many industries, the scale and scope of the analysis

requires a substantial amount of data to produce a complete value chain analysis of an organization and its competitors as well as identifying and understanding the key differences and strategy drivers.

Therefore, it is important to formulate an overall strategy that maintains a consistent flow between the different activities in the chain while also ensuring that each activity is fully optimized to ensure high profit margins.

In summary, value chain model can be used as the main value assessing tool with reference to the above arguments. By doing so, the value of developing mixed-use platforms in rail transit stations can be identified and compared with existing plans. Also, the author would understand the Thai railway station's marketing strategy and the focus of the railway industry as well.

2.4 SWOT Analysis

SWOT is an abbreviation of strength, weakness, opportunities and threats. It is used to obtain an objective appraisal of an organization. The process focuses on internal and external factors surrounding the organization, in this case, the development and planning of an underground rail transit station. Internal factors mentioned consist of strengths and weaknesses whereas external factors include opportunities and threats. Generally, governments and firms use SWOT analysis to determine key areas necessary when allocating its resources to achieve maximum value and return. This shows that firms are more alert of the threats when unstable external environmental change occurs, as well as opportunities which allows firms to identify the gaps in the competitive market and respond to those gaps first. This is important as it improves possible weaknesses of the organization (Baker and Hart, 2003).

External factors, however, are factors that the organization has limited control over. These factors are then marked against each other to produce a confrontation matrix.

To summarise the above, internal factors are factors that can be controlled to an extent by the organization. Strengths and weaknesses of the organization are the blueprint for a short-term operation and tactical plan. While opportunities and threats

impact the nature of the long-term strategies and planning, SWOT analysis benefits the firms to define the primary issues underlining the firm's current situation (Pearson and Ranchhod, 1999). This analysis is carried out to identify key points in each aspect, determine the main obstacle to the organization and to formulate an appropriate strategy based on this main obstacle.

Further refining of the SWOT analysis can be performed through force field analysis. This analysis defines the positive or negative forces which drives the success or derails an organization from succeeding respectively. Once these forces have been identified, an organization may then formulate an effective strategy to optimize its success and minimize its failure. For an organization to achieve success, it is crucial that the positive forces outweigh the negative forces (Baulcomb, 2003)

2.4.1 Advantage of SWOT analysis

The major advantages of conducting a SWOT analysis for the planning and development of a rail train station is that it bears little to no cost to understand the nature of the business can apply a SWOT analysis. Furthermore, users can use a SWOT analysis when limited time is given to obtain a complex situation of firm. This means that the business can follow the steps to be improved by internal, don't need external consultant or advisor. Moreover, benefit of a SWOT analysis is to focus on the most crucial factors affecting the related business. This encompasses the ability to understand the nature of the business better, address weaknesses of the business, deter threats, capture opportunities given, utilise the advantages of the strengths as well as to develop business objectives and strategies to reach them

2.4.2 Disadvantage of SWOT analysis

There is only one step of business planning process to conduct a SWOT analysis. In depth information need to be used to analyze. Information would come up with decisions. According to the definition of SWOT analysis is to analyze strength, weakness, opportunity and threat. So, it only covers those issues literally. Thus, it is hard to define uncertain or two-sided factors. For example, factors could not specifically define to be strength or weakness or both, with a SWOT analysis.

This analytical procedure has a limited perspective because of issue priority and unspecified solution. It has no alternative decisions. Moreover, it gives dozens of ideas but it hard to narrow down to suitable one. Lots of information from the analysis would not be useful. (Business.qld.gov.au, 2017).

In summary, SWOT analysis is tool to analyse internal information, which is depth detail. All information is gathered from interviewing MRT's officer to analysis SWOT of this station. Afterwards, all this information would be used to do planning and design for this station.

2.5 Marketing Opportunity Analysis

Marketing opportunity analysis is a tool for identifying and assessing the attractiveness of business opportunity. The usefulness of this tool is relying on the business planning by incorporating the market forecasting and plan development in order to assess the organization's financial capability and identifies future opportunities. As a result, the company can use the information to prepare and compete in the exploiting future opportunities, and identify underserved client needs and company resources. Furthermore, this tool can also analyse the competitive advantage and identifies target markets leading to the improvement of business competitiveness.

To conduct the analysis, the first step is to determine the potential size of demand in each market since market size plays an important role as the indication of potential revenue. However, the potential demand must be compared against the background of existing/potential competition in the market. If a market is relatively large but there are existing competitors, it offers a new entrant to the market no substantial opportunity in the short run. In other words, market opportunity depends not only on the size of potential demand but also on how well that demand is already serviced by other companies; foreign and local (Kuada, 2016).

Organisations that were not successful serve as a benchmark to assess efforts that may be required to serve the potential consumers effectively. This assessment

enables the company to determine profitability when entering the market as well as the required resources for the development of the market (Kuada, 2016). The following three key determinants of market opportunity are focal points of every market analyst (Kuada, 2016) which determines the primary outcome of a market opportunity analysis:

1. Size of market
2. Marketing program requirement to satisfy market wants.
3. Quality of competitors' marketing strategies.

For more detailed analysis of the three determinants of market opportunity, a market analyst is required to conduct five separate analyses from which he can obtain the information needed. These components are demand analysis, segmentation analysis, industry analysis and lastly competitor analysis. The framework below consists of seven initial investigative stages of idea creation as shown on Figure 7 (Rayport and Jaworski, 2005).

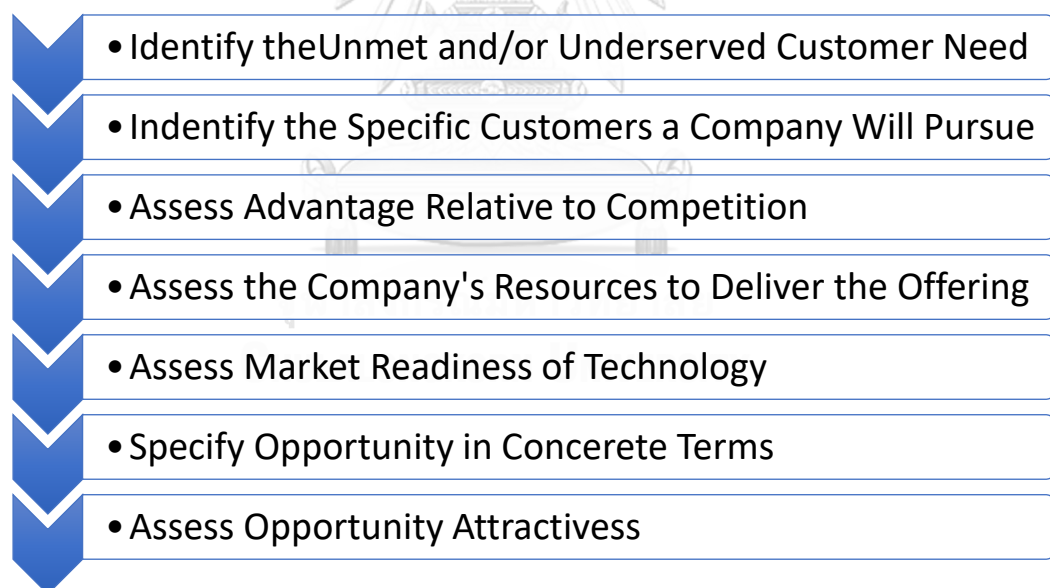


Figure 7: Framework for Market Opportunity (Rayport and Jaworski, 2005)

The starting point is to identify what are the customer needs. This is usually implemented by an individual who has strong knowledge in value systems and has the capabilities to reinvent or transform the system. This allows the business to determine the opportunities in improving customer satisfaction or to create a new and distinct

valued customer experience. The next step is to identify the specific customers a business will target. This is to assess and priorities the customer in the initial stage whilst understanding them as well.

This brings us to our next point; to access advantage relative to competition. In this step, it shows that the structure of the industry, as well as its market, the key competitors in the similar market, and the business's competitive advantage compared to its competitors. This paves the way for companies to start assessing its resources and capabilities to deliver the offering. It is essential for the company to assess the specific capabilities and activities it is able to offer in order to achieve competitive advantage. This usually is implemented using either the business's own resources or the potential partners.

In conjunction to that, businesses should also assess the market willingness to adopt the usage of a technology, as well as any other alternative technologies, of which is forecasted before marketing the business's products and services. This then leads us to specifying the opportunities in concrete terms. This is done by recognising the specific benefits of which the business would be able to offer in achieving competitive advantage over its competitors in the market.

The last step to the analysis is to assess opportunity attractiveness. This means that the business must identify the market's situation. This includes its competitiveness, its financial situations and the technological advancements.

2.5.1 Advantage of marketing opportunity analysis

There are 3 main advantages when implementing the marketing opportunity analysis. The first would be the ability to establish the company's identity and market position. This includes its mission, objectives and its existing market position. This is seen when analysing the business's strengths, weaknesses, opportunities and competition also known as the SWOT analysis. Generally, it is used to show how the firm is assessed internally and externally. The analysis is useful in this sense as it highlights the advantages and disadvantages that the business holds. The opportunities and

threats analysis is done to identify the direct and indirect competitors' products, services, marketing activities and brand positioning.

The second key advantage is the ability to identify the target markets. This is achieved by dividing the prospective customer base into divisions. It enables the business to distinguish the target market including the demographics and psychographics. Demographics consist of common traits that a group of prospective customers in a target market share. These traits consist of degree of income, formal education ranking, location and marital status. Psychographics are typical lifestyle and self-preferences such as maintaining high levels of physique, traveling to foreign countries or achieving high socioeconomic status.

Lastly, the ability to determine position of the business's product as well as strategy. Besides the business's rebranding or new product introduction, a market analysis will usually include an investigation of how the target market perceives the product being offered. The analysis distinguishes product features and benefits which are then matched together with a need that is created within the mind of the targeted customers. Businesses would then identify prospective package designs, strategy distribution, marketing and media placement, slogans, product characteristics, pricing model and customer expenditure patterns. Businesses may even carry out surveys to estimate the potential interest in a product and conclude what the consumer preferences are.

In summary, the key advantage of this analysis is the ability in assisting businesses to minimize their prospective losses. If a company deliberately advertises a new product into the market with no prior analysis, the product is likely to fail. This analysis aims to disclose to businesses the necessary steps for a business to meet the market's expectations and needs which results in higher profits. In other words, to identify how the firm will be able to appeal to its customer's needs. Carrying out a market analysis would also enable businesses to identify the discontinuation of its products.

2.5.2. Disadvantage of marketing opportunity analysis

Unfortunately, there are drawbacks to implementing this procedure. Firstly, marketing opportunity analysis is not a complete framework. It requires additional analytic tools to be able to produce a complete analysis for companies to use as reference. Secondly, the analysis requires large amount of information to analyse the various factors. This would then lead to the next point of which it is time-consuming. Large information requires large amount of time to produce best results and this is necessary for companies striving for greater heights.

In summary, the market opportunity analysis is an ideal tool to guide firms in determining the opportunities from a broad perspective down to a narrow perspective. The origin framework can be used to cover the 5-key market analysis. However, the current market trend is rapidly changing due to Information, Communication Technology (ICT). This makes the origin framework to be obsolete. The adapted MOA framework is considered to be the most effective framework as it includes further assessments on environmental and future trend which are uncontrollable forces.

In this project however, the main task is to assess the effectiveness of integrating TOD in underground transit stations' framework and development outside of Thailand. The adapted marketing opportunity analysis would be the appropriate guideline for the author to determine the differentiation of opportunities in each station.

2.6 Space Syntax

Space syntax encompasses a set of techniques and theories used to analyse the architectural and urban space as well as foreseeing functional outcomes (Hillier, 2014). It was first developed by a group led by Bill Hillier to create an analysis that best reflects human movement patterns based on an optimal urban representation i.e. the relationship between human beings and their inhabited spaces.

There are two main functions of Space Syntax i.e. creating and developing a theory as well as constructing a method to analyze layouts referring to the theory. The

theory defines spatial configuration for certain dynamic related to society and build structure which mainly concerned with city works and its influences. spatial instance as an explanatory variable for certain dynamics contained in the relationship between society and built structures. The research field of Space Syntax is mainly concerned with questions related to how spatial configuration affects the way the city works and its degree of influence on the city (Brasilia, 2015).

Underground spaces specifically, was related to Space Syntax during the 1980s as it was used to discuss its design issues and problems (Carmody, Huet and Sterling, 1994). The spatial configuration of an underground space can also relate to crime as crime incidences since metro stations is not only an organisational measure but also situational measures (López, 1996). Furthermore, by applying space syntax whilst taking social and psychological aspects of people into consideration, researchers were able to speculate and generalize the social rules which then produced shared design features in underground spaces (Osman and Suliman, 1994). This shows the need of a systematic design and quality assessment in order to produce a better quality underground transit stations (Durmisevic and Sariyildiz, 2001).

Space Syntax method operates using three key elements; i.e. convex space, isovist field and axial line as show in **Figure 8**. A convex space is defined as a void space which can be joined without surpassing boundaries to all points in the void space. A panoptical view is essential when defining a convex space to explain the functions and human activities within a bounded area such as sitting and standing. When analysing the set of spaces that exist, convex maps are then introduced (Hillier and Hanson, 2005) to analyse the space between building neighbourhoods and public space. In the urban analyses, the point depth and the all-lines analyses have replaced the convex space analysis. This is due to how time-consuming it is to produce the convex map. Further, there is none of software development has been introduced since the 1990's to create the convex space analysis. An isovist field is defined as the panoptical view which a person has from any given point in an urban space. It is used to create orientation or pathway in the urban fabric. Initially this was done manually,

however, a software called Depth map can now be used to create isovist analyses. An axial line represents the longest straight sight line and possible path a person can view in an urban space or street. It represents the way consumers or passengers behave in lines through an urban street and road network.

To summarise, these three basic spatial components are essential when defining the movement of consumers or passengers in lines, their interaction when present in convex spaces as well as the ability of having changeable panoptical views when moving around in the built environment (VAN NES, 2011).

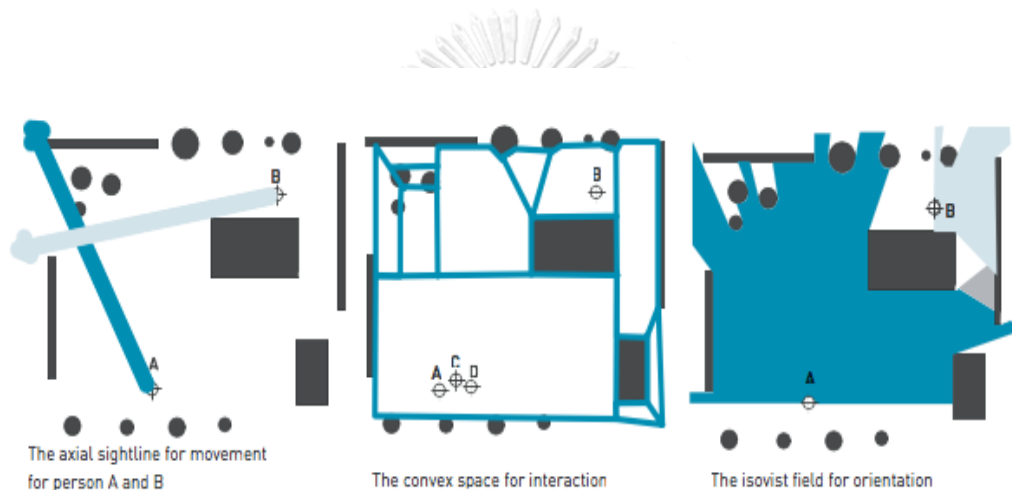


Figure 8 Example of axial lines, convex space and isovist field (VAN NES, 2011).

2.7.1 Advantages of the Space Syntax

There are several advantages when adopting Space Syntax into the design of buildings. Among them, the ease of conducting the analysis and its description. This leads to the ability to compare buildings or structures though in a two-dimensional form, together with their spatial qualities. Following the space syntax procedure, it gives users the ease to analyse floor plans of buildings to reveal their underlying morphological structure. Subsequently, important physical qualities that can dictate the functions of a building in certain ways can be concluded. By analysing building plans in the form of graphs, researchers are able to utilize the salient resources of graph theory and matrix algebra needed to solve various problems with great flexibility. Last, but not least, space

syntax provides promising modification and development effort that will improve and at the same time strengthen the method's analytical and interpretation procedures.

2.7.2 Limitations of the Space Syntax

Though the method has been widely used, the validity of the technique still remains doubtful as it has yet been completely investigated by architectural researchers. Lawrence (1990) criticises the method by briefly explaining the inadequacy of the technique as it was created to project society's norms. Similarly, Edmund Leach (1978) argues that it is inadequate to generalise a consumer or passenger's view by simply observing the patterns of a floor plan. However, it is possible to do so, Edmund Leach (1978) mentions that it is not possible to group together a population's behaviour in one generalised view.

2.7 Activity System

Activity System is a systematic approach to study the numerous types of human reactions and actual changes. The classification system uses to identify its own structure (Leontev 1981) when explaining the relationship between the thoughts of a person together with its social conditions. Most of the important abstracts and models related to activity system is originally derived from the work of Davydov (1982).

Activity system incorporates social, historical, and cultural properties together with physical properties, whilst emphasising the fact that a person's consciousness is active in our everyday lives. The objective is always constrained by an individual or even a society who involves themselves in a particular activity, providing a purpose for the activity, as well as provide the direction of the activity as shown in the figure below using the dotted line found between the subject and the object. There shows that there was no need for a moderator. The introduction of artefacts as a moderator in arbitrating the contradiction was found to be a key contribution to the foundation of an activity system. Moderator objects relate humans with objects as well as with other humans (Leontev,

1991)." This generalised process is where the object is focused into an intuitive form (i.e. mental models, theories, etc.) where its verbalized, concise and more importantly, capable of further advancement that gradually exceeds the limitations set by an external activity (Leontev, 1974, p. 18). This process is split into two; externalising process and internalising process. Both processes demonstrate external activities executed by people which is then assimilated into an objective result and product (Davydov, Zinchenko and Talyzina, 1982)

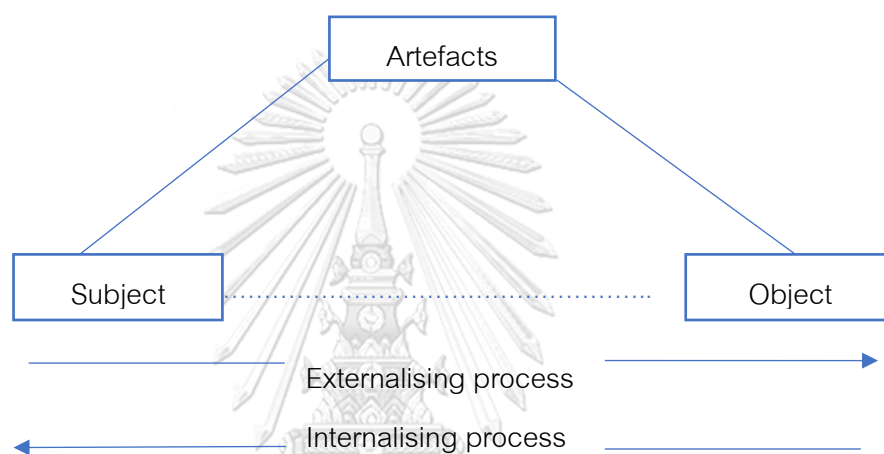


Figure 9: Activity mediated by artifacts (Bali, n.d.)

The three levels of activity model

Activities are planned and analyzed at distinct levels. Leontev (1974) obtained a three-level system of activity as seen in figure 10. As seen in figure 10, a combined action is influenced using a common motive. A motive exists when the common need encounters an object believed to have the capability to satisfy the specific need. Different activities are distinguished based on individual motives which are achieved by actions that are related to several concrete goals. Engaging in an activity shows voluntary movements that have short, concrete goals. When an action becomes more proficient, the action will then convert into an operation. However, when the condition changes, the operation may convert back to an action causing it to repeat (Kuutti, 1996).

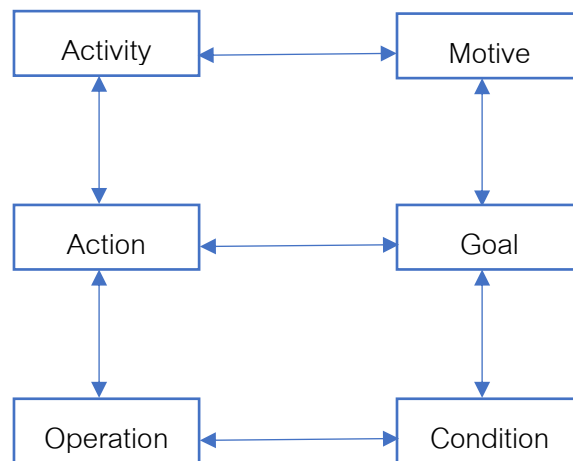


Figure 10 : Three levels of an activity

The system believes that in terms of sociology, to a certain degree, takes only individuals into account. Conference, socialization, norms, values, and culture are activities that are used to explain why individuals group together is called a society (Qvortrup, 1996). This is under the condition that the individuals are co-operative and social interaction among individuals takes place (Leonev, 1981). Leonev (1981) identified the importance of social influences in an activity and Engestrom (1987) envisioned the social conditions surrounding the community, social and cultural norms. This leads to the classification of social labour in one integrated system together with logical interrelation as seen in figure 3.

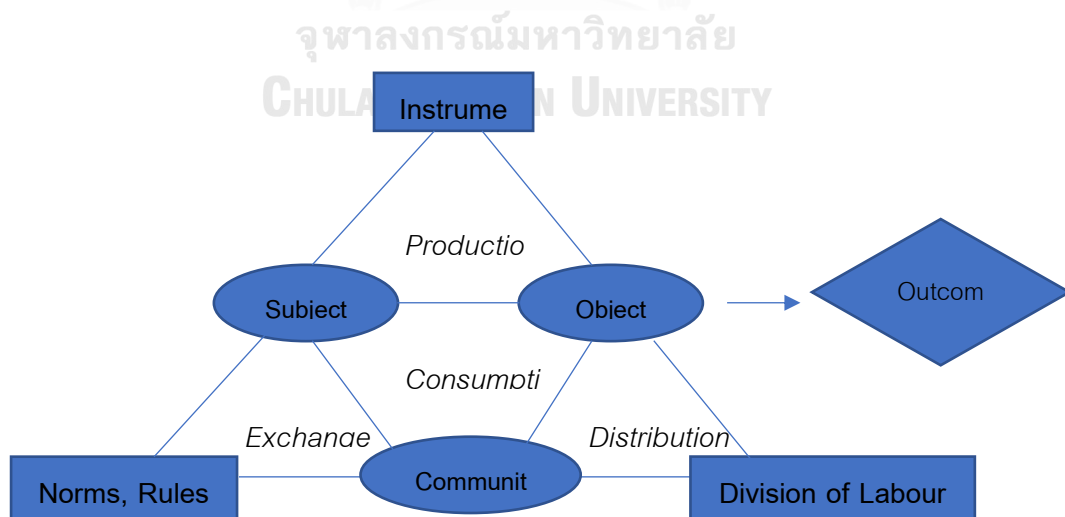


Figure 11: The structure of human activity (Engeström, 2015)

Activities are always in the process of dealing with challenges which is an important concept in a development process (Kuutti,1996). In figure 11, the rebuttal between subject and object arbitrated by an instrument generates two new factors to align with the introduction of community; the contradiction between subject and community, and the contradiction between object and community. The same goes for when instrument is introduced as the moderator of the contradiction between subject and object. Engestrom (1987) first introduced "Norms, Rules" as the moderator of the contradiction between subject and community. He then introduced division of labour as the moderator of the contradiction between an object and the community.

With reference to figure 3, it is shown that the development of production, exchange, distribution, and consumption activities are caused by four main contradictions. Firstly, instrument is used as a tool to create production activity when driving the contradiction between subject and object. Subject generates the object corresponding to the given need. Exchange activity is resulted from the contradiction between subject and community. The subject exchanges their services (exchange value) in the community to obtain the result according to the rule set by the community and social law as the second moderator. Distribution action is resulted from the contradiction between object and community. The product distributed from social recreation among peers in the community to the theories of division of labour moderator.

Finally, all social activities are met (the whole triangle) using a new type of contradiction; i.e. the contradiction between production and consumption. This contradiction contributes yet it may cause a repetition of an accumulating cycle between consumption and production. However, by not using the paradox of production and consumption, activity would have not existed between the median activities and its adjacent activities (Engeström, 2015)

2.8 Interview and questionnaire

One of basic research method is interview and questionnaire. This method has been used to obtain and explore constructive criticism. Alshengetti (2014) mentioned that interviewers are able to press for complete, clear answers when probing into any emerging topics. Hence, interviews are more preferred as it provides a scope of understanding and a more naturalistic data collection tool (Alshenqeeti, 2014).

Nowadays, there are many new channels to interviews, such as telephone interviewing, e-mail and chat boxes. These methods have become more and more common as new communication forms. However, other interview methods can be introduced and used in qualitative research (Opdenakker, 2006). All of these are developed from the general method, which is face- to-face interview. This method has been dominant technique of qualitative research. A conversation with interviewee is aimed to gather descriptions with respect to interpretation of the meanings of the 'describes phenomena' (Kvale, 1996).

Schostak (2006) define interview as more explanation in conversation from interviewee can have in-depth information about a certain topic or subject. However, meaning of interview can be in various ways. The most common interview is one-on-one interviews, but another popular is focus groups interview (Marshall and Rossman, 2006).

The main difference between interview and questionnaires is answer of an interviewee. In questionnaires, answer is limited by predetermine questions. On the other hand, answer of interview is accurate and not limited by question, since the interviewer is present with the subject, there is an opportunity to collect nonverbal data as well and to clarify the meaning of questions if the subjects do not understand (Wood and Kerr, 2011)

However, the interview or questionnaire method is needed for the subject's self-report in operation. Then, interviewees have to give a valid response to believe. If they are not to do so, this method is not appropriate. Additionally, questionnaires can be used to provide evaluation of various concepts and variety information to transportation research. Hence, transportation practitioners frequently ask questions as part of the

assessment and evaluation. When this method is involved or developed to be tool of study, the first consideration must be the content of the question and then structure in the format. There are two basic categories of content of question, which are factual (fact) and nonfactual (perception/feeling).

Factual questions aim to get fact from information about themselves (interviewees) or about thing they know. Nonfactual questions are relied on perception of interviewees' experiences or interviewee's feeling. This kind of question may or may not accurately reflect the facts.

In summary, the interview and questionnaire are selected by aim of answer. In this paper, author applied this method to gather information from passengers of study station, in depth information from station expert and the experience of station development. The interview and both factual and nonfactual question would be involved to let interviewee fully express and clear answer.



Chapter 3: Research Modelling

3.1 Introduction

This section aims to describe and illustrate the research modelling used to achieve the objective of this dissertation. The research modelling is divided into 3 tasks: Task 1, Task 2 and Task 3. These stages are illustrated in Figure 12, Figure 13 and Figure 14.

The objective of Stage 1 is to identify the most appropriate plan for the development of underground mass rapid transport (UMRT) stations in Bangkok in 2022. This involves gathering information on UMRT stations and identifying factors that contribute to the success and/or failure of these stations to gain an understanding of the requirements of developing UMRT stations. This was done through a case study analysis of the Osaka UMRT station. From there, value chain analysis of UMRT stations was performed to illustrate the value curation of each activity. Furthermore, Bangkok UMRT details were gathered so that the plan would be appropriate for already existing UMRT stations in Bangkok, such as the Thailand Cultural centre MRT station.

Flow chart of Research modelling

This flow chart to clarify goal and objective:

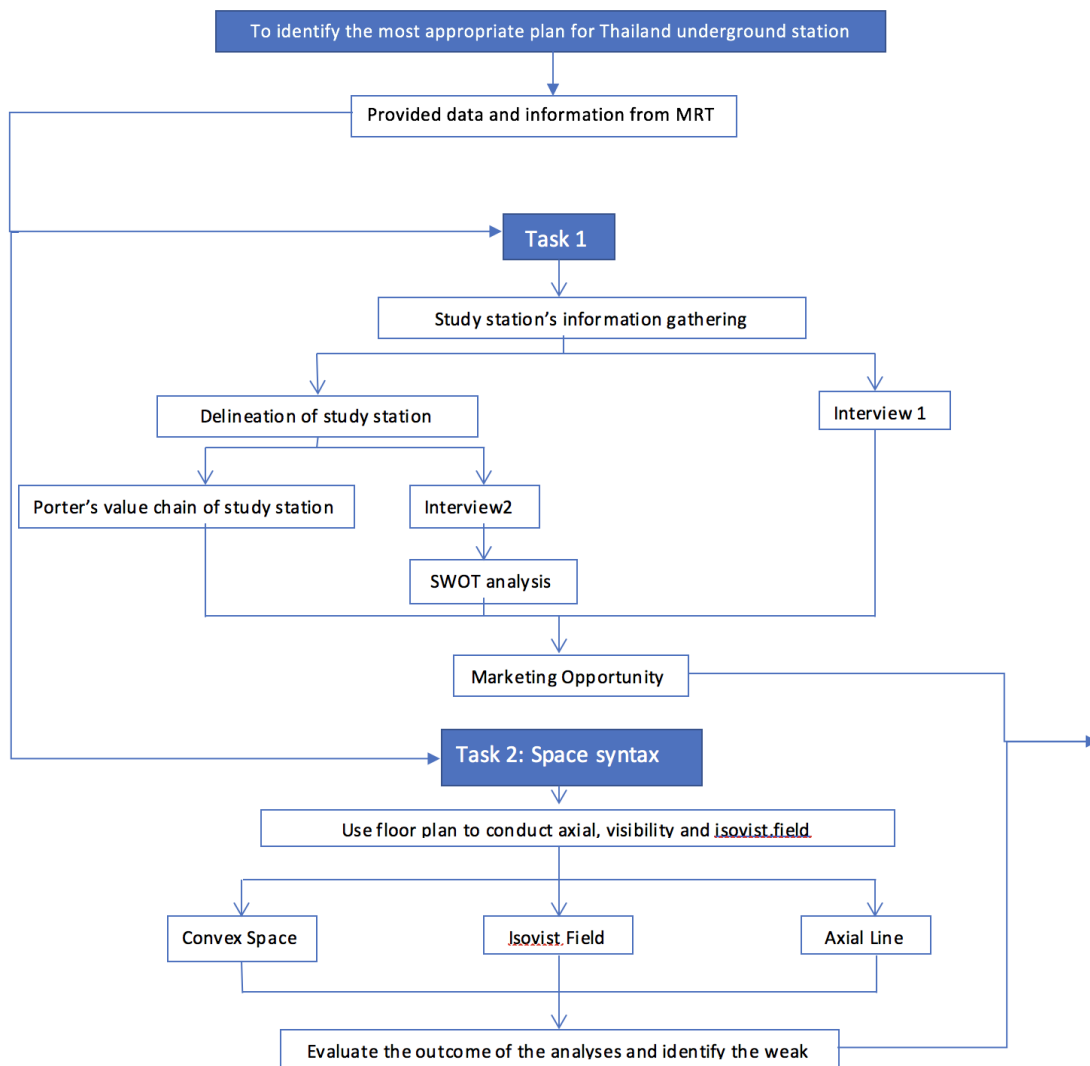


Figure 12: Flowchart of research modelling (Part 1 of 3)

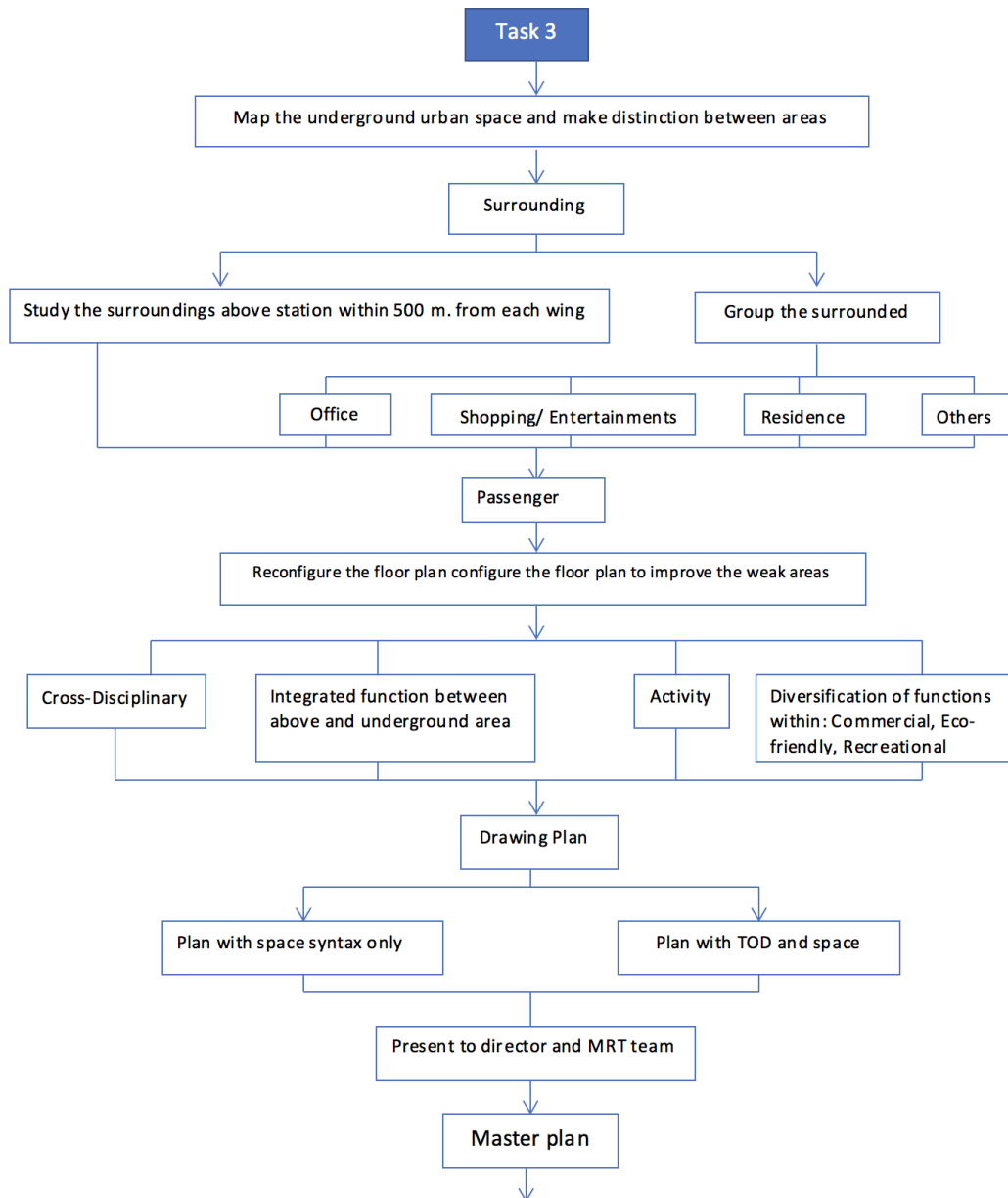


Figure 13: Flowchart of research modelling (Part 2 of 3)

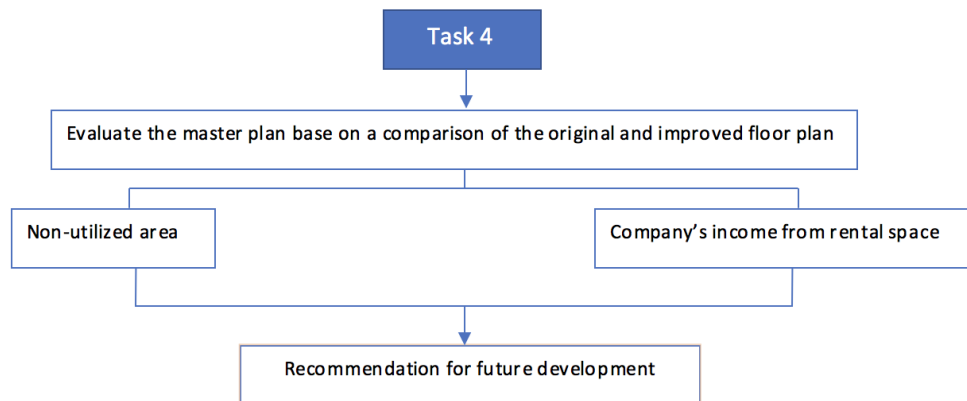


Figure 14: Flowchart of research modelling (Part 3 of 3)

3.2 Task 1

3.2.1 Objective

For this task, it is aimed to gather information both internal and external company. This information would be used to analyse, which focus on study station: Porter value's chain, SWOT and marketing opportunity.

3.2.2 Input Information

Annual report of year 2011-2016 were given by MRT Staff. To gathering more information about study station, Questions for interview were prepared for passengers and MRT staffs.

3.2.3 Information gathering and understanding of study station

This section illustrates the information that was collected to understand the necessary requirements to develop an appropriate plan for underground transit station. The information collected was provided by MRTA. The author also did interview to get more information. Lastly, information was also obtained through online resources such as published journal, articles, online text and news.

3.2.4 Bangkok MRT information gathering

This section illustrates the information gathering process of Bangkok MRT stations, in particular the Thailand Cultural Centre MRT station. The Thailand Cultural Centre MRT station was chosen for the following reasons:

1. Its close proximity to landmarks such as the Thailand Cultural Centre and nearby shopping complexes.
2. Its close proximity to the central business district (CBD) such as the Stock Exchange of Thailand.
3. The proposed opening of the MRT Orange line on its platform in addition to the already existing MRT Blue line.

The historical passenger data was found using given data form MRT on Appendix 2. The average number of passengers at the Thailand Cultural Centre station from years 2011-2016 is shown in Appendix 3. The annual growth percentage rate of passengers was calculated using the formula given in following equations. Number of passenger was assumed to be double in 2022:

1st step: working out the growth between 2 numbers that want to be compared

CHULALONGKORN UNIVERSITY
Equation 1: Growth difference

$$\text{Growth different number} = \text{New Number} - \text{Original number}$$

2nd step: divide the growth different number by the original number and multiply the answer by 100

Equation 2: Growth percentage

$$\text{growth percentage} = \frac{\text{growth difference number}}{\text{original number}} \times 100$$

Noted that if the answer is positive then the percentage is grow up. On the other hand, if the answer is negative then the growth rate is decrease.

3.2.4.1 Interview 1

To understand need of passenger and opinions about study station from real used station passenger. The author created question by based on past present and future. 15 random passengers were interviewed as shown on Appendix 4. The results are shown on Appendix 4.

3.2.5 The Porter's value chain

This section illustrates the value curation of each individual activity in reference to the UMRT business model. As specified in earlier sections, the 5 primary activities which make up the value chain are inbound logistic, operation, outbound logistic, marketing & sales and services. The components of each activity are identified through the information gathering in section the identification and analysis of each individual activity allows the author to develop a greater understanding of the UMRT business model and develop a strategy based on the model to optimize business efficiency and thus maximise profit margins.

3.2.6 Interview 2

In this session, the author did interview to MRT station's staff to gather information for next session, which is SWOT analysis. It does need internal information from the company to analyse SWOT of this station according to definition of SWOT analysis on literature review section 2.4. The author chose to interview MRT staff of development sector to get in depth Information. The result is shown on Appendix 4.

3.2.7 SWOT analysis

With the use of result from MRT staff, the author analysed and integrated it with gathered information. The aim is to solid and finalize SWOT analysis of SWOT analysis, which consist of 4 factors; strength, weakness, opportunity and threat.

3.2.8 Marketing opportunity analysis

According to definition of marketing opportunity on literature review on section 2.5. The author analysed opportunity in market from all previous information and analysis to filter information and support the developing plan.

3.2.9 Output Information

From this task, output information would be used in task 3 to reconfigure floor plan and set strategy.

3.3 Task 2

3.3.1 Objective

For this task, floor plan of station and on site were analysed to find weakness of the station.

3.3.2 Input information

Floor plan was given by MRT. Moreover, on site survey also needs to do.

3.3.3 Space syntax

In this section, space syntax was used to analyse and explain space of Thailand cultural centre underground transit station, and then identified the weak area.

Subsequently, Space syntax would be combined with TOD, gathered information and architectural skill to create the plan, because only looking at the layout plan of settlement patterns, can infer anything at all about the society, environment, passenger and marketing that make use of the resultant settlement according as show in literature

review section. Therefore, this paper goes a further step beyond the criticism of the other criticism for underground station planning.

1. Convex Space
2. Isovist Field

3.3.4 Output Information

From this task, outcome of in section 3.3.3 analysis including station's weakness were prepared for task 3.

3.4 Task 3

3.4.1 Objective

This task aims to create new 2 different plans to make distinction and get the best one to be masterplan.

3.4.2 Input Information

Output information from task 1 and 2 would be used in this task to create plans. However, surrounding area within 500 m was studied more to group customer needs and types.

3.4.3 Evaluation of surrounding area

This section, the author collected around study station to create the layout plans:

1. To survey and study the surrounding area on ground within 500 meters radius from each wing (north and south). 500 meters distance is TOD standard requirement as show on Table 2. The author did survey by on site survey and online map.

Table 2: Walk distance to Transit of TOD (ITDP, 2017)

Walk Distance to Transit	Points
Maximum walk distance is less than 1 kilometre to a high-capacity transit station, or less than 500 meters to a direct service station	TOD Standard requirement
Maximum walk distance is more than 1 kilometre to a high-capacity transit station, or more than 500 meters to a direct service station	Does not meet TOD Standard requirement

2. To group the surrounded places around each wing within 500 meters radius.

These were categorized into 4 groups:

- 1.1. Office Building
- 1.2. Shopping and Entertainments
- 1.3. Residence
- 1.4. Other

3. From last 2 processes, they were used to analyse passenger segment and behaviour.

3.4.4 Reconfigure the floor plan configure the floor plan to improve the weak areas

1. Cross-Disciplinary
2. Activity System
3. Integrated function between above and underground area
4. Diversification of functions within: Commercial, Eco-friendly, Recreational

The division of labour, by activity system theory, incorporated with the station context, the minor passengers are retail workers and SMEs. These groups of people have high possibility to occupy functions that are given. The instalment function shall be concerned for them at the most degree. Since the individual's power of purchasing is lower than the middle-upper class, functions suggested to improve their well-being are community centre, etc.

Regarding to the diversify of function which is one of major concerns, thus, the author avoids to install the completely same function as North wing. With this reason, we considered at the minor target passenger, the tourists, then put the hostel in this area to serve them.

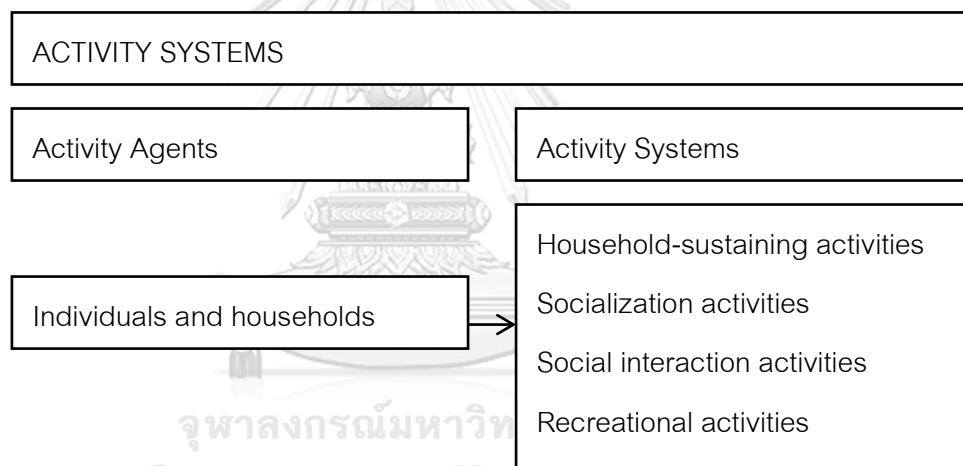


Figure 15: Activity Agents and Activity Systems

3.4.5 Creating layout plan

To find the most appropriate plan for the underground station, the authors created 2 plans to compare later. The first one is layout plan with space syntax only. The second plan is with TOD and space syntax. Both layout plans would show different walkways and structure, which mean it affects to ridership in 2022.

3.4.6 Getting master plan

After got 2 different layout plans, the author had meeting with director of area development and acting director of business development and area management and MRT team to propose and discuss about layout plans. The purpose of meeting is to get the master plan, feedback and suggestion for improve master plan in the future.

3.4.7 Output Information

From this task, Master plan would be selected from 2 different plans after meeting with MRT.

3.5 Task 4

3.5.1 Objective

This task aims to analysis Master plan by making comparison with current plan; non-utilized area and income.

3.5.2 Input information

Master plan from task 3 would be analysed in this task.

3.5.3 Evaluation the master plan base on

At this point, the master plan was evaluated base on a comparison of the original plan, **which are:**

1. Non-utilized area
2. Company's income from rental space.

3.5.4 Output information

Master plan would be evaluated recommendation for development in the future, and then sent to MRT to get comment for this master plan.

Chapter 4: Results and analysis

4.1 Task 1

4.1.1 Information Gathering and Understanding the Study Station

Before discussing the results of this thesis, it is essential to understand a general overview of the place of interest. The study station is MRT station number 12 of the blue line. It was formerly known as the Thiam Ruam Mit station but is now renamed the Cultural Centre Station for its close proximity to the Thailand Cultural Centre. The station is situated in the Huai Khwang District in the East side of Bangkok, stretching 350 meters under the Ratchadapisek Road from the Thailand Cultural Center to Esplanade Shopping Centre as seen in Figure 16.

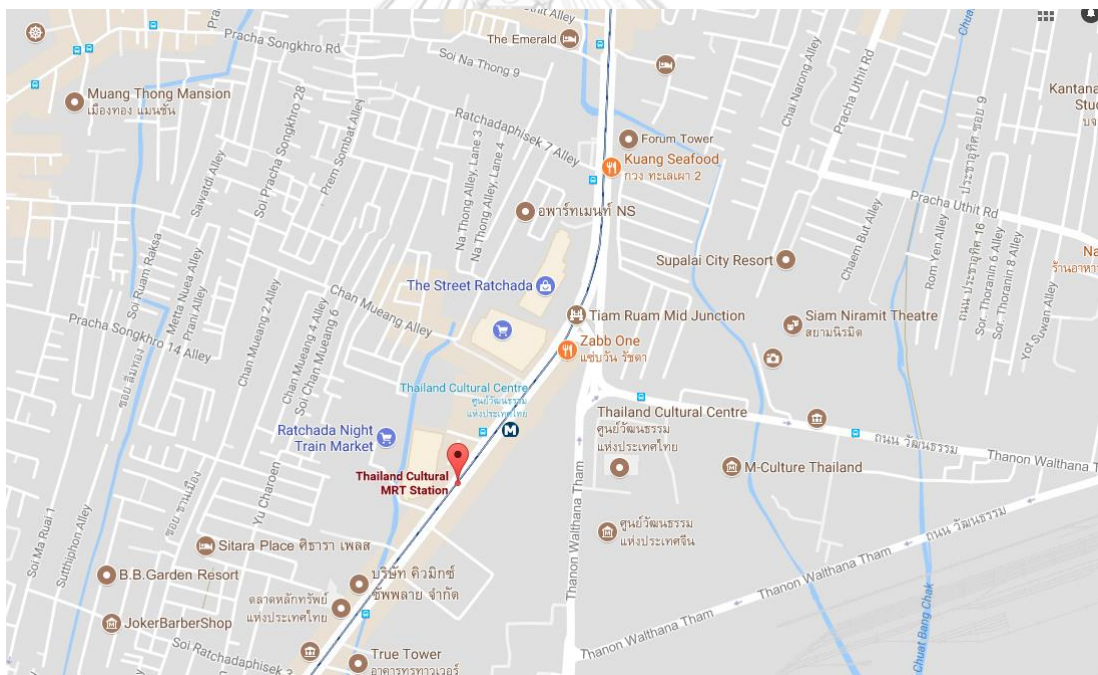


Figure 16: Maps showing Huai Kwang District and Thailand cultural centre underground station (Maps of Huai Kwang District, 2017)

The study station consists of 3 floors, B1, B2 and B3 where floor B1 consists of stores, ticket vending machines and information booths and B2 and B3 are the platform

area as shown in Figure 17. The station and the various levels are accessible via a staircase, escalator or lift. For the purpose of this study, the floor of interest is only B1.

There is a total of four exits from the station where exits number 1 and 4 is situated in the North end of the underground, leading commuters out toward the Thailand Culture Centre. On the other hand, an exit 2 and 3 leads them towards Esplanade Shopping Centre. This is the current arrangement of exits, which is different from Figure 18 where this is the old arrangement of exits. In the old arrangement, exit 1 and 4 was the South exit 2 and 3 was the North. To eliminate confusion the left side of Figure 18 will be referred as the South end and the right side will be referred as the North end from here after.

Figure 2 shows the plan view general assembly drawing of the study station. The area highlighted in green is currently rented space, the blue line indicates the path commuters would use to navigate around the station and the white area is mostly unused space. The drawing is divided into 33 sections as seen in the figure above, which will be used as a tool for referencing.

In the North end of the station, there are a wide selection of stores ranging from fast food restaurants, barbers, convenient stores and mobile phone stores. Other amenities that are available to the public are ATMS from a variety of banks, train ticket machines and the information booth. However, there are not as many stores available in the North end of the station. The North and South end of the station is separated by empty space as seen in the centre of Figure 2, spanning from section 11 to 22.

STATION 12 THIAM RUAM MIT

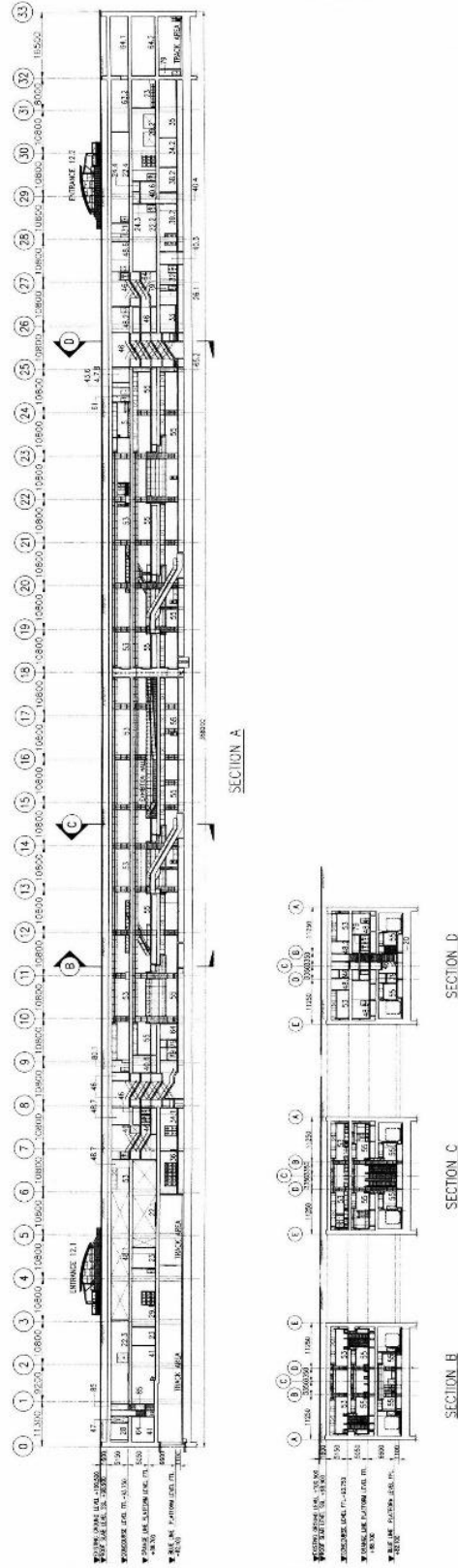


Figure 17: Side view of Thailand cultural centre underground station

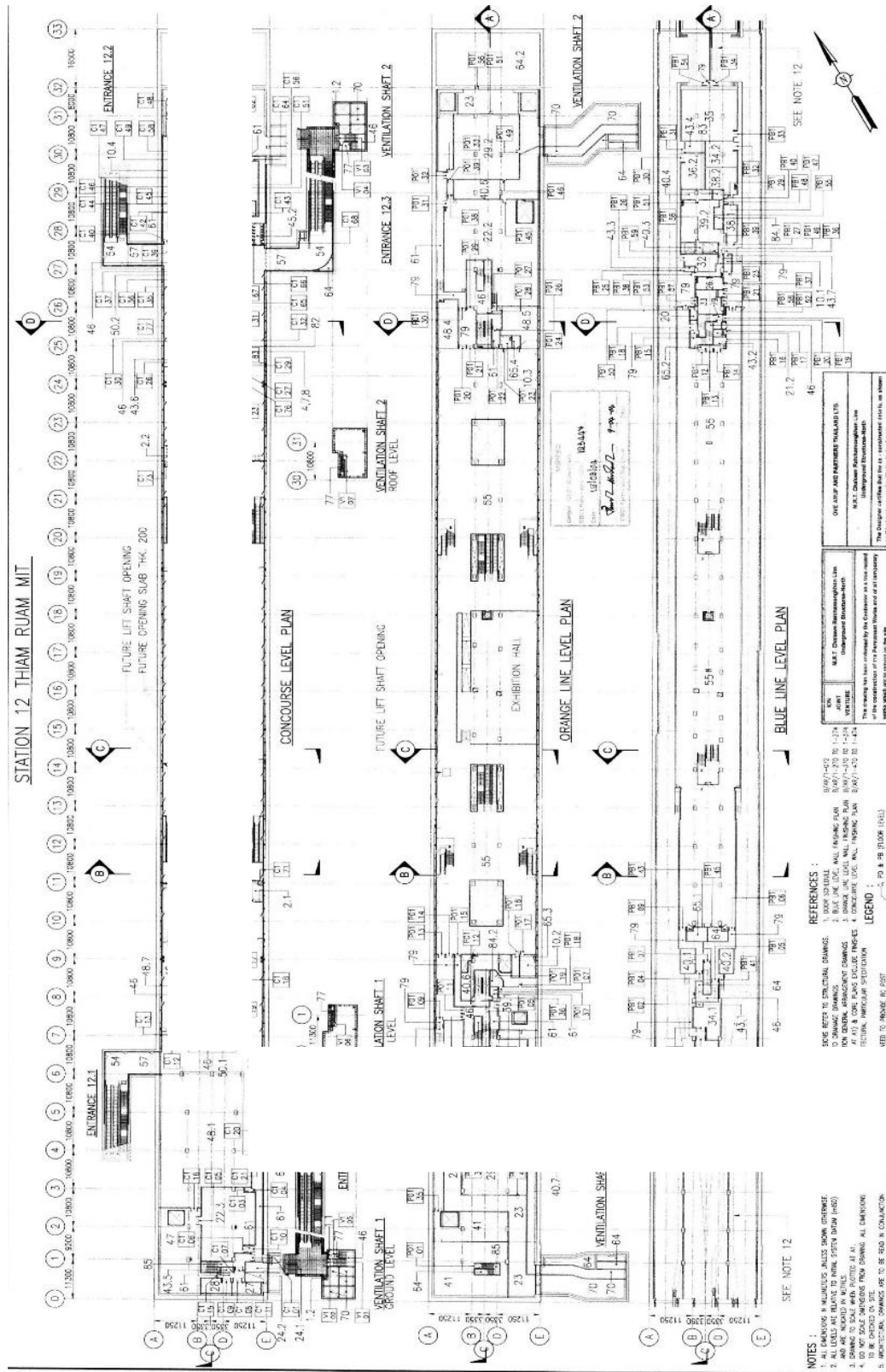


Figure 18: General arrangement plans with door indication of Thailand cultural centre underground station

4.1.2 MRT station information gathering

This study requires a significant amount of primary information gathering, because a re-allocation of the station space is required in the end. However, secondary sources are also needed to support and justify design choices.

The information gathering process begins with acquiring basic information from the MRT. Items such as the general assembly drawings and annual ridership traffic and revenue reports of the study station. They will be to support studies of the current station layout and as a basis for presenting the improved design. Several site visits were done to observe and experience the station and its surroundings. While on-site, pictures of the station are taken as reference for the design process and for the thesis. Interviews were conducted with random commuters on the station to get a general notion of their opinion on the current arrangement of the study station and their thoughts on changes that can be done to improve their experiences. MRT staff members were also interviewed.

Secondary sources of information are mainly used to justify the improved arrangement of the study station. The information is gathered from academic papers, books and the official MRT website.

The rationale behind the decision to use Cultural Centre Station as the study station are that the station is in the proximity of a dense population of commuters that are regular users of the MRT underground system and also have large number of potential users in the area. The station lies in one of the central business districts of Bangkok where, within walking distance of the station, there are shopping malls, office buildings, land marks and high-rise residential properties. The advantage of this choice of station is the amount of data that can be collected to compare the current against the improved arrangements and also any changes done to the station has potential create a significant impact to the value that MRT provide to their customers and the increased user satisfaction of experiencing underground service.

4.1.3 Interview with ridership

The result of this interview has shown on Appendix 4. There were randomly 15 passengers to interview about facilities in underground stations. For the first question, it is about facilities would make day easier. Top answers are convenient store, coffee shop, toilet and WI-FI.

Second question, it is about facilities that would make day happier. Top facility is WI-FI. However, there are a lot of more suggestions to create utilize for the space in MRT such as; toilet, some music in station, tourist suggestion, information signage, resting area.

4.1.4 Interview with MRT staff

Kindly refer to Appendix (iv). These results will be used in tackling the SWOT analysis. Mr. Anawin Juntaruthai is a senior staff of the MRTA company under the Area Development department. He was chosen to be interviewed because of his knowledge and expertise in the field when building the Thai Cultural Centre Underground Station that has recently been in operation. An interview was held with a staff of MRTA from the area development department to gain insights of the company's business model and their product information. This provides clarity on the strategy of the company's direction as well as the strengths and weaknesses of the company's product, in this case the Thai Cultural Centre Underground Station. By using these information, suggested improvements and initiatives can be produced for further refinement of the product or when creating a new product.

4.1.5 Porter's Value Chain

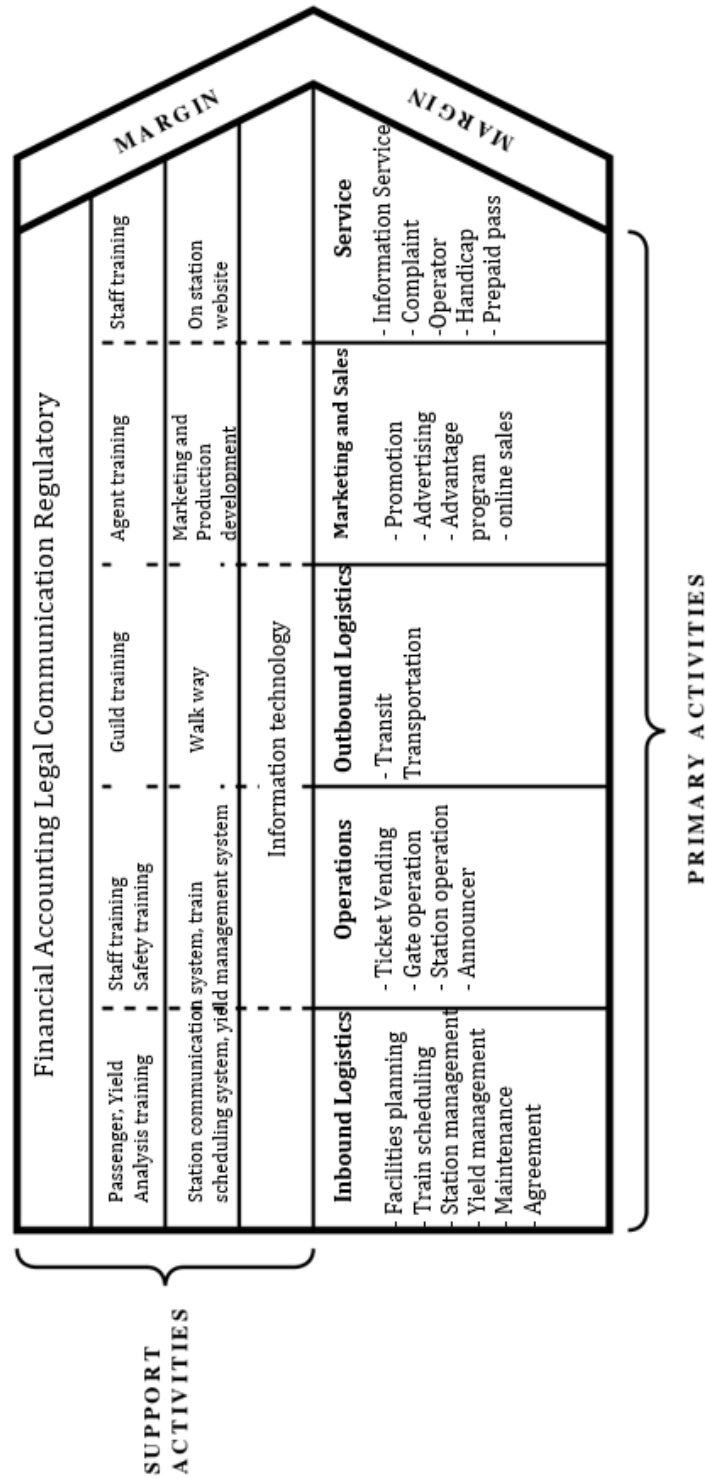


Figure 19: Porter's value chain of MRT

To align the understanding the reasons why the MRT are operating their service in the current, the Porter's Value Chain, shown in Figure 6 in section 2.3, is used to illustrate this.

Porter's Value Chain was created to represent a firm's collection of activities that are performed to design, produce, market, deliver and support its product. Porter explains that value is the amount buyers are willing to pay for what a firm provides them. He continues to categorise value into two major parts, primary and support activities. Referring to MRT's Value Chain diagram in Figure 19, the primary activities of the underground transit service provider are listed along the bottom of the diagram and the support activities are above the primary. Primary activities are related to physical creation of the product and its sales and transfer to the buyers, continuing to the after-sale services. Support activities, as the label depicts, supports the primary to create added value to the chain (Porter, 2008). The methodology has been explained in greater detail in chapter 3.

In the current state, the MRT is focused mainly on their primary activities which are increasing ridership, which is aligned with the primary activities as presented on the Porter's Value Chain diagram. This is shown in their annual reports and on MRTA website, whereby in the reports, an extensive amount of effort was invested in presenting ridership data. Some examples of the information on the report are average daily ridership in each quarter, ridership density during specific times of the day, ridership payment channels, incident reports and maintenance reports. As for the MRTA website, there are various documents that provide insight of the project, the goals and milestones the company has set and also plans for expansion.

According to Table 3, this table used data from Appendix 2. It shows the average daily passengers from the year 2011 to 2016 over the entire blue line. It is reported that in 2016 there were around 270,000 riders on average in each day. From the information on the table below, looking back on previous years and averaging the given percentage change from the previous year, the yearly average growth of ridership is approximately 7.5%.

Table 3: the average daily passengers from the year 2011 to 2016 over the entire blue line

Year	2011	2012	2013	2014	2015	2016
Monday-Friday	220,552	252,826	272,009	291,092	299,811	316,511
Saturday Sunday and official holiday	129,416	155,819	166,704	177,890	182,638	188,936
Average	189,506	220,225	236,811	253,255	260,325	273,637
Percentage Change from last year	6.53	16.21	7.53	6.94	2.79	5.11

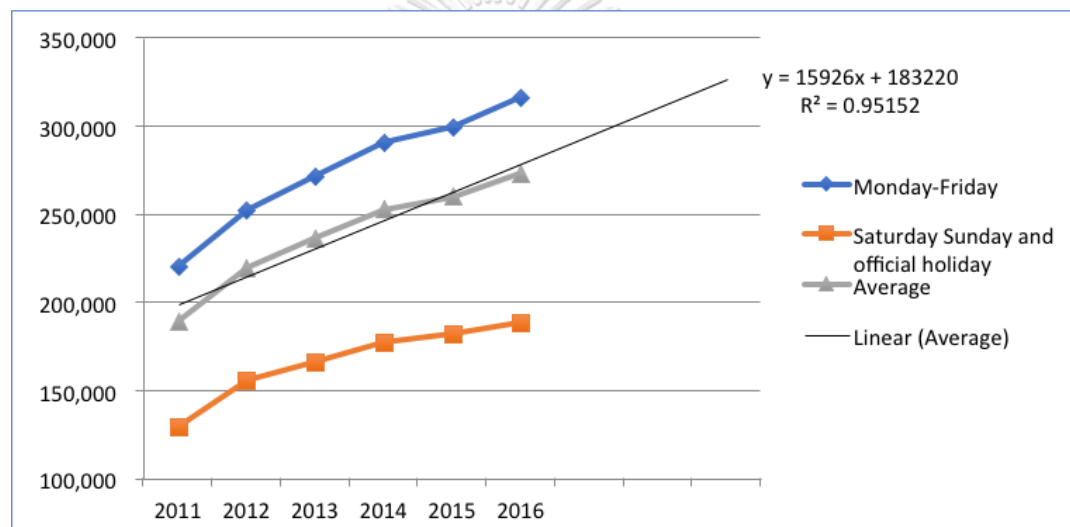


Figure 20: the data set of average daily passengers from the year 2011 to 2016 over the entire blue line

Having thorough review of the MRT reports, it was found that there were insignificant mentions of supporting activities. Some examples are reports of ridership satisfaction, advertisement space reports, rental space report, and marketing reports. There are no statements from the company that say they do not pay attention to these activities, the reports imply it. The supporting activities of the MRT are mainly activities that add value to the core service. By providing amenities such as restaurants, coffee shops, internet access and toilets, it generally improves user experience.

Currently, the MRT is focused mainly on the primary activities, which are providing a mass rapid transit system for Thai people. The value chain of which includes

train scheduling, maintenance plans and operations management. However, their focus on the supporting activities are somewhat lacking. An observation of the study station shows that overall user experience could be improved by making the space more intuitive, increasing the convenience of the station and create a communal environment so that people would enjoy being in the station.

4.1.6 SWOT analysis

To visualise the strengths and weakness of the current station of the study station, the SWOT analysis is used as shown in Table 4. Beginning with pointing out the strengths, the station has great advantages from being located in a CBD (central business district) where a majority of the population in the area are office employees. It is necessary for them to commute to and back from the office on daily basis and in most cases, they would have to travel during rush hour where road traffic is horrendous. The MRT solves most of these issues with scheduled commute times so that the office workers can arrive to work on time and on a budget despite the time of the day. Considering that there is no other direct competitor, the service has the potential to fully capitalise in this market group. This is already apparent, seeing from the performance report that there is a consistent increase of ridership every year since 2011. Another opportunity for the study station is to attract businesses that can increase the convenience and comfort of the station. Some examples can be convenient stores, electronics stores, banks, restaurants and cafes. Where the MRT can rent out space as an additional revenue stream and by managing the space can add value to their service.

As for the weaknesses in the study station, there is still a massive room for improving user experience of the station. There is no proper management of the space rented out to other businesses, a lack of information announcement, not enough and unintuitive signage, and a lack of amenities to make a commute more convenient. It is essential that the station find synergy between users and outside businesses because it will propagate to an increase of attractiveness in entering the station – more ridership will mean shops and stores make more money and more stores will more convenience

for users. None the less, the MRT will have to build and maintain a suitable environment for this synergy to happen. The station has to be appealing – people need to want to come into the station. Today, there are only a hand full of stores that are arrange without any congruence. Restaurants are not grouped together and placed an area where there are no tables and chairs instead a barber shop and a convenient store is placed in the area. This does not create convenience in any sense of the matter.

Table 4: SWOT analysis of MRT station Thailand cultural centre

<p>Strengths</p> <ul style="list-style-type: none"> Located at the new CBD area Has its own parking lot located in the building of the station? Interchange station between two of MRT's rail transit lines, namely the blue line (current) and orange line Passengers located around the new CBD building generally have better purchasing power According to Appendix 3, the total number of passengers riding the rail transit stations increase every year. 	<p>Weakness</p> <ul style="list-style-type: none"> Lack of space management Lack of information announcement No proper signage or directions to guide passengers Lack of strategic analysis. Not much data collection was made Lacking facilities such as Wi-Fi
<p>Opportunity</p> <ul style="list-style-type: none"> No stations have been developed to build a new community formed by mixed-used spaces New business partnerships can be created add more function to station 	<p>Threats</p> <ul style="list-style-type: none"> Uncertainty of political situation in Thailand may cause the cessation of its policy Current layout of station is not good no zoning layout no connected walkway to building/ mall/convenience store

4.1.7 Marketing Opportunity

After having described the values that MRT provide to their customers and having done the SWOT analysis, it is clear that there is a significant gap that the underground transit service provider can fill. The next order of matter is to conduct a marketing opportunity analysis to find out its potential revenue.

The first procedure of the Marketing Opportunity Analysis is determining the market size of the study station. The station's main target group are office workers residing in condominiums and apartments within a 500-meter radius that are required to travel to and from their work place. These are the highest potential users, especially during rush hour where gauging commuting time via road use is practically impossible. Office workers need to arrive at work on time while the costs of travelling should be relatively low. Having mentioned this, to estimate the number of potential ridership, one must first determine the total population in the area of interest and categorise the population into various groups of interest. With this information, the potential revenue can be determined by projecting historical data. Also, if the MRT station can improve space management, there can be opportunity in attracting businesses that are interested in capitalising the MRT's ridership traffic.

After determining the market size, the next step is to compare existing competitor's approach to attracting the same market group. If the entire ecosystem of mass transport is considered, the BTS sky train mass transit would be considered the major competitor. However, in the onset of this thesis, only the study station is considered. Therefore, the closest competitors would be the bus system and the taxi services. The bus systems provide a low-cost solution for low-budget commuters, nonetheless the service does not provide a mass transit solution for the population who are dictated by a work schedule. Other points worth mentioning are MRT provides a more comfortable commuting experience that of the bus system with well-ventilated and air-conditioned platforms and trains. On the other hand, taxi services provide more privacy and flexibility. One can choose to travel to any destination at any time while with the MRT a customer is limited to where the train line leads and must travel according to the train schedule. However, during rush hour travelling by road is not an option

because commuting time is unpredictable and taxi fares increase while travel in the MRT is relatively on-schedule throughout the day and the fares can easily be budgeted. The final competitor worth mentioning is the motorbike taxi whom provides a transport service that is highly flexible and arrival time is fairly predictable throughout the day when compared other means of transportation. The limitations of the motorbike taxi are the distance it can cover and the debatable safety standards of the service. One can easily pick out the MRT's advantages over alternative modes of transportation.

The opportunities for MRT to grow its ridership population and traffic flow into the station is to target the population that reside nearby the study station. In a 500-meter radius of the study station there are various office buildings, shopping malls and accommodations in the form of condominium and apartments, which will be discussed in detail in a later section of this thesis. The attractiveness of this group of interest is that they have the potential to become regular users because of the convenience and comfort the MRT provides relative to other modes of transportation. Not only will this population be train users but also businesses seeking profit from this group of interest. Businesses could be ones that cater to the commuters needs such as fast food, coffee, photo copying services, laundry services, it could be a space to exhibit exciting technological innovations, a space for artists and musicians to express their creativity and could be used as advertising space. Referring back to the SWOT analysis, execution of this kind of market opportunity some weaknesses must be improved upon. The attractiveness of getting business to acquire MRT station is that these businesses are the ones that will provide increased convenience to the MRT riders. Increasing ridership satisfaction and improve the loyalty of regular customers. Also, it will show potential customers the relative convenience of using the MRT compared to other modes of transportation.

4.2 Task 2: Space syntax

To improve the effectiveness of space usage in the underground station the space syntax analysis is used to better understand human movement in it. The theory was originally created to find the correlation between urban configuration and human movements in a city setting, however a majority of the ideology is applicable in a smaller urban space such as an MRT station with a similar type of ecosystem but on a much smaller scale. Imagine that the MRT station is a small city, the businesses, service providers and regular ridership are the locals and other underground users are tourists. Similarities between a city setting and a MRT station is visible.

Table 5: List of shops and stores in the Culture Centre Station

Unit No.	Function	Type	Area (m ²)
1-2	The White Box Underground	Barber/Salon	59.0
3-5	Lemon Telecom	IT Gadgets	130.0
6-9	Lawson 108	Convenient store	84.0
13-14	Oshaya	Food & beverages	13.0
15	Ramen Boy	Food & beverages	25.0
16	Easy Cut	Barber/Salon	27.0
17A	ATWby_Nok	Apparel	21.0
17B	The Waffle	Food & beverages	12.0
18-19ABC	Rocket X	Food & beverages	55.0
Event	Café Amazon	Food & beverages	68.0
Total			494.0

From the station floor plan shown in Figure 2 in section 1.2, there is approximately 7,500 square meters of usable space on floor B1 of the study station where the rented store space accumulates to around 500 square meters. This translates to 7% of space in the station that generates monthly revenue. Other current uses of this space are for information booths, electrical rooms, control rooms and ticket machines,

where the larger rooms such as the electrical room and control has been omitted from the calculation of the usable space and assume that the size the booth and ticket machines are negligible.

There is approximately 3,500 square meters of space in the middle of the station where in Figure 2 in section 1.2 is highlighted in yellow. This space is empty space located after a rider enter the turnstiles. If allocated properly, this area can generate revenue and add greater value to the station.

The space syntax operates under three key elements which are convex space, isovist field and axial line – which have been described in the literature review or can be visualized by Figure 8 in section 2.6.

Applying this analysis to the study station, one can better understand the weaknesses in the current method of space utilization and explore ways to improve upon this.

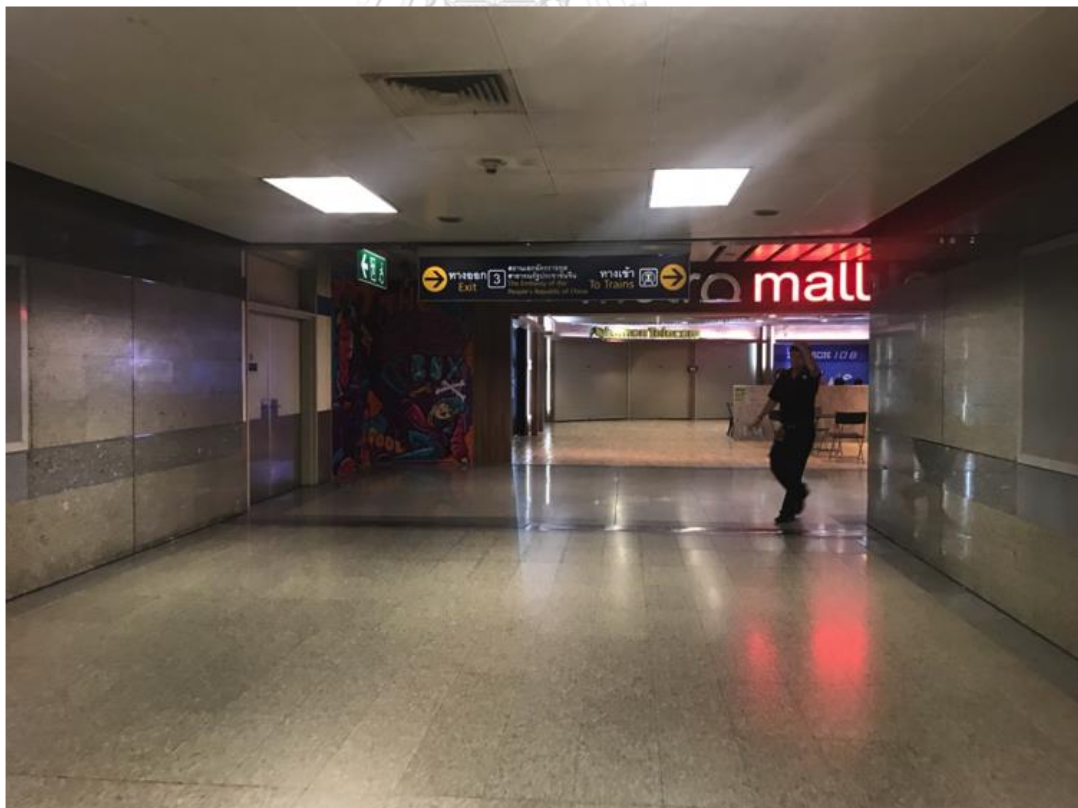


Figure 21: Picture showing the first view commuters will see entering from exit 4.

Upon entering, there is a very narrow axial sightline forcing people to move further into the station. There are not many distractions to attract the eye at this stage so the people would automatically feel they would have to move in further. The convex space for interaction is minimal as well, there is artwork toward the left side of the image and a bright neon sign behind the directions sign. The issue arises when looking at the isovist field. One cannot see anything within the station and will not know at all what is around the corner. In this context, a narrow axial sightline force people to move forward yet there is no attractive convex space to attract people inward, while there is suspense of not knowing what to expect around the corner. The way this first impression of the station is somewhat controversial in the sense that the decorations attempt to create a pleasant experience, yet the station layout creates a degree of suspense.



Figure 22: Picture showing the corridors after turning from the corner from Figure 21(above)

4.3 Task 3: Mapping Underground Urban Space and Making Distinction Between Areas

Now that a general understanding of the stations topography and current situations has been establish, an improvement plan can be built. The governing ideology behind the redesign of the station floor plans is the transient oriented development (TOD). As previously explained, it is a model used in sustainable urban planning for communities with compact neighbourhoods that have high population density, diverse land uses and abundant public spaces. The study station fits the profile

for this model. Another theory that is used to explain choices is space syntax, which aids in the explanation the significance of space in the station.

4.3.1 Evaluation of surrounding area

Keywords:

1. Context
2. Passenger
3. Activity system
4. Functions to serve them

The station is surrounded high density buildings. The major building that create people's need in transportation are Thai Cultural Centre, Esplanade, AIA Capital Centre, SEC, True Tower, and condominiums.

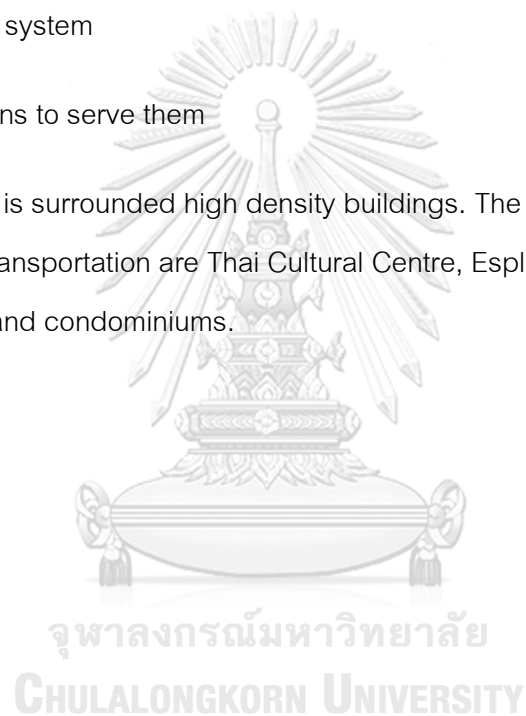


Table 6: List of surrounding buildings

Buildings	Building Types	Exit
Thai Cultural Centre	Public theatre	1
Esplanade	Shopping mall	4
AIA Capital Centre	Office Building	3
SEC	Office Building	3
True Tower	Office Building	2
Ivy Ampio	Condominium	2
Art in Paradise	Tourist attraction	4
Noble Revolve Ratchada	Condominium	2
Station Parking Lot	Car park building	2
China Embassy	Office Building	3
Ratchada Night Train Market	Marketplace	4
RS Tower	Office Building	4
K-market	Marketplace	4

Table 7: List showing connectivity of the context to the station

Entrance	Building Types	Passenger Types
1	Public theatre: 1	tourist
2	Condominium: 2	residence
3	Office Building: 3	officers, businessmen
4	Shopping mall: 1 Marketplace: 2	shoppers

The contexts of this station are residence, businesses, retail merchandising, entertainments. The linkage of the context and the station facilitate people to arrive at those buildings. In other words, the contexts determine types of passengers who use the station at each wing, North and South. North wing, with entrance 1 and 4, connects public theatre, shopping malls, and marketplaces. South wing, with entrance 2 and 3, connects condominiums and office buildings.

Passengers have several motives to utilise these buildings every day. Those motives are identified from the building types. North wing facilitates officers, businessmen, and residences. On the other hand, South wing facilitates tourists and shoppers. Passengers with motives have specific activities that they would achieve. Functions are input according to each motive.

Table 8: Passengers and their motives; divisions of labour.

Passenger Types	Motives
Officers	To update new information, to recreate themselves from work
Businessmen	To deal new businesses
Residences	To create peace of mind, to spend time with family
Tourists	To entertain themselves, to learn culture
Shoppers	To purchase goods for their needs

Table 9: Functions to serve each motive

Motives	Functions
To update new information	Innovative space
To recreate themselves from work	
To deal new businesses	Meeting point
To create peace of mind	
To spend time with family	Meeting point
To entertain themselves	Rental store
To learn culture	Rental store
To purchase goods for their needs	Rental store: eating; grocery shop

To help illustrate this, Figure 23 and Figure 24 is a visual representation of where the context is situated relative to the station exits. The green circle shows a 500-meter radius where the centre is located at the exits of each wing. The rationale for choosing this 500-meter radius is according to TOD's definition of walking distance as shown in Table 10.

Table 10: Walk distance to Transit (ITDP, 2017)

Walk Distance to Transit	Points
Maximum walk distance is less than 1 kilometer to a high-capacity transit station, or less than 500 meters to a direct service station	TOD Standard requirement
Maximum walk distance is more than 1 kilometer to a high-capacity transit station, or more than 500 meters to a direct service station	Does not meet TOD Standard requirement

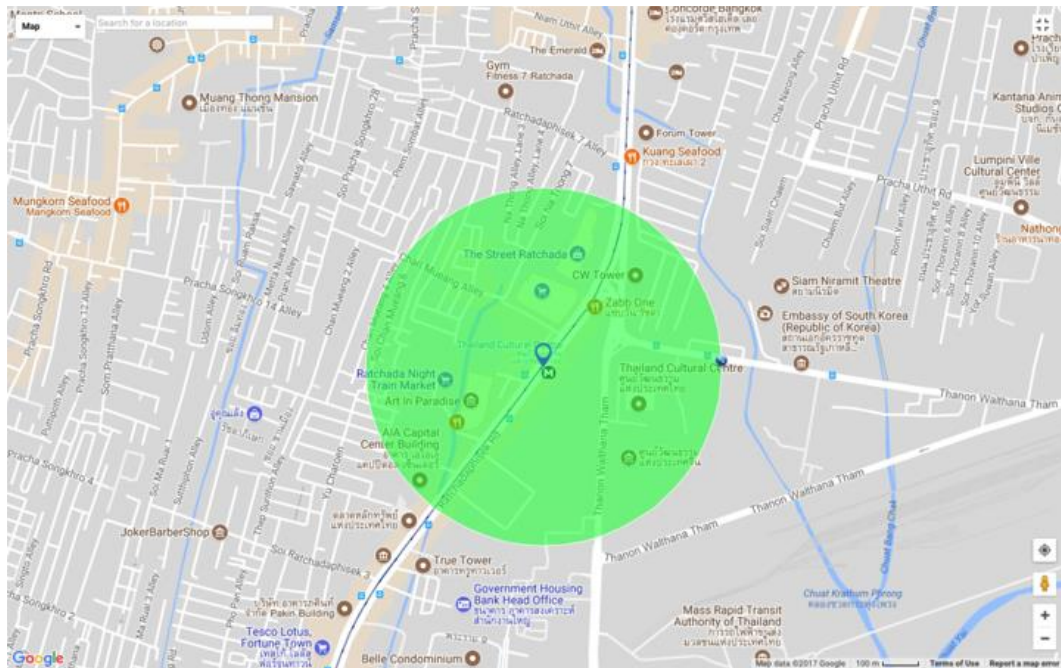


Figure 23: Area around north entrances in 500 meters radius (Google Maps, 2017)

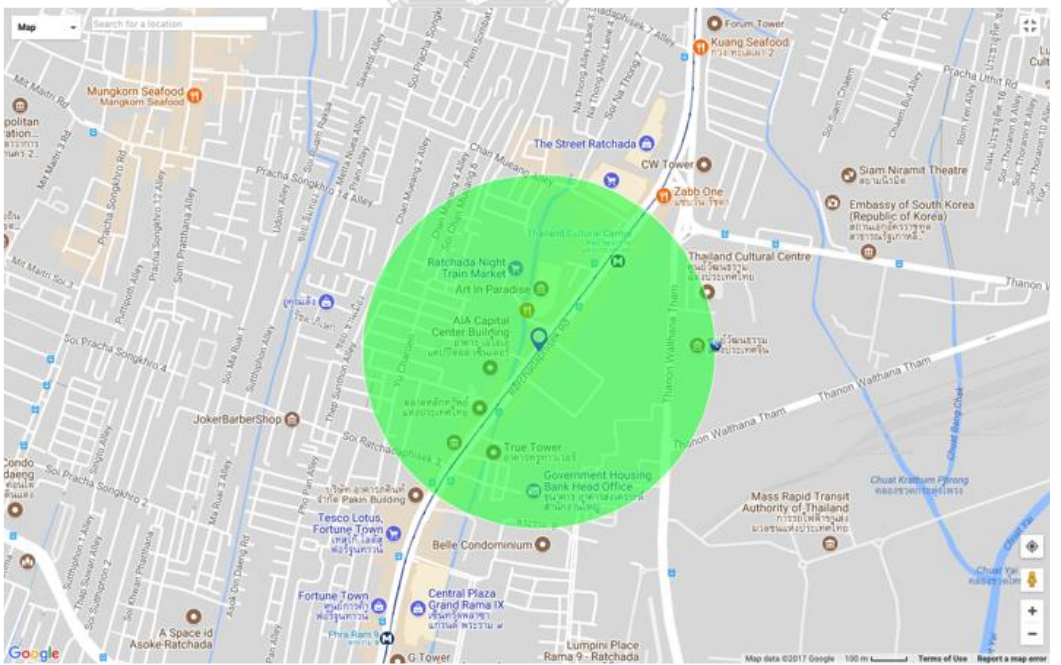


Figure 24: Area around south entrances in 500 meters radius (Google Maps, 2017)

4.3.2 Mapping the new floor plan

In order to create impact across the entire passenger segment, a cross-disciplinary approach is required. Planning a new layout for the study station requires expertise in business management, architecture, and psychology. The business aspect of the plan is to study the revenue and value gain. It is vital that the changes done to the station will result in the sustainability of the business. The architecture of the improvement must comply with the existing space and improve users' and space renters' experience within the station. Finally, the psychology aspect also appeals to the user experience.

The integration between above and underground areas is also another challenge that required a cross-disciplinary solution. This is important because it is a method to increase ridership and this is the primary activity and objective of the service. Currently there are four exits that serve as a physical pathway for commuters to access the station. In an ideal case, building more physical passages to link to buildings that are in close proximity to the station. However, such a plan would require a massive budget, years of work, and an engineering master mind to deliver. Other means of integration is with marketing and branding campaigns. The majority of the population reside above ground, it is a matter of sending a message that will attract them to decide to come down to experience the underground system. Branding is also an important tool because it associates MRT's identity to a particular experience or feeling. Done right, just the MRT name itself can aid in the integration. Never the less, whatever the message sent to the public, the MRT has been able to deliver.

The activity system is a concept that is relatively difficult to apply in this situation, however all commuters have a common goal in using the MRT system. This theory can be used to understand the values of riders and group them into more manageable sub-groups. With this a plan can be made to draw on the major groups instead of attempting to appeal to all individuals. The first group to appeal to is the regular ridership. They are the ones who will use the underground despite other services are available. It is a matter of finding conveniences that will make them rely more on the MRT. Conveniences such as cafes, laundromats and restaurants that will streamline their pre-commute tasks

in making coffee, cooking, and cleaning in the mornings and increase the time they have to rest upon returning. As for the riders who sometimes use the station, there should be a means of engaging them and attracting into the station. Finally, for non-users, there must a reason for them to want to enter the station, whether for work, play or necessity.

Having pointed out the requirements, the final goal of this redesign is to diversify function so that the study station acts as a small community where one can live, work and play. Once this is realised, a certain level of dependence on the station is created. If one is hungry one has food to eat, if one wants to work one has a table, coffee and internet connectivity and if one wants to rest one has a place escape from the heat of the Thai climate. It is a matter of acquiring public dependence, not only on the transit system, but the conveniences and necessities that come with it.



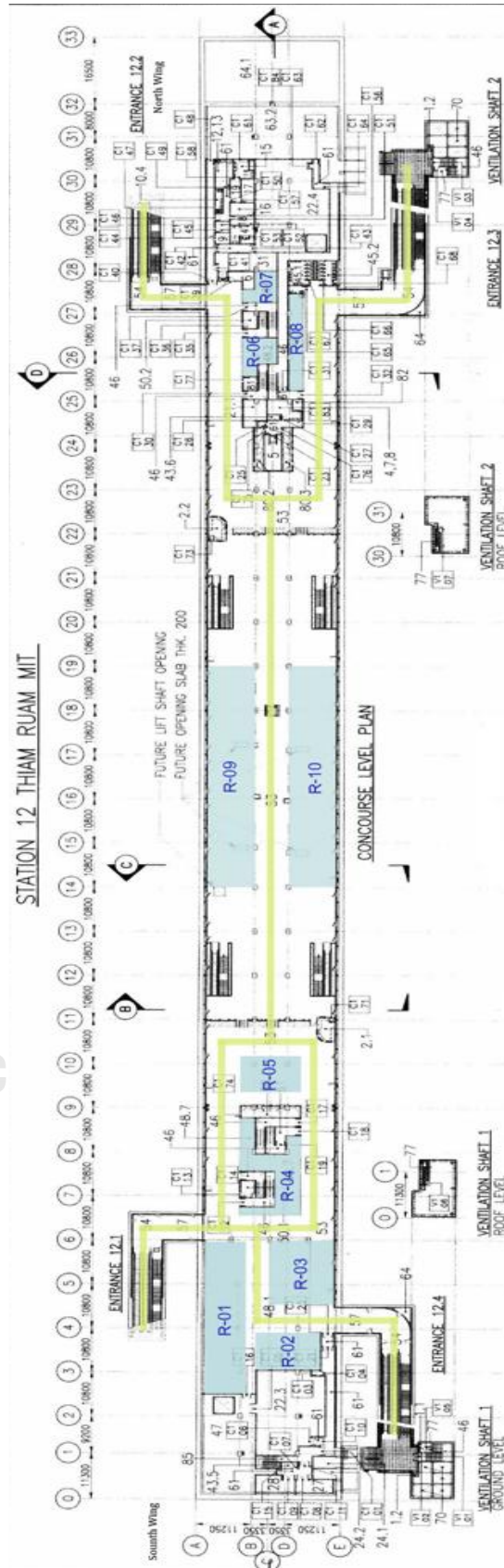


Figure 25: Drawing of Plan 1

Table 11: List of function for improved design of plan 1

Zone	Function	Code	Dimension (m)	Area (m ²)
South Wing	Innovation space	R-01	8.0 X 38.0	296.0
	Rented space: restaurant, grocery shop	R-02	15.0 X 10.0	150.0
		R-03	15.0 X 15.0	225.0
	Rented space: coffee shop	R-04	-	120.0
	Interactive meeting point Kiosk	R-05	15.0 X 15.0	225.0
North Wing	Tourist shop; souvenir	R-06	-	61.5
	Convenient store	R-07	-	47.5
	Locker/luggage storage	R-08	3.4 X 25.0	85.0
Central	Rental space for government office	R-09	40.0 X 11.25	450.0
	Banking services	R-10	40.0 X 11.25	450.0
Total				2,110.0

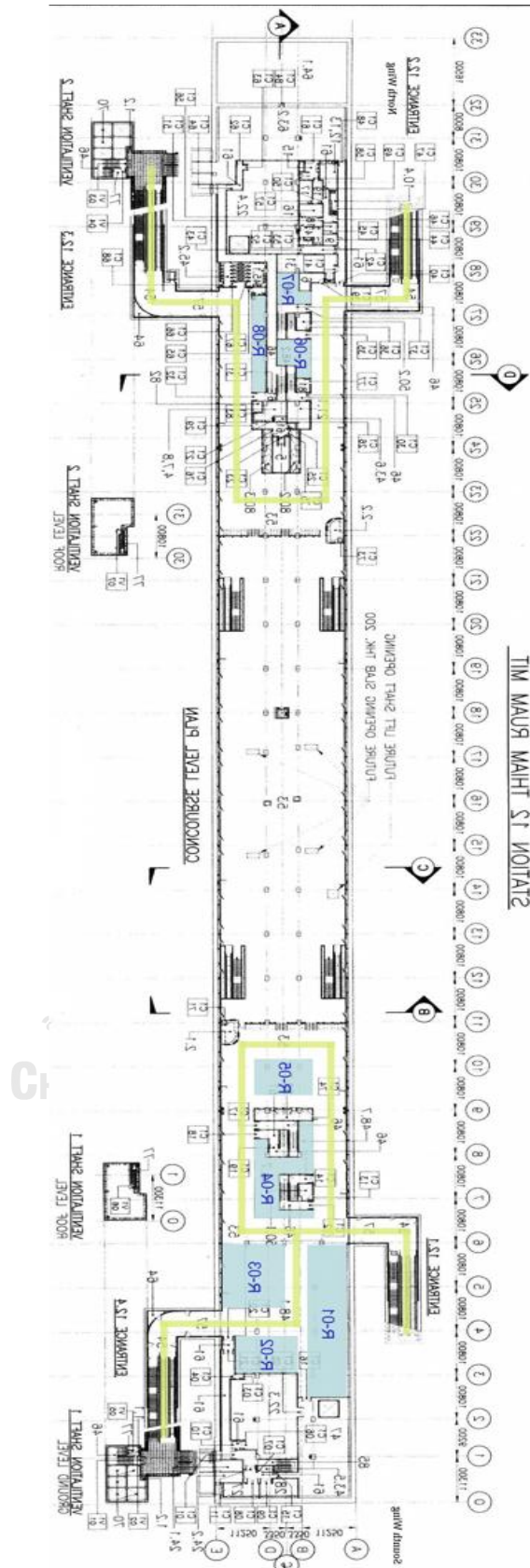


Figure 26: Drawing of Plan 2

Table 12: List of function for improved design of plan 2

Zone	Function	Code	Dimension (m)	Area (m ²)
South Wing	Innovation space	R-01	8.0 X 38.0	296.0
	Rented space: restaurant, grocery shop	R-02	15.0 X 10.0	150.0
		R-03	15.0 X 15.0	225.0
	Rented space: coffee shop	R-04	-	120.0
	Interactive meeting point	R-05	15.0 X 15.0	225.0
North Wing	Kiosk			
	Tourist shop; souvenir	R-06	-	61.5
	Convenient store	R-07	-	47.5
	Locker/luggage storage	R-08	3.4 X 25.0	85.0
Total				1,210.0

4.3.3 The Master Plan

The goal of remapping the study station was to create a more pleasant experience of being inside it. Several store locations are incongruent and does not have synergy between each other. Some examples are instead of having restaurants placed in an area that has table and chairs, one is in the right area, one is in the middle of the corridor and the other is in the far corner of the area. Another is having two barber shops in the same wing of the station located right across form one another. There is no user experience management to create a seamless flow of function within the station.

With TOD as the governing principles of the design and an underlying concept of live, work and play, the remapped floor plan is shown in Figure 25 and the explained in Table 11. The clear changes done to the station is that the turnstiles are moved to floor B2 so that the previously unused area could be accessed by the public. Area code R-09 and R-10 is then put in place as government office spaces and banking services in case of using for advertising and public events. Since the space is right in the middle of station, the tourist will walk pass this space eventually. For the South Wing, what used to be one large rental space is now separated into three sections; R-01, R-02 and R-03

which are now a restaurant, cafe, and an innovation space respectively. As the South of the station are tended to have more office buildings; therefore, the space will be designated for the grab-and-go or the short meals according to the lifestyle of office workers. After exiting this area, the ridership finds R-04, an interactive meeting point and further down R-05 a kiosk. The users are eased into the station by having attractions gradually draw them into the station and then followed with a space for them to have fun while waiting for other passengers to arrive. The North Wing of the station is more focused on serving tourists because more tourists will use those exits to get to the cultural centre. Hence, the shop around this area will be focused on the facility which can attract more tourists and provide more convenient service in traveling experiences for them. In the area, the tourist shops and souvenir shops will show the Thai product and cultural heritage to attract tourist and provide more of the general idea around the station leading to the understanding of Thai culture and heritage. The convenient stores will be a place for tourist to buy general items in case of needs. Lastly, luggage storage will be installed for tourist to have more convenient traveling experiences.

In the modern time, the lifestyle and living life have changed overtime. The modernistic have been integrated into lifestyle leading to require of the innovative space. R-01 has been designed as the innovative space to provide more pleasant experience of the riders and workers around the area to yield the different experiences compared to other station. Since, office employers and locals usually use the South gate to get from the station to their destination, the space provided for the R-01 should be more of the entrance to innovative lifestyle of modern era. With the space closed to station entrance, it can be easily notice and observe before getting into the station or going out of station. Moreover, the space is longer compared to R-02 and R-03 leading to the easier for utilisation of innovative idea and easier to observe from various angles.

R-02 and R-03 are generally the space provided for the workers to grab some bites or wait for their colleagues by enjoying some coffees. Hence, R-02 are slightly smaller than R-03 stemming from the change in customers behaviour. With the modern lifestyle, people tended to have a glass of coffee before or after working or chill-out

during their lunch time. Hence, the space provided for the coffee shop are slight larger for the reason of customer needs in case of sitting and chatting. However, R-02 (Restaurant, grocery shop) will be provided take-away foods and snacks before going to work in the morning or before going back home; hence, the space can be typically reduced to be more suitable space.

The space in the R-04 area is not a rectangular shape leading to the difficulty in the designing the shop; nonetheless, the space is right in the middle of the hallway. As a result, it is a suitable for the interactive meeting point for the customers to waiting around this area. R-04 will be designed the space utility based on the comfortable and convenient facility in order to let the customers feel more pleasant during waiting for their co-workers.

R-05 is stationed next to the South gate. Thus, this area will have the most traffic in the South wing. The self-service kiosk will be installed to provide more convenient in purchasing the ticket before getting into the platform.

For the North wing, the customer will be more focused on the tourists whose destination is Thailand Cultural Centre. After tourist come out from the North gate, the tourist would have to walk pass R-06. Hence, the tourist shop which sells various Thai souvenirs will attract the tourists before going to their destinations or after coming back from their traveling. Moreover, R-07 is designed for the convenient stores for the tourist to purchase some of the general items if they need. Both of R-06 and R-07 will be construct as small shops just for the final decision before getting into the platform. Since the North of the station has a bigger department store such as Big-C department store or The Street Ratchada. As a result, tourist will decide to purchase the items from R-06 and R-07 as gifts or souvenirs.

The self-service luggage storage will be installed to provide more convenient experiences for tourists in the R-08 area. The tourists can put their luggage before travelling to their destinations and retrieve afterward. As a result, tourists can enjoy their traveling without worry about their luggage.

R-09 and R-10 are stationed in the middle of the station; consequently, every rider will notice before or after getting into the platform. The space will be provided for the rental space for Government office to publicise their public relation and the banking services. Since the space is the right at the entrance of the platform, the space will be generally used for the general-purpose area to have more of the advertising and public relation to notify everyone. R-10 is designed for banking service to provide more convenient in withdrawal the money or currency exchange for tourists

4.3.3.1 Customer Attraction

Revitalization and re-imagination of this place are also important to create customer flow and attract customers both from internal station and external station.

Rama (2013) mentioned that reframing is technique to create new emotional and cognitive frame of reference (Balakrishnan, 2015). This master plan was reframed to a place to live, work and play. As the time are changing from manufacturing era to service era. The number of specialised fields of expertise and advances has increased. It would be more practical, if they all could have relax communication. So, it means the organisation could operate at a smaller scale, giving more people the opportunity to work from home (Alvarez, 2017).

Nowadays, sustainability has been considered as important factor. Alvarez (2017) mentioned that the flexible spaces can be more economically viable and land efficient, mixed use schemes are gaining popularity once more such as in some countries, legislation and financial incentives embrace the view that all different aspects of life can successfully be performed at a local level, in a shared place (Alvarez, 2017).

However, this study station is under name "Thailand cultural center". This can be used to communicate with external customers such as tourism and create landmark about Thai culture. This can attract tourism from all over the world, who want to learn Thai culture. Moreover, Thailand cultural center underground station can cooperate with ministry of tourism to promote new image of this station.

4.4 Task 4: Master Plan Evaluation

There is a distinctive increase in space usage. The current layout uses around 500 square meters while the proposed plan utilises over 2,000 square meters of space as seen in Table 11. This translates to approximately 400% increase. No information on the rental pricing was found but would equate to a 400% increase in rental revenue if the rental price is kept the same as today. In effect, the station can push down rental fees to draw in more business partnership opportunity while still increasing revenue. Putting all parties, MRT, the ridership and the store renters, in a winning situation.

An output impact is clear with the improved layout plan because of the increase in space usage. With this increase in revenue, the MRT can invest in more marketing, create incentives for more commuters to use their services and attract more potential business partners. It would be too soon to conclude that there is value added impact, however with output impact clear there is a high possibility for the MRT to do so.

To gain external evaluation, the plans were presented to director of development department of MRT and team. The feedback was positive in general. Previously, there were 2 plans that were presented, which are Figure 25 and Figure 26. They were impressed with Figure 25. According to important strategy of TOD is passenger flow could be circulated around station and connect each door to each other as show in section 4.4.3. Besides, the centre area in Figure 26 is unused and total used area in Table 12 is lower. Therefore, Figure 25 has been chosen as a master plan. However, suggested it could be improved to each different station.

Chapter 5: Discussion

5.1 Research Overview

This study was done with a variety of methods, with information found from both primary and secondary sources. The findings are then compared to proven theories to guide the design process of the new master plan. The plan was then evaluated by decisionmakers of the MRT to gauge their willingness to push the proposal until its realisation. Despite the direction of the results acquired, there is room for evaluation and improvement.

To begin with, the information gathering process was simple and straight forward. First to find out the total usable space in the study station then compare it with space currently in use. The second was to ask ridership and staff member their thoughts on what was lacking from the station and what they would like to have there that would improve their overall experience of using the underground service. This was done in a study group type interview to be able to exchange thoughts and dig deeper into a user rather than doing a questionnaire. The disadvantages of conducting this type of interview its qualitative nature. There is not enough quantitative data to make a definitive conclusion. For example, there is not enough data to be able to say that there is a certain percentage of male users that would like to see a certain service in the MRT. Perhaps in the future, both interviews and questionnaires should be done to acquire quantitative and qualitative data.

The study station itself was studied with the space syntax analysis. The methodology aided with illuminating the points that needed improvement within the station. It provided a clear guideline to conduct such data collection. However, this type of analysis generates a static model of how the ridership experience the station, while in reality the nature of traffic in the underground is extremely dynamic. Referring to figure 7 in Chapter 4, imagine people are walking at a fast pace. Their axial sightline is constantly changing and their isovist field is continuously shifting. The most effective way to apply it is at certain points of interested, for example, first line of sight upon

entering the station or arriving on floor B1 coming from the underground platforms. Perhaps, a dynamic model should be explored to compare if the resulting designs show any significant improvement in user experience.

Improving the current station layout was very difficult to do because there was no concrete method of hypothesizing to what degree the plan would have work. The redesign could have been better done with more in-depth information of surrounding buildings. Information such as population of residences in a condominium, or the traffic density of people going to and from an office building are some examples. Because this group of people are the target to attract into the study station, it is sensible to understand them in a deeper level understanding their thought process and psychology.

The masterplan was definitively evaluated to show significant growth in rental revenue with a few circumstances. Nonetheless, with the previously suggested the results have more depth.

5.2 Consideration of potential underground transit station

First of all, in the task 1, the author began to understand the given data and information. They were given by Thailand underground transit station. The author researched more by online information, new and article, and had meeting with staff of Thailand Underground transit station.

The scope was found too wide to create the master plan development. There are 2 line of operating underground stations, which are blue line and purple line. The purple line was started to operate in the middle of 2016. The collected data does not enough to consider. So, it was sorted out.

There are 18 stations in blue line. After gathering all information, the author made decision to choose Thailand cultural centre as study station.

The author got requirement, which is in 2022 number of passengers will grow up to double.

The results discussed in Chapter 4 sheds light on the potential for space allocation and property development within the study station. This master plan could also be suitable for other stations, current or ones under development.

Other stations that are currently under operation, are arranged similar to the study station. The stores, ticket machines and information booths are situated before the turnstiles and after the turnstiles having a wide unused space. By using the empty space there will be an increase in revenue from rent and a greater attraction to the ridership. Whether the proposed plan will be success is another story. The strategy needs to be tested and its data analysed to see if it is the right solution for Thailand.

If the plan proves to be success, it could potentially be applied to other existing stations that fit a similar profile, then to the stations that are soon due to be finished. With increased revenue and more riders, MRT stations could become a small underground community, generating significant revenue for the mass transit company and could be something Thai people will depend on for greater daily convenience.

Chapter 6: Conclusion

6.1 Conclusion and summary

This study was done to improve the layout of the Cultural Centre Station of the MRT by using TOD as an underlying theory. The aim of revisiting the current design are to attract more ridership to use the mass transit service and to provide a community space that is both innovative and convenient. In any case, the change will need to be economically viable as well.

The issue of the current layout of the station of interest is the ineffective use of space on the first floor of the station. Only 7% of space on floor B1 was used to rent out to stores. While a majority of the remaining space is unused space which is situated after the turnstiles. This space translates to approximately 3,500 square meters.

After having understood the issue, the proposed master plan was to put additional store space behind the turnstiles or even push back the turnstiles or even place it in a lower level of the station. With the improved plan, space usage increased to 2,000 square meters or approximately 26%, a significant increase. The foreseeable benefits are increasing revenue from space rental, the ability to be able to place a more diverse portfolio of stores to increase convenience for the riders, and use the underground space more effectively.

Whether the plan will be successful in real life is a matter of testing the master plan in the study station for a period of time. Once enough data is collected, one compares it to what is currently done.

6.2 Recommendation for future research

At the current state, the study is still lacking in-depth information on the population that resides in walking distance to the MRT station. It was established earlier in this thesis that the target client group of the mass transit is the people who reside in walking-distance of the study station. This includes residence, office buildings also point

of interest such as shopping malls and landmarks. Knowing how many of these people use the MRT's services on a regular basis is vital to determining, how much of this population is still untapped, finding their thoughts of the current station and how it can be improved. Finally, analyse the data statistically to make a conclusion. By doing a more in-depth research on the population residing in a close vicinity the MRT will provide insight into their psychology. This will perhaps confirm that the proposed master plan will cater to the needs of the target group or may point that the design needs revisiting.

After this is done, the next step could be implementing the master plan by using the study station as a pilot. Data collection is key during this trial periods. The results should conclude an increase in number of trips, revenue from renting space, and finally ridership and renter satisfaction. Other information that maybe essential is finding if there is an increase in the percentage of target market group using the MRT after the implementation of the master plan. If the results are as expected, then the model could be applicable to an underground station with a similar profile.

6.3 MRT feedback and comment

According to feedback and comment from the company as shown in Appendix 5, the overall outcome is positive. This feedback and comment is from director of area development and acting director of business development and area management. The master plan has been discussed and selected during the process from 2 designing plans. In term of academic, this paper is well description of research and constructed. However, in actual operation the plan has to study and apply government policy and agreement, because this organization is under government.

In conclusion, the director mentioned that this paper is the first paper that planning and design Thailand underground station, which has had problems about this for long time. The author has been able to identify methods where can be applied to situation.

REFERENCES

ALMEC Corporation, Oriental Consultants Global Co, Ltd. (2015). *Project for Studying*

the Implementation of Integrated UMRT and Urban Development for Hanoi in

Vietnam. JAPAN INTERNATIONAL COOPERATION AGENCY HANOI PEOPLE'S

COMMITTEE (HPC). [online] Available at:

http://open_jicareport.jica.go.jp/pdf/12248837.pdf [Accessed 13 Sep. 2017].

Alshenqeeti, H. (2014). *English Linguistics Research. Interviewing as a Data Collection*

Method: A Critical Review, [online] 3(1). Available at:

<http://www.sciedu.ca/journal/index.php/elr/article/download/4081/2608> [Accessed

14 Oct. 2017].

Alshenqeeti, H. (2014). *Interviewing as a Data Collection Method: A Critical Review.*

English Linguistics Research, 3(1).

Alvarez, L. (2017). *A place to live, work and play: why mixed-use developments are making a comeback.*

Assavavipapan, K. and Opananon, S. (2016). Thailand transportation infrastructure performance and the economics. *Asia Pacific Journal of Marketing and Logistics*,

[online] 28(5), pp.923-938. Available at:

[http://www.emeraldinsight.com/doi/abs/10.1108/APJML-09-2015-](http://www.emeraldinsight.com/doi/abs/10.1108/APJML-09-2015-0145?fullSc=1&journalCode=apjml)

[0145?fullSc=1&journalCode=apjml](http://www.emeraldinsight.com/doi/abs/10.1108/APJML-09-2015-0145?fullSc=1&journalCode=apjml) [Accessed 15 Aug. 2017].

Baker, M. and Hart, S. (2003). *The marketing book*. 5th ed. Oxford: Butterworth-Heinemann.

Balakrishnan, M. (2015). Touring Consumption. *Revitalizing Forgotten Place Brands*

through Touring Consumption: The Case of The Old London Underground

Company, [online] pp.21-30. Available at: http://10.1007/978-3-658-10019-3_2

[Accessed 5 Nov. 2017].

Bali, G. (n.d.). *Activity system theory approach to healthcare information system*.

[ebook] Available at: [http://www.diva-](http://www.diva-portal.se/smash/get/diva2:833786/FULLTEXT01.pdf)

[portal.se/smash/get/diva2:833786/FULLTEXT01.pdf](http://www.diva-portal.se/smash/get/diva2:833786/FULLTEXT01.pdf) [Accessed 13 Oct. 2017].

Bangkok Expressway and Metro (2017). *Route map MRT Blue line and Purple line*.

[image] Available at:

<http://www.bangkokmetro.co.th/web/imgcontent/Image/map17latest.jpg> [Accessed

15 Oct. 2017].

Bangkok Metro Public Company Limited (2012). *M.R.T. Chaloem Ratchamongkhon Line*

Annual year report of 2011.

จุฬาลงกรณ์มหาวิทยาลัย

CHULALONGKORN UNIVERSITY

Bangkok Metro Public Company Limited (2013). *M.R.T. Chaloem Ratchamongkhon Line*

Annual year report of 2012. Bangkok.

Bangkok Metro Public Company Limited (2014). *M.R.T. Chaloem Ratchamongkhon Line*

Annual year report of 2013. Bangkok.

Bangkok Metro Public Company Limited (2015). *M.R.T. Chaloem Ratchamongkhon Line*

Annual year report of 2014. Bangkok.

Bangkok Metro Public Company Limited (2016). *M.R.T. Chaloem Ratchamongkhon Line*

Annual year report of 2015. Bangkok.

Bangkok Metro Public Company Limited (2017). *M.R.T. Chaloem Ratchamongkhon Line*

Annual year report of 2016. Bangkok.

Baulcomb, J. (2003). Management of change through force field analysis. *Journal of*

Nursing Management, 11(4), pp.275-280.

BEM. (2017). *Investor Relations*. [online] Available at: [http://investor-](http://investor-th.bemplc.co.th/company_business.html)

[th.bemplc.co.th/company_business.html](http://investor-th.bemplc.co.th/company_business.html) [Accessed 15 Sep. 2017].

Brand Buffet. (2017). ถอดบทเรียน “เมโทร มอลล์” ปรับกลยุทธ์ ผนึกแบรนด์ยักษ์ เพิ่มมูลค่า

ชุมทรัพย์ค้าปลีกใต้ดิน. [online] Available at:

<https://www.brandbuffet.in.th/2017/08/metro-mall-retail-case->

study/<https://www.brandbuffet.in.th/2017/08/metro-mall-retail-case-study/>

[Accessed 15 Aug. 2017].

calBusiness.qld.gov.au. (2017). *Business Queensland*. [online] Available at:

<http://business.qld.gov.au> [Accessed 20 Sep. 2017].

Calthorpe, P. (1993). *The next American metropolis*. New York: Princeton Architectural Press.

Carmody, J., Huet, O. and Sterling, R. (1994). Life safety in large underground buildings:

Principles and examples. *Tunnelling and Underground Space Technology*, [online]

9(1), pp.19-29. Available at:

<http://www.sciencedirect.com/science/article/pii/0886779894900051?via%3Dihub>

[Accessed 9 Sep. 2017].

Cervero, R. and Sullivan, C. (2011). Green TODs: marrying transit-oriented development and green urbanism. *International Journal of Sustainable Development & World Ecology*, 18(3), pp.210-218.

Davydov, V., Zinchenko, V. and Talyzina, N. (1982). Soviet Psychology. *The problem of activity in the work of A.N. Leontev*, 21.

Demirdjian, Z. and Senguder, T. (2004). Journal of American Academy of Business, Cambridge. *Perspectives in consumer behavior: Paradigm shifts in prospect*, pp.348-353.

Dorsey, B. and Mulder, A. (2013). Planning, place-making and building consensus for transit-oriented development: Ogden, Utah case study. *Journal of Transport Geography*, 32, pp.65-76.

Durmisevic, S. and Sariyildiz, S. (2001). A systematic quality assessment of underground spaces – public transport stations. *Cities*, [online] 18(1), pp.13-23.

Available at:

<http://www.sciencedirect.com/science/article/pii/S0264275100000500?via%3Dihub>

[Accessed 9 Sep. 2017].

Engeström, Y. (2015). *Learning by expanding*. New York, NY: Cambridge University Press.

Google Maps (2017). [image] Available at:

<https://www.google.co.th/maps/@13.7651482,100.5697131,18.07z> [Accessed 10

Oct. 2017].

Google Maps (2017). [image] Available at:

<https://www.google.co.th/maps/@13.7651482,100.5697131,18.07z> [Accessed 10

Oct. 2017].

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

HBTB (2016). *America THINKS Transit Oriented Development*. [image] Available at:

[http://www.hntb.com/getattachment/Newsroom/Press-Kits/America-THINKS-](http://www.hntb.com/getattachment/Newsroom/Press-Kits/America-THINKS-surveys-(1)/AThinks_TOD_Factsheet_516.pdf.aspx)

[surveys-\(1\)/AThinks_TOD_Factsheet_516.pdf.aspx](http://www.hntb.com/getattachment/Newsroom/Press-Kits/America-THINKS-surveys-(1)/AThinks_TOD_Factsheet_516.pdf.aspx) [Accessed 10 Oct. 2017].

Hillier, B. (2014). *Space syntax as a theory as well as a method*.

Hillier, B. and Hanson, J. (2005). *The social logic of space*. Cambridge

[Cambridgeshire]: Cambridge University Press.

ITDP (2017). *Walk distance to transit*. [image] Available at: [https://www.itdp.org/wp-](https://www.itdp.org/wp-content/uploads/2014/03/The-TOD-Standard-2.1.pdf)

[content/uploads/2014/03/The-TOD-Standard-2.1.pdf](https://www.itdp.org/wp-content/uploads/2014/03/The-TOD-Standard-2.1.pdf) [Accessed 9 Oct. 2017].

Kannegiesser, M. (2010). *Value chain management in the chemical industry*.

Heidelberg: Physica-Verl.

Kuada, J. (2016). *Marketing Decisions and Strategies. A Framework for Market*

Opportunity Analysis, [online] 1, pp.69-93. Available at:

[https://www.researchgate.net/publication/317102914_A_Framework_for_Market_Op-](https://www.researchgate.net/publication/317102914_A_Framework_for_Market_Opportunity_Analysis)

[portunity_Analysis](https://www.researchgate.net/publication/317102914_A_Framework_for_Market_Opportunity_Analysis) [Accessed 7 Sep. 2017].

Kumar, D. and P. V., R. (2016). *International Journal of Engineering and management*

science. VALUE CHAIN: A CONCEPTUAL FRAMEWORK, [online] 7(1), pp.74-77.

Available at: [http://scienceandnature.org/IJEMS-Vol7\(1\)-](http://scienceandnature.org/IJEMS-Vol7(1)-Jan2016/IJEMS%20Vol7(1)-12.pdf)

[Jan2016/IJEMS%20Vol7\(1\)-12.pdf](http://scienceandnature.org/IJEMS-Vol7(1)-Jan2016/IJEMS%20Vol7(1)-12.pdf) [Accessed 5 Sep. 2017].

Kuutti, K. (1996). Context and consciousness. *Context and consciousness: Activity theory and human-computer interaction*.

Kvale, S. (1996). *InterViews: An Introduction to Qualitative Research Interviewing*.

Thousand Oaks, Calif: Sage Publications.

Leontev, A. (1981). Soviet Psychology. *The Problem of Activity in Psychology*.

López, M. (1996). Crime prevention within metro systems. *European Journal on Criminal*

Policy and Research, [online] 4(4), pp.113-119. Available at:

<https://link.springer.com/article/10.1007%2FBF02736717> [Accessed 9 Sep. 2017].

Maps of Huai Kwang Distruct. (2017). [image] Available at:

<https://www.google.co.th/maps/search/mrt+ศูนย์>

วัฒนธรรม/@13.7664121,100.5310935,14z/data=!3m1!4b1 [Accessed 25 Oct.

2017].

Marshall, C. and Rossman, G. (2006). *Designing qualitative research*. 4th ed.

MRTA. (2017). [online] Available at: <https://www.mrta.co.th/> [Accessed 15 Aug. 2017].

Opdenakker, R. (2006). Forum: Qualitative Social Research. *Advantages and*

Disadvantages of Four Interview Techniques in Qualitative Research, [online] 7(4).

Available at: <http://www.qualitative-research.net/index.php/fqs/article/view/175>

[Accessed 14 Sep. 2017].

Osman, K. and Suliman, M. (1994). Arch. & Comport. /Arch. & Behav. *The Space Syntax*

Methodology: Fits and Misfits, 10(2), pp.189-204.

Pawewun, O. and Sirimai, P. (2016). Resetting the economy. *Bangkok Post*. [online]

Available at: <https://www.bangkokpost.com/print/1132489/> [Accessed 18 Sep.

2017].



Pearson, D. and Ranchhod, A. (1999). *Strategic marketing management*. London: BPP.

Porter, M. (2008). *Competitive advantage*. New York: Free Press.

Qvortrup, L. (1996). *Cybernetic and Human Knowing. How is Society Possible? The Epistemology of Social Constructivism: A Comment on John R. Searle's The Construction Social Reality*, 3(4).

Rayport, J. and Jaworski, B. (2005). *Framing Market Opportunity*.

Th.wikipedia.org. (2017). *สถานีศูนย์วัฒนธรรมแห่งประเทศไทย*. [online] Available at:

<https://th.wikipedia.org/wiki/สถานีศูนย์วัฒนธรรมแห่งประเทศไทย> [Accessed 8 Oct. 2017].

The World Bank (2017). *Annual Report 2015*. [ebook] Available at:

<https://openknowledge.worldbank.org/bitstream/handle/10986/22550/WBAnnualReport2015EN.pdf> [Accessed 12 Sep. 2017].

Tod.org. (2017). *Transit Oriented Development*. [online] Available at: <http://www.tod.org>

[Accessed 5 Sep. 2017].

Un.or.th. (2017). *Service Category* ข้อมูลเกี่ยวกับประเทศไทย | *United Nations in Thailand*.

[online] Available at: <http://www.un.or.th/th/service-category/ข้อมูลเกี่ยวกับประเทศไทย/>

[Accessed 15 Aug. 2017].

United Division (2017). *UNSD — Methodology*. [online] Unstats.un.org. Available at:

<https://unstats.un.org/unsd/methodology/m49/> [Accessed 8 Sep. 2017].

VAN NES, A. (2011). Research in Urbanism Series. *The one- and two-dimensional*

isovists analyses in Space Syntax, [online] 2, pp.163-183. Available at:

<http://journals.library.tudelft.nl/index.php/rius/article/download/211/266> [Accessed

19 Sep. 2017].



WEST JAPAN RAILWAY COMPANY (2017). [image] Available at:

https://www.westjr.co.jp/global/tc/timetable/pdf/station_osaka.pdf [Accessed 14

Sep. 2017].

Wood, M. and Kerr, J. (2011). *Basic steps in planning nursing research*. Sudbury,

Mass.: Jones and Bartlett.

Zacharias, J., Zhang, T. and Nakajima, N. (2011). Tokyo Station City: The railway station

as urban place. *URBAN DESIGN International*, 16(4), pp.242-251.





Appendix 1: Thailand Cultural Centre's floor plans

Before the construction of Thailand cultural centre station, the station has been name “Thian Ruam Mit station”, which is the same name as the junction and road nearby (Th.wikipedia.org, 2017).

G	Street level	Bus stop, Thailand Cultural Centre, Park&Ride, The Esplanade,
B1	Concourse	Ticket machines
B2		Side platform planned
	Platform 1	MRT (planned) towards Suvinthawong →
	Platform 2	← MRT (planned) towards Bang Khun Non
		Side platform, planned
B3	Platform 1	MRT towards Hua Lamphong (Phra Ram 9) →
		Island platform, doors will open on the right
	Platform 2	← MRT towards Tao Poon (Huai Khwang)

Figure 27: Station layout of Thailand Cultural Center Station (Th.wikipedia.org, 2017)



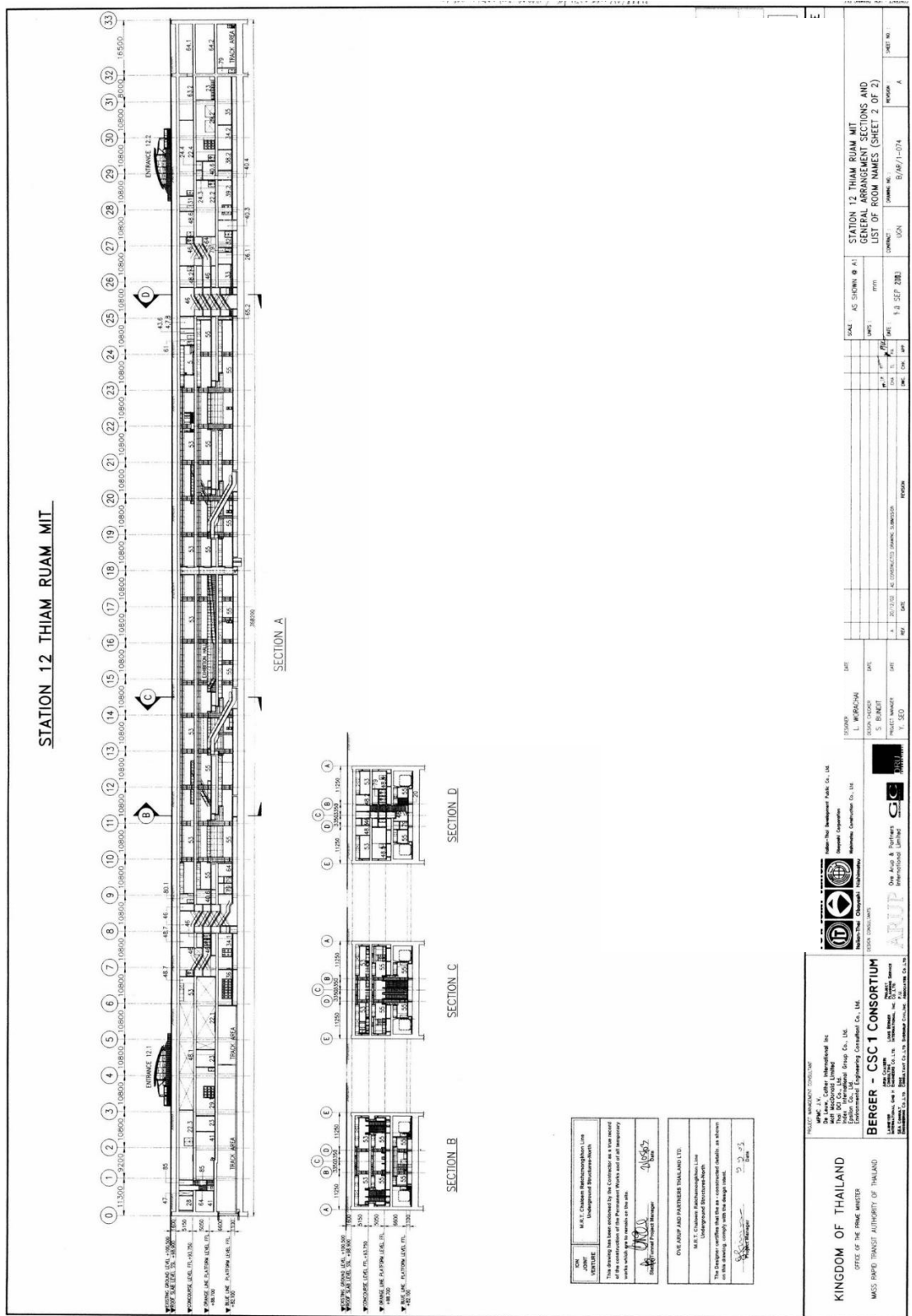


Figure 29: Thailand Cultural Centre Station General Arrangement Plan (Sheet 2 of 2)

APPENDIX 2 – Given Data from MRT

Year 2011

Table 13: Accumulated Passengers in 2011 (Bangkok Metro Public Company Limited, 2012)

Directory	Number of Passenger					
	Carrying over 2010	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2011
Total passenger	64,927,497	17,256,842	16,412,289	18,861,231	16,510,118	69,040,480
Accumulated Passenger	392,434,152	409,690,994	426,103,283	444,964,514	461,474,632	

Table 14: Average Daily Passengers in 2011 (Bangkok Metro Public Company Limited, 2012)

Day	Number of Passengers				
	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2011
Average Passenger Monday-Friday	215,910	217,573	235,634	212,155	220,552
Saturday Sunday and official holiday	138,230	120,806	141,284	120,998	129,416
Quarterly/Year	191,743	180,355	206,603	179,458	189,506
Percentage Change from last quarter	3.67 ⁽¹⁾	-5.94	14.55	-13.14	
Percentage Change from last year					6.53 ⁽²⁾

Note:

- (1) Average Passenger of 4th/2010 quarter is equal to 185,135 people. This number is used to compare with percentage change of 1st/2011.
- (2) Average Passenger of 2010 is equal to 177,884 people. This number is used to compare with percentage change in 2011

Table 15: Average Daily Arrival Passenger of each station in 2011

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	7,545	3.89	7,129	3.94	7828	3.78	7,328	4.07	7,457	3.92
KAM	3,828	1.98	3,690	2.04	3,972	1.92	3,135	1.74	3,654	1.92
CHA	12,969	6.69	12,476	6.90	13,811	6.67	9,666	5.37	12,219	6.42
PHA	12,498	6.45	10,764	5.95	13,215	6.38	11,423	6.35	11,970	6.29
LAT	12,007	6.20	11,411	6.31	12,660	6.11	10,058	5.59	11,527	6.06
RAT	5,489	2.83	5,328	2.95	6,203	2.99	5,088	2.83	5,526	2.9
SUT	9,676	4.99	9,336	5.16	10,352	5.00	9,946	5.53	9,829	5.16
HUI	14,455	7.46	13,874	7.67	15,551	7.51	14,104	7.84	14,495	7.61
CUL	12,382	6.39	12,265	6.78	13,670	6.60	12,085	6.72	12,601	6.62
RAM	11,367	5.87	11,026	6.10	12,341	5.96	12,587	7.00	11,835	6.22
PET	13,086	6.75	12,287	6.80	15,153	7.32	11,685	6.50	13,049	6.85
SUK	23,261	12.01	21,967	12.15	25,616	12.36	25,758	14.31	24,160	12.71
SIR	11,813	6.10	9,504	5.26	10,709	5.17	8,903	4.95	10,220	5.37
KHO	1,676	0.86	1,562	0.86	1,831	0.88	1,368	0.76	1,608	0.84
LUM	7,490	3.87	6,749	3.73	7,761	3.75	6,877	3.82	7,217	3.79
SIL	14,464	7.46	13,625	7.54	15,372	7.42	13,234	7.36	14,169	7.44
SAM	7,215	3.72	6,905	3.82	8,482	4.09	5,988	3.33	7,144	3.75
HUA	12,538	6.47	10,910	6.03	12,613	6.09	10,673	5.93	11,676	6.13
Total	277,952	100	238,618	100	247,388	100	252,038	100	253,912	100

Note:

- (1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.

Table 16: Average Daily Departure Passenger of each station in 2011

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	6,868	3.56	6,604	3.66	7,354	3.56	6,892	3.84	6,930	3.65
KAM	3,782	1.96	3,698	2.05	3,780	1.83	3,176	1.77	3,607	1.90
CHA	11,278	5.84	11,049	6.13	12,180	5.90	8,901	4.96	10,844	5.71
PHA	13,638	7.06	11,112	6.16	13,970	6.76	12,123	6.76	12,704	6.69
LAT	12,654	6.55	12,095	6.71	13,888	6.72	10,914	6.08	12,382	6.52
RAT	3,361	1.74	3,309	1.83	3,893	1.88	3,298	1.84	3,466	1.83
SUT	8,684	4.50	8,371	4.64	9,378	4.54	8,794	4.90	8,807	4.64
HUI	12,683	6.57	12,206	6.77	14,037	6.79	12,567	7.00	12,873	6.78
CUL	12,727	6.59	12,696	7.04	14,034	6.79	12,170	6.78	12,906	6.80
RAM	11,453	5.93	11,245	6.23	12,639	6.12	12,885	7.18	12,061	6.35
PET	12,954	6.71	12,119	6.72	15,112	7.31	11,399	6.35	12,892	6.79
SUK	25,770	13.34	24,557	13.62	28,120	13.61	27,986	15.59	26,617	14.02
SIR	12,083	6.26	9,593	5.32	10,638	5.15	8,816	4.91	10,269	5.41
KHO	1,545	0.80	1,453	0.81	1,694	0.82	1,318	0.73	1,502	0.79
LUM	8,639	4.47	7,753	4.30	8,884	4.30	7,761	4.32	8,256	4.35
SIL	15,417	7.98	14,778	8.19	16,256	7.87	14,018	7.81	15,112	7.96
SAM	7,455	3.86	7,086	3.93	8,542	4.13	6,135	3.42	7,301	3.85
HUA	12,175	6.30	10,632	5.90	12,202	5.91	10,303	5.74	11,320	5.96
Total	193,165 (2)	100	180,355	100	206,603	100	179,458	100	189,848 (2)	100

Note:

- (1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.
- (2) Average passenger in 1st/2011 in this topic is not equal to average passenger in other topic, because data of 1st of January 2011 has a lot of errors.

Year 2012

Table 17: Accumulated Passengers in 2012 (Bangkok Metro Public Company Limited, 2013)

Directory	Number of Passenger					
	Carrying over 2011	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2012
Total passenger	69,040,480	20,051,013	18,988,016	20,876,732	20,686,566	80,602,327
Accumulated Passenger	461,474,632	481,525,645	500,513,661	521,390,393	542,076,959	

Table 18: Average Daily Passengers in 2012 (Bangkok Metro Public Company Limited, 2013)

Day	Number of Passengers				
	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2012
Average Passenger	247,459	245,546	260,523	257,187	252,826
Monday-Friday	162,364	146,820	157,476	158,033	155,819
Saturday Sunday and official holiday	138,230	120,806	141,284	120,998	129,416
Quarterly/Year	220,341	208,660	226,921	224,854	220,225
Percentage Change from last quarter	22.78 ⁽¹⁾	-5.3	8.75	-0.91	
Percentage Change from last year					16.21 ⁽²⁾

Note:

- (1) Average Passenger of 4th/2011 quarter is equal to 179,458 people. This number is used to compare with percentage change of 1st/ 2012.
- (2) Average Passenger of 2011 is equal to 189,506 people. This number is used to compare with percentage change in 2012.

Table 19: Average Daily Arrival Passenger of each station in 2012

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	7890	3.57	7545	3.61	8168	3.59	8110	3.60	7930	3.59
KAM	3,873	1.75	3,687	1.76	4,085	1.80	4,014	1.78	3,916	1.77
CHA	13,460	6.09	13,532	6.47	14,545	6.39	14,408	6.39	13,989	6.34
PHA	14,488	6.56	14,244	6.81	15,238	6.70	14,999	6.65	14,744	6.68
LAT	13,078	5.92	12,700	6.07	13,813	6.07	13,559	6.01	13,289	6.02
RAT	6,406	2.90	5,994	2.87	6,647	2.92	6,487	2.88	6,384	2.89
SUT	10,606	4.80	10,317	4.93	11,222	4.93	11,091	4.92	10,811	4.90
HUI	16,566	7.50	15,612	7.46	17,245	7.58	16,897	7.49	16,583	7.51
CUL	13,070	5.92	12,261	5.86	13,030	5.73	12,639	5.61	12,750	5.77
RAM	17,113	7.75	16,594	7.93	18,102	7.96	17,620	7.82	17,360	7.86
PET	15,367	6.96	14,114	6.75	16,647	7.32	15,474	6.86	15,404	6.98
SUK	29,887	13.53	28,387	13.57	30,350	13.34	30,326	13.45	29,741	13.47
SIR	11,798	5.34	11,021	5.27	10,200	4.48	11,992	5.32	11,252	5.10
KHO	1,847	0.84	1,658	0.79	1,851	0.81	1,750	0.78	1,777	0.80
LUM	8,138	3.68	7,647	3.66	8,422	3.70	8,228	3.65	8,110	3.67
SIL	15,136	6.85	14,559	6.96	15,732	6.91	15,907	7.06	15,336	6.95
SAM	8,431	3.82	7,555	3.61	9,325	4.10	8,703	3.86	8,506	3.85
HUA	13,745	6.22	11,753	5.62	12,901	5.67	13,240	5.87	12,911	5.85
Total	277,952	100	238,618	100	247,388	100	252,038	100	253,912	100

Note:

- (1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.

Table 20: Average Daily Departure Passenger of each station in 2012

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	7228	3.28	6945	3.33	7554	3.33	7452	3.31	7296	3.31
KAM	3,785	1.72	3,707	1.78	3,886	1.71	4,023	1.79	3,851	1.75
CHA	12,014	5.45	11,923	5.71	12,731	5.61	12,811	5.70	12,372	5.62
PHA	15,521	7.04	15,355	7.36	16,512	7.28	16,275	7.24	15,918	7.23
LAT	13,812	6.27	13,470	6.46	14,866	6.55	14,353	6.38	14,128	6.42
RAT	4,025	1.83	3,793	1.82	4,288	1.89	4,084	1.82	4,048	1.84
SUT	9,530	4.32	9,280	4.45	10,216	4.50	9,941	4.42	9,744	4.42
HUI	14,914	6.77	14,175	6.79	15,746	6.94	15,253	6.78	15,025	6.82
CUL	12,960	5.88	12,057	5.78	12,780	5.63	12,379	5.50	12,544	5.70
RAM	18,081	8.21	17,651	8.46	19,260	8.49	18,730	8.33	18,433	8.37
PET	15,236	6.91	13,712	6.57	16,418	7.23	15,059	6.70	15,110	6.86
SUK	32,423	14.71	30,687	14.71	32,854	14.48	32,966	14.66	32,236	14.64
SIR	11,742	5.33	11,059	5.30	10,084	4.44	11,958	5.32	11,210	5.09
KHO	1,717	0.78	1,540	0.74	1,715	0.76	1,641	0.73	1,653	0.75
LUM	9,321	4.23	8,585	4.11	9,515	4.19	9,290	4.13	9,179	4.17
SIL	16,082	7.30	15,420	7.39	16,522	7.28	16,857	7.50	16,223	7.37
SAM	8,631	3.92	7,683	3.68	9,434	4.16	8,879	3.95	8,659	3.93
HUA	13,319	6.04	11,618	5.57	12,540	5.53	12,903	5.74	12,596	5.72
Total	220,341	100	208,660	100	226,921	100	224,854	100	220,225	100

Note:

- (1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.

Year 2013

Table 21: Accumulated Passengers in 2013 (Bangkok Metro Public Company Limited, 2014)

Directory	Number of Passenger					
	Carrying over 2012	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2013
Total passenger	80,602,327	20,995,960	20,728,994	22,268,239	22,442,775	80,602,327
Accumulated Passenger	542,076,959	563,072,919	583,801,913	606,070,152	628,512,927	

Table 22: Average Daily Passengers in 2013 (Bangkok Metro Public Company Limited, 2014)

Day	Number of Passengers				
	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2013
Average Passenger	261,804	268,010	278,265	279,655	272,009
Monday-Friday	170,148	160,366	163,363	173,671	166,704
Saturday Sunday and official holiday	138,230	120,806	141,284	120,998	129,416
Quarterly/Year	233,288	227,791	242,046	243,943	236,811
Percentage Change from last quarter	3.75 ⁽¹⁾	-2.36	6.26	0.78	
Percentage Change from last year					7.53 ⁽²⁾

Note:

- (1) Average Passenger of 4th/2012 quarter is equal to 224,854 people. This number is used to compare with percentage change of 1st/ 2013.
- (2) Average Passenger of 2012 is equal to 220,225 people. This number is used to compare with percentage change in 2013.

Table 23: Average Daily Arrival Passenger of each station in 2013

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	8217	3.51	8081	3.54	8611	3.55	8865	3.62	8446	3.56
KAM	4,287	1.83	3,969	1.74	3,953	1.63	4,092	1.67	4,074	1.71
CHA	14,815	6.34	15,025	6.58	15,590	6.42	16,162	6.61	15,402	6.49
PHA	15,299	6.54	15,320	6.71	15,902	6.55	16,272	6.65	15,702	6.61
LAT	14,035	6.00	13,798	6.04	14,492	5.97	14,706	6.01	14,260	6.01
RAT	6,747	2.89	6,474	2.83	7,002	2.88	6,771	2.77	6,749	2.84
SUT	11,678	4.99	11,431	5.00	12,370	5.10	12,318	5.04	11,952	5.03
HUI	17,408	7.44	16,812	7.36	18,262	7.52	18,059	7.38	17,638	7.43
CUL	13,477	5.76	12,302	5.38	12,990	5.35	12,517	5.12	12,819	5.40
RAM	18,355	7.85	18,455	8.08	19,973	8.23	20,121	8.22	19,233	8.10
PET	15,864	6.78	15,025	6.58	17,931	7.39	17,425	7.12	16,570	6.98
SUK	31,582	13.50	30,975	13.56	32,973	13.59	32,984	13.48	32,135	13.53
SIR	11,423	4.89	12,707	5.56	10,622	4.38	12,508	5.11	11,815	4.97
KHO	1,856	0.79	1,729	0.76	1,857	0.76	1,791	0.73	1,808	0.76
LUM	8,859	3.79	8,373	3.66	9,006	3.71	8,790	3.59	8,758	3.69
SIL	17,065	7.30	16,863	7.38	17,856	7.36	17,701	7.24	17,375	7.32
SAM	8,799	3.76	8,719	3.82	10,059	4.14	9,264	3.79	9,214	3.88
HUA	14,121	6.04	12,375	5.42	13,265	5.47	14,302	5.85	13,516	5.69
Total	233890	100	228433	100	242715	100	244647	100	237466	100

Note:

- (1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.

Table 24: Average Daily Departure Passenger of each station in 2013

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	7,495	3.21	7,421	3.26	7,969	3.29	8,218	3.37	7,778	3.28
KAM	4,250	1.82	3,947	1.73	3,633	1.50	3,868	1.59	3,923	1.66
CHA	13,172	5.65	13,169	5.78	13,596	5.62	14,190	5.82	13,535	5.72
PHA	16,451	7.05	16,454	7.22	17,149	7.09	17,464	7.16	16,883	7.13
LAT	14,853	6.37	14,753	6.48	15,757	6.51	15,619	6.40	15,249	6.44
RAT	4,297	1.84	4,158	1.83	4,508	1.86	4,369	1.79	4,334	1.83
SUT	10,587	4.54	10,410	4.57	11,375	4.70	11,073	4.54	10,864	4.59
HUI	15,852	6.79	15,489	6.80	16,923	6.99	16,427	6.73	16,176	6.83
CUL	13,199	5.66	11,924	5.23	12,542	5.18	12,085	4.95	12,435	5.25
RAM	19,580	8.39	19,830	8.70	21,502	8.88	21,518	8.82	20,615	8.70
PET	15,426	6.61	14,438	6.34	17,490	7.23	16,831	6.90	16,054	6.78
SUK	34,170	14.65	33,381	14.65	35,573	14.70	36,128	14.81	34,820	14.70
SIR	11,288	4.84	12,680	5.57	10,435	4.31	12,486	5.12	11,722	4.95
KHO	1,760	0.75	1,634	0.72	1,749	0.72	1,652	0.68	1,699	0.72
LUM	10,028	4.30	9,467	4.16	10,169	4.20	9,857	4.04	9,881	4.17
SIL	18,022	7.73	17,723	7.78	18,605	7.69	18,834	7.72	18,299	7.73
SAM	9,006	3.86	8,808	3.87	10,089	4.17	9,350	3.83	9,316	3.93
HUA	13,853	5.94	12,104	5.31	12,981	5.36	13,976	5.73	13,228	5.59
Total	233288	100	227,791	100	242,046	100	243,943	100	236,811	100

Note:

- (1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.

Year 2014

Table 25: Accumulated Passengers in 2014 (Bangkok Metro Public Company Limited, 2015)

Directory	Number of Passenger					
	Carrying over 2013	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2014
Total passenger	86,435,968	24,949,649	21,654,739	22,705,980	23,127,623	92,437,991
Accumulated Passenger	628,512,927	653,462,576	675,117,315	697,823,295	720,950,918	

Table 26: Average Daily Passengers in 2014 (Bangkok Metro Public Company Limited, 2015)

Day	Number of Passengers				
	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2014
Average Passenger	310,461	280,146	285,558	287,322	291,092
Monday-Friday	203,611	167,248	166,712	177,122	177,890
Saturday Sunday and official holiday	138,230	120,806	141,284	120,998	129,416
Quarterly/Year	277,218	237,964	246,804	251,387	253,255
Percentage Change from last quarter	13.64 ⁽¹⁾	-14.16	3.71	1.86	
Percentage Change from last year					6.94 ⁽²⁾

Note:

- (1) Average Passenger of 4th/2013 quarter is equal to 243,943 people. This number is used to compare with percentage change of 1st/ 2014.
- (2) Average Passenger of 2013 is equal to 236,811 people. This number is used to compare with percentage change in 2014.

Table 27: Average Daily Arrival Passenger of each station in 2014

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	10,044	3.61	8811	3.69	8909	3.60	8934	3.54	9171	3.61
KAM	4,655	1.67	3,827	1.60	3,905	1.58	4,012	1.59	4,097	1.61
CHA	17,408	6.26	15,702	6.58	16,338	6.60	16,533	6.56	16,492	6.50
PHA	18,765	6.75	16,316	6.84	16,579	6.70	16,831	6.68	17,116	6.74
LAT	17,231	6.20	14,442	6.05	14,915	6.03	14,833	5.89	15,347	6.04
RAT	7,239	2.60	6,350	2.66	6,702	2.71	6,526	2.59	6,702	2.64
SUT	12,890	4.64	11,999	5.03	12,685	5.13	12,669	5.03	12,560	4.95
HUI	18,779	6.76	17,298	7.25	18,364	7.42	18,421	7.31	18,215	7.17
CUL	12,960	4.66	12,101	5.07	13,014	5.26	13,202	5.24	12,820	5.05
RAM	21,708	7.81	20,132	8.44	21,262	8.59	21,510	8.53	21,153	8.33
PET	19,809	7.13	16,356	6.85	18,868	7.63	18,838	7.47	18,466	7.27
SUK	36,735	13.22	31,810	13.34	33,145	13.40	33,894	13.45	33,886	13.36
SIR	13,534	4.87	12,683	5.32	10,220	4.13	13,193	5.23	12,401	4.88
KHO	2,658	0.96	1,786	0.75	1,895	0.77	1,889	0.75	2,054	0.81
LUM	11,291	4.06	8,838	3.70	9,255	3.74	9,166	3.64	9,631	3.79
SIL	22,721	8.17	18,642	7.81	18,299	7.40	18,440	7.32	19,510	7.68
SAM	12,024	4.33	8,872	3.72	10,162	4.11	9,783	3.88	10,204	4.02
HUA	17,504	6.30	12,655	5.30	12,871	5.20	13,366	5.30	14,084	5.55
Total	277,952	100	238,618	100	247,388	100	252,038	100	253,912	100

Note:

(1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.

(2) Data in each quarter has error as follows:

- 1st of January 2014 - 2nd of January 2014 - 15th of May 2014
- 21st of June 2014 - 9th of August 2014 - 10th of August 2014

Table 28: Average Daily Departure Passenger of each station in 2014

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	9490	3.42	8316	3.49	8374	3.39	8308	3.30	8618	3.40
KAM	4,332	1.56	3,679	1.55	3,677	1.49	3,837	1.53	3,879	1.53
CHA	16,111	5.81	13,922	5.85	14,484	5.87	15,008	5.97	14,877	5.87
PHA	19,707	7.11	17,184	7.22	17,587	7.13	17,827	7.09	18,070	7.13
LAT	18,143	6.54	15,619	6.56	16,127	6.53	15,731	6.26	16,398	6.47
RAT	4,668	1.68	4,151	1.74	4,426	1.79	4,286	1.71	4,382	1.73
SUT	11,664	4.21	10,872	4.57	11,575	4.69	11,454	4.56	11,391	4.50
HUI	17,526	6.32	16,056	6.75	17,155	6.95	17,053	6.78	16,947	6.69
CUL	12,621	4.55	11,761	4.94	12,766	5.17	12,817	5.10	12,493	4.93
RAM	23,428	8.45	21,535	9.05	22,733	9.21	22,936	9.12	22,657	8.95
PET	18,757	6.77	15,523	6.52	18,076	7.32	17,908	7.12	17,565	6.94
SUK	39,434	14.23	34,246	14.40	35,635	14.45	36,407	14.48	36,420	14.39
SIR	13,570	4.89	12,843	5.40	10,202	4.13	13,621	5.42	12,553	4.96
KHO	2,421	0.87	1,748	0.73	1,807	0.73	1,793	0.71	1,940	0.77
LUM	12,188	4.40	9,817	4.13	10,335	4.19	10,250	4.08	10,641	4.20
SIL	23,361	8.43	19,411	8.16	18,919	7.67	19,157	7.62	20,197	7.97
SAM	12,079	4.36	8,742	3.67	10,255	4.16	9,781	3.89	10,208	4.03
HUA	17,717	6.39	12,542	5.27	12,671	5.13	13,214	5.26	14,020	5.54
Total	277,217	100	237,966	100	246,804	100	251,387	100	253,255	100

Note:

(1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.

(2) Data in each quarter has error as follows:

- 1st of January 2014
- 2nd of January 2014
- 15th of May 2014
- 21st of June 2014
- 9th of August 2014
- 10th of August 2014

Year 2015

Table 29: Accumulated Passengers in 2015 (Bangkok Metro Public Company Limited, 2016)

Directory	Number of Passenger					
	Carrying over 2014	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2015
Total passenger	92,437,991	23,482,811	22,592,917	24,585,847	24,357,121	95,018,696
Accumulated Passenger	720,950,918	744,433,729	767,026,646	791,612,493	815,969,614	

Table 30: Average Daily Passengers in 2015 (Bangkok Metro Public Company Limited, 2016)

Day	Number of Passengers				
	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2015
Average Passenger					
Monday-Friday	297,156	296,398	302,714	302,555	299,811
Saturday Sunday and official holiday	184,701	171,275	190,167	186,623	182,638
Quarterly/Year	260,920	248,274	267,237	264,751	260,325
Percentage Change from last quarter	3.79 ⁽¹⁾	4.85-	7.64	-0.93	
Percentage Change from last year					2.79 (2)

Note:

- (1) Average Passenger of 4th/2014 quarter is equal to 243,943 people. This number is used to compare with percentage change of 1st/ 2015.
- (2) Average Passenger of 2014 is equal to 236,811 people. This number is used to compare with percentage change in 2015.

Table 31: Average Daily Arrival Passenger of each station in 2015

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	9,060	3.46	8,762	3.52	9,533	3.56	9,353	3.52	9,179	3.52
KAM	4,137	1.58	3,687	1.48	3,788	1.41	3,728	1.40	3,834	1.47
CHA	16,875	6.45	16,685	6.70	17,951	6.70	17,802	6.70	17,332	6.64
PHA	17,053	6.52	16,525	6.64	17,477	6.52	16,958	6.39	17,004	6.51
LAT	15,216	5.82	14,593	5.86	15,596	5.82	15,324	5.77	15,184	5.82
RAT	6,809	2.60	6,627	2.66	7,256	2.71	6,968	2.62	6,916	2.65
SUT	13,046	4.99	12,462	5.01	13,522	5.05	13,268	5.00	13,076	5.01
HUI	18,774	7.18	17,927	7.20	19,086	7.12	18,686	7.04	18,619	7.13
CUL	14,767	5.64	14,538	5.84	16,233	6.06	16,302	6.14	15,466	5.92
RAM	22,254	8.51	21,681	8.71	23,404	8.73	22,696	8.55	22,512	8.62
PET	19,999	7.64	18,573	7.46	21,761	8.12	20,995	7.91	20,339	7.79
SUK	35,017	13.39	33,866	13.60	35,836	13.37	35,399	13.33	35,033	13.42
SIR	12,341	4.72	12,615	5.07	11,138	4.16	12,900	4.86	12,247	4.69
KHO	1,923	0.74	1,794	0.72	2,009	0.75	1,894	0.71	1,905	0.73
LUM	9,727	3.72	9,016	3.62	9,899	3.69	9,574	3.61	9,554	3.66
SIL	19,835	7.58	18,392	7.39	19,554	7.30	19,432	7.32	19,303	7.39
SAM	10,090	3.86	8,996	3.61	10,758	4.01	10,429	3.93	10,071	3.86
HUA	14,681	5.61	12,202	4.90	12,202	4.55	13,843	5.21	13,466	5.16
Total	261,604	100	248,940	100	267,950	100	265,550	100	261,040	100

Note:

- (1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.
- (2) There was passenger card test after operation time in July 2015 – September 2015.

Table 32: Average Daily Departure Passenger of each station in 2015

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	8,418	3.23	8,073	3.25	8,847	3.31	8,661	3.27	8,501	3.27
KAM	3,897	1.49	3,557	1.43	3,533	1.32	3,584	1.35	3,642	1.40
CHA	15,480	5.93	15,288	6.16	16,346	6.12	16,590	6.27	15,930	6.12
PHA	17,692	6.78	17,141	6.90	18,283	6.84	17,487	6.61	17,652	6.78
LAT	15,999	6.13	15,229	6.13	16,767	6.27	16,517	6.24	16,131	6.20
RAT	4,528	1.74	4,368	1.76	4,820	1.80	4,617	1.74	4,584	1.76
SUT	11,937	4.57	11,428	4.60	12,506	4.68	12,060	4.56	11,985	4.60
HUI	17,368	6.66	16,506	6.65	17,863	6.68	17,376	6.56	17,280	6.64
CUL	14,995	5.75	15,085	6.08	16,908	6.33	16,985	6.42	16,001	6.15
RAM	23,802	9.12	23,208	9.35	24,868	9.31	23,988	9.06	23,970	9.21
PET	18,951	7.26	17,476	7.04	20,442	7.65	19,599	7.40	19,122	7.35
SUK	37,529	14.38	36,379	14.65	38,320	14.34	37,985	14.35	37,557	14.43
SIR	12,359	4.74	12,679	5.11	11,055	4.14	12,998	4.91	12,272	4.71
KHO	1,858	0.71	1,687	0.68	1,917	0.72	1,811	0.68	1,818	0.70
LUM	10,925	4.19	9,954	4.01	10,976	4.11	10,597	4.00	10,613	4.08
SIL	20,426	7.83	19,038	7.67	20,020	7.49	19,845	7.50	19,831	7.62
SAM	10,157	3.89	8,970	3.61	10,732	4.02	10,367	3.92	10,059	3.86
HUA	14,594	5.59	12,209	4.92	13,036	4.88	13,686	5.17	13,378	5.14
Total	277,217	100	237,966	100	246,804	100	251,387	100	253,255	100

Note:

- (1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.
- (2) There was passenger card test after operation time in July 2015 – September 2015.

Year 2016

Table 33: Accumulated Passengers in 2016 (Bangkok Metro Public Company Limited, 2017)

Directory	Number of Passenger					Year 2016
	Carrying over 2015	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	
Total passenger	95,018,696	24,752,983	23,429,701	26,036,662	25,931,928	100,151,274
Accumulated Passenger	815,969,614	840,722,597	864,152,298	890,188,960	916,120,888	

Table 34: Average Daily Passengers in 2016 (Bangkok Metro Public Company Limited, 2017)

Day	Number of Passengers				
	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	Year 2016
Average Passenger					
Monday-Friday	309,369	306,422	325,847	323,544	316,511
Saturday Sunday and official holiday	187,954	179,145	194,471	195,740	188,936
Quarterly/Year	272,011	257,469	283,007	281,869	273,637
Percentage Change from last quarter	2.74(1)	5.35-	9.92	-0.40	
Percentage Change from last year					5.11(2)

Note:

- (1) Average Passenger of 4th/2015 quarter is equal to 264,751 people. This number is used to compare with percentage change of 1st/ 2016.
- (2) Average Passenger of 2015 is equal to 260,325 people. This number is used to compare with percentage change in 2016.

Table 35: Average Daily Arrival Passenger of each station in 2016

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	9,411	3.45	9,135	3.54	12,258	4.32	14,064	4.98	11,228	4.09
KAM	3,824	1.4	3,574	1.39	3,993	1.41	4,700	1.66	4,024	1.47
CHA	18,248	6.69	18,116	7.02	20,623	7.27	21,336	7.55	19,588	7.14
PHA	16,367	6	16,091	6.24	16,764	5.91	17,037	6.03	16,567	6.04
LAT	15,702	5.76	14,970	5.8	16,106	5.68	16,021	5.67	15,702	5.73
RAT	7,168	2.63	6,754	2.62	7,382	2.6	7,174	2.54	7,121	2.6
SUT	13,848	5.08	13,118	5.08	14,180	5	13,736	4.86	13,722	5
HUI	18,931	6.94	17,946	6.96	19,178	6.76	18,619	6.59	18,670	6.81
CUL	17,486	6.41	16,885	6.54	18,241	6.43	17,603	6.23	17,556	6.4
RAM	23,164	8.5	22,385	8.68	24,292	8.57	23,899	8.46	23,439	8.55
PET	21,765	7.98	19,587	7.59	22,639	7.98	21,944	7.77	21,488	7.84
SUK	36,583	13.42	34,976	13.56	37,755	13.32	36,166	12.8	36,373	13.26
SIR	11,590	4.25	12,642	4.9	12,184	4.3	12,581	4.45	12,250	4.47
KHO	1,965	0.72	1,759	0.68	1,984	0.7	1,992	0.71	1,925	0.7
LUM	10,389	3.81	9,522	3.69	10,467	3.69	9,803	3.47	10,046	3.66
SIL	20,850	7.65	18,879	7.32	20,723	7.31	19,776	7	20,058	7.31
SAM	10,635	3.9	9,190	3.56	10,864	3.83	10,453	3.7	10,287	3.75
HUA	14,737	5.4	12,474	4.83	13,911	4.91	15,542	5.5	14,169	5.17
Total	272,664	100	258,003	100	283,543	100	282,446	100	274,212	100

Note:

- (1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.

Table 36: Average Daily Departure Passenger of each station in 2016

Station	Average Passenger									
	1st quarter		2nd quarter		3rd quarter		4th quarter		5th quarter	
	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent	Passengers	Percent
BAN	8,647	3.18	8,426	3.27	11,644	4.11	13,433	4.77	10,548	3.85
KAM	3,606	1.33	3,377	1.31	3,663	1.29	4,576	1.62	3,807	1.39
CHA	16,840	6.19	16,516	6.41	18,398	6.5	18,985	6.74	17,690	6.46
PHA	17,092	6.28	16,801	6.53	17,628	6.23	17,985	6.38	17,379	6.35
LAT	17,046	6.27	16,354	6.35	18,284	6.46	17,683	6.27	17,345	6.34
RAT	4,799	1.76	4,538	1.76	5,081	1.8	4,954	1.76	4,844	1.77
SUT	12,662	4.66	12,030	4.67	13,119	4.64	12,624	4.48	12,610	4.61
HUI	17,643	6.49	16,714	6.49	18,220	6.44	17,396	6.17	17,495	6.39
CUL	18,547	6.82	18,037	7.01	19,415	6.86	18,719	6.64	18,682	6.83
RAM	24,419	8.98	23,565	9.15	25,479	9	25,108	8.91	24,646	9.01
PET	20,380	7.49	18,344	7.12	21,096	7.45	20,465	7.26	20,075	7.34
SUK	39,003	14.34	37,341	14.5	40,212	14.21	38,783	13.76	38,838	14.19
SIR	11,457	4.21	12,512	4.86	11,954	4.22	12,423	4.41	12,087	4.42
KHO	1,872	0.69	1,720	0.67	1,969	0.7	1,956	0.69	1,880	0.69
LUM	11,601	4.26	10,475	4.07	11,415	4.03	10,675	3.79	11,041	4.04
SIL	21,134	7.77	19,219	7.46	20,957	7.4	20,012	7.1	20,331	7.43
SAM	10,572	3.89	9,084	3.53	10,633	3.76	10,328	3.66	10,156	3.71
HUA	14,690	5.4	12,418	4.82	13,842	4.89	15,762	5.59	14,181	5.18
Total	272,011	100	257,469	100	283,007	100	281,869	100	273,637	100

Note:

- (1) The result of average passenger would be in decimal number. However, it would be roundup to be integer. So, some numbers might be error.

APPENDIX 3– Comparing Data

Table 37: Table: Accumulated Passengers 2011-2016

Year	2011	2012	2013	2014	2015	2016
Total passenger	69,040,480	80,602,327	86,435,968	92,437,991	95,018,696	100,151,274
Accumulated Passenger	2	9	7	8	4	8

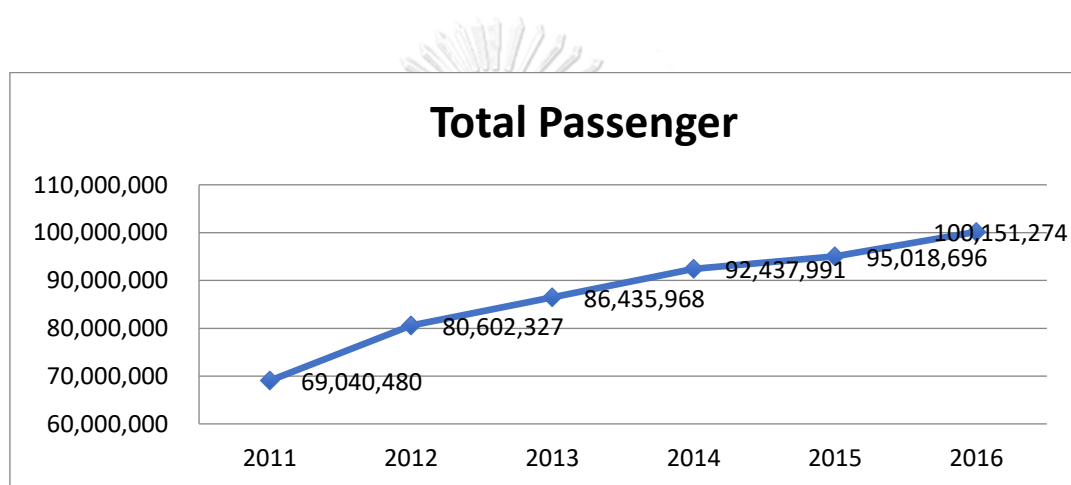


Figure 30: Graph of total passenger in 2011-2016

Table 38: Average Daily Passenger 2011-2016 for overall stations of blue line

Year	2011	2012	2013	2014	2015	2016
Monday-Friday	220,552	252,826	272,009	291,092	299,811	316,511
Saturday Sunday and official holiday	129,416	155,819	166,704	177,890	182,638	188,936
Average	189,506	220,225	236,811	253,255	260,325	273,637
Percentage Change from last year	6.53	16.21	7.53	6.94	2.79	5.11

Table 39: Average Daily Passenger of Thailand Cultural Center in 2011-2016

Year	2011	2012	2013	2014	2015	2016
Arrival	12,601	12,750	12,819	12,820	15,466	17,556
Departure	12,906	12,544	12,435	12,493	16,001	18,682

APPENDIX 4: Interview form

Interview form 1

Interview 1

Interview for MRT development

Gender: Male Female

Age: 24 years old

Monthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000

What facilities would make your day easier?

convenient store and coffee shop

What facilities would make your day happier?

Art work to decoration in the station

Any more suggestions to create utilize for the space in MRT

I want WIFI and Toilet

Figure 31: The result of Interview 1 (1/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 24 years old

Monthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000

What facilities would make your day easier?

nice coffee shop and convenience store
atm and post office

What facilities would make your day happier?

WiFi intive station would be nice
and even better if could have in the train as well

Any more suggestions to create utilize for the space in MRT

-

Figure 32: The result of Interview 1 (2/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 27 years old

Monthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000

What facilities would make your day easier?

Convenient store to grab a quick breakfast.

What facilities would make your day happier?

I like listening to music so maybe some live music in the station would liven up the place quite a bit.

Any more suggestions to create utilize for the space in MRT

Toilets would make the station more convenient.

Figure 33: The result of Interview 1 (3/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 20 years old

Monthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000

What facilities would make your day easier?

I want to have coffee shop so I can get
some coffee by the time I walk out

What facilities would make your day happier?

Clearer sign for the direction as I get
confuse with the platform sometime

Any more suggestions to create utilize for the space in MRT

some ~~has~~ music in the station
as it's so ~~quite~~ quiet in some
part of the station

Figure 34: The result of Interview 1 (4/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 22 years old

Monthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000

What facilities would make your day easier?

coffee shop and express bank and post office
would be nice to have in MRT

What facilities would make your day happier?

having WIFI

Any more suggestions to create utilize for the space in MRT

tourist suggestion

Figure 35: The result of Interview 1 (5/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 28 years old

Monthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000

What facilities would make your day easier?

Bank Tablet ~~conter~~ 7-11 / Family Mart / Lawson
Restaurant

What facilities would make your day happier?

Co-working space
Wi-Fi

Any more suggestions to create utilize for the space in MRT

Guild post

Figure 36: The result of Interview 1 (6/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 26 years old

Monthly income: lower than 10,000 10,000-30,000

30,001-50,000 More than 50,000

What facilities would make your day easier?

TOILETS AND WIFI. TOILETS TO FIX MY MAKEUP
AND WIFI TO BE ABLE CHECK E-MAILS BEFORE
WORK.

What facilities would make your day happier?

PROMOTIONS, MARKETING EVENTS, THIS MRT
STATION GETS TOO QUIET SOMETIMES

Any more suggestions to create utilize for the space in MRT

THERE IS STILL ALOT OF FREE SPACE THAT CAN
BE used.

Figure 37: The result of Interview 1 (7/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 42 years old

Monthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000

What facilities would make your day easier?

show time for the time table in the station

What facilities would make your day happier?

Wifi would be nice for using as
in underground have me signal sometimes

Any more suggestions to create utilize for the space in MRT

toilet in the station
also more coffee shop

Figure 38: The result of Interview 1 (8/15)

Interview 1**Interview for MRT development**Gender: Male FemaleAge: 28 years oldMonthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000**What facilities would make your day easier?**

having convenience store and more
spot for ATM.; post office in big station

What facilities would make your day happier?

WIFI within every station

Any more suggestions to create utilize for the space in MRT

wish it could have toilet

Figure 39: The result of Interview 1 (9/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 35 years old

Monthly income: lower than 10,000 10,000-30,000

30,001-50,000 More than 50,000

What facilities would make your day easier?

Grab and Go restaurant

Each Exit conned to each other

Post office

What facilities would make your day happier?

Coffee shop

Spa / Massage

Any more suggestions to create utilize for the space in MRT

Toilet WIFI Resting Area

Travel Information

Co-working space

Figure 40: The result of Interview 1 (10/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 25 years old

Monthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000

What facilities would make your day easier?

~~Toilets~~ Toilets; it is impossible for anyone
to anticipate when you have to use it.
Wifi is also important. It is very important
to stay connected.

What facilities would make your day happier?

Live music would give a fresh start to a
~~morning~~ stressful morning.

Any more suggestions to create utilize for the space in MRT

Put in more stores; ~~is~~ too much space.
for people to spread around.

Figure 41: The result of Interview 1 (11/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 22 years old

Monthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000

What facilities would make your day easier?

Rest Office

On time time table of train at that station.

What facilities would make your day happier?

Sleeping place

Easy Restaurant

Mini mart

Coffee shop

Any more suggestions to create utilize for the space in MRT

WC-RT

Toilet

Rest-office

Figure 42: The result of Interview 1 (12/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 29 years old

Monthly income: lower than 10,000 10,000-30,000

30,001-50,000 More than 50,000

What facilities would make your day easier?

post office and ATM in the main
station

What facilities would make your day happier?

sleep capsule for getting some rest
Free WiFi in the station

Any more suggestions to create utilize for the space in MRT

coffee shop or convenience store

Figure 43: The result of Interview 1 (13/15)

Interview 1

Interview for MRT development

Gender: Male Female

Age: 31 years old

Monthly income: lower than 10,000 10,000-30,000
 30,001-50,000 More than 50,000

What facilities would make your day easier?

~~lift and toilets and sleeping capsule.~~
 Sleeping capsules and a working. If there
 is urgent that can be done on the spot
 then that would be convenient.

What facilities would make your day happier?

I would enjoy art exhibition host at
 in the MRT station.

Any more suggestions to create utilize for the space in MRT

Toilets please

Figure 44: The result of Interview 1 (14/15)

Interview 1**Interview for MRT development**Gender: Male FemaleAge: 28 years oldMonthly income: lower than 10,000 10,000-30,000 30,001-50,000 More than 50,000

What facilities would make your day easier?

Express banking services. I use the bank
a lot so it would make my life much
easier

What facilities would make your day happier?

Live music would be a great addit
addition to the MRT stations.

Any more suggestions to create utilize for the space in MRT

Figure 45: The result of Interview 1 (15/15)

Interview 2



REGIONAL CENTRE FOR MANUFACTURING SYSTEMS ENGINEERING
 Faculty of Engineering, Chulalongkorn University
 Phayathai Road, Bangkok 10330, Thailand
 Tel. (662)2186804, Fax (662)2186805, Email: Cuse.chual@gmail.com

Interview 2

Candidate's name: Mr.Anawin Juntaruthai

Interviewed by: Ms.Wirasinee Tongsoo

1. Why do you think there are opportunities to develop Thailand Cultural Center underground station?

I would like to separate Opportunities of Thailand Cultural Center underground station into 4 factors by land's utilization:

1. Convenient Store and Nightspots (Esplanade and Ratchada's Trian night market)
2. There are a lot of office buildings near this station such as AIA building, True corporation building and etc.
3. In the future, This station will be transit underground station between orange line and blue line.
4. Near China's Embassy

According to above 4 factors, they will attract people to use underground station and travel by underground rail more.

2. What is strength of Thailand Cultural Center underground station?

Strength of this station:

Future: Transit station between orange line and blue line.

Present: Land is using for many activities.

CHULALONGKORN UNIVERSITY

Figure 46: Result of Interview 2 (1/2)

3. What is weakness of this station that it needs to be developed?

I would separate into 2 points:

1. Station layout is not appropriate for commercial development
2. There are empty spaces, which lack of management and development. This area should be developed for attracting customer

4. What is threat of this station, that makes this station undeveloped?

1. Layout/zoning of station
 2. Area development in this station is slower than Rama9, which is next to this station
 3. No connected walk way between station and Esplanade (convenient store)
- Therefore, this station cannot be attracted passengers.

Anon

(Interview Signature)

(ANONIN Juntarathai)

Figure 47: Result of Interview (2/2)

APPENDIX 5: Feedback and Comment from Thailand underground station



REGIONAL CENTRE FOR MANUFACTURING SYSTEMS ENGINEERING



REGIONAL CENTRE FOR MANUFACTURING SYSTEMS ENGINEERING

Faculty of Engineering, Chulalongkorn University

Phayathai Road, Bangkok 10330, Thailand

Tel. (662)2186804, Fax (662)2186805, Email: Cuse.chual@gmail.com

Company Feedback

	Excellent	Good	Fair	Poor
1. How appropriate is the approaching methodology	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. How would you rate the overall quality of the thesis	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. How practical is the thesis towards the development of underground transit station	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. How effective is the solution towards the problem found	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. How satisfy underground transit station toward the result in overall	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comment and suggestions

..The concept of design satisfy passengers at study station. Overall.....
 ..method and analysis might help our company to create the master plan.....
 to develop other station in very soon future. The result is well
 constructed in academic purpose and realistic. However, all of these
 have to be under government policy and agreement for the actual
 operation, which has to study and apply when designing the master
 plan.

Signature *S. Sutlayam*
 (Somprasong S.)

Figure 48: Feedback and Comment from Thailand underground station

VITA

Miss Wirasinee Tongsoo was born on 12th November 1991 in Khonkaen, Thailand. In 2010, she firstly finished the high school from Demonstration school of Khonkaen University (secondary school) in Khonkaen, Thailand. Then she continued her education in the dual undergraduate degrees of Chemical Engineering from Thammasat University, Thailand and University of Nottingham, United Kingdom in 2010 and graduated in 2014.

Afterwards, she decided to start the dual degree in 2014 in Supply Chain and Logistics Management (SCLM) with the cooperation of the Regional Centre for Manufacturing Systems Engineering, Chulalongkorn University, Thailand and University of Warwick, United Kingdom.





จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY