THE UNIVERSITY OF TOKYO

National Institute
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Traffic Demand Model for Corridor Projects in CAREC

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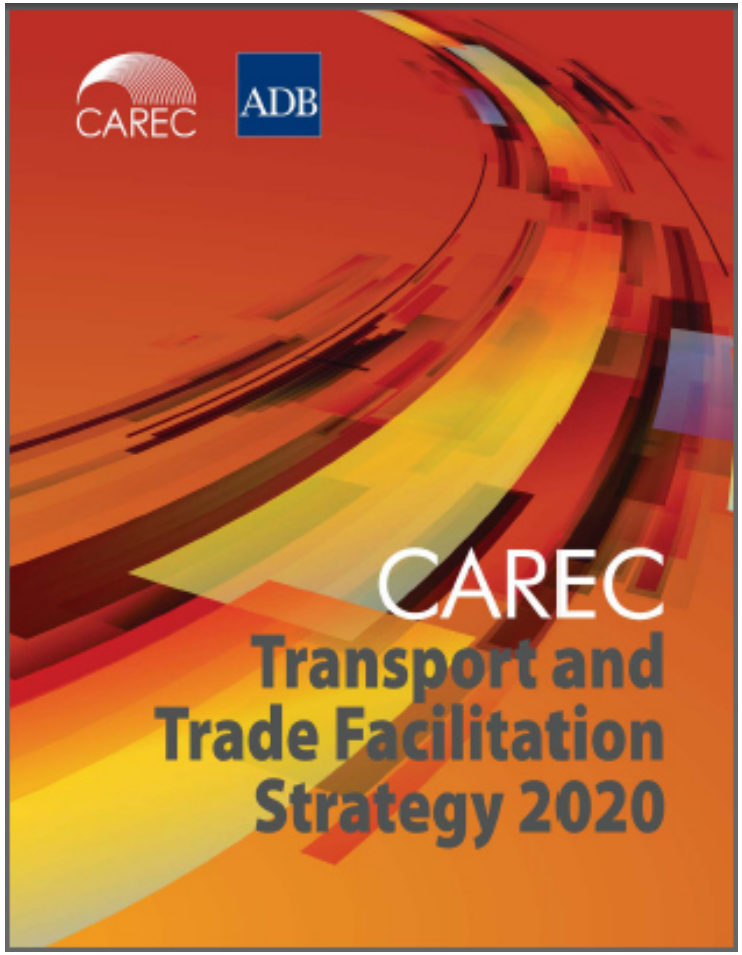
Goals of Today's Presentation

- Introduction
  - Why is a model needed?
- Model Development
  - How have we developed the model?
- Case Studies with the Model
  - How can we apply the model to CAREC project?
- Conclusion

Introduction

Why is a model needed?

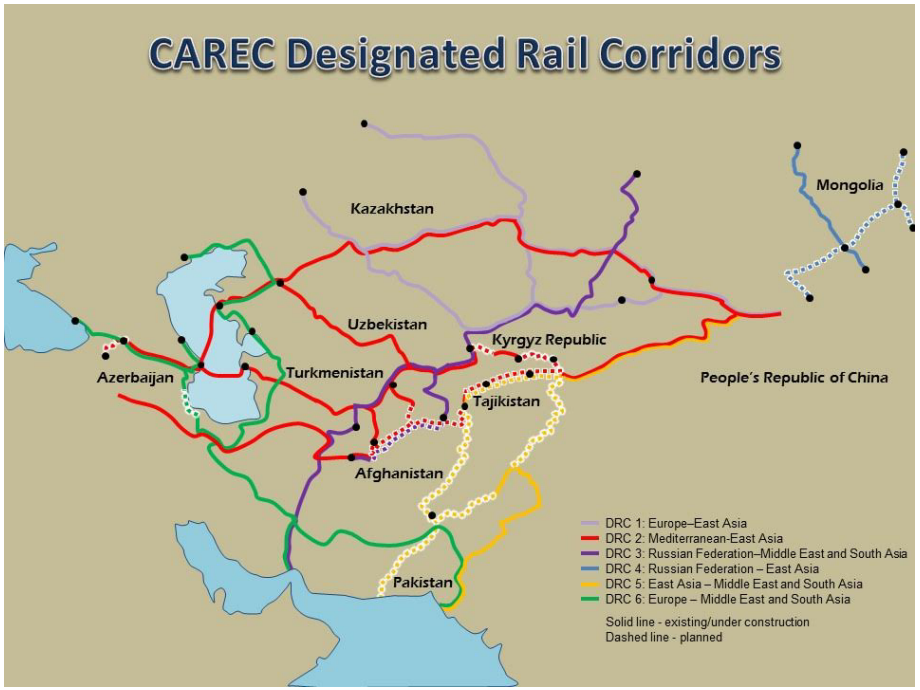
Transport and Trade Facilitation in CAREC



- For rail projects, the planning horizon is typically 50 to 100 years.
- Improvements in rail transport require the coordination of movements across borders and through neighboring countries.
- Coordination requires changes in procedures and management, and is therefore more difficult to achieve.

Importance of Prioritizing Projects

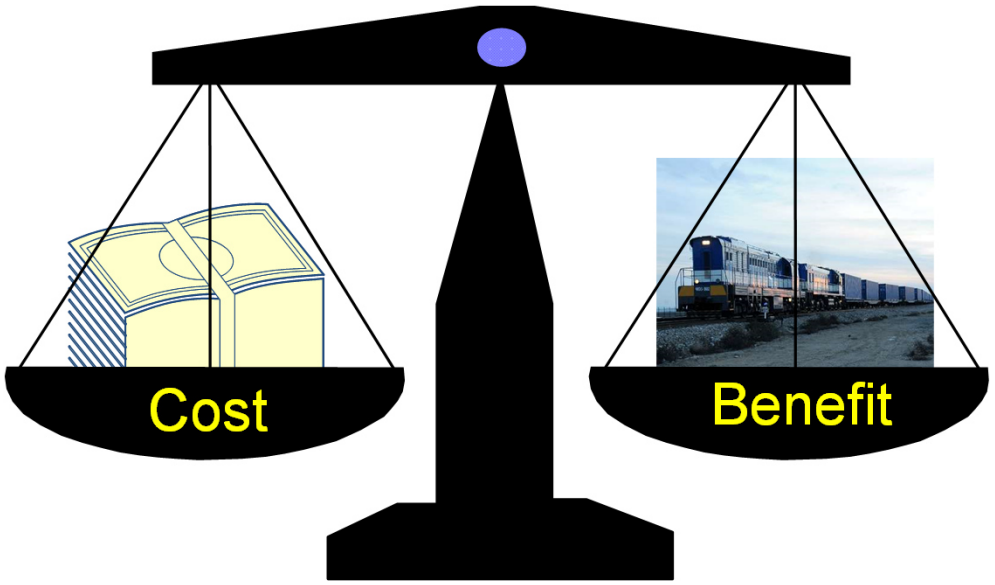
- Many proposed projects in CAREC
- But all of them may not be economically /financially supported.
- Investment projects should be prioritized for better transport and trade facilitation.



Source: ADB (2016)

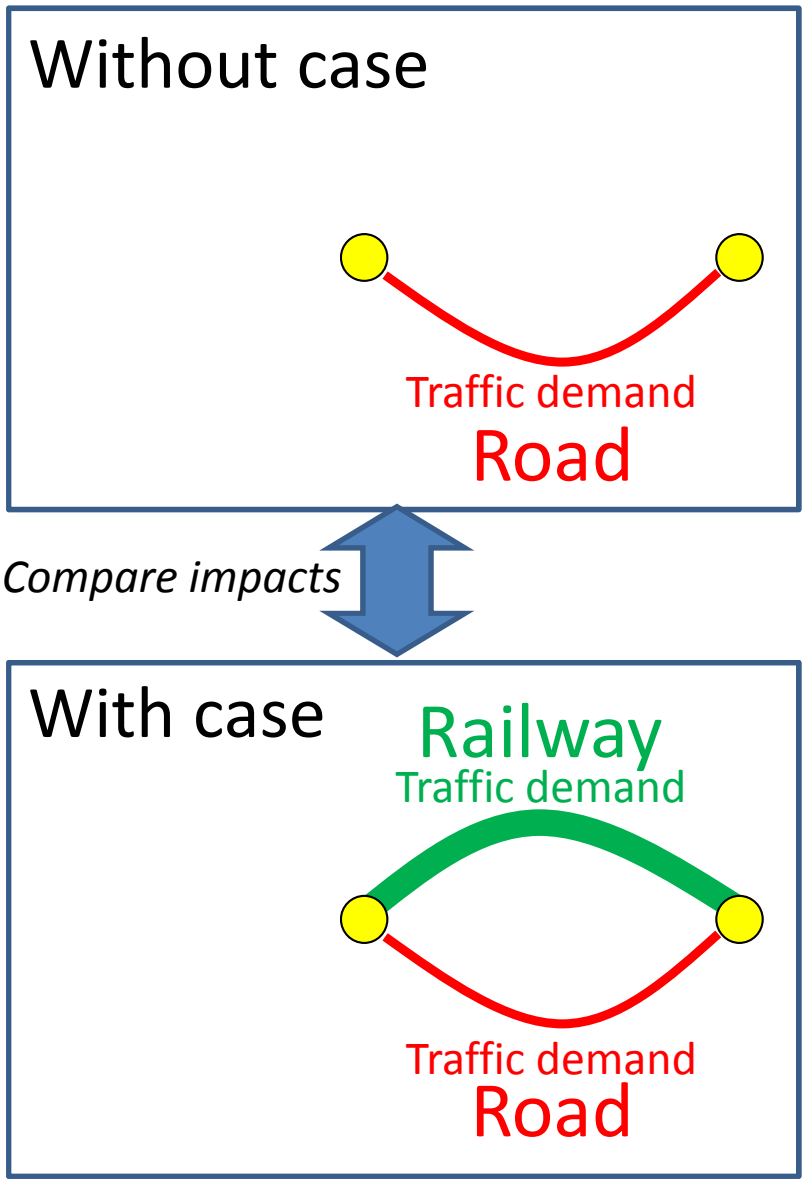
How Can We Prioritize Projects?

- Projects with higher positive impacts should be prioritized.
- Impacts should be assessed from a viewpoint of cost-benefit.



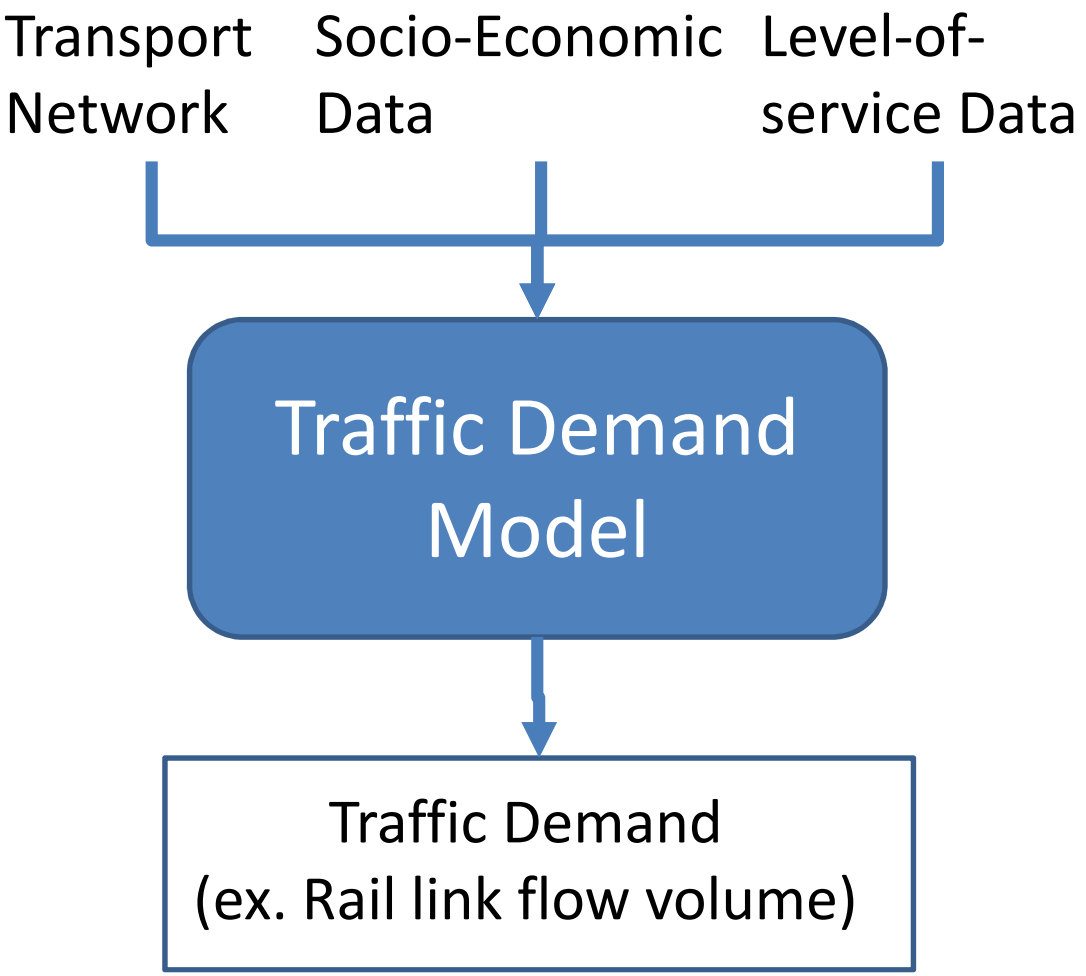
How Benefit is Estimated?

- Benefit is estimated by comparing cases with and without projects.
- To estimate the benefit, traffic demands are required.
- Demand is forecasted with a Traffic Demand Model.



What is the Traffic Demand Model?

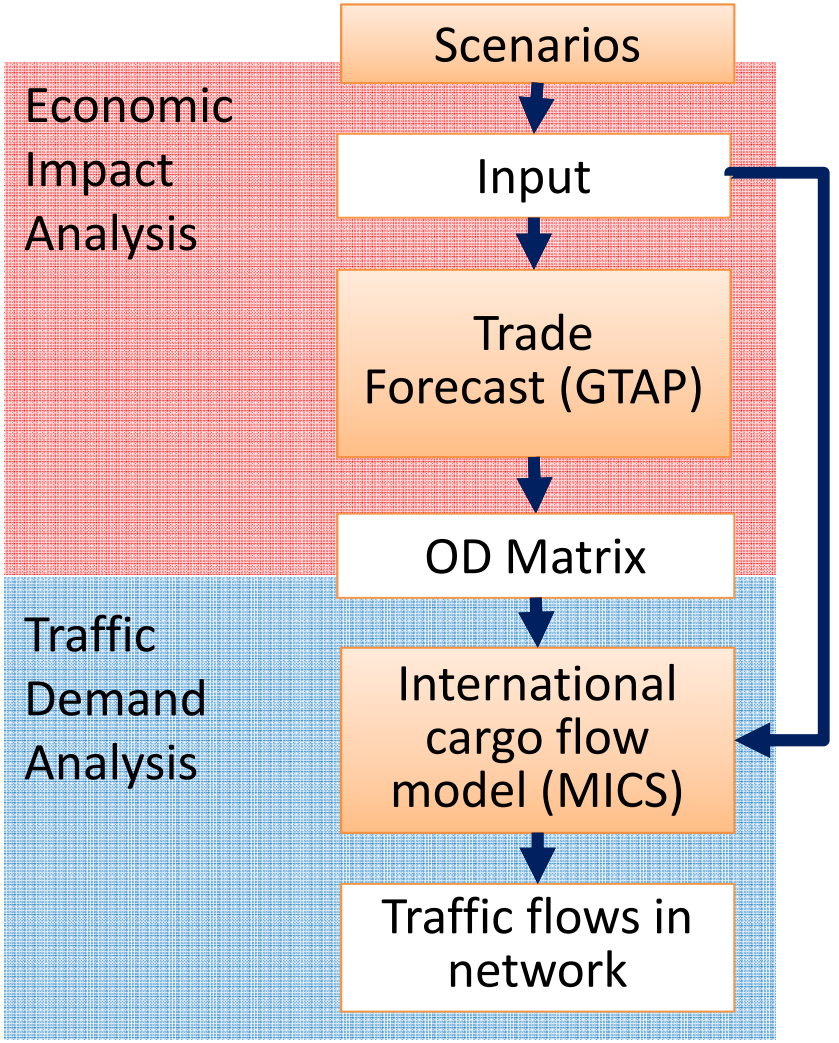
- Given input data, the traffic demand is computed using the traffic demand model (TDM).
- There are various types of TDMs.



Model for CAREC Rail Demand Forecast

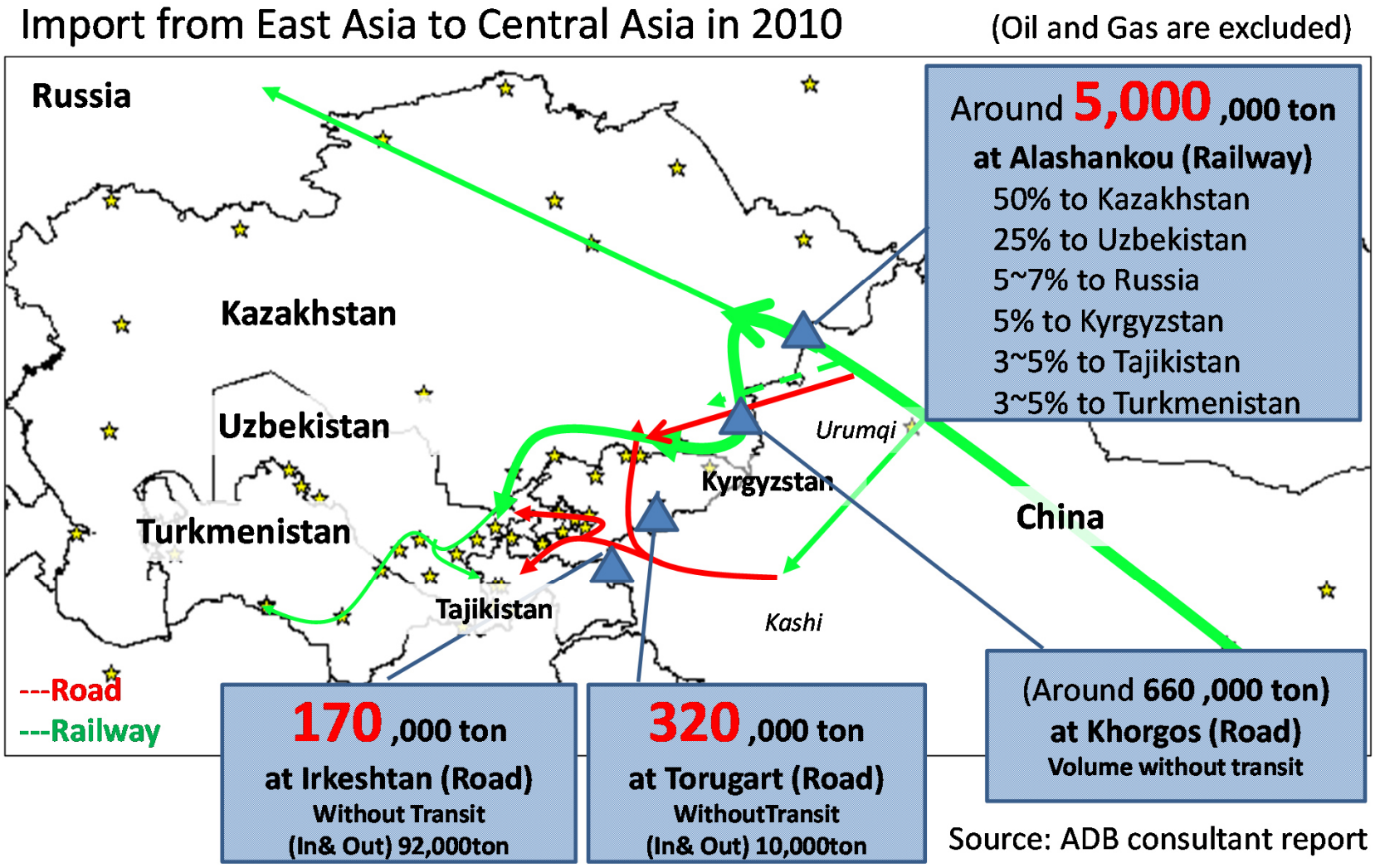
Two-stage Model

1. Economic Impact Model (GTAP)
   - Input: Socio-economic data
   - Output: trade patterns and economic impacts
2. Traffic Demand Model (MICS)
   - Input: OD trade volume and transport network
   - Output: Traffic flows in rail/road/maritime network



Road network is covered in addition to Rail

Competition between rail and road is incorporated.

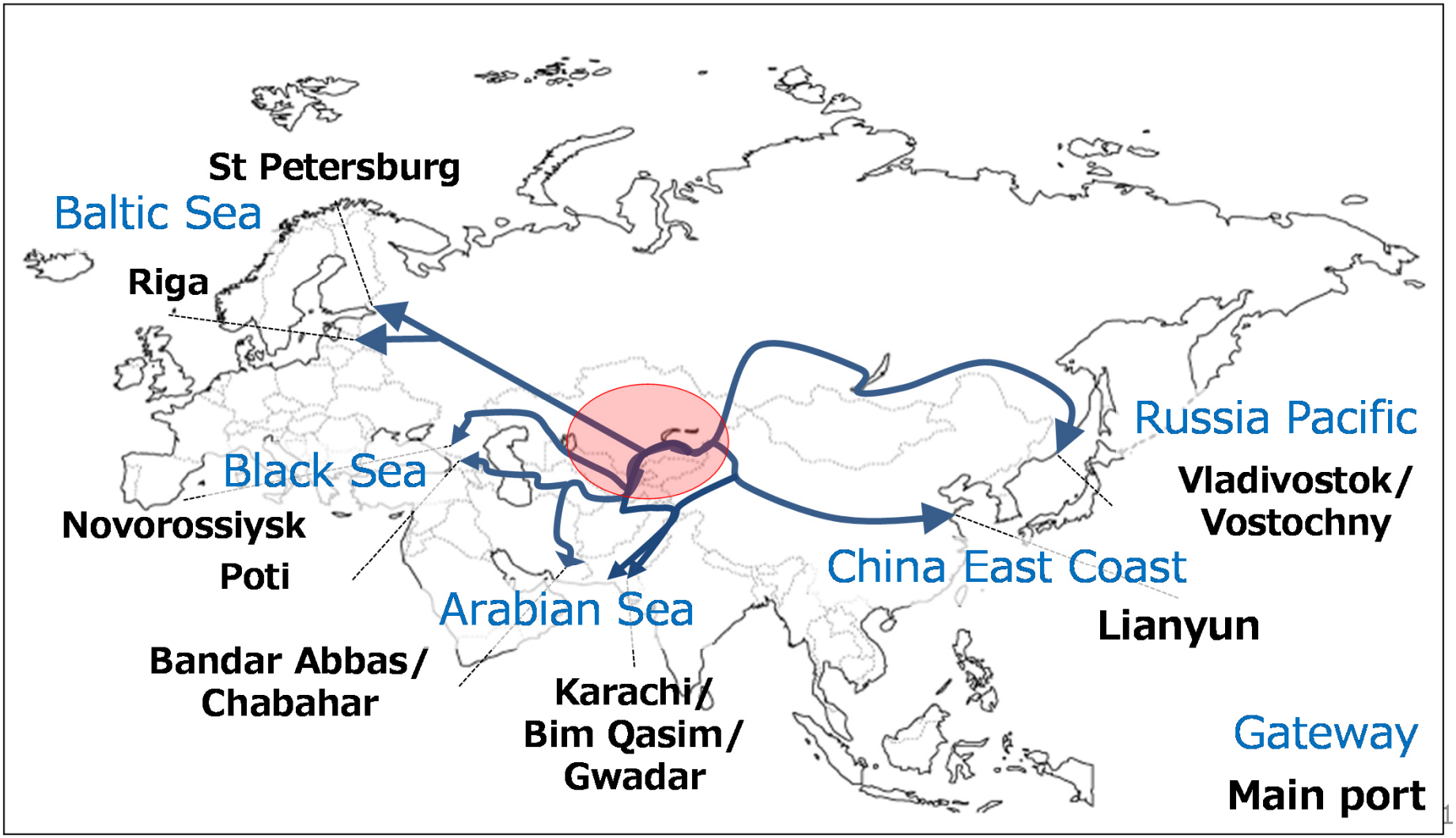


Source: ADB consultant report

Advantage of Our Model (Continued)

Worldwide network is considered

Trades through maritime network are also incorporated.



What Can We Do with the Model?

We CAN:

- Forecast future rail demand
- Assess rail development project with forecasted demand
- Prioritize projects based on assessment

They could contribute to facilitating consensus-building among stakeholders in CAREC.

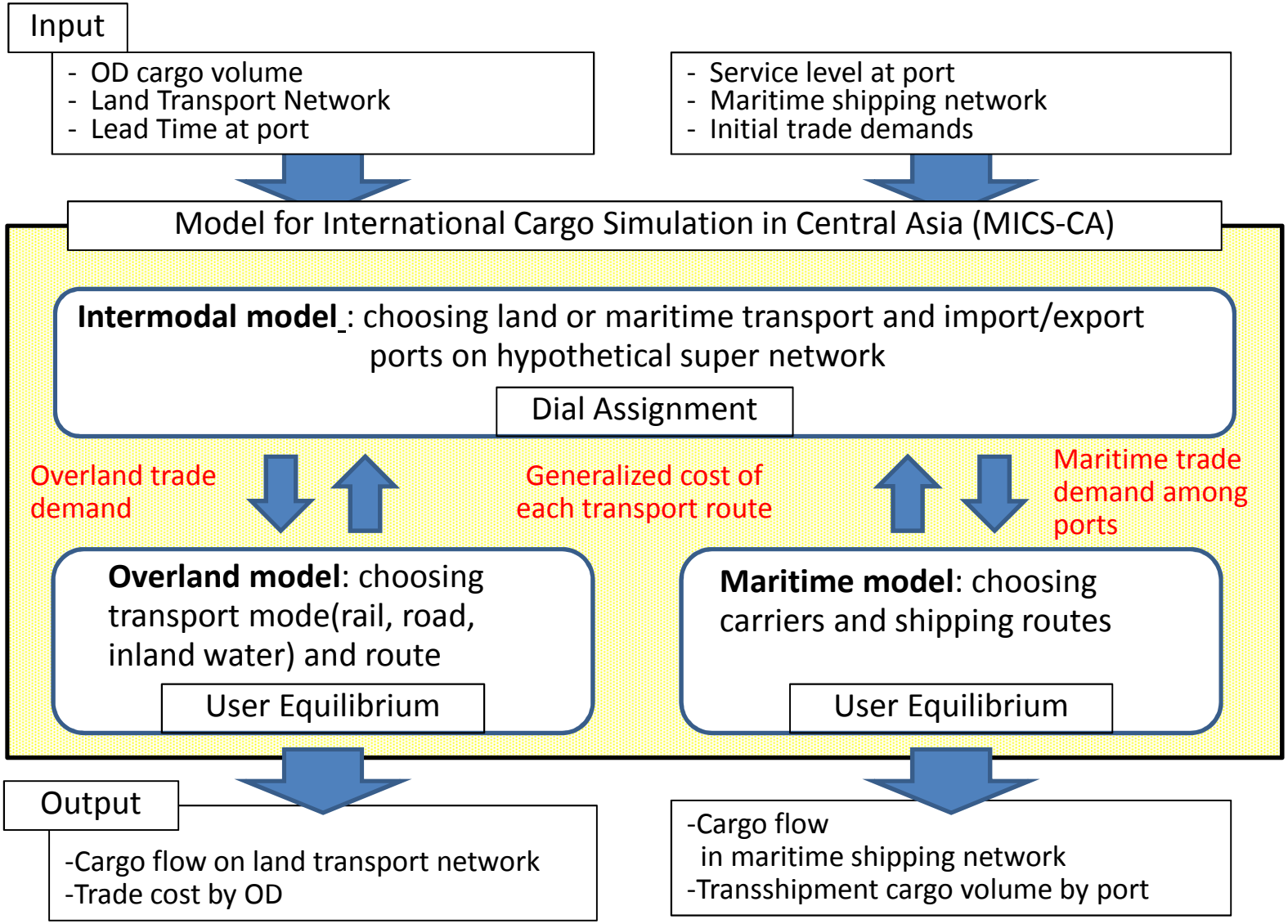
Model Development

How have we developed the model?

Model Development

- The model was developed by a study team of the UTokyo since 2013.
  - The concept of model was originally proposed by Shibasaki *et al*. (2005).
- It has been revised through multiple projects of ADB, JICA, and UTokyo's research.
  - Latest model was developed in Tanabe, Shibasaki & Kato (2015).

Traffic Demand Model Structure



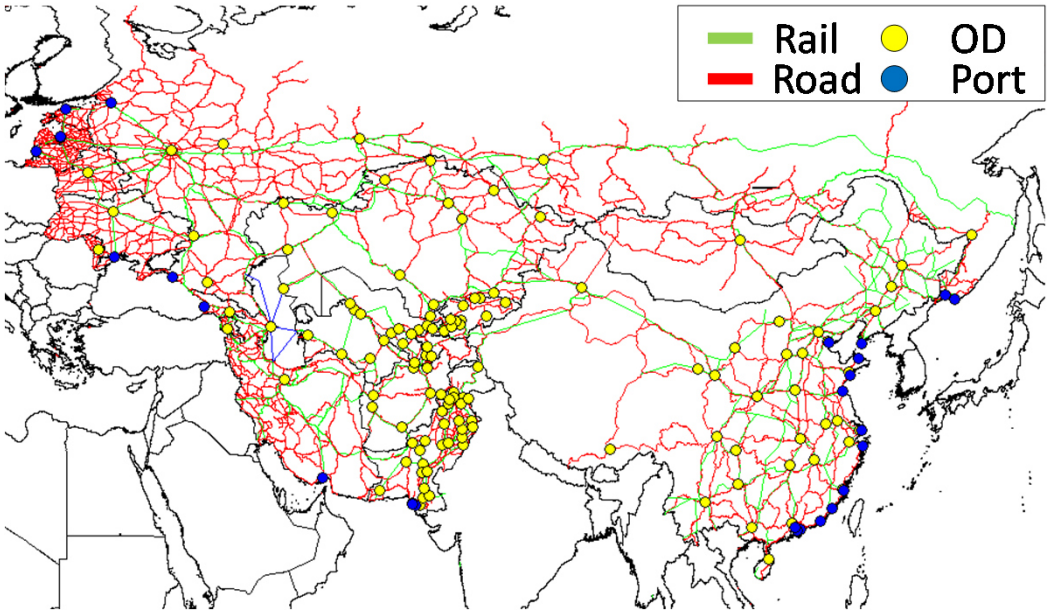
Transportation Network

- Based on ADC World Map, CAREC railway links data are added.

OD: 134 points
Road : 16,398 links
Railway : 3,026 links
Ferry: 8 links

- Railway access to the ports can be analyzed.

Transportation Network



Model：Railway Capacity

- Both road and rail transportation networks are considered
- Freight forwarders are assumed to consider both transportation time and monetary cost (generalized cost) to choose a transportation mode and a route.

$$G_{ij} = C_{ij} + vt \cdot T_{ij}$$

Value of time

- Consideration of railway capacity

The railway link cost function depending on traffic volumes

$$T_R = \frac{L}{V}\left(1 + \beta_1 \cdot \left(\frac{Q}{C}\right)^{\beta_2}\right)$$

T_R : Link Time（hour）
L : Link Length（km）
V : Link Speed（km/hour）
Q : Link Flow（TEU/hour）
C : Link Capacity（TEU/hour）
β_1, β_2 : Parameter

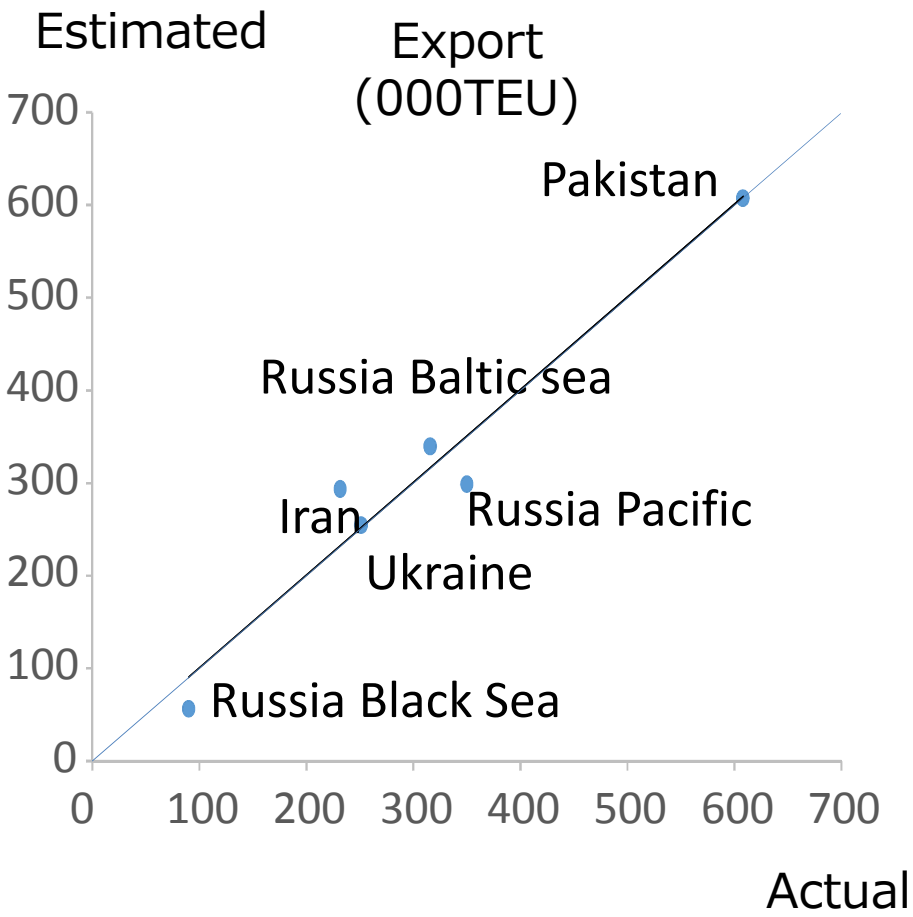
Railway cargo transshipment facilities in Alashankou

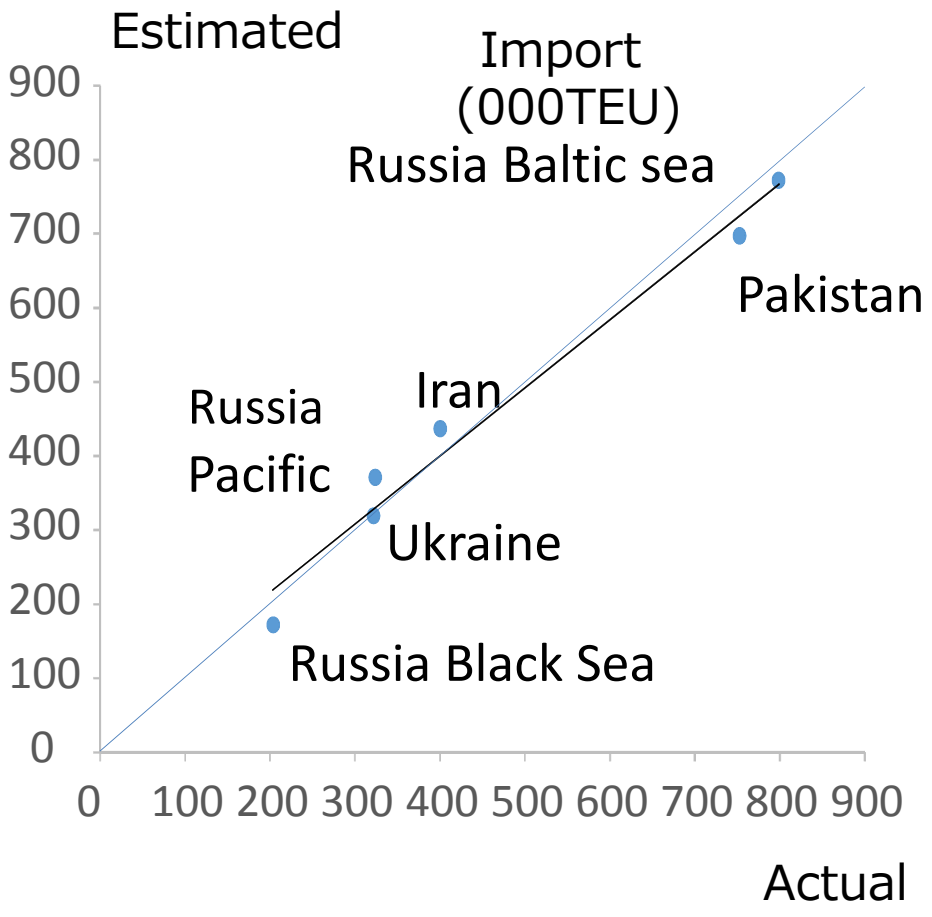
Data Used for Analysis

- Socio-economic data
  - population, skilled labor, unskilled labor, capital, natural resources, and expected GDP growth rate.
- LOS (Level of Service) of Shipping Network
  - Distance, speed, cost (freight charge), capacity, transshipment time, etc.
  - for maritime shipping, port, and land shipping
- Cargo Shipping Demand (OD Volume)
  - country-basis or more detail zone-basis trade demand
  - current and future

Model Accuracy

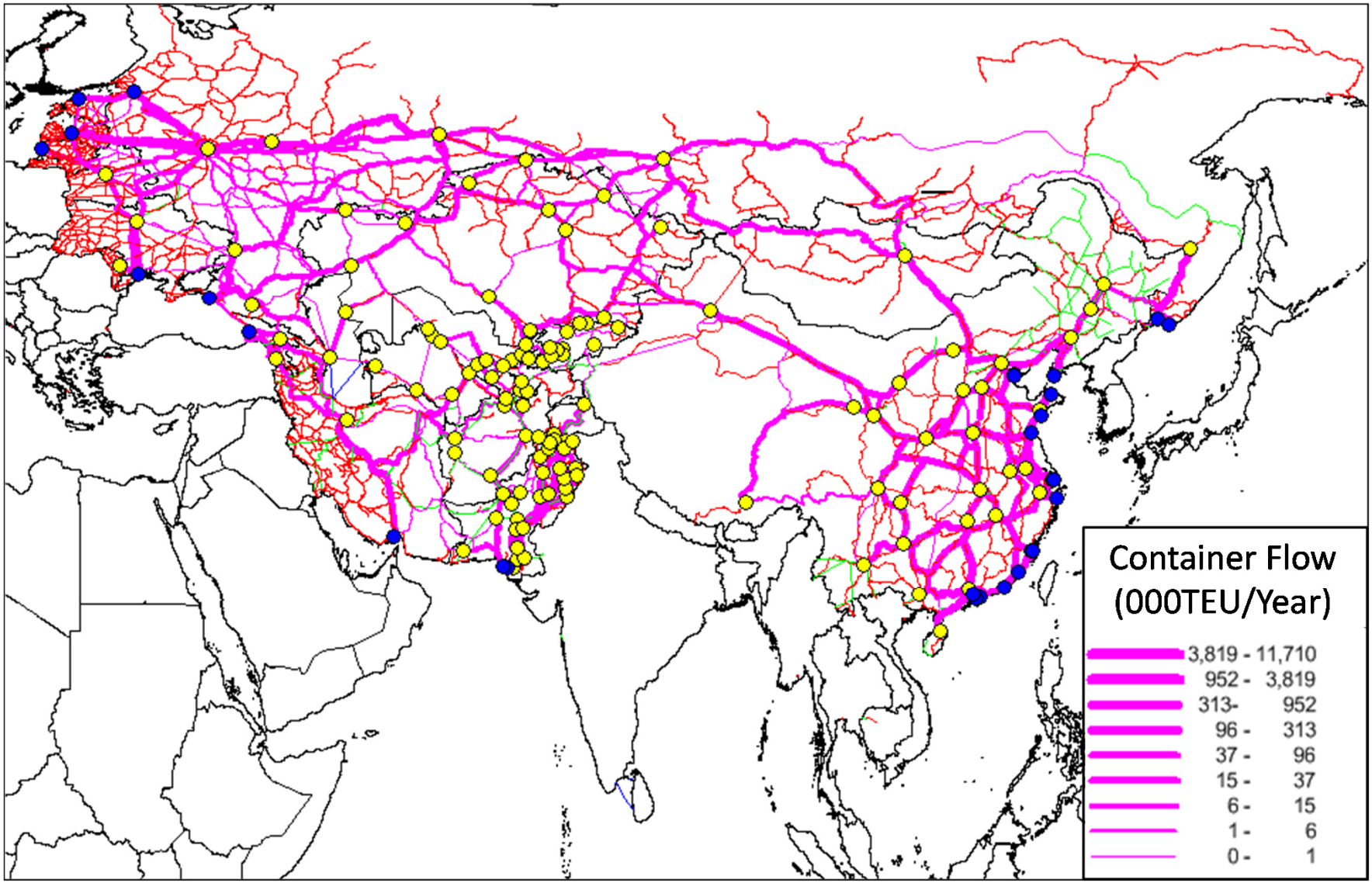
Export/Import Containers at ports (2013)





*Excluding empty containers

Result of Cargo Flow Simulation (2013)



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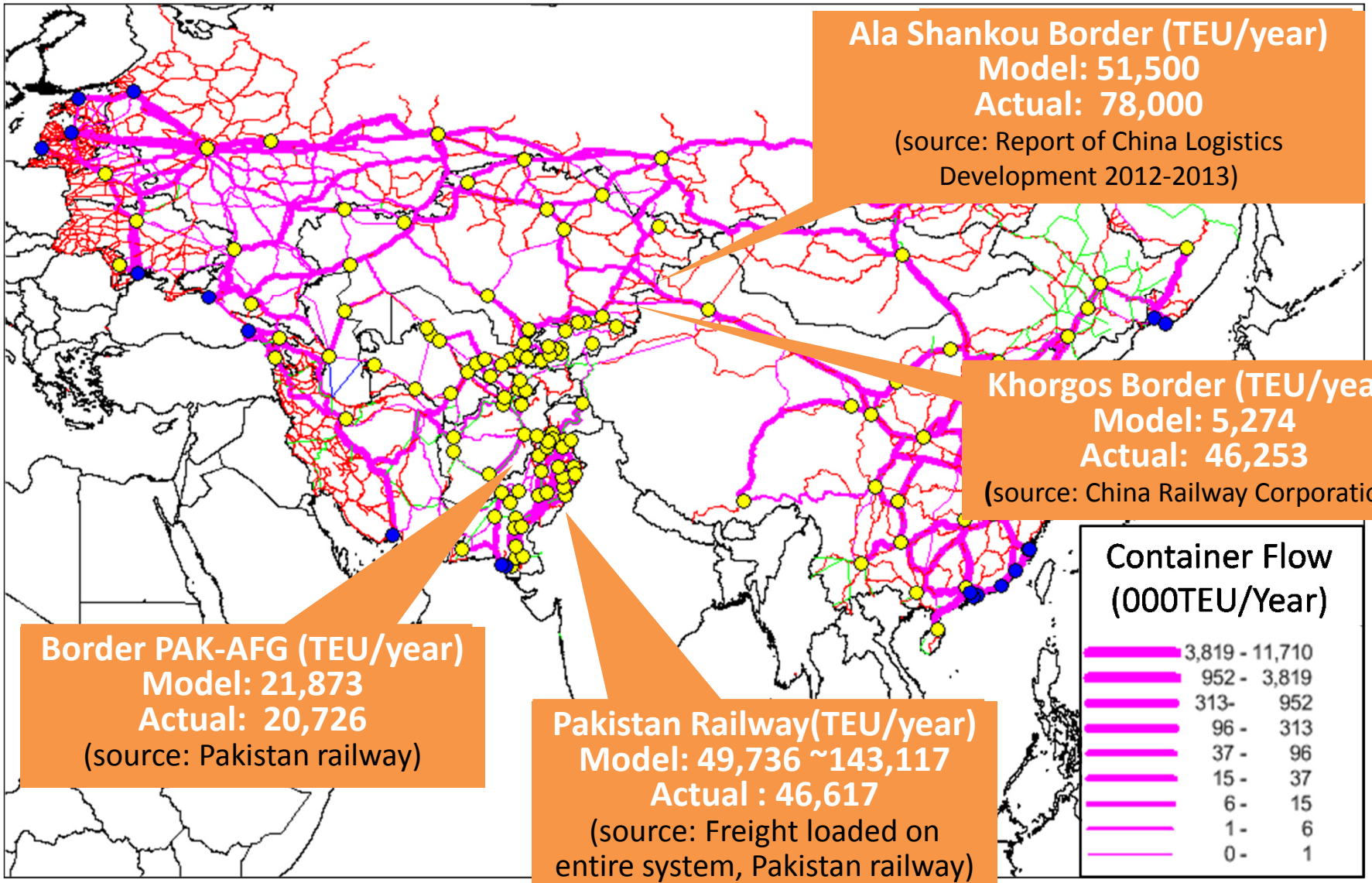


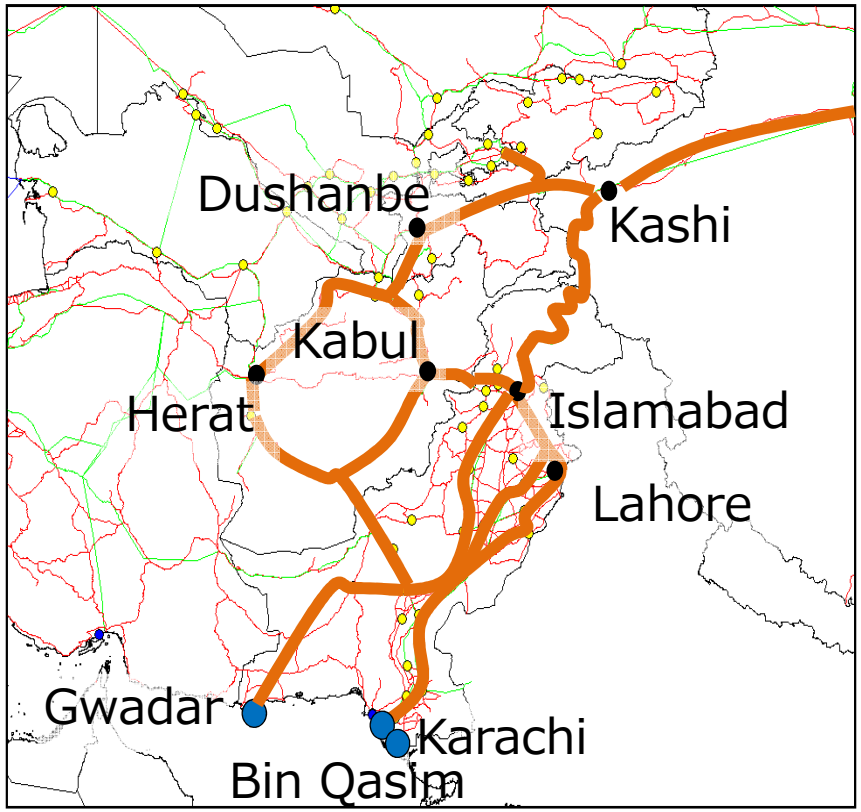
Case Studies

Application to CAREC projects

Case Studies

The developed model is applied to two cases:

- Case 1: Railway corridor extension along DRC 5
- Case 2: Incompletion of DRC 5 corridor development



Case 1：Railway corridor extension along DRC 5

Background：

- New railway links construction and capacity improvement are planned along DRC 5.
- This DRC is expected to provide better access to Arabian sea of CAREC members.
- Target year is 2030 in this analysis.

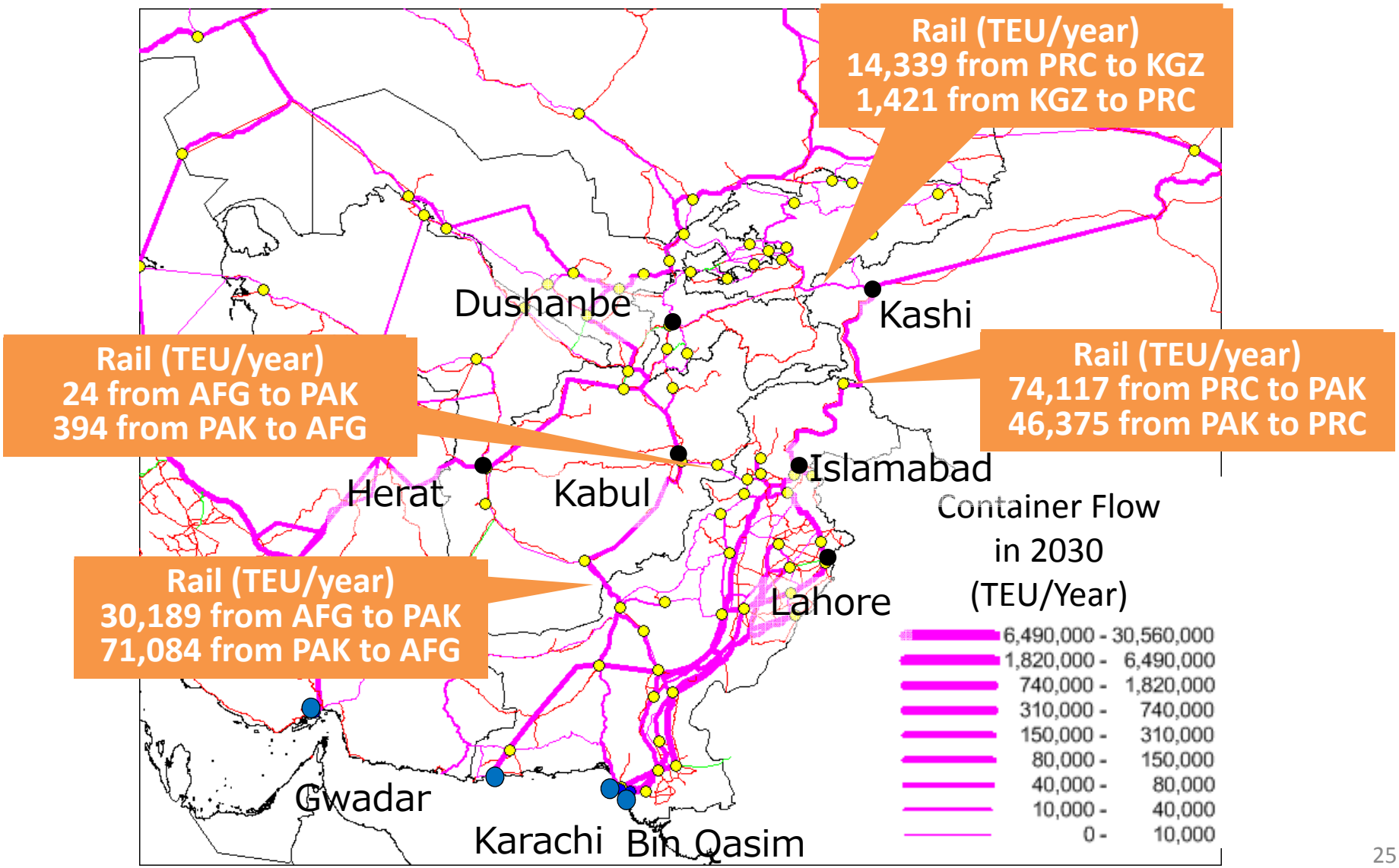
Assumptions

	Current Status	Future Scenario
Capacity	50, 62, 90 TEU /train	62, 90 TEU /train
Speed	20 km/h	20 km/h
Frequency	0, 5, 10 trains/week	10, 50 trains/week
Handling time at station	24 hours	24 hours
Operation Cost	1.0 USD/km	1.0 USD/km

* 12 shipping services are estimated to call at the Gwadar port.

Demand Estimation Results in Case 1

Case 1 : Railway corridor extension along DRC 5



Case 2： Incompletion of DRC 5 development

Background：

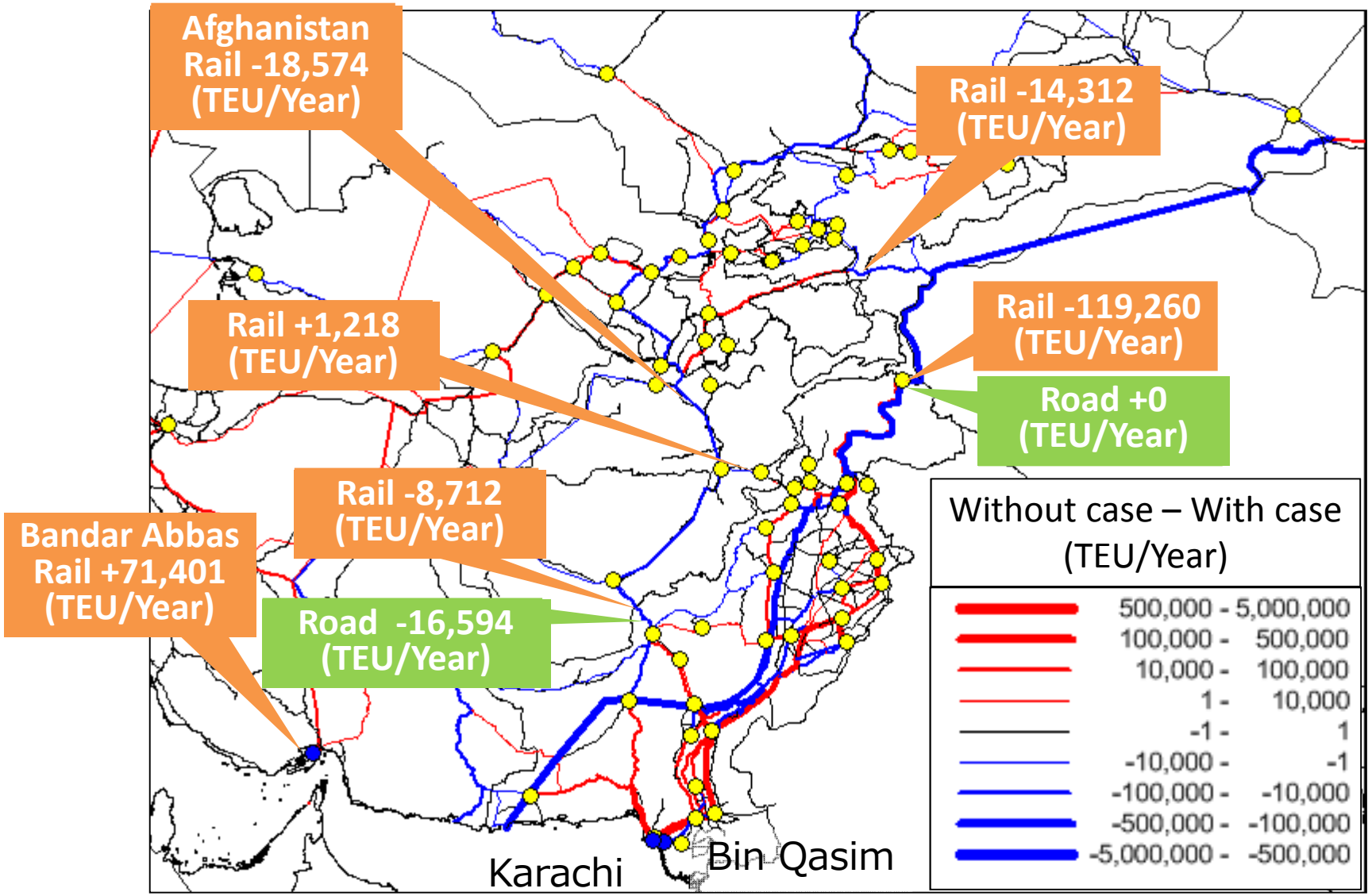
- This DRC 5 is expected to provide better access to Arabian sea of CAREC members.
- New railway development and the Gwadar port development are expected to improve the accessibility of CAREC countries to global market.

Assumptions

- This case assumes the situation where the development of new railway link between Kashi in PRC and Islamabad in Pakistan has not been completed.
- This case also assumes that no container service call at the Gwadar port.

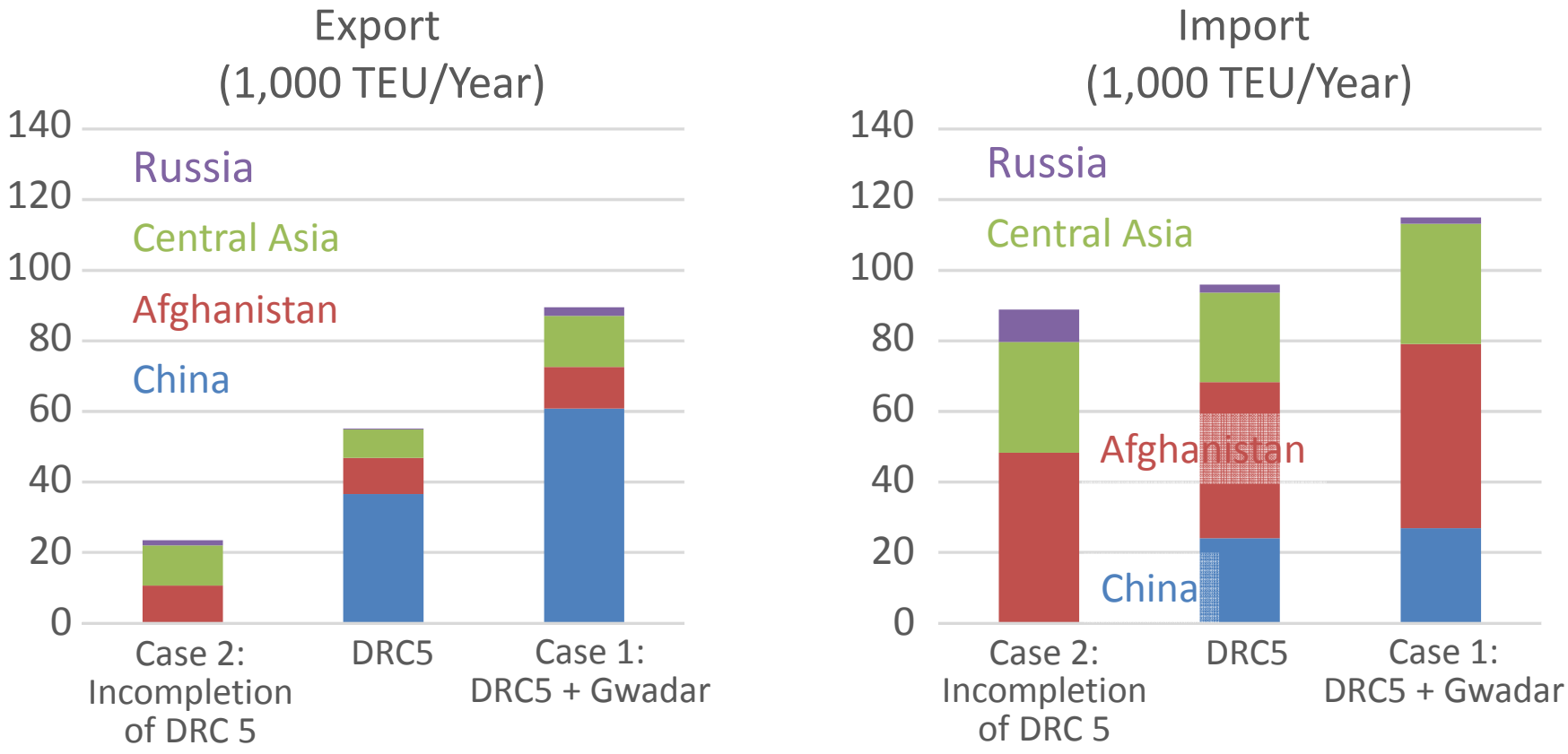
Demand Estimation Results in Case 2

Case 2 : Without railway between Kashi and Islamabad and the Gwadar port



Demand Estimation Results in Case Studies

Estimated Export/Import Container Volume from/to Other Countries Handled at Pakistani Ports in Each Case



*Central Asia is defined as Kyrgyz, Kazakhstan, Tajikistan, Turkmenistan, and Uzbekistan here. This follows the definition by data source of container trade volume.

Conclusion

Concluding Remarks

- Model analysis could contribute to facilitating consensus-building among stakeholders in CAREC.

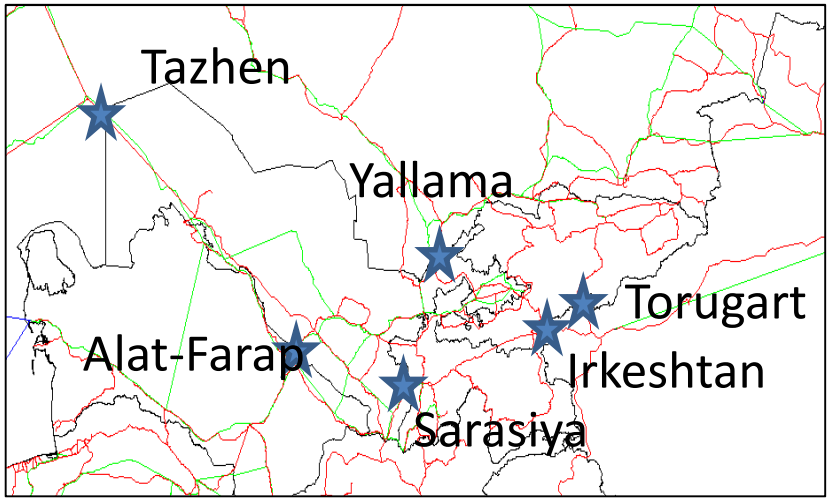
- Traffic demand model was developed, which reproduces the observed traffic patterns well.

- The developed model is applied to two cases:
  - ✓ Case 1: DRC 5 development
  - ✓ Case 2: Incompletion of DRC 5 development

Limitation of Current Model

- Model accuracy depends on data availability.
- Data about level of services and traffic flow are limited.
- We utilized the data integrated by Tanaka *et al.* (2014) for overcoming the limited data availability.

Location of borders with traffic data



Future Cooperation

Richer data enables us to analyze traffic flows with higher accuracy.

- LOS (Level of Service) of Shipping Network
  - distance, speed, cost (freight charge), capacity, transshipment time, etc.
  - for maritime shipping, port, and land shipping
- Cargo Shipping Demand (OD Volume)
  - country-basis or more detail zone-basis
  - current and future

References

- Shibasaki, R., Ieda, H., Watanabe, T. (2005). An international container shipping model in East Asia and its transferability, *Research in Transportation Economics*, Vol.13, pp.299-336.
- Tanabe, S., Shibasaki, R., Kato, H. (2015) Impact assessment model of international transportation infrastructure development: Focusing on trade and freight traffic in Central Asia, *Asian Transport Studies*, Vol.4, No.1, pp.159-177.
- Tanaka, K., Tanabe, S., Shibasaki, R, Kato, H.(2014) Estimation of cross-border freight volumes at border crossing points in the Central Asia Regional Economic Cooperation Region, Paper presented at T-LOG 2014, Bangkok, 2014.

Thank you for your attention.

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