An Evaluation of the Effectiveness of the Travel Restriction Policy During the COVID-19 Pandemic to Control the Numbers of Daily Rail Passengers in the Bangkok Metropolitan Region

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Study team

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OUTLINE

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- • COVID-19 Thailand Situation
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- • Travel Restriction Policies Focused in the Study
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- • Analysis of the Effectiveness of the Travel Restriction Policy to Control the Number of Daily Rail Passengers

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INTRODUCTION

Background

❖ Impact of COVID-19 pandemic especially policies implemented by the Government to public transport focusing on railway system can be perceived

- Less travel, less demand: A reduction in railway occurs naturally due to the outbreak situation. However, the government is still not confident that this level of reduction will decrease the spread of the COVID-19 virus

- Number of passengers needs to be controlled to prevent the further virus spread, by using policies to reduce demand to a satisfactory level
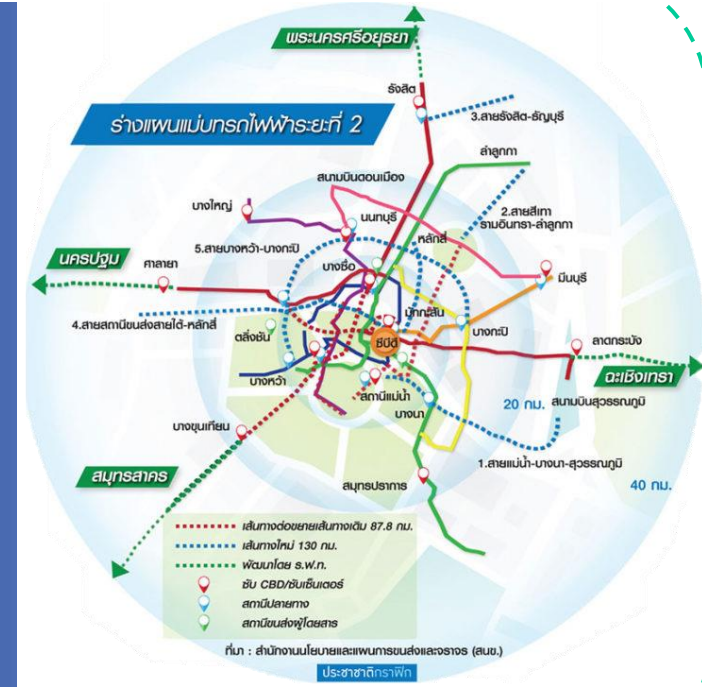
This study delves into the "Project for Enhancing the Capacity of the Formulation of the Second Mass Rapid Transit Master Plan in the Bangkok Metropolitan Region" (M-MAP2).

Rail System in the Bangkok Metropolitan Region (BMR)

Table 1. Summary of the rail system in the BMR

| Line	Owner	Station	Length	Purpose
BTS Sukhumvit Line	BMA	47	59.3	Support the North-East Corridor
Silom Line	BMA	14	14	Support the South-West Corridor
MRT Blue Line	MRTA	38	48	Support the Circular Corridor
Purple Line	MRTA	16	23.6	Support the North-West Corridor
SRT Inter-city	SRT	29	89.95	Collect Passengers from other provinces
ARL (City line)	SRT	8	28.6	Support airport transfers
Red Line	SRT	14	36.6	Support the North-West Corridor

Rail System in the Bangkok Metropolitan Region (BMR)
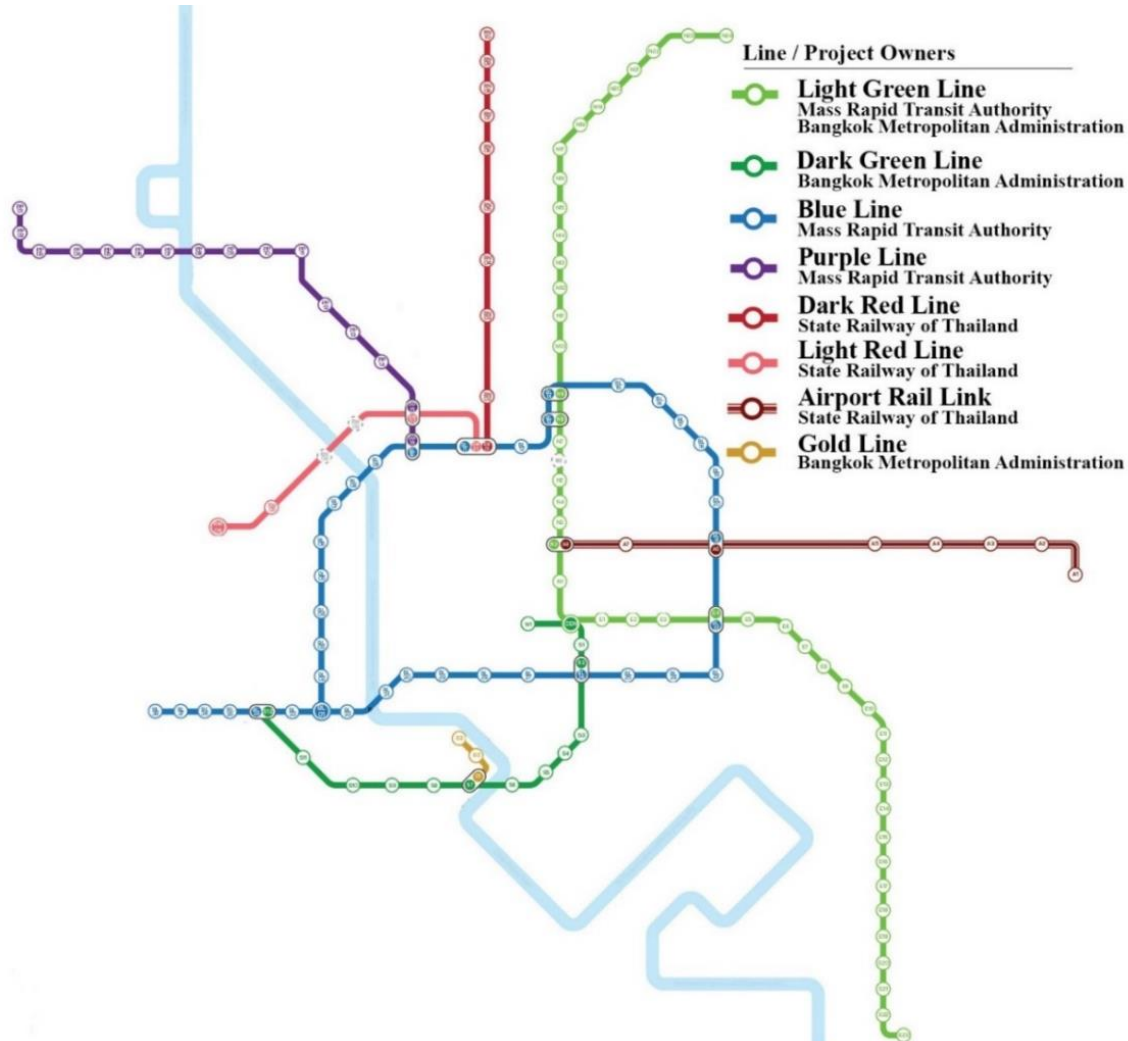
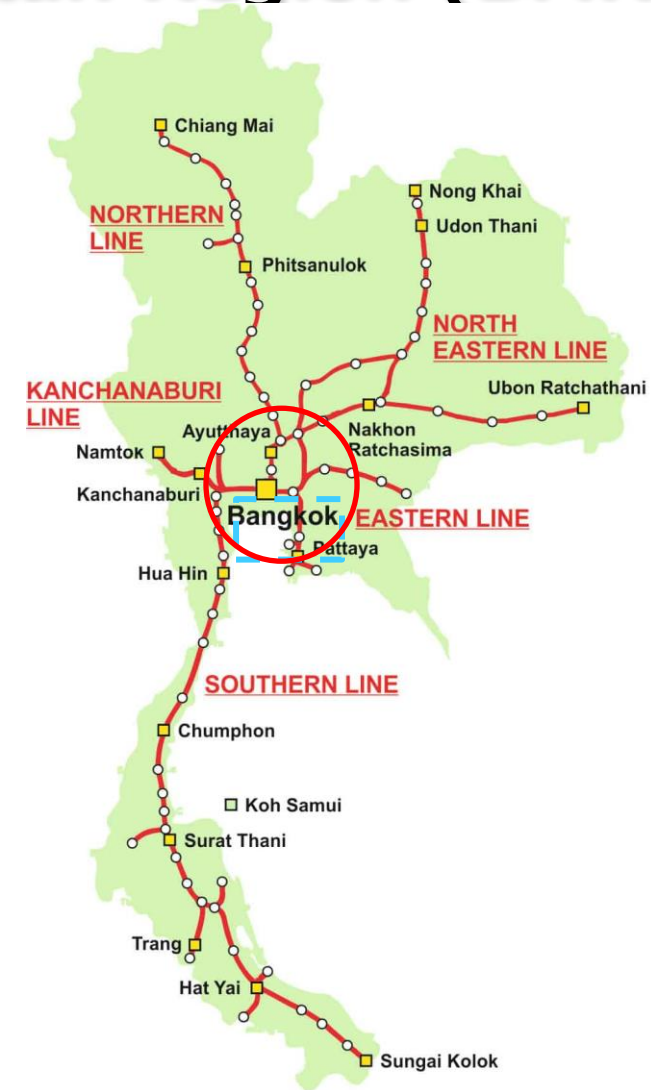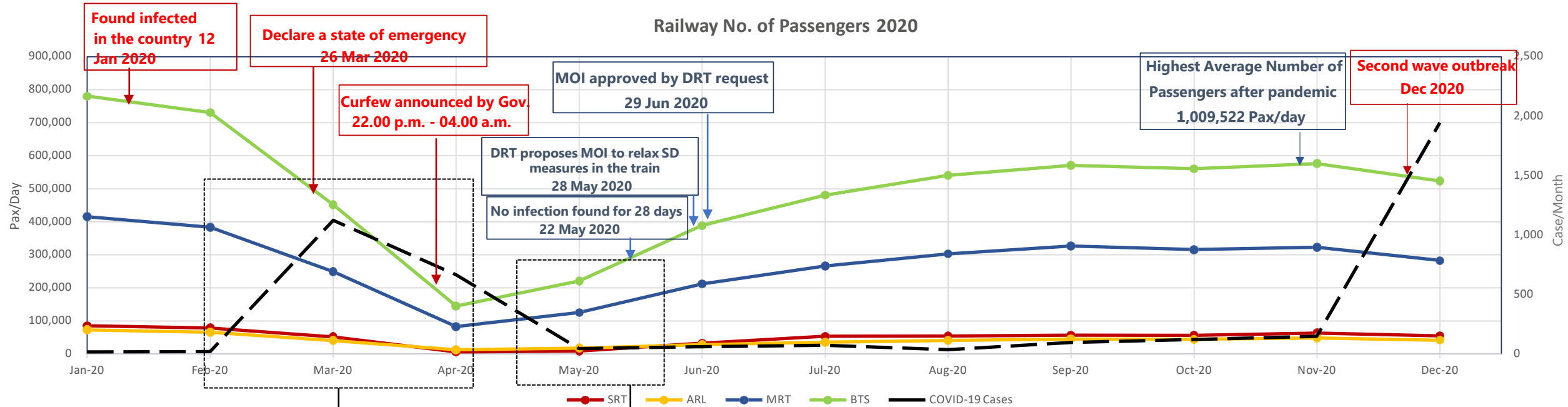Figure 1. Bangkok mass rapid transit system in the BMR (Clare, 2022)

Figure 2. Thailand SRT train map

Average monthly passenger traffic in rail transport compared to the COVID-19 outbreak situation and number of COVID-19 cases during January 2020

Railway No. of Passengers 2020

Found infected in the country 12 Jan 2020

Declare a state of emergency 26 Mar 2020

Curfew announced by Gov. 22.00 p.m. - 04.00 a.m.

MOI approved by DRT request 29 Jun 2020

Highest Average Number of Passengers after pandemic 1,009,522 Pax/day

Second wave outbreak Dec 2020

DRT proposes MOI to relax SD measures in the train 28 May 2020

No infection found for 28 days 22 May 2020
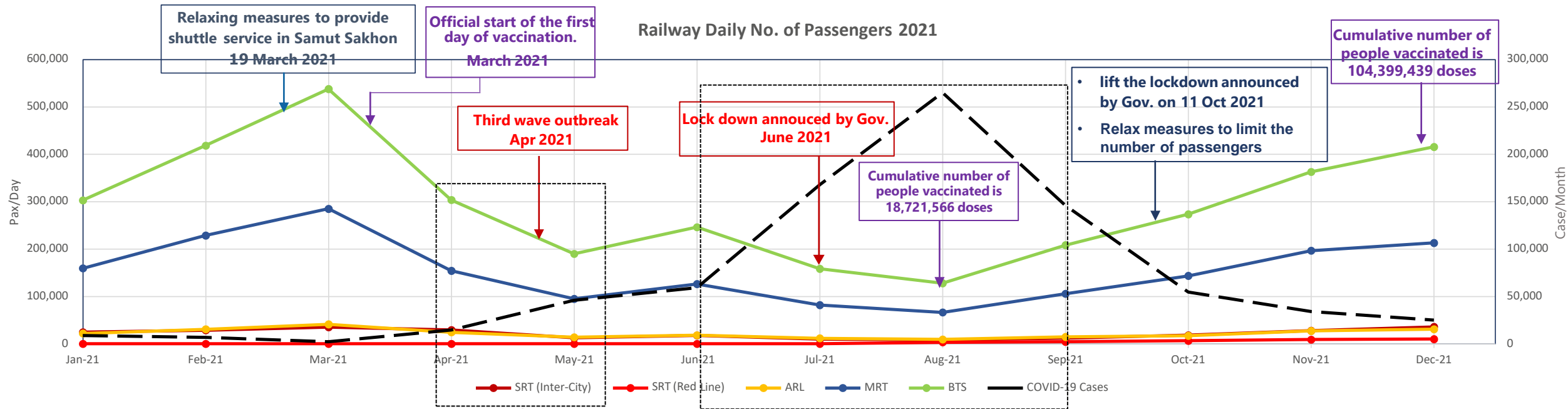
Legend: SRT — ARL — MRT — BTS — COVID-19 Cases

- (First Outbreak) Number of COVID cases getting higher
- Curfew 10 p.m. – 4.00 a.m. announced by Gov.
- Time and spatial travel restrictions
- Fear and Panic

- Number of COVID cases getting lower.
- Measures Relaxation by Ministry of Interior (MOI).

Average monthly passenger traffic in rail transport compared to the COVID-19 outbreak situation and number of COVID-19 cases during January 2021

Relaxing measures to provide shuttle service in Samut Sakhon 19 March 2021

Official start of the first day of vaccination. March 2021

Railway Daily No. of Passengers 2021

Cumulative number of people vaccinated is 104,399,439 doses

Third wave outbreak Apr 2021

Lock down annouced by Gov. June 2021

- lift the lockdown announced by Gov. on 11 Oct 2021
- Relax measures to limit the number of passengers

Cumulative number of people vaccinated is 18,721,566 doses

SRT (Inter-City) SRT (Red Line) ARL MRT BTS COVID-19 Cases

- Third wave outbreak
- Number of people infected getting higher
- The number of passengers are not decrease much due to people beginning to receive vaccines.
- Closures of major travel destinations
- Promotion of remote work practices

- Lockdown announced by Gov.
- Curfew 10.00 p.m. – 04.00 a.m. announced by Gov.
- Train operation time 04.00 a.m. – 9.00 p.m. announced by DRT
- Highest number of COVID cases

To Evaluate the effectiveness of travel restriction measures in Thailand during the pandemic. Specifically, focus on:

Source: https://travel.kapook.com/view226286.html

Source:https://www.thairath.co.th/money/business_marketing/marketing/2115855

Source: https://www.dittothailand.com/dittonews/5-working-edition-in-the-future/

| 1.Time and spatial travel restrictions | 2.Closures of major travel destinations | 3.Promotion of remote work practices |

To **understand how these policies impacted daily rail passenger** in the Bangkok Metropolitan Region during the COVID-19 outbreak.

LITERATURE REVIEW

Source: https://travelpro.com/blogs/the-travelpro-blog/avoid-getting-sick-on-your-commute

Source: https://asia.nikkei.com/Spotlight/Coronavirus/Less-crowded-but-Tokyo-loop-train-is-far-from-empty

Source: https://www.today.com/health/public-transit-covid-19-what-expect-your-commute-t184042

- The COVID-19 pandemic began in December 2019 and has impacted over 30 million people globally.
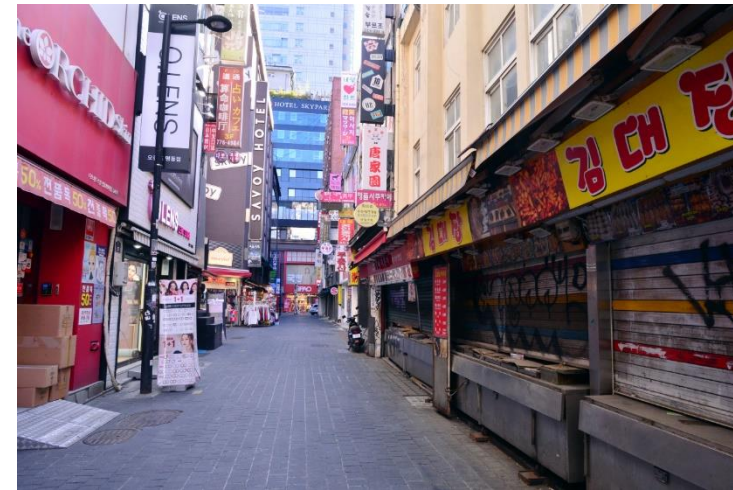- Crowded public transport systems were identified as potential risk zones for virus transmission.

- Pandemic-induced anxiety resulted in a sharp decline in public transport usage:
  - UK a 77% decrease.
  - Canada observed a 75% decrease.
  - The US experienced a 70% decrease.
  (Salmi et al., 2021)

Reference: Study Team

Country	Example of Government Reactions
Japan	Modifying service schedules, encouraging off-peak travel, and promoting remote work.
Singapore (Lee & Ong, 2020)	Introduced policies promoting remote work and online education, limited travel across high-risk zones, and closely tracked infected groups.
South Korea (Le, 2022)	Reduced travel in Seoul by shutting major destinations e.g., restaurants and community spaces.

Source: https://hbr.org/2021/01/what-to-do-if-your-team-doesnt-want-to-go-back-to-the-office

Source:https://www.koreaherald.com/view.php?ud=20210115000301

Literature Review: Previous Case Studies

Researcher(s)	Focus Area	Key Findings
Palm et al. (2021)	Psychological impacts in Canada	Women and individuals with poorer health were more likely to avoid public transit during policy implementation.
Hara & Yamaguchi (2021)	Changes in Japanese travel behavior	Significant trip reduction without strong government enforcement; significant behavioral change occurred with the mere declaration of a state of emergency.
Lam et al. (2020)	Border control in Hong Kong	Entrance limits and mandatory quarantine led to decreased transportation demand and subsequently reduced infections.
Vichiensan et al. (2021)	Transportation mode shifts internationally	Notable shift from public transportation to private cars in Europe and Asia; increase in motorcycle use in areas like India.
Bian et al. (2021)	Transportation effects in New York and Seattle	Post social-distancing restrictions: vehicular traffic recovered faster than public transport usage.
Riggs & Appleyard (2021)	Travel behavior during telework	A notable rise in recreational non-motorized trips during initial months of the pandemic due to telework.
Crokidakis (2020)	Effectiveness of travel restriction in Rio de Janeiro	Use of SIQR model showed isolation policy led to a predicted number of infected people that was 600 times lower than without the policy.
Seoul case	Subway ridership in Seoul	Major decrease in subway use in late February 2021 due to travel restrictions; gradual recovery as the pandemic's severity decreased.
Japanese case	Rail system use control during the pandemic	Service schedule reductions and policies like avoiding rush hour led to a significant decrease in rail passengers. Osaka Station visitors reduced by 55%, and JR East's major station passengers decreased by 35% to 60% compared to no-policy scenarios.

METHODOLOGY

Analysis of the Effectiveness of the Travel Restriction Policy to Control the Number of Daily Rail Passengers

Linear Regression Model: $Y_i = \beta_0 + \beta_i \cdot X_i \cdots \beta_n X_n$

Where:

Y_i : Number of daily rail passengers
$X_i \ldots n$: The day of the policy implementation
β_0 : Constant value
$\beta_i \ldots n$: Coefficient value for each policy.

Where:
if X_i has significant relationship with Y > policy has effect on Pax/day

Type of Variables	Information Source	Explanation
Pax per day (Y_i)		
Number of daily passengers using the BTS Skytrain	MOT Data Catalog	Daily passenger (Pax/day)
Number of daily passengers using the MRT Subway		
Number of daily passengers using the Airport Rail Link		
Number of daily passengers using the SRT (Inter-city) train		
Number of daily passengers using the SRT (Red Line) train		
Policy (X_i)		
Information for the 'time and spatial travel restriction' policy	The Emergency Decree on Public Administration in Emergency Situation, B.E. 2548 (2005)	1 = Implement; 0= Not implement
Information for the 'closure of travel destinations' policy		
Information for the 'promotion to remote working' policy		

Terms of the Government Gazette in an emergency situation (COVID-19) related to Railway System (X$_i$) [1/2]
Red text means policies that affected travel by railway

No.	Published	Restriction policy (Affect travel)	No.	Published	Restriction policy (Affect travel)
1	March 25, 2020.	• Curfew from 10.00 p.m. - 04.00 a.m. for 14 days. • Close the risky place in Bangkok and surrounding areas. • Refrain/delay travel across provinces.	18	January 29, 2021	• Samut Sakhon be categorized as maximum and strict COVID-19 control. • Bangkok, Nonthaburi, Pathum Thani and Samut Prakan be categorized as maximum COVID-19 control.
2	April 1, 2020.	• Curfew from 10.00 p.m. - 04.00 a.m. for 14 days.	20	April 16, 2021	• Refrain/delay travel across provinces. Especially maximum control areas.
5	May 1, 2020	• Curfew from 10.00 p.m. - 04.00 a.m. for 14 days. • Refrain/delay travel across provinces.	22	April 29, 2021	• Organizations (Public and Private) are asking to work from home as much as possible.
7	May 15, 2020	• Curfew from 11.00 p.m. - 04.00 a.m. for 14 days. • Open-air restaurants, food courts, canteens, places of entertainment. • Open department stores, shopping centers and community malls • Open Exercising, health care and recreational activities, fitness center.	25	June 26, 2021	• Set up a checkpoint to prevent travel across the red area. • Organizations are asking to work from home as much as possible.
			27	July 10, 2021	• Curfew from 9.00 p.m. - 04.00 a.m. for 14 days. • Organizations are asking to work from home as much as possible.
9	May 29, 2020	• Curfew from 11.00 p.m. - 03.00 a.m. for 14 days.	28	July 18, 2021	• People in the dark red areas must refrain from traveling outside of their dwellings unnecessarily. • Curfew from 9.00 p.m. - 04.00 a.m. for 14 days. • Set up a "strong checkpoint" to prevent travel across the red area. • Limit the number of passengers on all types of public transport. In the Dark red area, 50% of the passenger capacity. • Organizations are asking to work from home as much as possible.
11	June 30, 2020	• Prepare public transport to cope with increased travel due to the easing of measures. • Measures Relaxation by MOI			
14	August 31, 2020	• Open all school educational institutions, universities, and tutoring schools • Open Sports fields or sport competition venues. • Public transportation open with full capacity.	32	August 28, 2021	• Refrain/delay travel across provinces. Especially maximum control areas. • Limit the number of passengers on all types of public transport. In the Dark red area, 75% of the passenger capacity.
15	December 25, 2020	• Forbidden people to enter area, place that is at risk of getting disease.	33	September 10, 2021	• Curfew from 9.00 p.m. - 04.00 a.m. for 14 days to 30 September 2021.
16	January 3, 2021	• Close buildings and premises of all types of schools and educational institutions located in COVID-19 zoning areas. • Refrain/delay travel across provinces. • Organizations (Public and Private) are asking to work from home	34	September 19, 2021.	• Curfew from 10.00 p.m. - 04.00 a.m. for 14 days • All measures will continue to be in force until 15 October 2021.

Terms of the Government Gazette in an emergency situation (COVID-19) related to Railway System (X$_i$) [2/2]

No.	Published	Restriction policy (Affect travel)
35	October 15, 2021.	• Curfew from 11.00 p.m. - 03.00 a.m. for 14 days. • Restaurants, food courts, Open department stores, shopping centers and community malls service until 10.00 p.m. • Relax measures to limit the number of passengers.
36	October 21, 2021	• No curfew start on 31 October 2021
37	October 21, 2021	• Curfew from 11.00 p.m. - 03.00 a.m. for 14 days. • Maximum Control area (School, University, Library, Nursery) • Restaurants, food courts, Open department stores, shopping centers and community malls service until 10.00 p.m.
38	November 13, 2021	• Curfew from 11.00 p.m. - 03.00 a.m. • All measures from No.37 will continue to be in force.
39	November 30, 2021	• No curfew start on 30 November 2021 • All measures from No.38 will continue to be in force.
40	December 15, 2021	• Air-Restaurants, food courts, service until 01.00 a.m. • The venue of New Year's festival activities must comply with the COVID-19 screening measures.
41	January 1, 2021	• All measures from No.37 will continue to be in force. • Work from home

There are no further announcements from the government after this.

Methodology: Data collection

Department of Rail Transport restrictions policies (Xi)

No.	Published	Restriction policy (Affect travel)
1	March 26, 2020	• Avoid touching other people while traveling • Social distancing at least 1 meter
2	April 7, 2020.	• All Train will start service at 4.00 a.m. and close at 9.30 p.m. • Social distancing at least 1 meter
4	May 15, 2020	• All Train will start service at 4.00 a.m. and close at 10.30 p.m. • Social distancing at least 1 meter
5	October 15, 2020	• BTS SkyTrain has made a Group Release at Chidlom Station to reduce the density of people. • Arrange a service with the highest frequency is on the Sukhumvit Line every 2.25 minutes and the Silom Line every 3.45 minutes • Social distancing at least 1 meter
6	December 21, 2020	• All Train will not park and pick up passenger at Samut Sakhon • All Train will not service during curfew between 10.00 p.m. to 05.00 a.m. • Social distancing at least 1 meter
8	January 14, 2021	• Refrain from operating trains with service routes in the most restricted area (Red area). • Added passenger screening officers. • Social distancing at least 1 meter
10	July 12, 2021	• All Train will start service at 4.00 a.m. and close at 9.00 p.m. • Limiting service of the train system across the strictest provincial area • Social distancing at least 1 meter
12	August 5, 2021	• Extension of enforcement measures No.10 from 10 July 2021 to 31 August 2021 • Reduce the service of the train system across the provincial that is defined as the highest and strict control area
13	September 30, 2021	• All Train will start service at 4.00 a.m. and close at 10.00 p.m. • Social distancing at least 1 meter

Zone	Province (BMR)
Dark Red (Full Control area)	Bangkok, Nonthaburi, Pathumthani, Samut Prakan
Red (Control area)	Nakhon Pathom, Samut Sakhon
Yellow (Control area)	-

Source: Department of Disease Control of Thailand, 2020

Operators	Operation Time (No COVID-19)
ARL	06.00 a.m. – 12.00 a.m.
MRT	06.00 a.m. – 12.00 a.m.
BTS	06.00 a.m. – 12.00 a.m.

Source: ARL, MRT, and BTS, 2020

There are no further announcements from the government after this.

RESULTS

Results

Descriptive Statistics

Table 3. Descriptive statistics (Analysis Period: January 12, 2020, to November 22, 2022 (1,036 days)).

Description (Y_i)	Unit	Obs.	Mean	Std. Dev.	Min	Max
Number of passengers of all systems.	Passengers/day	1036	731,397	347,289	95,394	1,601,451
Number of passengers using the SRT (Inter-city) train	Passengers/day	1036	37,397	21,128	1,733	101,061
Number of passengers using SRT (Red Line) train	Passengers/day	468	10,505	4,617	2,205	25,125
Number of passengers using Airport Rail Link train	Passengers/day	1036	33,952	17,268	5,183	88,133
Number of passengers using MRT Subway	Passengers/day	1036	228,534	113,300	28,223	492,282
Number of passengers using BTS Skytrain	Passengers/day	1036	426,769	199,704	56,100	950,500
Time and spatial travel restrictions	1 = Implemented on that day; 0 = others	1036	0.595	0.491	0	1
Closure of travel destinations	1 = Implemented on that day; 0 = others	1036	0.756	0.430	0	1
Promotion of remote working	1 = Implemented on that day; 0 = others	1036	0.655	0.475	0	1

Note: Obs. is the number of observations or days; Std. Dev. is the standard deviation.

Effect of Each Grouped Travel Restriction Policy

Table 4. The regression analysis model of the effect of the travel restriction policy on the demand for rail transport

Railway Line	Constant	1.Time & Spatial Travel Restriction		2.Closure of Travel Destinations		3.Promotion of Remote Working		Adj R-squared
		Coef. (B_i)	%Red	Coef. (B_i)	%Red	Coef. (B_i)	%Red	
All Lines	**1,262,015**	**-162,150**	**-22%**	**-362,138**	**-50%**	**-244,473**	**-33%**	**0.44**
SRT Inter-city Train	72,968	-14,531***	-39%	-16,291***	-44%	-22,279***	-60%	0.51
SRT Red Line	15,074	-3,410***	-32%	-5,992***	-57%	(dropped)	NA	0.69
SRT Airport Rail Link	62,255	-9,132***	-27%	-19,382***	-57%	-12,534***	-37%	0.52
MRT Lines	393,435	-43,550***	-19%	-113,100***	-49%	-81,539***	-36%	0.39
BTS Lines	726,451	-89,440***	-21%	-210,173***	-49%	-133,489***	-31%	0.43

Note: All variables had a 99% significant level (***); %Red was a % decrease in the daily passenger volume on the day that the policy was implemented.

CONCLUSION

CONCLUSION

1. Contributions

- Demonstrated the method to evaluate policy effectiveness to help government for better decision-making during outbreaks.

2. Key Findings

- **Most Impacted Policy:**

  ➤Closure of travel destinations reduced rail passenger count by approximately 50%.

- **Least Effective Policy:**

  ➤Time and spatial travel restriction caused only a 22% drop in passengers.

  ➤Impact was significantly felt on the SRT inter-city trains, with a 39% reduction.

- **Greatest Impact on SRT Inter-city Line:**

  ➤Promoting remote working discouraged many commuters, resulting in a 60% drop in passengers, due to longer commute times and distances.

## 3. Limitations and Further study

- Future studies will consider variables like vaccination rates, alternative modes, and others.

- This study relied on macro data which in-depth interviews can inform more effective policymaking by understanding individual travel behaviors.

THANK YOU FOR YOUR KIND ATTENTION

APPENDIX

Number of Total passenger in 2019 (No Covid-19) compared with 2020 and 2021

Number of passengers of all Railway system
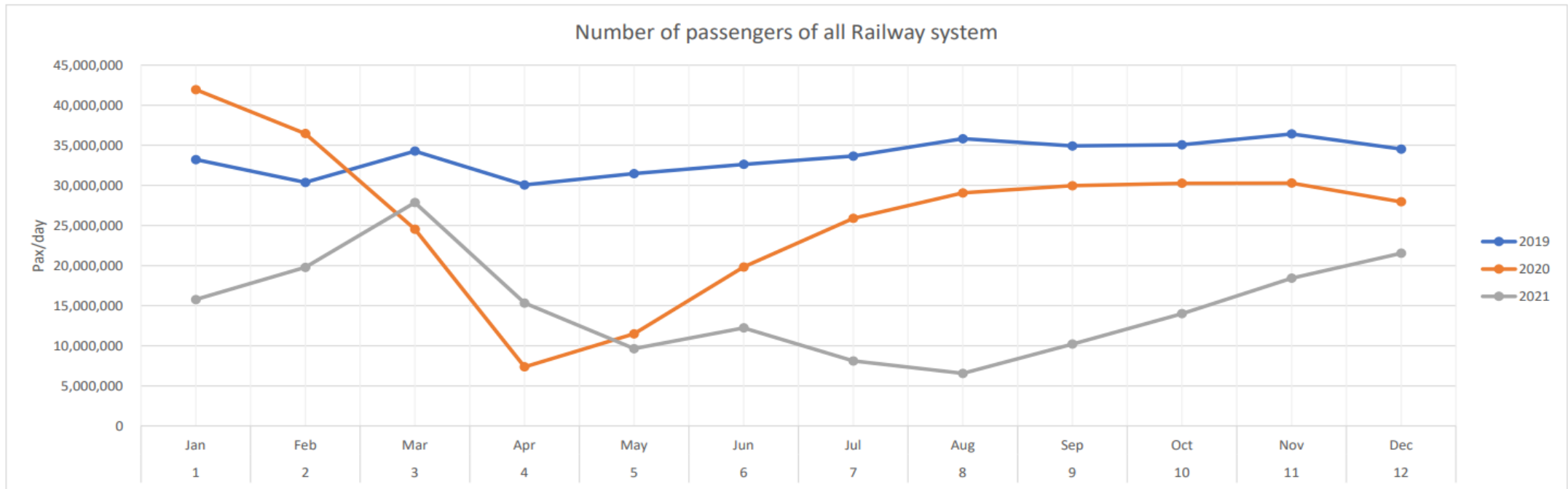
	1	2	3	4	5	6	7	8	9	10	11	12	Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2019	33,220,907	30,381,051	34,281,843	30,053,726	31,468,142	32,622,270	33,656,124	35,816,440	34,926,655	35,071,491	36,416,406	34,525,886	402,440,941
2020	41,947,594	36,460,619	24,542,018	7,373,859	11,493,622	19,824,922	25,887,263	29,062,523	29,967,096	30,263,647	30,285,619	27,952,550	315,061,332
2021	15,761,222	19,774,222	27,859,605	15,324,232	9,644,802	12,233,874	8,106,584	6,549,615	10,211,582	14,004,942	18,424,290	21,543,652	179,438,622
%YoY 2019-2020	26.27%	20.01%	-28.41%	-75.46%	-63.48%	-39.23%	-23.08%	-18.86%	-14.20%	-13.71%	-16.84%	-19.04%	-21.71%
%YoY 2019-2021	-52.56%	-34.91%	-18.73%	-49.01%	-69.35%	-62.50%	-75.91%	-81.71%	-70.76%	-60.07%	-49.41%	-37.60%	-43.05%