

해외출장복명서

기 간: 2014. 2. 25~2014. 3. 1

출장지: 말레이시아 쿠알라룸푸르

출장자: 오성호, 정진규, 김종학, 박종일

I. 출장개요

1. 출 장 지: 말레이시아 쿠알라룸푸르

2. 출장기간: 2014. 02. 25 ~ 03. 01 (3박 5일)

3. 출 장 자

소속	직급	성명
국토인프라연구본부	연구위원	오성호
국토인프라연구본부	연구위원	정진규
국토인프라연구본부	책임연구원	김종학
국토인프라연구본부	연구원	박종일

* 국제 세미나 참석자

○ 태 조(5인) : 김설주(부사장), 서용철(상무), 이승환(이사), 박환영(부장), 박미영(대리)

○ 아세안국가(10인) : 캄보디아_Uon Song, Ly Borin

라오스 _ Pholsena Sompong, Lakhonevong Hinhphet

미얀마 _ Maung Maung Pyone,, Htay Myint Aung

베트남 _ Nguyen Tien Thinh,, Han Nhu Quynh(Ms)

태국 _ Voravuth Mala, Phuphuakrat Thana

4. 출장목적

☐ 대상국가의 관계자들에게 연구 결과를 보고하고 세미나를 통해 SKRL Missing Link 연계에 대한 이해도 향상 및 대상국 참여 유도를 통하여 원활한 사업추진을 위함

☐ ASEAN사무국 및 대상 5개국의 철도노선 개선에 대한 관계기관 및 관계자 협의, 의견수렴

II. 출장일정

날짜	출발지	도착지	방문기관/장소	주요 수행업무	관계자
2.25 (화)	인천	쿠알라 룸푸르		(23:00) 현지 도착	
2.26 (수)			Royal Chulan 호텔	국제세미나 개최 준비	
2.27 (목)			Royal Chulan 호텔	(09:00) 국제세미나 개최 발표 I : The Study of Arterial Railway Network on CLMVT “Result of demand analysis and carbon emission reduction by ASEAN railway conversion” by Oh Sung-ho (Researcher Fellow, KRIHS) 발표 II : The Study of Arterial Railway Network on CLMVT “Technical approach of Missing Links” by Kim Seoljoo (Vice President, TESO)	CLMVT 5개국 대표 각 2인
			KTM(Kereta pi Tanah Melayu) 본사, KL 중앙역	(14:00) KTM 견학 ◦ KTM 기관에 대한 PT 설명 ◦ KTM 관제센터 방문, 관제실 견학, 관제실 시스템 운영에 대한 관제실장의 설명 청취 ◦ KL역~KL Central역 견학 및 Komuter 전철 탑승	KTM 관계자
2.25 (화)	쿠알라 룸푸르			(23:00) 현지 출발	
2.26 (수)		인천		(07:00) 인천공항 도착	

III. 수행사항

1. 국제세미나 개최

□ 회의일시 : 2014. 02. 27(목), 09:00~13:30

□ 회의장소 : The Royale Chulan Hotel(말레이시아 쿠알라룸푸르)

□ 참 석 자 :

○ KRIHS(4인) : 오성호(연구위원), 정진규(연구위원), 김종학(책임연구원), 박종일(연구원)

○ 태 조(5인) : 김설주(부사장), 서웅철(상무), 이승환(이사), 박환영(부장), 박미영(대리)

○ 아세안국가(10인) : 캄보디아_Uon Song, Ly Borin

라오스 _ Pholsena Sompong, Lakhonevong Hinhphet

미얀마 _ Maung Maung Pyone, Htay Myint Aung

베트남 _ Nguyen Tien Thinh, Han Nhu Quynh(Ms)

태국 _ Voravuth Mala, Phuphuakrat Thana

□ 발표

Presentation I : The Study of Arterial Railway Network on CLMVT “Result of demand analysis and carbon emission reduction by ASEAN railway conversion”
by Oh Sung-ho (Researcher Fellow, KRIHS)_부록 참고

Presentation II : The Study of Arterial Railway Network on CLMVT “Technical approach of Missing Links” by Kim Seoljoo (Vice President, TESO)_부록 참고

□ 주요 토론

○ Cambodia 의견 및 답변사항(Uon Song/ Under secretary of State of MPWT)

- 여객열차와 화물열차의 속도를 차별적으로 반영 필요

- 캄보디아의 경우 표정속도 70km/h는 달성하기 힘들 것으로 판단되며, 속도 증가를 위해서 많은 입체교차 필요

- 최소곡선반경은 1100m(한국기준)로 되어 있는데 캄보디아 철도의 경우 호주에서 설계하면서 최소곡선반경은 1200m을 적용하고 있음
- 캄보디아-베트남연결철도가 우선순위가 가장 높게 나온 것이 타당하다고 생각하며, 결과를 지지하고 감사

○ Lao PDR 의견 및 답변사항(Pholsena Sompong/ Director general of MOPWT)

- 축중하중 22톤(한국기준) 적용에 대한 질의와 신호, 통신 시스템에 관한 질의가 있었으며, 신호나 통신은 초기단계의 연구에는 포함하지 않으며 연구가 계속 진행되어 조사 및 설계를 할 때 자세한 조사를 하여 포함되어야 할 사항으로 처리

○ Myanmar 의견 및 답변사항(Htay Myint Aung/ Assistant General Manager of MR)

- 미얀마 철도 미상구간은 Dawei~ 태국 캄차나부리, 무세~라슈우 142km, 무세~초큐 88 km 등이며, CLMVT 철도 미싱링크는 철도기술표준을 따라 계속 진행 예정

○ Viet Nam 의견 및 답변사항(Nguyen Tien Thinh/ Head of Vietnam Authority)

- 철도 CO₂저감 관련하여, CLMVT 정부는 철도부문이 환경과 경제에 얼마나 영향을 주는지를 고려하고 있음
- 한 달 전 캄보디아와 베트남 수상 회담에서 두 국가 연결 신설노선은 표준궤도로 하기로 논의한 바 있으며, 또한 록난~호치민, 호치민~껀터, 호치민~붕따우 등의 신설 노선은 모두 표준궤로 계획하고 있음
- 캄보디아-베트남 연결철도는 미싱링크 관점에 포커스를 맞추고 있기 때문에 협궤로 계획한 것이나 향후 표준궤로 확장되어야 할 것

○ Thailand 의견 및 답변사항(Phuphuakrat Thana/ Engineer of STR)

- 열차속도 20km/h가 아닌, 여객열차의 경우 42~50km/h, 화물열차의 경우 22~30km/h, 좌석수는 70 seats가 아닌 40 seats로 했을 때의 결과가 추가되면 좋을 것임
- CO₂의 절감량을 화폐가치로 표현할 수 있다면 이해도가 높을 것임

- 신규철도(반파이~나콘파놈)이 누락되었고, Chiang Mai를 Chiang Lai로 수정 필요
- 축하중은 동남아시아의 경우 현재 16톤/축으로 건설하고 있으며 이는 적정하다 판단되나, 발표자료에서 제시한 22톤/축을 사용한다면 공사비가 너무 증가될 것으로 판단됨
- 협궤와 표준궤에 관하여는 아세안네트워크는 협궤이며, 이는 작년 라오스 팍세에서 개최된 한-아세안 교통장관회의 때 명확히 천명됨
- 라오스는 3.5km라서 별 관계가 없지만 미얀마는 6,000km, 베트남은 2,500km, 태국은 4,000km, 캄보디아는 650km가 협궤로 건설되어 있음. 이를 모두 표준궤로 바꾸는 비용은 막대하여 사실상 불가능함. 미싱링크의 연결은 우선 협궤로 하고 추후 궤간을 통일하는 것을 고려해 봐야 할 것임
- 태국의 경우는 정부는 고속철도 등은 표준궤, 기존철도는 협궤 등으로 하여 이원화된 철도를 구상하고 있음

※ 표준궤와 협궤에 관하여는 철도 연장이 긴 태국과 미얀마는 협궤를 주장하였으며 철도 연장이 적은 라오스는 표준궤 주장

※ 베트남의 경우는 협궤 철도 연장이 긴 편이나 2020 국가계획, 2030 국가비전 등의 상위계획이 표준궤로 되어 있어 표준궤를 선호하고 있었으며, 캄보디아는 협궤로 되어 있으나 거의 사용하지 않고, 캄보디아 철도마스터플랜이 표준궤로 계획되어 있음

□ 방명록

List of Seminar Participants

**The study of Arterial Railway Network
on Cambodia, Lao PDR, Myanmar, Viet Nam and Thailand.**

Date : Feb. 27 (Thursday) 2014

Venue : The Royale Chulan Hotel Kuala Lumpur, Sri Panglima 2

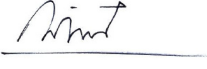
No.	Affiliation/ Title	Name	Contact Point	Signed
1	LAOS	Mr. Himphet	himlathkhouang@yahoo.co	
2	Myanmar	Ms. Maung Maung Pyone	maungmaungpyone.mr@gmail.com	
3	"	Mr. Ngaz Myint Aung	"	
4	Viet Nam	Mr. Nguyen Tran Thinh	tranthinh.nguyen.vr@gmail.com	
5	Vietnam	Hàn Nhu Quỳnh	quynh.hannhu@gmail.com	

List of Seminar Participants

**The study of Arterial Railway Network
on Cambodia, Lao PDR, Myanmar, Viet Nam and Thailand.**

Date : Feb. 27 (Thursday) 2014

Venue : The Royale Chulan Hotel Kuala Lumpur, Sri Panglima 2

No.	Affiliation/ Title	Name	Contact Point	Signed
1	Mr.	VORAVUTH	vathumala@gmail.com	
2	Mr	Sompeng Pholsena	Pholsena@gmail.com	
3	Dr.	Thana Phuphuchart	thana.p@railway.mail.go.th	
4	Ms	LY BORIN	lyborin@yahoo.com	
5	H.E.	UON SONG	uonsong@yahoo.com	

□ 발표현장 사진



▲ 세미나 1



▲ 세미나 2



▲ 세미나 3



▲ 세미나 4



▲ 기념촬영(대표단)



▲ 기념촬영(참석자)

2. KTM 방문

□ 방문일시 : 2014. 02. 27(목), 14:30

□ 방문장소 : KTM(Keretapi Tanah Melayu) 본사, KL Central Station 관제실

□ 참석자 : 국제세미나 참석자 전원 및 관계자

□ 주요 수행사항

○KTM 기관에 대한 PT 설명

– 말레이시아 철도 현황

– 3대 간선(웨스트코스트 선, 이스트코스트 선, 케다 선) 운영 현황

– 태국, 싱가포르와의 국제철도 연결 현황

○KTM 관제센터 방문, 관제실 견학, 관제실 시스템 운영에 대한 관제실장의 설명 청취

– 쿠알라룸푸르 광역 및 도시철도 운영 현황

– 관제시스템 설명

○KL역~KL Central역 견학 및 Komuter 전철 탑승

– 쿠알라룸푸르의 2대 중앙역인 KL Central 역과 KL(쿠알라룸푸르)역 견학

– KTM Komuter 탑승

○기관소개

– 말레이시아 철도공사

– Keretapi Tanah Melayu Berhad

– 1992년 설립

– 영업지역 : 말레이시아, 싱가포르

– 보유선로 : 1,699km

– <http://www.ktmb.com.my>

– 문의처: callcenter@ktmb.com.my



◦ 견학 주요 사진



▲ KTM 소개



▲ KTM 사업 설명



▲ KTM 관제실



▲ KTM Komuter 실내



▲ KTM 본사



▲ 기념촬영

IV. 부록

□ 세미나 발표 자료집(국제세미나 개요)

The study of Arterial Railway Network on Cambodia,
Lao RDR, Myanmar, Viet Nam, Thailand

International Seminar

International Seminar

Date / Location

- Date : February 27th 2014
- Location: The Royale Chulan Hotel Kuala Lumpur

Schedule

Date	Contents
26 (Wed.)	Check in 19:00 ~ 21:00 Kick-off meeting
27 (Thu.)	09:00 ~ 12:00 Seminar 12:00 ~ 13:30 Luncheon 13:30 ~ 17:00 Site Visit 18:00 ~ 20:00 Dinner
28 (Fri.)	Check out

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Seminar Program

Time	Contents	Remark
09:00 ~ 09:30	• Registration	Royale CHULAN Hotel Sri Panglima 2
09:30 ~ 09:40	• Opening • Introduce for Participants	
09:40 ~ 10:10	• Presentation I - The study of Arterial Railway Network on CLMVT - Result of demand analysis and Carbon emission reduction by ASEAN railway conversion - - Oh, Sung Ho (Researcher Fellow, KRIHS)	
10:10 ~ 10:40	• Presentation II - The study of Arterial Railway Network on CLMVT - Technical Approach of Missing Links - - Kim, Seol Joo (Vice President, TESO)	
10:40 ~ 11:00	• Coffee Break	
11:00 ~ 12:00	• Discussion (Question and Answer)	
12:00	• Closing	
12:00 ~ 12:10	• Photo	
12:10 ~ 13:30	• Luncheon	

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Participants (ASEAN)

Nationality	Name	Position	e-mail
Cambodia	Uon Song	Under Secretary of State of MPWT(Ministry of Public Works and Transport) in charge of Railway related matter	uonsong @yahoo.com
	Ly Borin	Director of Railway Department of MPWT	borin @yahoo.com
Lao PDR	Pholsena Sompong	Director General, Department of Railways, Ministry of Public Works and Transport	pholsenas @gmail.com
	Lakhonevong Hinhphet	Director General, Engineering Division, Department of Railways, Ministry of Public Works and Transport	
Myanmar	Maung Maung Pyone	Executive Engineer of Myanmar Railways	maungmaungpy one.mv @gmail.com
	Htay Myint Aung	Assistant General Manager of Myanmar Railways	
Viet Nam	Nguyen Tien Thinh	Head of Planning and Investment Division, Viet Nam Railway Authority	tienthinnguyen vn@gmail.com
	Han Nhu Quynh	Director of International Cooperation Department, Viet Nam Railways Coporation	quynh.hannhu @gmail.com
Thailand	Mala Voravuth	Marketing Director, Marketing Department	vuthmala @gmail.com
	Phuphuakrat Thana	Engineer in Charge of Carriage and Wagon Technics and Design Division, Mechanical Engineering Center, Mechanical Engineering Department	thanap@railway .mail.go.th

- 3 -

Participants (KOREA)

- KRIHS (Korea Research Institute for Human Settlements)

Full Name	Position	TEL	E-mail
Oh Sung Ho	Research Fellow	+82+31-380-0343 +82+10-4910-8728	shoh @krihs.re.kr
Chung Jin Kyu	Research Fellow	+82+31-380-0390 +82+10-9114-4377	jkchung @krihs.re.kr
Kim Jong Hak	Associate Research Fellow	+82+31-380-0352 +82+10-2776-1208	jonghkim @krihs.re.kr
Park Jong Il	Assistant Research Fellow	+82+31-380-0354 +82+10-3663-2679	sevenfriend @nate.com

- TESO (TESO Engineering Co., Ltd.)

Full Name	Position	TEL	E-mail
Kim Seol Joo	Vice President	+82+2-2140-9250 +82+10-3711-6577	seoljookim @gmail.com
Seo Woong Chol	Director	+82+2-2140-9240 +82+10-2662-0778	seowc1966 @gmail.com
Lee Seung Hwan	Director	+82+2-2140-9229 +82+10-5343-2915	trish69 @korea.com
Park Hwan Young	Principal Engineer	+82+2-2140-9296 +82+10-9445-9217	wel1209 @naver.com
Park Mi Young	Lead Engineer	+82+2-2140-9292 +82+10-9835-1982	gracep431 @naver.com

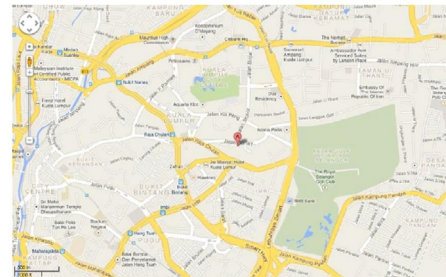
- 4 -

Flight Schedule

Nationality	26 (Wed.)			28 (Fri.)		
	Flight	Departure	Arrival	Flight	Departure	Arrival
Cambodia	MH 755	11:10	14:00	MH 762	14:40	15:30
	TG 571	13:50	14:55 (BKK)	TG 416	13:05	14:10 (BKK)
Lao PDR	TG 417	16:40 (BKK)	19:50	TG 574	19:45 (BKK)	20:55
Myanmar	MH 741	12:15	16:30	16:30	MH 740	10:05
Viet Nam	VN 681	15:40	19:50	VN 680	19:15	21:20
Thailand	MH 785	11:05	14:15	MH 782	15:15	16:20

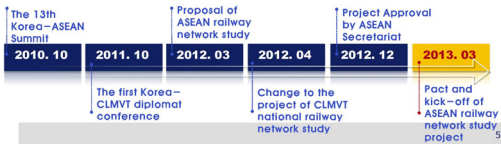
Information of the Hotel

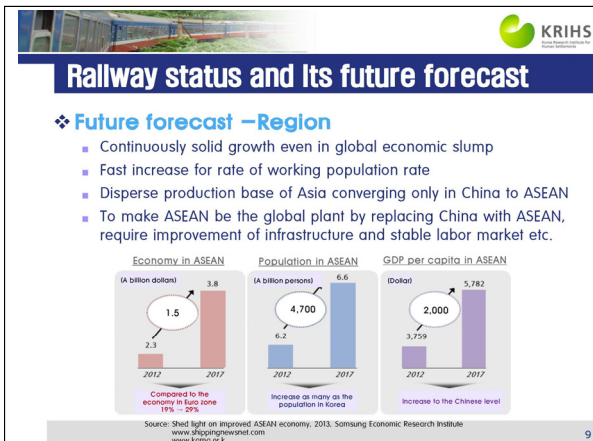
- The Royale Chulan Hotel Kuala Lumpur
- address : 5 Jalan Conlay, 50450 Kuala Lumpur, Wilayah Persekutuan, Malaysia (1person/1room)
- Phone : +603-2688-9688
- <http://www.theroyalechulan.com>



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□ 세미나 발표자료(발표 1)

 The study of Arterial Railway Network on CLMVT - Result of demand analysis and Carbon emission reduction by ASEAN railway- Oh, Sung-Ho 	 Contents 1 General on study 2 Railway status and its future forecast 3 Conversion rate of SKRL and demand forecast 4 Analysis on effect of carbon reduction 5 Conclusion 2
 General on study ❖ Background - Secure connectivity of ASEAN nations - Lead green growth in case of a climate change - Need to build competitive railway network ❖ Objective - Technical review and proposal of investment priority for 4 non-connected sections in Mekong basin - Analyze reduction effect of carbon emission in case of completion of railroad connection 3	<Note> ❖ Background of study - Lack connectivity function between ASEAN nations by missing railway network and focus on the extension of the road facility - The road based traffic system is unfavorable to take action for climate change caused by emission of carbon etc. due to the reduction of transport capacity and its low efficiency - ASEAN summit is welcoming the Korean initiative for low carbon green growth. In Han River Declaration, infrastructures connecting ASEAN and a green growth leading sustainable development have been selected to a priority cooperation field considering demand of Mekong regions, strong point of Korea and support capacity ❖ Objective of study - Find out cooperation method by planning the project objective for a short and long term - Project objective for a short term - Secure competitive railway network of CLMVT - Lead green growth of relevant regions - Build cooperation system supported by experts related to the railway institutes in Korea and CLMVT nations - Project objective for a long-term - Build eco-friendly traffic system by converting the road based traffic system to the railway - Enhance competitiveness in ASEAN nations and regions by connecting railway network of SKRL - Prepare the base of green growth in case of climate change 4
 General on study ❖ Scope of study - Cambodia, Lao PDR, Myanmar, Viet Nam and Thailand ❖ Period 21 March, 2013 ~ 20 March, 2014 (12 months) ❖ Process  5	<Note> ❖ Process - Oct 2010 The 13th Korea-ASEAN Summit - Build strategic partnership between Korea and ASEAN - Oct 2011 The 1st diplomat summit between Korea and Mekong (CLMVT) - Han river Declaration to build comprehensive partnership between Korea and Mekong for mutual prosperity - Mar 2012 Proposed the project on ASEAN railway network study - Apr 2012 Be changed to study project of CLMVT national railway network study - Dec 2012 Approved the project by ASEAN Secretariat - Discussed connection project of Missing Link in SKRL railway route in CLMVT nation - Mar 2013 Agreed and kicked off ASEAN railway network study project 6
 Railway status and Its future forecast ❖ Railway status - Section : Singapore~Kunming - Total Length : L=5,000km - Missing link : L=1,285km - Lao PDR & Viet Nam : 585 km - Thailand & Cambodia : 54km - Cambodia & Viet Nam : 383km - Myanmar & Thailand : 263km  ※ Details will be described in technical part. 7	<Note> Lao PDR & Viet Nam : New proposal link Vientiane ~ Thakek ~ Mu Gia, 466 km Mu Gia ~ Tan Ap ~ Vung Ang, 119 km Thailand & Cambodia : Aranyaprathet ~ Klongluk, 6 km Poipet ~ Sisophon, 48 km Cambodia & Viet Nam : Phnom Penh ~ Snuol ~ Loc Ninh, 254 km Loc Ninh ~ Ho Chi Minh, 129 km Myanmar & Thailand : Thanbyuzayat ~ Three Pagoda Pass, 110 km Three Pagoda Pass ~ Nam Tok, 153 km 8

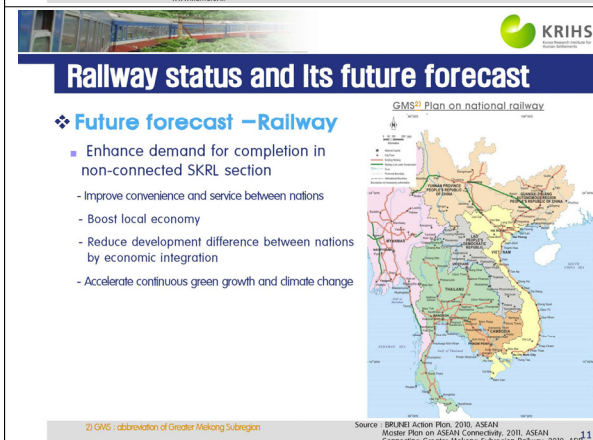


<Note>

- Emerge as a global production base because it has sufficient labor of low wage
 - Fast increase of rate for ASEAN production age population rate to the year 2025
 - On the other hand, weaken labor-intensive manufacture competitiveness of China, the existing global plant due to continuous increase of wage, revaluation of exchange rate, unstable demand and supply of labor, etc.
 - Disperse production base of Asia converged in China to ASEAN
- Expect to continuously grow consumption market because 60% of ASEAN population is under the age of 35, young generation
 - Lead consumption trend in ASEAN by Yuppies¹⁾ to be increased together with the improvement of education level, increase of income and urbanization
- Expect to continuously grow by encouraging the investment due to the policy of reformation and openness of CLMV nations, relatively poor economic structure
 - Attracted attention of global economy through average growth of 6.1% even after global financial crisis of CLMV
 - Average economy growth rate in 2008~2012: 5.3% in Cambodia, 8.1% in Laos, 5.2% in Myanmar, 5.9% in Vietnam, 4.7% in ASEAN and 2.9% in the world
 - Have sufficient potential as a consumption market because it accounts for 28% of ASEAN population

¹⁾ Yuppies: abbreviation of Young Urban Professional

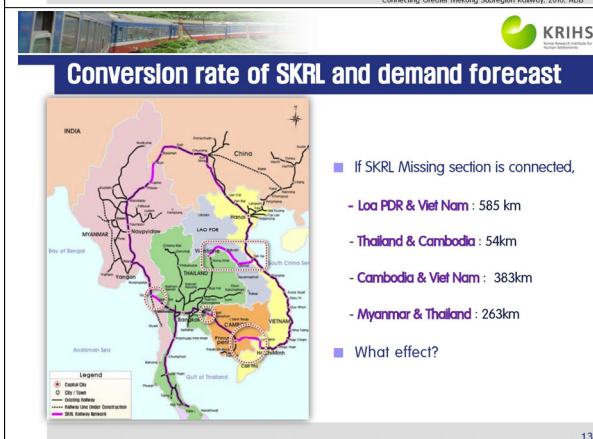
Source: Shed light on improved ASEAN economy, 2013, Samsung Economic Research Institute
www.shippingnewsnet.com www.kiaic.or.kr



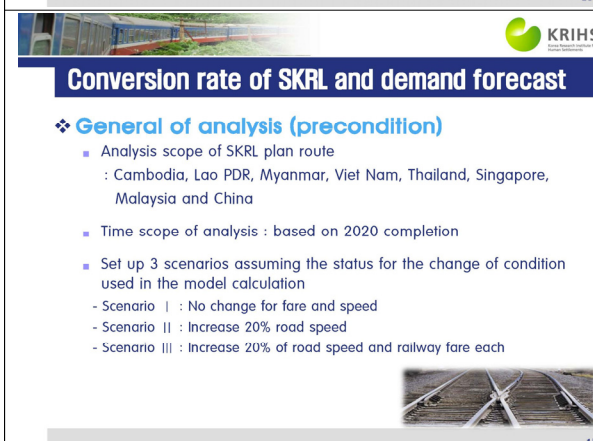
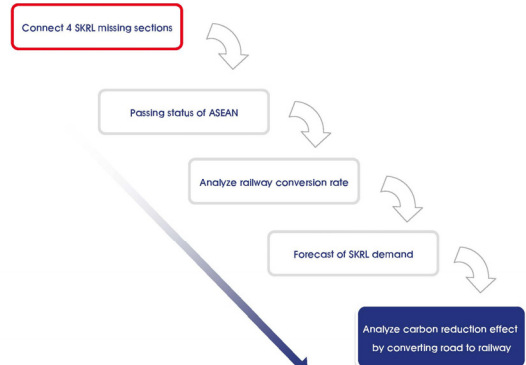
<Note>

- SKRL is globally and politically vital project and require quick proceeding with the project to complete the non-connected section as a major agenda for traffic cooperation as soon as possible
 - Expect to have positive influence such as improvement of convenience and service between ASEAN nations, enhancement of local economy and social development, economic unification, reduction of development difference between members etc.
 - Also, lead continuous acceleration of green growth and climate change
- Boost development of GMS economic cooperation program by improvement of trade environment by network connection of Cambodia, China, Laos, Myanmar, Thailand and Vietnam, in Mekong Region
- Enhance cooperation and unification of ASEAN and global competitiveness by network connection
- Also, improvement of the welfare and living of people, reduction of development difference between members, forecast of local competitiveness development
- Moreover, review on possibility of the extension of the route up to Surabaya, Indonesia

Source: BRUNEI Action Plan, 2010, ASEAN Master Plan on ASEAN Connectivity, 2011, ASEAN Connecting Greater Mekong Subregion Railway, 2010, ADB

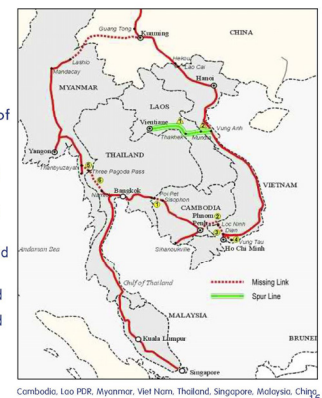


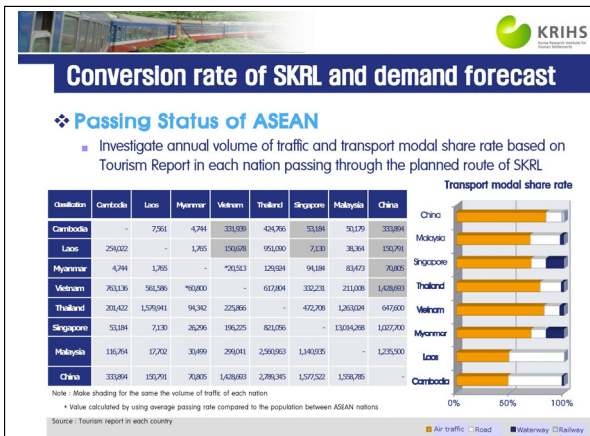
<Note>



<Note>

- Set up 3 scenarios assuming status for the change of condition used in model calculation such as increase of railway fare, speed, etc. due to increase of railway connectivity and development of railway project by connection of missing section
 - Scenario I : No change for fare and speed
 - Scenario II : Increase 20% road speed
 - Scenario III : Increase 20% road speed and railway fare each





<Note>

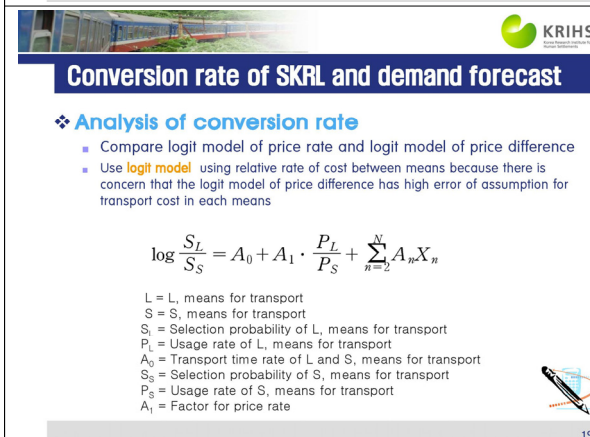
- The volume of traffic has been assumed as the same due to the difficulties of data collection for shading the volume of traffic such as the volume of traffic from Cambodia to Myanmar, Singapore and China, and the volume of traffic from Laos to Myanmar, Singapore and China
- Due to the difficulties of the data collection for the passing rate between Myanmar and Vietnam, mean passing rate between indirect nations compared to the population has been used for the calculation
- Used passing rate of Cambodia, Singapore and Malaysia as an indirect nation to Myanmar

Total population	Cambodia	Laos	Thailand	Vietnam	Myanmar	Singapore	Malaysia	China
Total population (1,000)	6,586	6,586	64,070	87,840	60,400	5,399	29,300	1,347,350

Source: www.globalwonder.org

Classification	Myanmar ↔ Cambodian	Myanmar ↔ Singapore	Myanmar ↔ Malaysia	Average
Flow in rate	0.01%	0.16%	0.14%	0.10%
Flow out rate	0.01%	0.04%	0.05%	0.03%

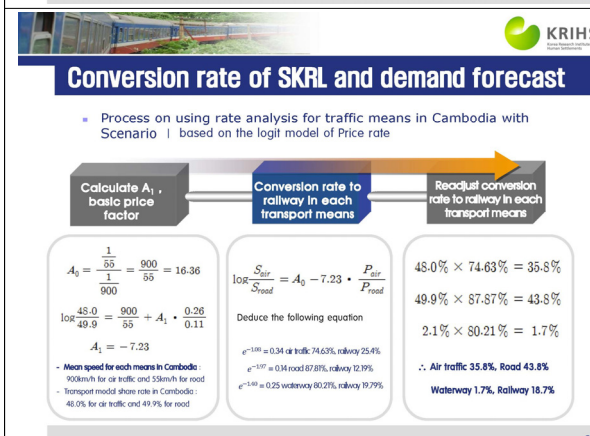
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<Note>

- Usage rate of traffic means can be calculated based on the selection rate of transport means of each nation, transport time and fare. In case of transport time, transport time is difficult to be calculated in each nation so that in the study, an average speed of transport means has been used for the calculation
- Based on 'Transport time = distance/speed', the time is assumed to be changed by speed when moving the same distance. It is applied to logit model of price rate for '1/mean speed'
- Used traffic fare in each means by averaging fare per km of transport means between ASEAN nations

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<Note>

- Average speed and fare per km in each nation and means applied to logit model of price rate

Classification	Mean speed (km/h)				Classification	Airfare (\$/km)	Fare per km (\$/km)	Fare per km (\$/km)	Fare per km (\$/km)	Cost for oil (\$/l) (On an estimated basis to 100km per hour)	Average gas mileage
	Railway	Road	Air traffic	Water channel							
Cambodia	30	55		45	Cambodia	0.14	0.04	0.11		\$0.98	
Laos	30	50		-	Laos	-	0.03	0.18		\$1.55	
Myanmar	40	65		50	Myanmar	0.08	0.04	0.18		\$0.91	8.5km/l
Vietnam	40	50		55	Vietnam	0.26	0.18	0.04	0.14	\$1.15	(On a Toyota VENZA 3.456cc base) based on Toyota, which is the most popular vehicle in Asia
Thailand	20	65		45	Thailand	0.14	0.04	0.11		\$1.53	
Singapore	50	65		57	Singapore	1.07	0.09	0.21		\$1.78	
Malaysia	50	65		42	Malaysia	0.43	0.05	0.07		\$0.56	
China	55	55		-	China	-	0.06	0.16		\$1.39	

Source: ko.wikipedia.org

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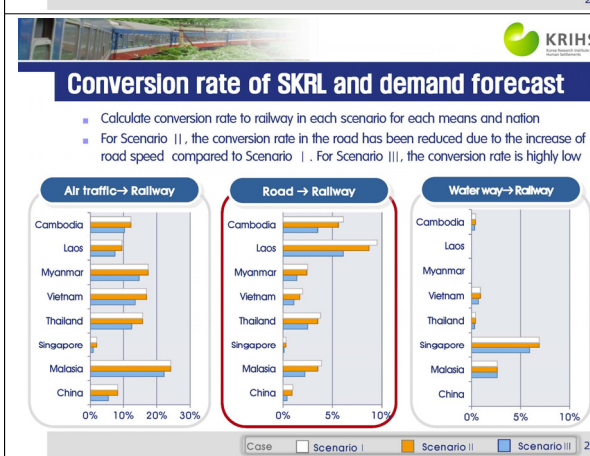
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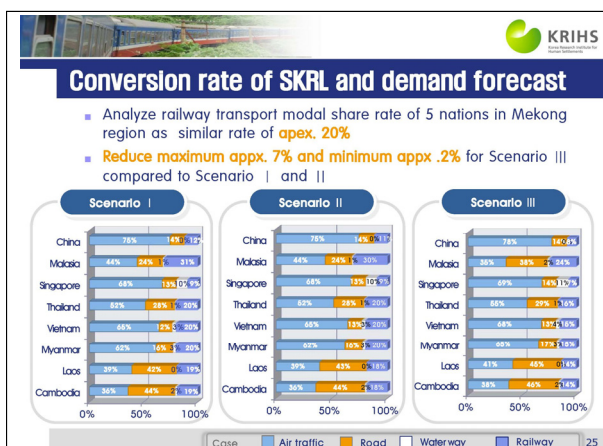


<Note>

- Calculate conversion rate to railway in each scenario for each means and nation

Scenario I	Cambodia	Laos	Myanmar	Vietnam	Thailand	Singapore	Malaysia	China
Air traffic → Railway	12.2%	9.5%	17.4%	16.9%	15.7%	1.9%	24.2%	8.2%
Road → Railway	6.1%	9.5%	2.5%	2.0%	3.8%	0.3%	3.9%	1.0%
Waterway → Railway	0.4%	0.0%	0.0%	0.9%	0.4%	6.9%	2.6%	0.0%
Scenario II	Cambodia	Laos	Myanmar	Vietnam	Thailand	Singapore	Malaysia	China
Air traffic → Railway	12.2%	9.5%	17.4%	16.9%	15.7%	1.9%	24.2%	8.2%
Road → Railway	5.6%	8.7%	2.4%	1.7%	3.5%	0.3%	3.5%	0.9%
Waterway → Railway	0.4%	0.0%	0.0%	0.9%	0.4%	6.9%	2.6%	0.0%
Scenario III	Cambodia	Laos	Myanmar	Vietnam	Thailand	Singapore	Malaysia	China
Air traffic → Railway	10.3%	7.4%	14.7%	13.5%	12.4%	0.9%	22.2%	5.4%
Road → Railway	3.5%	6.1%	1.4%	1.1%	2.5%	0.1%	2.2%	0.4%
Waterway → Railway	0.3%	0.0%	0.0%	0.7%	0.3%	5.9%	2.6%	0.0%

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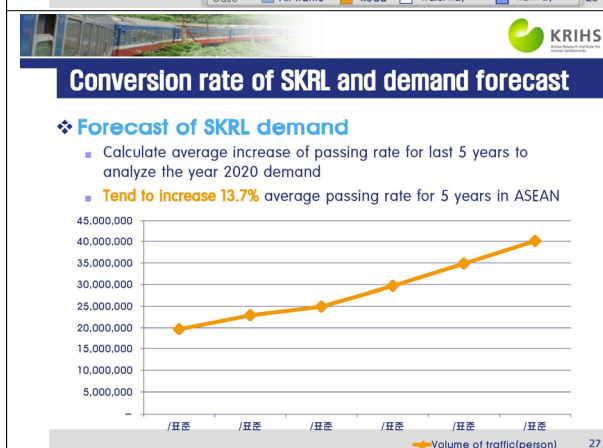


<Note>

- Calculate conversion rate to railway in each scenario for each means and nation

Classification	Cambodia	Laos	Myanmar	Vietnam	Thailand	Singapore	Malaysia	China
Scenario I								
Air traffic	35.8%	39.3%	61.9%	64.5%	51.9%	67.5%	44.2%	74.7%
Road	43.8%	41.7%	15.7%	12.4%	27.5%	13.4%	23.9%	13.7%
Waterway	1.7%	0.0%	2.5%	3.3%	0.7%	10.0%	1.2%	0.0%
Railway	18.7%	19.0%	19.9%	19.8%	20.0%	9.1%	30.7%	11.6%
Scenario II								
Air traffic	35.8%	39.3%	61.9%	64.5%	51.9%	67.5%	44.2%	74.7%
Road	44.3%	42.5%	16.0%	12.7%	27.6%	13.4%	24.3%	13.9%
Waterway	1.7%	0.0%	2.5%	3.3%	0.7%	10.0%	1.2%	0.0%
Railway	18.2%	18.2%	19.6%	19.5%	19.8%	9.1%	30.3%	11.4%
Scenario III								
Air traffic	37.7%	41.4%	65.2%	67.9%	54.6%	68.5%	34.5%	77.5%
Road	46.4%	45.1%	17.0%	13.3%	28.6%	13.6%	37.8%	14.3%
Waterway	1.8%	0.0%	2.6%	3.5%	0.7%	11.0%	2.0%	0.0%
Railway	14.1%	13.6%	15.2%	15.2%	16.1%	7.0%	23.8%	8.2%

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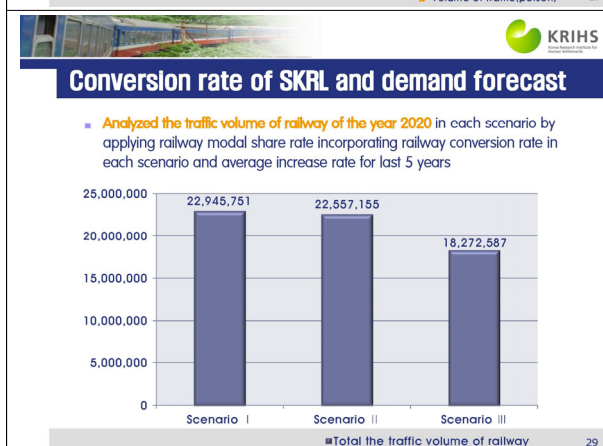
<Note>

- Calculate average increase of passing rate for last 5 years to analyze the year 2020 demand
- Highly increased passing rate to Cambodia for last 5 years from Laos and Vietnam

Classification	Cambodia	Laos	Myanmar	Vietnam	Thailand	Singapore	Malaysia	China
Cambodia	-	16.1%	27.7%	16.6%	32.9%	12.8%	22.9%	6.6%
Laos	65.4%	-	27.7%	6.9%	15.1%	12.8%	1.9%	6.6%
Myanmar	26.4%	10.2%	-	6.9%	11.6%	10.6%	3.1%	6.6%
Vietnam	49.3%	20.2%	27.7%	-	21.3%	13.3%	9.9%	6.6%
Thailand	4.1%	15.0%	20.4%	6.2%	-	8.7%	-2.9%	4.3%
Singapore	7.5%	7.9%	15.6%	12.1%	3.3%	-	6.4%	3.8%
Malaysia	5.6%	32.1%	31.7%	13.1%	13.3%	16.0%	-	4.3%
China	21.6%	35.0%	19.6%	31.4%	20.7%	10.8%	12.3%	-

Data : tourism report in each nation for last 5 years

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<Note>

- Analysis the traffic volume of railway in 2020 for Scenario I

Scenario I	Cambodia	Laos	Myanmar	Vietnam	Thailand	Singapore	Malaysia	China	Total
Cambodia	-	4065	5236	18955	69089	10245	65456	60293	952299
Laos	166248	-	1948	47459	505281	1507	11402	27229	2202074
Myanmar	4579	660	-	1850	55634	17431	31846	12786	140286
Vietnam	235426	36661	22639	-	473574	72664	125881	257486	3693541
Thailand	49946	797232	69083	68940	-	77432	38689	103555	1478377
Singapore	16467	2384	14495	86459	22530	-	686560	15445	6646150
Malaysia	3977	23337	40784	140086	129886	294264	-	192269	1943723
China	244779	223370	49446	1908539	2073335	295953	1076469	-	5882941
Total	4307212	1448469	204531	2463668	582039	770496	7795843	805493	22945751

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<Note>

- Analysis the traffic volume of railway in 2020 for Scenario II

Scenario II	Cambodia	Laos	Myanmar	Vietnam	Thailand	Singapore	Malaysia	China	Total
Cambodia	-	3994	5206	18954	69579	10200	64558	59530	943871
Laos	1564923	-	1937	46944	497576	1502	13225	26884	2352991
Myanmar	4464	634	-	18943	54785	17362	31423	12624	140225
Vietnam	2295077	373377	22539	-	466332	72377	124131	254721	3696544
Thailand	48691	765740	68688	67303	-	77326	381646	99282	1438406
Singapore	16154	2273	14142	86542	23519	-	684148	15257	6357367
Malaysia	3104	22607	41565	138587	1201283	293103	-	189736	1981033
China	238130	224722	49133	1887388	204176	294783	1062674	-	5799488
Total	4199083	1391207	203360	2404381	5073472	767483	7692365	795296	22557555

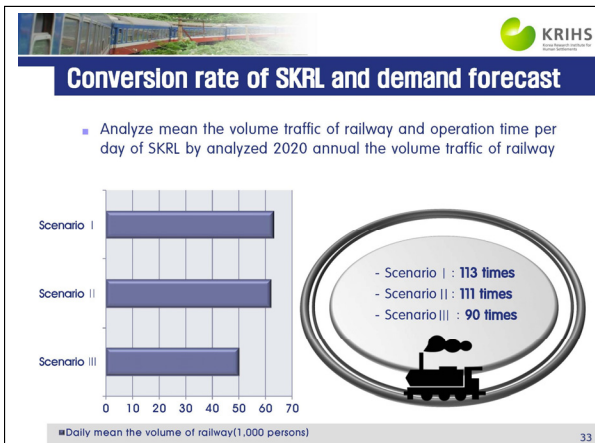
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<Note>

- Analysis the traffic volume of railway in 2020 for Scenario III

Scenario III	Cambodia	Laos	Myanmar	Vietnam	Thailand	Singapore	Malaysia	China	Total
Cambodia	-	2922	4236	147836	471676	8598	57370	42657	738295
Laos	1282444	-	1576	36553	36608	153	11752	18264	1666251
Myanmar	3460	472	-	14749	42391	13338	27925	9046	111371
Vietnam	1776674	276566	18394	-	360851	55560	10330	183523	2782998
Thailand	37739	570249	55830	52402	-	59206	276947	7142	102355
Singapore	12443	1648	11765	66572	16441	-	540232	109289	546551
Malaysia	24162	16355	33802	107904	929521	225000	-	135957	1473181
China	184568	167351	39976	1469866	1579827	226292	944355	-	4602625
Total	3254580	1036043	165460	1895880	392578	589137	6835891	569808	18272587

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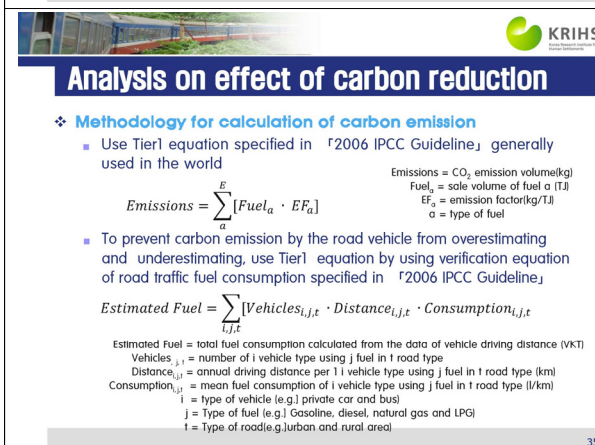
<Note>

- Analyze mean the volume traffic of railway and operation time per day of SKRL by analyzed 2020 annual the volume traffic of railway
- Based on 17 seats per 1 rolling stock and 8 rolling stocks per one train in Korea Mugunghwa-ho (General room)

Classification	Annual the volume traffic of railway	Daily mean the volume traffic of railway	Rolling stock per one train	Number of seat per 1 rolling stock	Number of operation a day
Scenario I	22,945,751 persons	62,866 persons	8 rolling stocks	70 seats	113 times
Scenario II	22,557,155 persons	61,801 persons			111 times
Scenario III	18,272,587 persons	50,062 persons			90 times

Note : daily mean the volume traffic of railway = annual the volume traffic of railway/365 days
 Number operation a day = daily mean the volume traffic of railway / 8 rolling stock(number of rolling stock) / 70 seats
 (number of seat per 1 rolling stock)
 Number of rolling stock, on number of seat per 1 rolling stock = based on domestic Mugunghwa-ho (General room)

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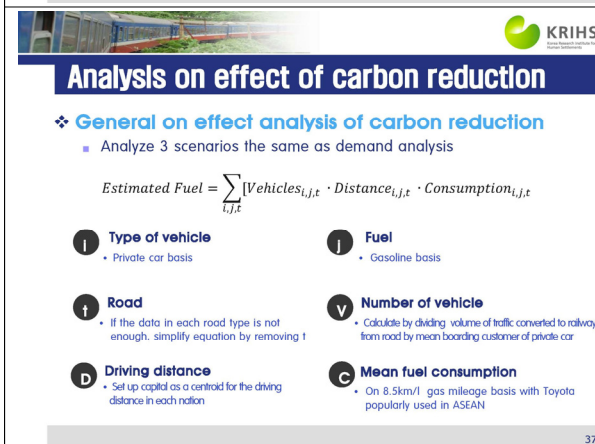


<Note>

❖ 2006 IPCC Guideline

- IPCC (Intergovernmental Panel on Climate Change), jointly established by WMO and UNEP specifies the Guideline for calculation method of greenhouse gas
- It indicates 2 types of method for the calculation of greenhouse gas emission in the road transport filed and for the calculation of CO₂ emission, Tier 1 and 2 methods have been proposed based on the volume of fuel
- Tier 1 method is calculated to multiply basic CO₂ emission factor by sale volume of fuel
- The calculation method for Tier 2 is the same as the Tier 1 method except the use of national own carbon contents of the selling fuel in road transport field but the discharge factor should be used based on the actual carbon content for selling fuel in the country and the year calculating the inventory
- To prevent overestimation and underestimation of the emission from the road vehicle and ensure the data of the fuel used only in the road, verify fuel consumption of road traffic
- Use Tier 1 equation using verification equation of fuel consumption volume in road traffic

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<Note>

- Analysis with 3 scenarios the same as demand analysis
- Scenario I : No change for fare and speed
- Scenario II : Increase 20% road speed
- Scenario III : Increase 20% of road speed and railway fare each

D Driving distance

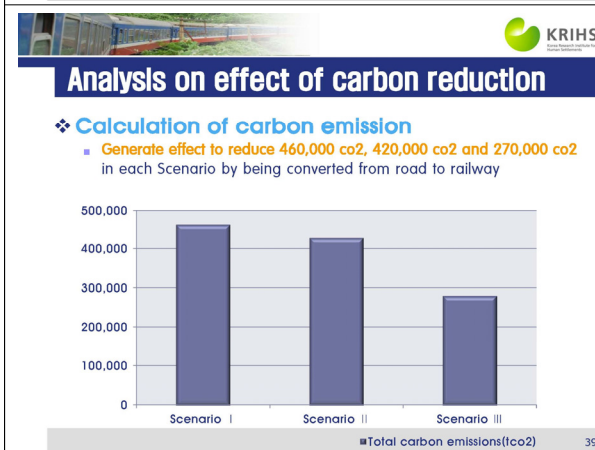
Classification	Cambodia	Laos	Myanmar	Vietnam	Thailand
Cambodia	-	991	1,707	1,509	1,509
Laos	991	-	1,313	786	647
Myanmar	1,707	131	-	1,852	1,129
Vietnam	1,509	786	1,852	-	1,342
Thailand	1,509	647	1,129	1,342	-

Note: distance between city halls in each capital and based on the recommending route in the Google

V Number of vehicle

Classification	Cambodia	Laos	Myanmar	Vietnam	Thailand
Scenario I	-	1,364	434	12,638	78,609
Laos	348,573	-	162	3,125	64,163
Myanmar	994	220	-	1,261	7,065
Vietnam	511,208	120,134	1,877	-	60,137
Thailand	10,845	266,261	5,723	4,480	-
Scenario II	-	1,257	414	11,251	72,313
Laos	321,690	-	154	2,782	59,026
Myanmar	918	203	-	1,122	6,499
Vietnam	471,782	118,946	1,791	-	55,322
Thailand	10,039	245,235	5,450	3,988	-
Scenario III	-	880	249	6,964	51,168
Laos	203,391	-	93	1,722	41,766
Myanmar	580	142	-	695	4,599
Vietnam	298,286	83,321	1,076	-	39,145
Thailand	6,328	171,799	3,282	2,468	-

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<Note>

- Calculation on carbon emission for each scenario in 2020

Classification	Cambodia	Laos	Myanmar	Vietnam	Thailand
Cambodia	-	368	202	5,190	32,278
Laos	93,999	-	58	668	11,297
Myanmar	462	79	-	635	2,170
Vietnam	209,915	27,620	946	-	21,961
Thailand	4,453	46,878	1,758	1,636	-
Classification	Cambodia	Laos	Myanmar	Vietnam	Thailand
Cambodia	-	339	192	4,620	29,693
Laos	86,750	-	55	595	10,392
Myanmar	426	73	-	566	1,997
Vietnam	193,726	25,441	903	-	20,203
Thailand	4,110	43,179	1,677	1,456	-
Classification	Cambodia	Laos	Myanmar	Vietnam	Thailand
Cambodia	-	237	116	2,859	21,011
Laos	54,848	-	33	368	7,353
Myanmar	269	51	-	350	1,413
Vietnam	122,485	17,821	543	-	14,295
Thailand	2,599	30,247	1,008	901	-



Analysis on effect of carbon reduction

❖ **Calculation on carbon emission of CLMVT and Asia**

- **24.4%** carbon dioxide in each target nation and major sector is discharged in **traffic sector** and most of the portion is generated in the road sector
- Expect to generate **appx. 5%** carbon reduction effect in overall CLMVT traffic

Target nation	Total ① (Total CO ₂ emissions from fuel combustion)	Backyard production ②	Other energy industry own use ③	Manufacturing and construction ④	Transport ⑤	Road (of which road) ⑥	Other (other sector) ⑦	Residence (of which residential) ⑧
Cambodia	4.0	0.6	—	0.6	2.0	1.7	0.6	0.6
Laos	—	—	—	—	—	—	—	—
Myanmar	8.3	1.9	0.7	2.6	2.3	1.7	0.7	0.0
Vietnam	137.4	42.5	1.5	47.3	32.9	32.0	13.2	7.7
Thailand	243.2	81.4	15.4	68.6	58.3	57.6	19.5	5.3
Sub-total	392.9	126.6	17.6	119.1	95.5	93.0	34.0	13.6
Asia	3,484.0	1,558.3	154.3	943.9	557.2	514.6	270.4	142.7

Note : ① total sum is ①+②+③+④+⑤+⑥+⑦+⑧
Source : CO₂ Emissions from fuel combustion, IEA(International Energy Agency), 2013 edition.

<Note>

- Carbon dioxide discharged in transport and traffic fields accounts for 15~20% of total greenhouse gas
- According to the date of IEA, calculated carbon dioxide emission in each major nation of Asia in 2011

Name of nation	2007	2008	2009	2010	2011
World	29,686	29,478	28,966	30,509	31,342
Asia	2,911.0	3,022.2	3,214.8	3,404.7	3,484.0
Cambodia	3.4	3.5	3.6	3.8	4.0
Myanmar	10.1	7.5	7.0	8.0	8.3
Viet Nam	91.3	101.9	113.8	129.4	137.4
Thailand	217.4	222.4	216.2	236.2	243.2
Indonesia	367.5	361.4	379.1	410.1	425.9
Malaysia	171.8	182.9	168.1	183.4	194.0
India	1,356.6	1,451.9	1,640.5	1,710.4	1,745.1
China	6,359.9	6,532.3	6,838.6	7,294.1	7,999.6

Source : CO₂ Emissions from fuel combustion, IEA(International Energy Agency), 2013 edition.



Conclusion

- About 20% train modal share rate for only oversea(overland) trips.
- About 450,000 ton CO₂ per year saved
- If train speed over 70 km/h, then reduction of CO₂ will more than 1Mton CO₂ for only oversea(overland) trips.
- Also, total reduction of CO₂ will be 20M ton CO₂ including domestic trips.




Thank You !

□ 세미나 발표자료(발표 2)

ASEAN-ROK Cooperation Project

The study of Arterial Railway Network on Cambodia, Lao PDR, Myanmar, Viet Nam, and Thailand

- Technical Approach of Missing Links -

February 27, 2014

Seol Joo Kim
TESO ENGINEERING Co.
Republic of KOREA

Contents

The study of Arterial Railway Network on Cambodia, Lao PDR, Myanmar, Viet Nam, and Thailand

- I Project Outline
- II Status of Country and Railway
- III Railway Plan for Each Country
- IV Analysis on Railway Alternatives
- V Conclusion

I Project Outline

1. Project Overview
2. Implementation Organization
3. Work Schedule

1. Project Overview

- Implementation of 「The study of Arterial Railway Network on Cambodia, Lao PDR, Myanmar, Viet Nam and Thailand」
- Sponsored by Ministry of Foreign affairs (ROK) & ASEAN Secretariat

Back-ground

- High and immediate impact on ASEAN Connectivity
- Completion of SKRL missing link → Secure national competitiveness
- Need for improvement of existing railway and new construction
- Carbon reduction on road transport → Lead the low CO₂ green growth
- Need for establishment of competitive railway network
- Action plan for ASEAN-ROK strategic partnership
- 「ROK is committed to examine the possibility of providing technical and technological support to the countries in the Mekong sub-region for the development of the Mekong River Basin region in accordance with local requirements」

1. Project Overview

Objective

- Short-term**
 - To accomplish a competitive railway network in the CLMVT ;
 - To drive regional green growth ; and
 - To build an experts' network between railway-related agencies of CLMVT, ASEAN and Korea
- Long-term**
 - To shift road-dependent transport system to railway-oriented one, establishing a greener transport system ;
 - To enhance national and regional competitiveness by seamlessly connecting ASEAN SKRL
 - To review on alternative route of missing links in the CLMVT and suggest the priority
 - To pave the way for green growth to prepare for climate change

1. Project Overview

Scope of study

- Spatial Scope**
 - Country : 5 countries of the Greater Mekong Sub-region (Cambodia, Lao PDR, Myanmar, Viet Nam and Thailand)
- Time Scope**
 - Period of Implementation : 21 March, 2013 ~ 20 March, 2014
- Work Scope**
 - Field study and analysis on current status of regional railway
 - Review on current railway policies of CLMVT countries & generating policy recommendations
 - Analysis of technical alternatives and decision of priority (SKRL missing link)
 - Estimation of CO₂ reduction according to adopting alternatives
 - Verification and evaluation
 - Seminar

1. Project Overview

Site Map

- SKRL Network
- Section : Singapore~Kunming
- Total Length : L=5,000km
- Missing link : L=1,285km
- Lao PDR & Viet Nam : New proposal link Vientiane ~ Thakhek ~ Mu Gia, 466 km
- Mu Gia ~ Tao Ap ~ Vung Ang, 119 km
- Thailand & Cambodia : Aranyaprathet ~ Klongluk, 6 km
- Poipet ~ Sisophon, 48 km
- Cambodia & Viet Nam : Phnom Penh ~ Snuol ~ Loc Ninh, 254 km
- Loc Ninh ~ Ho Chi Minh, 129 kilometres
- Myanmar & Thailand : Thanlyinzay ~ Three Pagoda Pass, 110 km
- Three Pagoda Pass ~ Nam Tok, 153 km

2. Implementation Organization

❖ Implementation Organization

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graph TD
    ASEAN[ASEAN Secretariat] --> MOFA[Ministry of Foreign Affairs  
(Republic of Korea)]
    ROK[Ministry of Foreign Affairs  
(Republic of Korea)] --> PM[Project Manager (Joint)]
    ROK --> PHD[Ph. D. OH Sung Ho (KRIHS)]
    ROK --> PEO[P.E. KIM Seol Joo (TESO)]
    PM --> TP[Transportation Planning]
    PM --> RP[Railway Planning]
    PM --> TPO[Transportation Policy]
    PM --> ENV[Environment]
    TP --> TP_MEMBERS[Ph. D. CHUNG Jin Kyu (KRIHS) & 2 experts]
    RP --> RP_MEMBERS[P.E. LEE Yi Jong (TESO Eng.) & 3 experts]
    TPO --> TPO_MEMBERS[Ph. D. LEE Back Jin (KRIHS) & 2 experts]
    ENV --> ENV_MEMBERS[P.E. KIM Young Hwan (TESO Eng.) & 1 expert]
    PM --> DAB[Domestic Advisory Board]
    
```

3. Work Schedule

❖ Work Schedule

2013. 03	Commencement of Study on ASEAN Railway Network
2013. 04	Meeting with ASEAN Secretariat and Cambodia Authority
2013. 04	Site Investigation in Cambodia and Thailand
2013. 05	Meeting with Myanmar and Lao PDR Authority and Site Investigation in Myanmar
2013. 06	Meeting with Thailand and Viet Nam Authority
2013. 07	Site Investigation in Viet Nam
2014. 02	Seminar (with ASEAN Countries and Study Team)
2014. 03	Submission of Final Report

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I

Status of Country and Railway

- 1. Country Status
- 2. Railway Status

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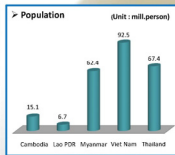
1. Country Status

❖ Population

- No. of Population in CLMVT : 6.7 mill.persons ~ 92.5 mill.persons
- Total No. of population in CLMVT: 244.1 mill.Persons about 35% of ASEAN Countries
- Average population density: 122.4 person/km about 80% of ASEAN Countries

Country	Population (mill.person)	Area (thou.km)	Population Density (person/km)
Cambodia	15.1	181	83.4
Lao PDR	6.7	293	22.9
Myanmar	62.4	677	92.2
Viet Nam	92.5	331	279.5
Thailand	67.4	513	131.4
Total	244.1	1,995	122.4
ASEAN	687.9	4,535	151.7

Source : 2014 World Fact Book, Korea EXIM Bank(Au of 2013)



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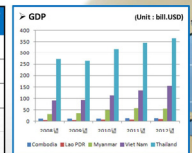
1. Country Status

❖ GDP

- In terms of GDP per capita, Thailand is the highest amount at 5,390 USD per capita.
- The gross rates are 5.2% ~7.9%.

Country	GDP (bill.USD)	GDP per Capita(USD)	Growth Rate (%)
Cambodia	14.2	934	7.3
Lao PDR	9.2	1,446	7.9
Myanmar	55.3	835	6.3
Viet Nam	155.6	1,735	5.2
Thailand	365.6	5,390	6.4

Source : 2014 World Fact Book, Korea EXIM Bank(Au of 2012)



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2. Railway Status

❖ Cambodia

- Total length : 650km (included railway not in-service)
- North line
 - Length : 386km
 - Thailand Border ~ Phnom Penh
- South line
 - Length : 264km
 - Phnom Penh ~ Sihanoukville
- Track type : Single track
- Track type : Meter gauge
- Operating train
 - Locomotive : 18 EA
 - Passenger car : 9 EA
 - Freight car : 100 EA

Source : 1) Asian-Japan transport partnership, atp information center, 2013
2) Development of the Tran-Asian Railway in the Indo-China and ASEAN Subregion, 2011, UNESCAP

➤ Railway Network



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2. Railway Status

❖ Lao PDR

- Total length : 3.5km
- Nongkhai in Thailand~Thanaleng in Lao PDR
- Railway station : 1 station
- Track type : Single track
- Track gauge : Meter gauge

Source : 1) Asian-Japan transport partnership, atp information center, 2013
2) Development of the Tran-Asian Railway in the Indo-China and ASEAN Subregion, 2011, UNESCAP



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2. Railway Status

❖ Myanmar

- Total length : 5,949km
- Railway station : 944 stations
- Track type : Single and Double tracks
- Track gauge : Meter gauge
- Operating train
 - Locomotive : 250 EA
 - Passenger car : 1,281 EA
 - Freight car : 3,188 EA

Source : 1) Asian-Japan transport partnership, atp information center, 2013
2) Development of the Tran-Asian Railway in the Indo-China and ASEAN Subregion, 2011, UNESCAP

➤ Railway Network



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2. Railway Status

❖ Viet Nam

- Total length : 2,544km
- Track type : Single track
- Track gauge : Meter and Standard gauge
- Operating train
 - Locomotive : 303 EA
 - Passenger car : 1,040 EA
 - Freight car : 5,332 EA

Source : 1) Asian-Japan transport partnership, atp information center, 2013
2) Development of the Tran-Asian Railway in the Indo-China and ASEAN Subregion, 2011, UNESCAP



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2. Railway Status

❖ Thailand

- Total length : 4,043km
- Track type : Single and Double tracks
- Track gauge : Meter and Standard gauge
- Operating train
 - Locomotive : 263 EA
 - Passenger car : 1,260 EA
 - Freight car : 5,637 EA



Source : 1) Asian Japan transport partnership, ajtp information center, 2013
2) Development of the Train-Asian Railway in the Indo-China and ASEAN Subregion, 2011, UNESCOAP

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III

Railways Plan for Each Country

- 1. Review on Previous Railway Reports
- 2. Cambodia
- 3. Lao PDR
- 4. Myanmar
- 5. Viet Nam
- 6. Thailand

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1. Review on Previous Railway Reports

❖ F/S for the Railway Singapore-Kunming Rail Link (SWG, 2000)

• Route 1 : Select the economical route

Route	Length (km)	Missing Link (km)	Related Country
Route 1	5,382	431	Cambodia, Lao PDR, Viet Nam
Route 2	4,559	1,127	Myanmar, Thailand, China
Route 3	4,259	531	Lao PDR, Viet Nam
Route 4	4,164	1,300	Lao PDR, China
Route 5	4,481	616	Lao PDR, Viet Nam, Thailand
Route 6	4,225	589	Lao PDR, Viet Nam, Thailand

Source : F/S for the Railway Singapore-Kunming Rail Link, 2000, Special Working Group

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2. Cambodia

❖ Cambodia Railway Master Plan (MPWT, 2012)

- Total : 21 lines
- 5 Main lines (L=1,524km)
- 8 Branch lines (L=1,042km)
- 4 High-speed lines
- 4 Industrial & Extended lines



Source : Cambodia Railway Master Plan, 2012, Ministry of Public Works and Transport

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2. Cambodia

❖ Cambodia Railway Master Plan (KOICA, 2012)

Short Term (Radiation - Internal Circulation)



Medium Term (Extensional Radiation)



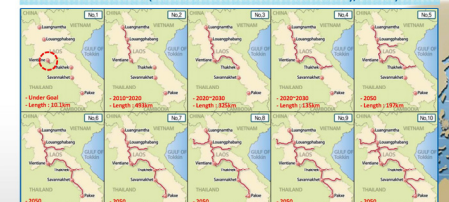
Source : Cambodia Railway Master Plan, 2012, KOICA

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3. Lao PDR

❖ Lao PDR Railway Plan (CREEC, 2008)

- Railway plan based on feasibility study of SKRL lines
- Total length : 2,152km (Phase 10)
- Work scope : Phase 3 (Vientiane~Thanhek Railway, 325 km), Phase 4 (Thakhek~Viet Nam Outbound Railway, 135km)



Source : Lao PDR Railway Plan, 2008, China Railway Eryuan Engineering Group Co. Ltd

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3. Lao PDR

❖ Pre F/S for the Railway Construction between Vientiane in Lao PDR and Vung Ang in Viet Nam (Korea, 2011)

- Implementation organization : Chung Suk Engineering in Korea
- Total length : 431km
- Section : Vientiane~ Pakxan~ Viengkham~ Thakhek~ Banlangkhang



Source : Pre F/S for the Railway Construction between Vientiane in Lao PDR and Vung Ang in Viet Nam, 2011, Korea

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3. Lao PDR

❖ Pre F/S for the Railway Construction between Thakhek ~ Savannakhet ~ Pakse in Lao PDR (Korea, 2012)

- Implementation organization : TESO Engineering in Korea
- Total length : 323.5km
- Section : Thakhek~ Savannakhet~ Pakse~ Chong Mek



Source : Pre F/S for the Railway Construction between Thakhek ~ Savannakhet ~ Pakse in Lao PDR, 2012, Korea

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4. Myanmar

❖ Regional Railway Network Extension Plan and Outbound Railway Construction Plan (MR, 2010)

Section	Length(km)
1. Motagyi ~ Bhamo	130
2. Mongnai ~ Kyaingtong	346
3. Minbu-An ~ Yechanpyin	395
4. Dawei ~ Myeik	213
5. Pathain-Nyaungdon ~ Yangon	143
6. Pyay-Taungtha ~ Nyaungpyitaw	193
7. Hinthada ~ Nyaungdon	77
8. Thayet ~ Kyaukse	307
9. Yawataw ~ Kanpya	105
Total	1,909
Out-bound Railway	
A. Dawei ~ Thailand Kanchanaburi	250
B. Thanbyuzayat ~ Thailand Nam Tok	263
C. Kyaukse Phyu ~ Muse	868
Total	1,381

Source : Regional Railway Network Extension Plan and Outbound Railway Construction Plan, 2010, Myanmar Railways

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5. Viet Nam

❖ Railway by 2020 & Vision 2030 (MOT, 2009)

- Railway Plan by 2020
 - Upgrading of existing railways (L=1,818km)
 - Building of new railways or sections (L=2,012km)
 - Urban and interregional railways (L=915.3km)
 - Axial railways through cities (L=196km)
 - Some North - South high speed railways
- Railway Vision 2030
 - Building of new railways or sections (L=1,609km)
 - Urban and interregional railways (L=183.6km)
 - Remaining sections of North - South high speed railways (total length 2,020km)



Source : Railway by 2020 & Vision 2030, 2009, Ministry of Transport

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5. Viet Nam

❖ FS for Viet Nam Railways (KOICA, 2007, 2008)

- Implementation organization:
 - Chung Suk Engineering in Korea
- Total length :
 - Phase 1 : 412km
 - Phase 2 : 350km
- Section
 - Phase 1 : Ho Chi Minh City ~ Nha Trang
 - Phase 2 : Hanoi ~ Vinh



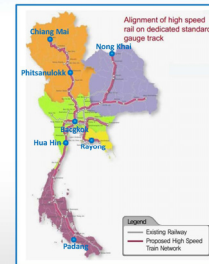
Source : 1) FS for building and electrifying double track gauge from Sai Gon to Nha Trang on the North-South track line (Chung Suk Eng., KOICA, 2007)
2) FS for building and electrifying double track gauge from Hanoi to Vinh on the North-South track line (Chung Suk Eng., KOICA, 2008)

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6. Thailand

❖ High-speed Railway Construction Plan (OTP, 2010)

Route	Length (km)
Bangkok ~ Korat ~ Nong Khai	615
Bangkok ~ Hua Hin ~ Padang Besar	982
Bangkok ~ Pattaya ~ Rayong	221
Bangkok ~ Phitsanulok ~ Chiangmai	745
Total	2,563



Source : High-speed Railway Construction Plan, 2010, Office of Transport and Traffic Policy and Planning

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6. Thailand

❖ Double Track Master Plan (SRT, 2010)

Route	Length (km)
1. Chachoengsao ~ Kaeng Khoi	360
2. Lop Buri ~ Nakhonsawan	420
3. Map Kabao ~ Thanon Chira Junction	370
4. Thanon Chira Junction ~ Khonkaen	410
5. Nakhonpathom ~ Huahin	530
6. Prachuap Khiri Khan ~ Chumphon	500
Total	2,590



Source : Double Track Master Plan, 2010, State Railway of Thailand

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6. Thailand

❖ New Railway Construction Plan (SRT, 2010)

- Total : 17 lines (Included 4 Outbound Lines)

• Outbound Lines

Route	Destination
1. Nam Tok ~ Three Pagoda	Myanmar
2. Den Chai ~ Chiang Mai	China
3. Ubon ~ Chong Mek	Lao PDR
4. Rayong ~ Trad	Cambodia



Source : New Railway Construction Plan, 2010, State Railway of Thailand

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IV

Analysis on Railway Network Alternatives

- 1. Technical Review
- 2. Cost Estimate
- 3. Priority Assessment

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1. Technical Review

❖ Construction Standards

Item	Construction Standards	Note
Track type	Single track	Consider connection of existing railway
Design speed	150km/hr	Consider future demand and economics
Track gauge	Meter gauge	Consider connection of existing railway
Ballast type	Gravel ballast	Consider connection of existing railway
Minimum radius	1,100m	600m in exceptional case
Maximum slope	12.5/1,000 or less	Exceptional case : 15/1,000 or less Station slope : 2/1,000 or less
Roadbed width	Over 8m	Consider to improve the standard gauge

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1. Technical Review

❖ Myanmar ~ Thailand Connecting Line

• Route 1 : Myanmar Thanbyuzayat ~ Three Pagoda ~ Thailand Nam Tok (L=261.2km)

Division	MMR	THA
Length	110.9km	150.3km
Earth work	108.2km (12EA)	132.1km (16EA)
Bridge	1.7km (2EA)	4.0km (10EA)
Tunnel	1.0km (2EA)	14.2km (10EA)
Station	8EA	9EA

MMR : Myanmar, THA : Thailand



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1. Technical Review

❖ Thailand ~ Cambodia Connecting Line

• Route 2 : Cambodia Sisophon ~ Poipet ~ Thailand Aranyaprathet (L=56.7km)

Division	KHM	THA
Length	47.2km	9.5km
Earth work	46.3km (4EA)	8.9km (4EA)
Bridge	0.9km (4EA)	0.6km (4EA)
Tunnel	-	-
Station	3EA	1EA

KHM : Cambodia, THA : Thailand



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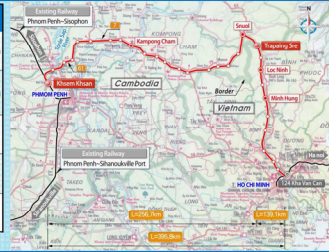
1. Technical Review

❖ Cambodia ~ Viet Nam Connecting Line

• Route 3 : Cambodia Khsem Khsan ~ Kampong Cham ~ Snoul ~ Viet Nam Loc Ninh ~ Min Hung ~ Ho Chi Minh (L=395.8km)

Division	KHM	VNM
Length	256.7km	139.1km
Earth work	253.9km (6EA)	136.0km (35EA)
Bridge	2.8km (6EA)	3.1km (35EA)
Tunnel	-	-
Station	20EA	9EA

KHM : Cambodia, VNM : Viet Nam



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1. Technical Review

❖ Lao PDR ~ Viet Nam Connecting Line

• Route 4 : Lao PDR Vientiane ~ Pakxan ~ Thakhek ~ Mu Gia ~ Viet Nam Tan Ap (L=494.4km)

Division	LAO	VNM
Length	448.0km	46.4km
Earth work	426.0km (92EA)	40.8km (16EA)
Bridge	17.0km (92EA)	1.7km (16EA)
Tunnel	5.0km (4EA)	3.9km (7EA)
Station	39EA	3EA

LAO : Lao PDR, VNM : Viet Nam



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2. Cost Estimate

❖ Basic Premise of Cost Estimate

Basic Premise of Cost Estimate

- Construction cost has been calculated based on the collected data from the site investigation in each country and the construction cost of completion.
- If materials can be produced and supplied at local area, the price investigated in the local area has been determined.
- Railway electric facilities have been assumed to be provided from Korea.
- The labor cost of roadbed and track construction has been applied for the price in each country.
- If equipment, material, facilities, etc. are used only for the project, no tax will be assumed.
- Price fluctuation has not been additionally applied and 1USD = 1,071 Korean won exchange rate has been applied.

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2. Cost Estimate

❖ Result of Project Cost Estimate

Classification	Route 1 Myanmar ~ Thailand	Route 2 Thailand ~ Cambodia	Route 3 Cambodia ~ Viet Nam	Route 4 Lao PDR ~ Viet Nam
A. Construction Cost	1,524.8	317.7	2,195.7	1,940.7
A-1. Roadbed	1,115.3	227.2	1,577.9	864.4
A-2. Station	86.3	19.9	140.4	56.8
A-3. Track	60.4	13.1	88.4	116.5
A-4. Buildings(Station)	28.4	6.6	46.2	100.6
A-5. Electric Facility	234.3	50.8	342.8	802.3
B. Incidental Cost	113.3	24.5	162.5	143.5
B-1. Design	60.8	13.2	86.7	76.4
B-2. Supervision	37.4	8.2	53.8	47.5
B-3. Survey	15.2	3.2	22.0	19.4
C. Contingency Cost	163.8	34.2	235.8	208.4
D. Total	1,801.8	376.4	2,594.0	2,292.5

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3. Priority Assessment

❖ Selection of Assessment Indicators

- Selection of Assessment Indicators by AHP(Analytic Hierarchy Process)
- To classify indicators into higher class with 3 categories, lower class with 6 categories and third class with 6 categories

First Class	Second Class	Contents	Score				
			1	2	3	4	5
Economic	Demand creation and Increase	Railway diversion demand (2020 year)	Small		Medium		Large
	Least cost	Total project cost (million USD)	High		Medium		Low
Policy	Promotion effort and request level	Absolute evaluation on promotion effort by relevant countries	Low		Medium		High
	Correspond with relevant plan and policy direction	Correspond with upper plan of designated routes and nation	Low		Medium		High
Environmental	Construction availability and period	[(Bridge+ Tunnel) length/ total length] × 100	Less 5%	5~10 %	10~20 %	20~30 %	Over 30%
	Reduction in carbon emission	Green gas reduction by diversion road traffic volume (t CO ₂)	Very Little	Little	Normal	Much	Very Much

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3. Priority Assessment

❖ Results of Priority Route

- Method of priority selecting by Multi-Criteria Analysis

- As a result of analysis, Route 3 (Cambodia ~ Viet Nam) is the highest priority with total weighting score of 3.35.

Item (Weight)	Economic Analysis (0.427)				Policy Analysis (0.315)				Environmental Analysis (0.258)				Total Score
	Traffic demand (0.317)	Minimum project cost (0.338)	Promotion will (0.105)	Plan conformity (0.148)	Workability (0.265)	Carbon Emission Decrease (0.356)	Score	Weight	Score	Weight	Score	Weight	
Route 1 Myanmar ~ Thailand	2.0	0.27	2.0	0.29	3.0	0.10	4.0	0.19	2.0	0.17	1.0	0.36	1.37
Route 2 Thailand ~ Cambodia	4.0	0.54	5.0	0.72	3.0	0.10	5.0	0.23	2.5	0.21	2.0	0.71	2.52
Route 3 Cambodia ~ Viet Nam	5.0	0.68	2.0	0.29	3.0	0.10	5.5	0.26	3.0	0.25	5.0	0.78	3.85
Route 4 Lao PDR ~ Viet Nam	4.0	0.54	3.0	0.43	3.0	0.10	4.5	0.21	1.5	0.13	2.0	0.71	2.12

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