Technical Assistance Consultant’s Report

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PRC: Strategy for Restructuring Inland Waterway Transport and Multimodal Logistics in Chongqing
(Financed by Technical Assistance Special Fund)

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For Chongqing Communications Committee

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Asian Development Bank
TA-8476 PRC: Strategy for Restructuring Inland Waterway Transport and Multimodal Logistics in Chongqing

General Report

Chongqing Communications Planning Survey and Design Institute, China

Joint Venture with

China Waterborne Transportation Research Institute/NiyaFangzhou Transport and Logistics Consulting Limited Company, China

NEA, Business Unit of Panteia, Netherlands

December 2015
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1. Introduction

1.1 Overview

The government has requested technical assistance (TA) from the Asian Development Bank (ADB) to prepare a strategy for restructuring inland waterway transport (IWT) and multimodal logistics in Chongqing. The research will be based on an analysis of freight multimodal infrastructure supply and market demand to prepare a sector development strategy focusing on IWT and intermodal connectivity. IWT sector development plans will be based on the assessment of economic and financial returns and seek to promote private sector participation where appropriate. The research will assist the government in promoting Chongqing as a shipping center of the upper reaches of the Yangtze River; develop an efficient, safe, green, and modern inland waterway system; and apply international best practices to support sector reform and development.

1.2 Project schedule

**Output 1: Freight market assessment for Chongqing**

This output will be a report section which will include the freight market assessment methodology, all data and information collected and analyzed to support the analysis and an assessment of the validity and reliability of the available data, market analysis results and key indicators and measures, comparisons to international standards and experience in comparable countries, and assessment of economic and financial trends in the IWT and freight shipping sector.

**Output 2: Infrastructure development and management plan for inland waterways**

This output will be a report section detailing the proposed infrastructure development and sector management plan including the proposed revisions to the 12th five-year plan and proposed projects for the 13th five-year plan. The output will include estimates of the expected financial and economic returns to the investments, financing plans indicating potential for ADB, private sector financing and management, and/or public private partnerships.

**Output 3: Ship fleet standards, equipment and organizational review**

This output will be a report section describing the analysis of ship fleet capacity, options for standardization, environmental recommendations, and economic rationale for reforming the ship fleet standards.

**Output 4: Recommendations for further development of the Chongqing Shipping Exchange**
This output will be a report section describing the methodology for analyzing the performance of the Chongqing shipping exchange, all data collected to support the analysis, the results of the assessment and recommendations to increase utilization of the exchange. Include detailed assessment of all key functions of the exchange, identify areas in need of improvement, and present lessons learned from international experiences and the study tour.

**Output 5: Policy notes on future research needs in key areas**

Policy notes should be concise and included as an appendix to the main report. The policy notes should seek to present the key issues under each topic and present a plan for further research and capacity building that could be implemented under a future ADB financed loan or TA project. The policy notes will be prepared early during TA implementation to provide ample time for review and revision.

**1.3 Progress of the project**

(1) Internal seminar 1

**Time:** July 30th – 31st, 2014

**Venue:** Meeting room at Chongqing Communications Planning Survey & Design Institute

**Theme:** Finalise the outline of the Initial Report

**Attendants:** TANG Bing (Team leader), Harrie De Leijer (Deputy Team leader) and all the experts

Outcomes: The project team conducted an in-depth study on the outline and relevant content of the Initial Report, and preliminarily analysed the data about Chongqing freight market, and they believed that the sources of data were reliable, prepared methodology was appropriate, and the quantity of materials collected was sufficient, which was suitable for further analysis in order to complete the reports. The team also finalized the outline of Output 1, and had an in-depth discussion about the three policy recommendations of Output 5 from various aspects of inland waterway transport such as security requirements, energy conservation and environment protection, human resource development, and reached an agreement on the content framework of the report.

(2) Internal seminar 2

**Time:** October 13th, 2014

**Venue:** Meeting room at Chongqing Communications Planning Survey & Design Institute

**Theme:** Finalise the Initial Report
General Report

Attendants: TANG Bing (Team leader), Harrie De Leijer (Deputy Team leader) and all the experts

Outcomes: The project team conducted an in-depth discussion over the content of the Initial Report, put forward suggestions for further improvement, and decided to submit the modified Initial Report to Asian Development Bank in late October.

(3) Consult EA (Chongqing Municipal Communications Committee) for suggestions

Time: October 29th, 2014

Venue: Meeting room at Chongqing Municipal Communications Committee

Theme: Consult EA for comments on the Output 1

Attendants: Representatives from port and navigation construction management authority, Financial Bureau and members of the project team

Outcomes:

I. The types, quantity and sources of the materials and data collected are reliable and authoritative, the research methodology is scientific and reasonable, and the conclusions are reliable. The Report of Chongqing Freight Market Assessment has met the requirements set out in the Terms of Reference, and it can provide data support to the study of the Strategy for Restructuring Inland Waterway Transport and Multimodal Logistics in Chongqing.

II. Suggested modifications and improvements are as follows:

1. It is suggested that the report should start with an abstract of it, which will make it easier for the readers to have an overview about the contents of the report as well as the purposes of compiling it; add the sources and references of data as well as an introduction to the survey to the report.

2. The conclusion of each chapter is too weak and insubstantial, so it is suggested that the conclusion of each chapter should be presented in a more detailed way.

3. The analysis of the expected freight volume of the Three Gorges ship lock should be added to the report.

4. The conclusion of the report should also include contents related to the forecast of development trend of the freight market, and enrich existing opinions concerning the focus of development, solutions and supportive policies, etc.

(4) Initial project seminar in Chongqing (the first symposium)
Time: 2 December 2014

Venue: Meeting room on the 7st floor of the office building of CCC.

Theme: EA (CCC and municipal financial bureau) and expert review panel reviewed the quality of the initial report.

Attendants: EA representatives, expert review panel and members of the project team

Outcomes: the initial report was accepted by EA and review panel officially.

1. The content and depth of initial report satisfied the requirements specified by the Asian Development Bank in the Terms of Reference.

2. Output 1: Assessment of Chongqing Freight Market: the data about the current state of freight market was detailed and accurate, and the assessment was also accurate. PEST method was adopted to analyze the development of freight market, and shipping tariff and time cost were adopted as indicators to analyze the advantages and disadvantages of the main transport modes and multimodal transport. Moreover, forecast about Chongqing freight volume was made from aspects including total freight volume, waterway freight volume, volume passing through the Three Gorges, throughput of terminals and multimodal transport, which is appropriate and reliable.

3. Output 5: Policy Notes on Further Conduct Studies on Key Areas: the report fully absorbed international advanced experience and combined it with the realities in Chongqing, and put forward policy notes concerning security of inland waterway transport, energy conservation and environment protection and shipping talents, which is appropriate and practical.

4. The Outline of Report and Next-step Survey Plan (Output 2, 3 and 4) was clearly structured, well organized with abundant contents. It also satisfied the requirements specified in the Terms of Reference, and can be used as a research plan for completing the remaining reports.

5. It is suggested to revise and improve the reports based on other specific opinions of the experts.

(5) Interim report output review meeting (the second symposium)

Time: January 21st, 2015

Venue: Meeting room on the 7st floor of the office building of CCC.

Theme: ADB, EA and expert panel reviewed the interim report

Attendants: EA representatives, ADB representative, expert review panel and members of the project team
Outcomes: The initial report was officially accepted by ADB, EA and the expert panel.

Opinions and suggestions of the expert panel were as follows:

1. The content and depth of initial report satisfied the requirements specified by the Asian Development Bank in the Terms of Reference.

2. Output 1: Assessment of Chongqing Freight Market: the data about the current state of freight market was detailed and accurate, and the assessment was also accurate. PEST method was adopted to analyze the development of freight market, and shipping tariff and time cost were adopted as indicators to analyze the advantages and disadvantages of the main transport modes and multimodal transport. Moreover, forecast about Chongqing freight volume was made from aspects including total freight volume, waterway freight volume, volume passing through the Three Gorges, throughput of terminals and multimodal transport, which is appropriate and reliable.

3. Output 2: Infrastructure development and management plan for inland waterways: analyzed the current state of IWT infrastructure in Chongqing in details, systematically analyzed and referenced the IWT infrastructure and multimodal logistics structure in the world, adopted adaptability analysis to objectively analyze the adaptability of worldwide IWT infrastructure and multimodal logistics structure, and put forward a clear thought, goals and a practical structure adjustment plan. The assessment analysis conclusion about infrastructure investment projects and operational structure was reliable and could be preliminarily recommended to ADB.

4. Output 3: Ship fleet standards, equipment and organizational review described the current state of shipping capacity and shipping organizations in Chongqing, conducted adaptability analysis on shipping capacity and shipping organizations in Chongqing in terms of total shipping capacity, shipping capacity for different categories, distribution of vessel tonnage, vessel age structure, vessel standardization and shipping organizations, etc., put forward clear goals and a practical structure adjustment plan and proposed reasonable suggestions for developing green and environmental-friendly vessel types and new transport modes, etc.

5. Output 4: Recommendations for further development of the Chongqing Shipping Exchange: on the basis of analyzing the development history and current state of Chongqing Shipping Exchange, it precisely pointed out the challenges and opportunities faced by the development of Chongqing Shipping Exchange, systematically evaluated the major achievements of Chongqing Shipping Exchange, scientifically analyzed the businesses to be further developed by the Exchange, and reasonably proposed suggestions on promoting the construction of Chongqing Shipping Exchange information platform.

6. Output 5: Policy Notes on Further Conduct Studies on Key Areas: the report fully absorbed international advanced experience and combined it with the realities in Chongqing, and put
forward policy notes concerning security of inland waterway transport, energy conservation and environment protection and shipping talents, which is appropriate and practical.

7. The Outline of Report and Next-step Survey Plan was clearly structured, well organized with abundant contents. It also satisfied the requirements specified in the Terms of Reference, and can be used as a research plan for completing the remaining reports.

8. It was suggested to revise and improve the reports based on other specific opinions of the experts.

(6) Conduction of international technological cooperation and discussion

Time: October 24\textsuperscript{th} – 30\textsuperscript{th} 2015

Venue: The Netherlands, Germany (please refer to the Report on Technological Cooperation and Discussion on the Trip to the Netherlands and Germany for specific places visited)

Purpose: As was required by the Terms of Reference and the Project Contract issued by Asian Development Bank, the Executive Agency and the research unit of the project should conduct international technological cooperation and discussion to absorb international advanced practical experience and improve the level of the research outputs.

Attendants: Representatives of the EA, members of the project team

Outcomes: Please refer to the Report on Technological Cooperation and Discussion on the Trip to the Netherlands and Germany for details.

(7) Project output report review meeting planned) (the 3\textsuperscript{rd} symposium)

Expected time: December 15\textsuperscript{th}, 2015

Venue: Meeting room of Chongqing Jinjiang Oriental Hotel

Theme: ADB, EA and expert panel to review the output reports of the project

Attendants: ADB representatives, EA representatives, expert panel and members of the project team
2. Analysis of the current state

2.1 Assessment of the Freight Market for Chongqing

2.1.1 Assessment of major freight mode and the current state of total freight volume

(1) Based on the statistics about the total volume via highway, waterway and railway in Chongqing during 2006-2014 (see Table 1.1.1-1), the proportions, changes in the total volume, changes in growth rate of different transport modes (see Table 1.1.1-2) etc., the current state of freight volume of major transport modes in Chongqing was assessed.

Table 1.1.1-1 Statistics of the total freight volume via highway, waterway and railway in Chongqing during 2006-2014

<table>
<thead>
<tr>
<th>Freight volume (10,000 tons)</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway</td>
<td>36,254</td>
<td>42,011</td>
<td>54,589</td>
<td>58,532</td>
<td>69,438</td>
<td>82,818</td>
<td>71,272</td>
<td>80,695</td>
<td>81,206</td>
</tr>
<tr>
<td>Railway</td>
<td>4,346</td>
<td>4,623</td>
<td>4,918</td>
<td>5,232</td>
<td>5,810</td>
<td>6,174</td>
<td>6,266</td>
<td>6,770</td>
<td>6,731</td>
</tr>
<tr>
<td>Waterway</td>
<td>4,550</td>
<td>5,904</td>
<td>6,971</td>
<td>7,771</td>
<td>9,660</td>
<td>11,762</td>
<td>12,874</td>
<td>14,360</td>
<td>14,117</td>
</tr>
</tbody>
</table>

Source: Based on data from Chongqing Municipal Shipping and Navigation Authority, Chengdu Railway Bureau and Chongqing Municipal Road Transportation Authority.

Table 1.1.1-2 Changes in the freight volume of Chongqing during 2006-2014

<table>
<thead>
<tr>
<th>Item</th>
<th>2006</th>
<th>2014</th>
<th>Total times of growth (times)</th>
<th>Average growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freight volume (10,000 tons)</td>
<td>Proportion (%)</td>
<td>Freight volume (10,000 tons)</td>
<td>Proportion (%)</td>
</tr>
<tr>
<td>Total</td>
<td>45150</td>
<td>100</td>
<td>102054</td>
<td>100</td>
</tr>
<tr>
<td>Waterway</td>
<td>4550</td>
<td>10.07</td>
<td>14117</td>
<td>13.83</td>
</tr>
<tr>
<td>Railway</td>
<td>4346</td>
<td>9.63</td>
<td>6731</td>
<td>6.6</td>
</tr>
<tr>
<td>Highway</td>
<td>36254</td>
<td>80.3</td>
<td>81206</td>
<td>79.57</td>
</tr>
</tbody>
</table>

(2) Conclusion of total freight volume assessment: ① freight volume via waterway experienced rapid growth over the years; ② the growth speed of railway freight volume was slow over the years; ③ waterway transport has been playing an increasingly important role in
the integrated transport system; the proportions of waterway and railway freight volume were low in the integrated transport system.

2.1.2 Assessment of the current state of the transit volume for major freight modes

(1) Based on the statistics about the freight transit volume of transport industry in Chongqing during 2006-2014 (see Table 1.1.2-1), the proportions, changes in the total volume, changes in growth rate of freight transit volume for different transport modes (see Table 1.1.2-2) etc., the current state of freight transit volume for major transport modes was assessed.

Table 1.1.2-1 Statistics of the freight transit volume via highway, waterway and railway in Chongqing during 2006-2014

<table>
<thead>
<tr>
<th>Freight transit volume (100 million tons km)</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway</td>
<td>173</td>
<td>205</td>
<td>435</td>
<td>503</td>
<td>610</td>
<td>779</td>
<td>732</td>
<td>696</td>
<td>798</td>
</tr>
<tr>
<td>Railway</td>
<td>115</td>
<td>144</td>
<td>167</td>
<td>172</td>
<td>180</td>
<td>184</td>
<td>174</td>
<td>176</td>
<td>158</td>
</tr>
<tr>
<td>Waterway</td>
<td>533</td>
<td>700</td>
<td>866</td>
<td>968</td>
<td>1,219</td>
<td>1,558</td>
<td>1,740</td>
<td>1,420</td>
<td>1,631</td>
</tr>
</tbody>
</table>

Source: Chongqing Shipping Development Report 2014 by Chongqing Municipal Communication Commission

Table 1.1.2-2 Changes in the freight transit volume in Chongqing during 2006-2014

<table>
<thead>
<tr>
<th>Item</th>
<th>2006</th>
<th>2014</th>
<th>Total times of growth (times)</th>
<th>Average growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2006</td>
<td>2014</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Freight transit volume</td>
<td>Proportion (%)</td>
<td>Freight transit volume</td>
<td>Proportion (%)</td>
</tr>
<tr>
<td></td>
<td>(100 million tons km)</td>
<td>(%)</td>
<td>(100 million tons km)</td>
<td>(%)</td>
</tr>
<tr>
<td>Total</td>
<td>821</td>
<td>100</td>
<td>2587</td>
<td>100</td>
</tr>
<tr>
<td>Waterway</td>
<td>173</td>
<td>21.07</td>
<td>798</td>
<td>30.85</td>
</tr>
<tr>
<td>Railway</td>
<td>115</td>
<td>14.01</td>
<td>158</td>
<td>6.11</td>
</tr>
<tr>
<td>Highway</td>
<td>533</td>
<td>64.92</td>
<td>1631</td>
<td>63.05</td>
</tr>
</tbody>
</table>

(2) Conclusions of assessment on freight transit volume: over the years, freight transit volume of waterway has always accounted of over 60% of the total freight transit volume, and has played a dominant role in cross-provincial, long haul transportation of bulk cargos; over
the years, freight transit volume of railway increased slowly and its proportion has been decreasing year by year; freight transit volume of highway transport grew relatively rapid, and has been playing an increasingly important role in short distance cargo transport.

2.1.3 Assessment of freight volume through main transportation modes

(1) Current status of freight flows and freight directions for major freight in Chongqing by waterway transport

As the surrounding areas around Chongqing gradually develop their own economy, the enterprises in industrial parks go into operation and production, cargos exported by Chongqing will see a gradual increase, outbound freight from Chongqing will gradually increase, and the freight flows and convection will become more balanced.

With the improvement of shipping channels on the upper reaches of the Yangtze River, the upgrade of branch streams of the Yangtze River, the volume of freight for vessel-to-vessel transfer at terminals in Chongqing will grow significantly, and the contribution rate of the upper reaches of the Yangtze River as well as its branch streams to the volume of freight by waterway transport in Chongqing will also increase significantly.

(2) Current status of freight flows and freight directions for major freight in Chongqing by railway transport

Outbound freight of Chongqing is transported mainly through the following 7 rail lines: Chengdu-Chongqing, Chongqing-Guizhou, Dazhou-Wanzhou-Yichang, Chongqing-Suining, Xiangyang-Chongqing, Chongqing-Huaihua and the Chongqing-Lichuan. Analyzing based on the flow direction of railway transport, only the Chongqing-Lichuan Line has the same flow direction with that of the waterways, so it is likely to become a competitor for the waterway transport. But it could be an alternative only when it is value-added freight, such as containers, light industrial products, chemical materials and products. Since the railways in the Three Gorges Dam area are not so well developed, waterway transport will not be impacted much in the near future. And other railways have played a positive role in connecting and expanding the economic hinterland for waterway transport in Chongqing. As a whole, the inadequate railway with low total mileage is an unfavorable condition for the development of Chongqing’s freight market.

(3) Current status of freight flows and freight directions for major freight in Chongqing by highway transport

Since Chongqing became a municipality directly under the Central Government, the highway transport in Chongqing has rapidly developed in terms of the volume of freight and the volume of transfers. It is easy to organize vehicles to transport freight through highways, with
the advantage of high speed and door-to-door service, so highway transport is the most acceptable transport mode for public. However, with high cost and short economic radius, highway transport cannot take place of waterway transport, but will promote the development of waterway transport and railway transport.

2.1.4 Evaluation on the current freight volume via major transport modes in typical enterprises

According to the analysis of freight volume of typical logistics enterprises, cargo owners and other research data, transport modes are selected mainly on their respective pros and cons. Economically, their first choice falls on waterway transport, which is why major industrial parks in Chongqing are located along riverside.

2.1.5 Assessment of the current freight volume, flow and constitution of key ports

Through conducting survey and analyzing the layout and channels of key terminals, the industrial layout as well as the directions and volume of freight at key terminals, it has been concluded that the link between the layout of industries and terminals is close and reasonable; the major economic hinterland of terminals in Chongqing are the local industrial parks in Chongqing as well as the surrounding provinces and the number of terminals directly connected with railway and expressway is too small.

2.1.6 Assessment of the current status of multimodal logistics market

The freight volume of Chongqing transported by rail–water multimodal transport in 2014 was 6.6 million tons, accounting for only 0.65% of the total freight volume of Chongqing, 4.68% of the total waterway freight volume, and 9.8% of the railways freight volume. The freight volume of multimodal transport accounted for a seriously low proportion of the comprehensive transportation freight volume.

2.2 Inland waterway transport infrastructure

2.2.1 Waterways

By the end of 2014, the total waterway mileage of Chongqing was 4,451 kilometers, including 2,704 kilometers standard waterways, with a standardization rate of 61%. There were 1,400 kilometers of high-class waterways of class IV and above, accounting for 31% of the total mileage. The whole waterway system takes a form of spreading leaf veins, summarized as “one main stream, two tributaries and six routes”.

“One main stream” refers to the Yangtze River main stream. The maintenance standard of the
515-kilometer waterway between Bianyuxi (Wushan) and Louxigou (Jiulongpo) had been raised, which allows the passage of fleets of 5,000 tons and 10,000 tons, making it a class I waterway. The 164-kilometer waterway between Louxigou (Jiulongpo) and Shaxikou (Jiangjin), which is a class III waterway, allows ships of 1,000~3,000-ton-class to pass through.

“Two tributaries” refers to the Jialing River and the Wujiang River. The 69-kilometer waterway form the Jialing Caojie waterway hub to Hechuan Lize waterway hub is a class III waterway in reservoir area. And the 68-kilometer waterway between Caojie and the estuary reached class III after renovation of three phases. The 35-kilometer waterway beyond Lize remains class V since the Lize hub has not been constructed. The impoundment of the Pengshui (Wujiang) hub has raised the 45-kilometer waterway beyond the hub to class IV and the impoundment of Yinpan power station made the 53-kilometer waterway beyond it class III. The 45-kilometer waterway from the estuary to Baimaduan is under renovation as a class III waterway. As the last phase of the Wujiang mainstream planning, the Baima waterway hub, which is going to be constructed, will canalize the 45.3-kilometer waterway beyond it and raise it from class V to class III.

2.2.1.2 Adaptability Analysis of the Waterway

(1) Adaptability analysis of the waterway scale

The total freight volume of waterway transport in Chongqing in 2014 was 141 million tons; the freight volume passed the Three Gorges Ship Lock was 109 million tons. According to the Output One of this research, *The Evaluation and Prediction of Freight Market in Chongqing*, the predicted freight volume of waterway transport in Chongqing in 2020 will be 266 million tons and the freight volume passing the Three Gorges Ship Lock will be 237 million tons. The section with minimum passing capacity should be regarded as a controlling index for the passing capacity of this waterway. As for the carrying capacity of the main line of the Yangtze River waterway in Chongqing, the passing capacity of the Three Gorges Reservoir Region is adequate, so the passing capacity of the Three Gorges Ship Lock should be used as a controlling index for the passing capacity of main line.
Table 2.3.1.1 Analysis of the adaptability of the waterway scale in the trunk line of the Yangtze River in Chongqing

<table>
<thead>
<tr>
<th>Analysis Factors</th>
<th>2014</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freight volume</td>
<td>1.41</td>
<td>2.5</td>
</tr>
<tr>
<td>Capacity achieved</td>
<td>2.5</td>
<td>1.77</td>
</tr>
<tr>
<td>Adaptability</td>
<td>1.77</td>
<td>2.66</td>
</tr>
<tr>
<td>Freight volume</td>
<td>1.09</td>
<td>1.0</td>
</tr>
<tr>
<td>Planned capacity</td>
<td>1.0</td>
<td>0.92</td>
</tr>
<tr>
<td>Adaptability</td>
<td>1.0</td>
<td>2.37</td>
</tr>
<tr>
<td>Freight volume</td>
<td>1.09</td>
<td>1.0</td>
</tr>
<tr>
<td>Planned capacity</td>
<td>1.0</td>
<td>0.92</td>
</tr>
<tr>
<td>Adaptability</td>
<td>1.0</td>
<td>2.37</td>
</tr>
</tbody>
</table>

The total freight volume of waterway transport in Chongqing in 2014 was 141 million tons. After calculation, the passing capacity of waterway in Chongqing was 250 million tons, and the adaptability was 1.77. It is estimated that in 2020, the total freight volume of waterway transport in Chongqing will be about 266 million tons, and the passing capacity of waterway in Chongqing will be 280 million tons with an adaptability of 1.05.

The actual freight volume of waterway transport in the Three Gorges Ship Lock in 2014 was 109 million tons (two-way track, similarly hereinafter), the designed passing capacity of the Three Gorges Ship Lock is 100 million tons with an adaptability of 0.94. Thus the actual passing capacity of the Three Gorges Ship Lock has exceeded the designed capacity. The predicted freight volume of waterway transport of the Three Gorges Ship Lock in 2020 is expected to be 237 million tons. The passing capacity of the Three Gorge Dam in 2020 depends on whether the second passage will be built.

Most of the freights in Chongqing go to the middle and lower reaches of Yangtze River through the Three Gorges, or come from the middle and lower reaches of the Yangtze River to Chongqing through The Three Gorges. Thus, the waterway scale of main line in Chongqing depends on the passing capacity of the Three Gorges Ship Lock, Jingjiang River on the middle reaches of Yangtze River and the waterway regulation in the fluctuating backwater area of the Three Gorges.

① The inadequate capacity of the Three Gorges Ship Lock has increasingly become a bottleneck for developing waterway transport in regions on the upper reaches of the Yangtze River

The Three Gorges Ship Lock was designed with a one-way passing capacity of 50 million tons per way, two-way 100 million tons in 2030. However, the total freight volume of waterway transport in the Three Gorges Ship Lock in 2011 already reached 100.3 million tons, 19 years ahead of the designed passing capacity. The freight volume transporting to upstream have already
reached 55.33 million tons, 10% over the designed passing capacity.

② The low-class waterways of Jingjiang River on the middle reaches of the Yangtze River restricted the development of the waterway transport on the upper reaches of the Yangtze River

Jingjiang River, located in the middle reaches of the Yangtze River, is 347.2 kilometer long, originating from Zhicheng in Yichang and ending in Chenglingji in Hunan. The waterway in Jinjiang River is full of twists and turns, the evolution of bottomlands is severe. During the past 50 years, the dredging depth of waterway during dry season is maintained about 2.9 meters. After renovating waterway during the Tenth and Eleventh 5-years Plan, the water depth increased from 2.9 meters to 3.0 meters. In January of 2011, the minimum dredging depth of waterway in Jingjiang River rose from 3.0 meters to 3.2 meters, still lower than the dredging depth of the upstream and downstream waterways during the same period. The dry season lasts for 4-5 months, so during this time, the shipping companies can only operate with lower load which leads to great loss during the dry season. This dilemma caused by “deep in both sides but shallow in the middle” in the Yangtze River is becoming a bottleneck for expanding the passing capacity of waterways.

③ The low-class waterway in the Three Gorges fluctuating backwater area has become a major restriction on the development of the waterway transportation on the upper Yangtze River

Influenced by the fluctuating backwater area in the Three Gorges, the main stream of The Yangtze River in Chongqing forms “three different depths in one port”, which means that the average minimum dredging depth of waterway in reservoir area downwards Fuling already reaches 4.5 meters, while the minimum dredging depth upwards Fuling and downwards Chaotianmen is 3.5 meters, and the minimum dredging depth upwards Chaotianmen is 2.7 meters. When the reservoir level in the Three Gorges Reservoir is low, the scale of waterways of some shoals in the backwater area upwards Fuling are too narrow to sail, therefore there are about 3 months per year that the large-scale ships and luxury cruises are unable to sail into the main urban area of Chongqing. Thus, to accelerate renovating the waterway from Fuling to Yongchuan and expanding the passing capacity of the upper Yangtze River is extremely urgent.

(2) Analysis of the standardization rate of waterway and the proportion of high-class waterway

By the end of 2014, the total length of waterway in Chongqing was 4,451 kilometers, the length of standard-reaching waterway was 2,704 kilometers, and the standard-reaching rate was 61%. The length of high-class waterway above Class IV was 1400 kilometers. The high class waterway occupied 31% among the total length of waterway, but accounting for 97% of total freight volume of waterway transport in Chongqing.

The advantage of waterway transport is the low-price for large freight volume over long
distance. At present, the breakeven point of long distance waterway transportation is beyond 3000 tonner ship, while large ship needs high-class waterway. In countries with advanced waterway transportation, the standard-reaching rate of waterway and the proportion of high-class waterway among total length of waterway are both high; and they rarely consider elements like economic scale when constructing the waterway. In 1920, when the GDP per person in America was 860 dollars, the large scale construction stage of inland waterway transportation was already accomplished and entered modern development stage. The length of inland waterway is 41 thousand kilometers, the length of waterway with 2.74 meter depth and navigable for ships above 1000 tons is 25 thousand kilometers, occupying 64% of the total length; in Netherlands, Belgium, French and Germany, the total length of inland waterway is 20 thousand kilometers, the length waterway navigable for ships above 1000 tons is 8284 kilometers, occupying 41.7% of the total length. The length of waterway in the main stream of Rhine is about 900 kilometers, among which 866 kilometers are completely channelized. All the 35 cascades adopt navigation structure which is navigable for European standard ship of 1350 tons. In 1960s, Russian already formed an 8000 kilometers long, 3.65 meters deep unified deep-water waterway network based on the Volga River.

The attached importance waterway development and construction efficiently support the rapid economic development of the advanced countries. In recent years, the administration and Chongqing government seized the opportunity of the 175 meters impoundment in Three Gorge and developed the waterway construction in Chongqing. However, there's still a big gap when compared with the waterway construction in advanced countries. Thus, the construction and development of waterway in Chongqing still has a long way to go.

(3) Analysis of the tributaries’ contribution rate to the trunk stream

In recent years, the central government has strengthened the support to the construction of waterway transport in West China. Chongqing Municipal Party committee and government have made great effort to finance the waterway construction in tributaries. With the 175 metres impoundment in Three Gorge and channelization of some tributaries, the total freight volume of waterway transport in Chongqing in 2014 was 141 million tons, while the freight volume of tributaries is only 9.24 million tons. With 6.5% contribution rate to main stream, to some extent, the waterway transport in tributaries drives the economic development in the coastwise area. However, most of the tributaries in Chongqing are still at a native state, Jialing River and Wujiang River are not completely channelized and haven’t effectively connected the main stream with tributary streams. The contribution of waterway transport in tributary streams to main stream of The Yangtze River has not yet adequately achieved, and its contribution to develop the hinterland economy in coast areas is not realized as well. Specific information as follows:

(1) The national high-class waterway, including Jialing River and Wujiang River, have not
The total freight volume of waterway transport in Chongqing in 2014 reached 141 million tons. Jialing River and Wujiang River are the “two tributary streams” in “one main stream, two tributary streams and six lines”, whose upper reaches are expanded to the hinterland of Sichuan and Guizhou respectively. The key counties, including Hechuan, Beibei, Pengshui and Wulong, etc., are located on the coast of those two rivers. They are the bonds to link the core area, expanded area and new developed area in the city, and they also support the development of the ecological protection zones in the Southeast of Chongqing. The cascading channelization of Jialing River and Wujiang River can improve the comprehensive transportation system in coast area; it can drive the development of urban and rural industry and agriculture, improve the quality of the riverside landscape in the coast counties, and also help expanding tourism market. The two rivers are with great strategic significance in the development strategy of Five Major Functional Areas. Jialing River and Wujiang River are both national high-class waterways. In the past few years, the central government has strengthen the support to construct the waterway in “two tributary streams”, Chongqing government also inject significant capital to channelize “two tributary streams”, and Cao Street waterway junction in Jialing River and Yinpan waterway junction in Wujiang River are constructed. But at present, the channelization of “two tributary streams” high-class waterway is not accomplished, the shipping function is not adequately achieved. The rate of tributary contributing for the main stream in The Yangtze River and for the economics of the coast counties does not achieve the expected level.

(2) Key local waterways have not yielded desired benefits.

In the framework of waterways in Chongqing, “Six lines” are Qujiang River, Fujiang River, Qijiang River, Daning River, Meixi River and Xiaojiang River. The upstream of these waterways is expanded to the undeveloped counties and villages in “one circle” and “the northeast of Chongqing”; the downstream reaches the key towns, which are important to coordinate an integrative development between urban and rural areas and accelerating the development of industrialization, urbanization and agricultural modernization. The renovation and channelization of waterways in “six lines” will facilitate the communication between coast areas and economically developed areas. It will also promote the renovation of the development of industry and agriculture and improve the quality in the coast counties.

Qujiang River and Fujiang River are the tributaries of Jialing River. The backwater of Cao Street navigation junction is well connected with the tail water of Fuliu Shoal Power Station located at the lowest downstream cascade of Qujiang River, so Qujiang River in Chongqing area is located in the Cao Street reservoir area. At present, the renovation of Qujiang River in Chongqing area is accomplished by the obstacle clearing project before impounding Cao Street Junction, and
the waterway in Qujiang River already reached class III. The backwater of Cao Street navigation junction is connected with the tail water of the tail water of Weituo Power Station located at the lowest downstream cascade of Qujiang River, the channelized waterway is 23 kilometers. With the impounding of Fujin Dam Junction, the 48.7 kilometres waterway from the tail area of Fujin Dam to Anju Junction reaches V level, other waterways in Fujiang River in Chongqing area reaches class VI.

Qijiang River is located in the upstream of Xiaonanhai Junction. At present, the waterway from Ganshui to Hekou is ranked class VII. Qijiang River has applied cascading channelization in an early stage in China with a glorious history of waterway transportation. In recent years, due to the accelerated investment of railway and highway and the hysteretic reconstruction of the original navigation facilities, the waterway transportation in Qijiang River has been declined. However, many resource consumption enterprises, including Chongqing Steel Industry, Wancheng Coal Company, are distributed among the upstream of Qijiang River. Since the hinterland in Guizhou contains abundant resources of stones and coals which are suitable for transporting through waterway, the companies are calling for revitalizing waterway transportation in Qijiang River. Many key counties, such as Qijiang County, are expecting the cascading channelization of Qijiang River in order to improving the riverside landscape. However, the ownership of Wufu and its above cascade power stations are complex: some of them are newly built; some are old power stations which are under remolding according to the hydroelectric planning. Some of the ship locks are out of maintenance for many years, and some power stations don’t contain a ship lock, which disrupts the waterway transportation. The phenomenon of multiple-management is severe; the cascading channelization of waterway transportation in Qijiang River calls for a comprehensive planning and strong organization and implementation.

Daning River, Meixi River and Xiaojiang River are key first level tributaries of the Yangtze River; they are all formed after the impoundment of The Three Gorges. Those rivers are with great importance to open the channel for the coastal areas to communicate with external areas, to promote urban and rural balanced development and to lift the reservoir area out of poverty. After the waterway renovation, the downstream of Dachang in Daning River already reaches class III of waterway standard, but the upstream waterways of Dachang are below the class standard. The cascading channelization of these waterways is with large investment scale, deficient economic performance and multiple investors, so the implementation of renovation is in difficulty. The preliminary renovation work to waterways in Meixi River and Xiaojiang River is in process, which is expected to be completed before the end of the year. The preliminary work of building other important tributary waterways in the Three Gorge Reservoir Region, including in Baolong River, Pengxi River, Zhuyi River, Dongxi River and Bianyuxi River, etc., is also in process. In general, the regional important waterways haven’t adequately achieved the expected benefits.
2.2.2 Ports

2.2.2.1 Current state of ports

By the end of 2014, Chongqing’s port freight transportation capacity reached 170 million tons with container freight transportation capacity of 3.7 million TEU. In 2014, the total port freight throughput of Chongqing reached 147 million tons, comprising 1.01 million TEU, 101.165 million tons bulk cargos, 11.11 million tons dangerous chemicals, 362,400 automobile ro-ro and 347,100 truck ro-ro.

By the end of 2014, Chongqing’s port container throughput capacity reached 3.7 million TEU, with 1.01 million TEU. By the end of 2014, Chongqing’s dry bulk throughput capacity reached 116.9 million tons, with a dry bulk throughput of 101.65 million tons. By the end of 2014, Chongqing’s ro-ro shipment throughput capacity reached 1.49 million vehicles, among which 760,000 were commercial vehicles and 730,000 were freight vehicles. And in 2014, Chongqing’s actual ro-ro shipment handling was 610,000 vehicles, among which 362,400 were commercial vehicles and 347,100 were freight vehicles. By the end of 2014, Chongqing’s dangerous chemical throughput capacity reached 7.84 million tons. In 2014, Chongqing’s actual dangerous chemical throughput was 11.11 million tons, 4.803 million tons of which were oil, natural gas and derived products, 6.305 million tons were chemical materials and derived products.

2.2.2.2 Port Adaptability Analysis

(1) Adaptability analysis of port scale

The Hong Kong government’s successful "trigger point mechanism" shed light on how to study the reasonable adaptability of Chongqing’s freight ports’ capacity. The basic definition of "trigger point mechanism" is "Unless the forecast demand in five years exceeds current throughput capacity, the government would not encourage building new terminals." Based on the predicted demand of the next five years in Hong Kong, the trigger point is set at 70 percent utilization, correspondingly with a reasonable adaptability of 1.4.

① The overall scale adaptability of Chongqing Port

The total capacity of Chongqing’s ports in 2014 was 170 million tons, with a adaptability of 1.16, slightly less than the reasonable adaptability of 1.4. After the rapid development of Chongqing’s ports in recent years, its capacity bottleneck has been preliminarily eased, yet in general remains insufficient, and should continue to grow steadily. To reach the target total size of 336 million tons in 2020, the adaptability should be maintained a reasonable adaptability of around 1.4.

② Container terminals
The capacity of container terminal in 2014 was 3.7 million TEU with a adaptability as high as 3.66, greater than the reasonable figure of 1.8. Given such a large capacity surplus, its development should be controlled. With a reasonable adaptability of 1.8 in 2020, the container terminal should achieve a passing capacity of 5 million TEU.

3. Dry bulk cargo terminals

Dry bulk terminals in 2014 had a passing capacity of 116.90 million tons and a throughput of 101.65 million tons, with an adaptability of 1.23, slightly less than a reasonable degree of 1.3. However, it can be seen in Table 2.2.1-2 that large scale terminals for dry bulk, with 45 berths and a capacity of only 32.87 million tons, accounted for only 28% of total capacity, and the rest was done by small and scattered terminals. Therefore, the focus for the dry bulk terminals development should be transition from small, scattered and chaotic ports to large-scale specialized ones.

4. Dangerous chemicals terminals

Terminals for dangerous chemicals had a capacity 7.84 million tons and a throughput of 11.11 million tons in 2014. Therefore the adaptability of dangerous chemicals terminals was only 0.71, much less than the reasonable adaptability of 1.6 and ports’ capacity was insufficient. With a reasonable adaptability of 1.6 in 2020, the capacity for dangerous chemical terminals should reach 28.98 million tons, and a gap of 21.14 million tons should be filled. Although currently some of the less dangerous solid chemicals in the total throughput of 11.11 million tons have been handled as ordinary general cargo, with further standardization of terminal handling of dangerous chemicals, priority should be given to the development of such terminals.

5. Commercial automobile ro-ro terminals

Ro-ro terminals for commercial automobiles had a capacity of 760,000 vehicles and a throughput of 362,400 in 2014. Its current capacity is slightly rich with an adaptability of 2.10, higher than the reasonable figure of 1.6; but in 2020, with an adaptability of 1.6, the passing capacity for automobile ro-ro terminals should reach 1.07 million. Therefore its moderate development should be encouraged based on market demand.

6. Truck ro-ro terminals

Trucks ro-ro terminals had a capacity of 730,000 and a throughput of 347,100 in 2014, higher than the reasonable figure of 1.2, suggesting sufficient capacity; in 2020, with a adaptability of 1.2, the capacity for truck ro-ro terminal should reach 460,000, still less than the current actual passing capacity. Therefore, the approval of new truck ro-ro terminals for should be controlled before 2020.

(2) Analysis of large-scale degree of freight ports
Freight ship’s breakeven point in Chongqing corresponds to a continuously increasing dwt, due to the rise of operating costs including ship crew’s wages, fuel prices etc. It is estimated that in 2014 transportation business from Chongqing to middle and lower reaches of the Yangtze River cannot be profitable unless bulk carriers have a capacity of more than 4,000 tons or container ships have a capacity of more than 250 TEUs. In recent years, almost all the new ships of shipping companies in Chongqing have a tonnage of more than 5,000. The process of transforming and dismantling old ships is accelerating, and ships’ technical structure, tonnage structure and age structure continue optimization.

The trend of upsizing ships will require large-scale cargo port. According to the above analysis, the degree of the port largeness is measured as the "ratio of large deep-water berths with over 3000 tonnage in the total number of port cargo berths ". In total, there were 824 production berths available in 2014 in Chongqing, of which 171 were large deep-water berths with more than 3000 tonnage, which meant 20.8% of all ports in Chongqing in 2014 were large ones. Of them, 144 were cargo berths of more than 3,000 tonnages, with a cargo capacity of 97.22 million tons, accounting for 57.2% of the city’s total port cargo capacity. The above data suggested that the large ports in Chongqing were far from being sufficient, yet the capacity of large-scale port was so huge that the development of large-scale specialized ports should be accelerated. New ports with 5,000-ton standard should be built if possible or at least not less than 3,000-ton standard along the Yangtze River.

2.3 Shipping capacity and shipping organizations

2.3.1 Current state of vessel shipping capacity

(1) Vessels are in complete categories and sufficient quantity, and major vessel types are in large scale

In 2014, there were 2,425 freight vessels in Chongqing with a total loading tonnage of 615,500 tons, 71,104 standard container spaces and 11,004 ro-ro parking spaces. Among them, the quantity of dry bulk cargo vessels with a tonnage of over 5,000 tons accounted for only 16.66%,while the shipping capacity of this vessel type accounted for 46.55%; the quantity of container vessels with 300TEU was 132 which was the most, accounting for 53.44% of the total number of container vessels, with a proportion of shipping capacity of 61.25%; the quantity and shipping capacity of truck ro-ro vessels with 60 parking spaces accounted for a most share; the quantity of automobile ro-ro vessels with over 800 parking spaces accounted for only 28.58%, but their shipping capacity accounted for as high as 47.7%; the quantity of dangerous liquid goods vessels with a tonnage of over 5,000 tons was 49, accounting for 28.99%, and their shipping capacity was as high as 44.52%.
(2) Vessels are young overall, and major vessel types are becoming younger

The overall average age of freight vessels was 7.04 years, and the ages of those vessels mainly concentrated within 9 years, while the shipping capacity was mainly shouldered by vessels with an age of less than 5 years. The average age of dry bulk cargo vessels with a tonnage of over 3,000 tons was 4.94 years, and the quantity of this type of vessel accounted for 30.51% and the shipping capacity accounted for 71.33%; the average age of container vessels with 300TEU was 3.14 years, the quantity and shipping capacity of this type of vessel accounted for 53.44% and 61.25% respectively; the average age of dangerous liquid goods vessels with a tonnage of over 5,000 tons was 1.78 years, the quantity and shipping capacity of this vessel type accounted for 28.99% and 44.52% respectively. The average age of truck ro-ro vessels with 60 parking spaces was 7.61 years which was relatively old, the average age of automobile ro-ro vessels was 3.0 years, which was the shortest compared with the other types of freight vessels; the average age of automobile ro-ro vessels with 1,300 parking spaces was only 3 years, the quantity of this vessel type accounted for 14.29% and it accounted for the highest shipping capacity which as 29.53%.

(3) Shipping capacity increased steadily, and the newly-built shipping capacity was in a large scale and standardized

In 2014, the total shipping capacity of freight vessels in Chongqing grew by about 5% compared with that of 2013, and each type of vessels witnessed different degrees of growth. The impetus for growth was mainly from large-scale and standardized newly-built shipping capacity being put into operation as well as that vessel type standardization and shipping capacity concentration in 2014 were improved than in 2013. The quantity and shipping capacity of dry bulk cargo vessels in Chongqing in 2014 increased by 52 (namely +2.73% based on the previous year) ad 129,000 tons (namely +3.15% based on the previous year) compared with those in 2013, and the newly-built vessels were mainly those with a tonnage of over 3,000, while the dismantled vessels were mainly those with a tonnage of less than 3,000, among which the quantity and shipping capacity of vessels with a shipping capacity of over 5,000 experienced the highest growth rate; the quantity of container vessels had a year-on-year increase of 2.92% and the shipping capacity had a year-on-year increase of 5.37%, and the shipping capacity of container vessels with less than 250TEU continued to decrease, that of vessels with 300TEU maintained growth, and their average age was 3.14 years, accounted for 53.44% of total quantity and 61.25% of shipping capacity, and the standardization of vessel type was further improved; dangerous liquid goods vessels in Chongqing maintained the momentum of growing and the growth of shipping capacity exceeded 20% for two years in a roll which increased by 211,000 tons compared with that of 2012, registering a growth magnitude of 53.96% and the newly-built shipping capacity mainly concentrated in vessels with a tonnage of over 3,000 and its quantity
and shipping capacity increased by 32% and 34.32 respectively.

(4) **Vessel standardization progressed steadily and entered a new phase focusing on developing advanced vessels**

By 2014, there have been 2,425 freight vessels in Chongqing with a loading tonnage of 615,500 tons; the quantity and shipping capacity of standard vessels reached 72% and 75% respectively. The standardization rate of ro-ro vessels reached 100%, 96% for dangerous liquid goods vessels, 69.5% for dry bulk cargo vessels and 70% for container vessels.

Since the initiation of vessel standardization by the Ministry of Transportation in 2003, through a decade of implementation, vessels with serious pollution, high energy consumption and long operation life have basically been weeded out in Chongqing. The “Three Gorges vessel type” has been built up and put into operation. Vessel standardization has made marked achievements and a new phase of focusing on developing advanced vessels has started.

### 2.3.2 Current state of shipping organizations

**（1）Shipping enterprises were in complete categories, the scale of shipping capacity continued to expand and the development sought for progress while maintaining stability**

By the end of 2014, there have been 315 shipping enterprises in the whole municipality. Among them, 22 were specialized in container transportation, 13 specialized in dangerous chemical transportation, 6 specialized in luxurious cruise transportation and 1 specialized in automobile ro-ro transportation. There were 15 enterprises with large scale shipping capacity of over 100,000 tons, with a total shipping capacity of 3.3113 million tons, accounting for 53.79% of the total shipping capacity of the whole municipality, registering a year-on-year growth of 6.31%. Within the whole municipality, expect the volume of containers loaded experienced a decrease, the quantity of freight vessel, loading tonnage and volume of cars loaded all increased. The original large-scale enterprises are steadily developing their shipping capacity, and some newly-emerged private enterprises have accelerated market expansion.

**（2）The shipping capacity for containers and dangerous liquid goods transport was concentrated, while that for dry bulk cargo was scattered**

There were 17 shipping enterprises qualified for container transport in Chongqing, but only 8 of them launched regular shipping liner business. There were 247 container vessels in total, which provided 71,104 container spaces. The market concentration was high, and the top 5 shipping enterprises accounted for more than 76.67% of the total capacity for container transportation. Currently, there are 13 shipping enterprises specialized in dangerous liquid goods transportation in Chongqing, with a total loading tonnage of 602,000 tons, and the top five
enterprises have a total shipping capacity of 587,400 tons, accounting for 97.6%. As this business is relatively highly specialized with a higher market entry threshold, so the dangerous chemical transportation market in Chongqing is relatively highly concentrated. Compared with other cargo types, dry bulk cargo had the most shipping capacity and volume, relatively low technological threshold and the most quantity of operating enterprises which was 213, 1,957 vessels with a total loading tonnage of 4.189 tons, and the total vessel quantity and shipping capacity of the top 5 dry bulk cargo transportation enterprises accounted for only 10.37% and 32.45% respectively, suggesting a low market concentration degree.

(3) Slow development of multimodal transport, poor coordination among waterway transport enterprises

Trans-enterprise organization refers to multimodal transport, i.e. the coordinated and cooperative transport among waterway, highway and railway. The major problem in railway-waterway transport lies in how railway could be paved into ports, so the current operation of railway-waterway transport is difficult. Currently, railways are accessible only in the Jiulongpo Port in the major city zone, the Mao’ertuo Port and the Lanjiatuo Port in Jiangjin District, the Hongxigou Port in Wanzhou and the Guoyuan Port. In addition, the coordination among the waterway enterprises and the railway enterprises was a major technical bottleneck which restricted the development of the multi-modal transport.

The cooperation between shipping enterprises and port enterprises is crucial, and at present the cooperation often runs according to contracts. However, the contracts only specify the rights and liabilities of both parties and the expiry date of the contracts, instead of stipulating the specific period for vessels to berth, so some vessels arrive in ports but cannot enter ports for unloading. Besides, a coordination department among waterway transport enterprises, ports and ship locks was absent, which further resulted in excessive time taken by vessels waiting for berth and passing ship locks, hence a low operating efficiency.

(4) Self-propelled vessels developed rapidly, vessel fleet disappeared and highly-efficient new transport modes developed slowly

Self-propelled vessels are developing towards being professional, standardized and large-scale, and its superiority has been commonly recognized by cargo owners, vessel owners and ports, and has become a backbone vessel type. Currently, limited by the navigation specifications of the Three Gorges Ship Lock and the complex navigation environment on the upper reaches of the Yangtze River as well as part of shallow water level from the middle to upper reaches of the River, “river and sea through transport vessel” and “river and sea multimodal” transport from Chongqing to offshore areas and from Chongqing to ocean is developing slowly, and the State has not issued any relate regulations an codes. In addition, the
institutional barrier of waterway-highway drop and pull transport is the fundamental reasons behind the restriction in the development, and the outdated drop and pull transport technology as well as equipment and facilities is also an important reason.

2.3.3 Evaluation on shipping capacity and shipping organizations

(1) Shipping safety problem still exist. Vessel standardization is still in progress, shipping safety problems have been relieved to some extent, but still lagging behind that in European areas, mainly in aspects of vessel construction technology, quality of crew, safety regulatory mechanism and equipment and facilities, etc.

(2) Monotonous transport modes. The current dominant transport mode is self-propulsion transport, but it is not the most efficient mode, so research on barge, push boat, river and sea through transport, river and sea intermodal transport, trunk and tributaries intermodal transport and other green and environment-friendly transport modes.

(3) Incomplete vessel pollution prevention system. Current there is a lack of vessel pollution joint prevention and control mechanism, lack of emergency response equipment for dangerous liquid goods vessels ad lack of vessel household wastewater treatment equipment.

(4) A commonly low adaptability of passing ship locks. Currently, waiting in queue for a long time to pass ship locks has become a normal state, so the organizational method for passing ship locks need further research.

(5) A commonly low profit in shipping industry, existence of malicious competition and low service quality. Currently, there is a lack of regulatory mechanism targeted at malicious competition in shipping industry and malicious operating at a price lower than cost, shipping service quality is low and the inappropriate market competition behavior remains to be regulated.

(6) Shipping enterprises commonly lack of dominance and say over the market. The shipping market is under fierce competition, and the differentiation trend is obvious. The form of competition has fundamentally changed, enterprises are concerned with their own interest, the resources are scattered, the logistics chain is short and monotonous, and lack of large scale leading shipping enterprises.

2.4 Chongqing Shipping Exchange

2.4.1 The current development of Chongqing Shipping Exchange

In order to further support building Chongqing as an inland waterway transport center, under the support of the Ministry of Transport, Chongqing Municipal Government approved setting up Chongqing Shipping Exchange in August 2010. The purpose was to concentrate
shipping elements including financial settlement, trade, insurance, maritime arbitration for shipping, enhance the connection and communication among the shipping industry, the financial industry, the trading industry and other industries, lead and drive the transformation and upgrading of shipping industry in Chongqing and foster the formation of a shipping center and financial center on the upper reaches of the Yangtze River.

Since its establishment, Chongqing Shipping Exchange has conducted multiple works to enhancing the development of inland waterway transport, including building Chongqing e-port, conduction of shipping transaction service, research and compilation of shipping market analysis report and provision of shipping index service, providing shipping talents training service, and further promoting the healthy and orderly development of the shipping market through constructing a shipping transaction e-commerce platform, establishing shipping financing and guarantee companies as well as inland ship-owners mutual insurance organizations and other financial service products.

2.4.2 Comments on the work of Chongqing Shipping Exchange

Although there is no experience available from similar inland shipping service institutions worldwide, as a bridge between government and market, Chongqing Shipping Exchange has effectively implemented related government policies for support inland waterway transport development. According to the survey on shipping enterprises, port operators, banks and insurance institutions on the market, it is commonly believed in the industry that, the existence of Chongqing Shipping Exchange is extremely necessary. Under the general background of the inland waterway transport market lacking of effective competitiveness, the existence of Chongqing Shipping Exchange has played an important role in accelerating the implementation of related supportive policies, protection of small vessels owners’ interests and improvement of confidence in inland waterway transport market, etc.

2.5 Safety and security of inland waterway transport in Chongqing

Currently, the safety and security infrastructure of inland waterway in Chongqing has preliminarily achieved effects, and the laws and regulation system is relatively complete, but departments related to waterway safety in Chongqing, including regulatory, rescue and salvaging as well as firefighting, etc., have not prepared any complete accident emergency response plan, let alone accident prevention and alert system, and they also lack of advanced technological measures which can be applied in safety accident prevention and alert system.
2.6 Chongqing inland waterway transport talents

With the deepened implementation of reform and opening up, China’s economy has achieved rapid development, and the salary level of each industry has been significantly improved. However, the inland waterway transport industry which used to provide relatively higher salary levels has gradually lost its competitive advantages, resulting in senior crews flowing to coastal and ocean shipping industries, while low level crews can hardly arouse the interest of young people, and this has further led to an increasing shortage of talents in the inland waterway transport industry, and it is difficult for enterprises to recruit new staff. Moreover, professional education and training capability of IWT industry is developing slowly, lagging far behind the demand for talents. Additionally, with the gradual application of modern technologies in IWT industry, due to limited education degree of a large number of IWT crews, they can hardly effectively utilize the existing technological equipment.

2.7 Environmental protection of inland waterway transport in Chongqing

As Chongqing is located on the upper reaches of the Yangtze River, so the municipal government attaches great importance to environmental protection in the reservoir area and other navigable waters. It has formulated the 12th Fiver Year Planning for the energy conservation and emission reduction of the transport industry, and specified priorities based on the planning. According to the work plan and priorities, Chongqing has endeavored in port shore power, solar-powered navigation mark on waterways, application of energy-saving vessel type and equipment, and has achieved good performance. However, compared with developed inland waterway areas in the other parts of the world, Chongqing still lack of inland vessel waste recycling system construction and operational mechanism, lack of capability of dealing with pollution accidents and needs to improve policies for promoting the development of new energy green vessels.

3. Situation and forecast analysis in the “13th Five-Year Plan” period

3.1 The development of Chongqing in the “13th Five-Year Plan” period

(1) National strategy of building the Yangtze River Economic Belt

In April 2014, Premier Li Keqiang urged again the development of the Yangtze River
Economic Belt relying on the “golden waterway” with national and provincial efforts to carry out the planning for the whole region. A China’s new economic supportive belt is expected to be built along the Yangtze River waterway. To achieve this goal, firstly, the transport capacity of the Yangtze River waterway should be greatly improved to take advantage of waterway transport as large freight volume, low cost and energy and land-saving. Measures include building a comprehensive multi-leveled transport corridor while conducting major waterway dredging projects, eliminating the traffic bottlenecks, expanding the traffic capacity of Three Gorges as well as the trunk routes. Secondly, improve the construction of railway lines with higher capacity, build high class highway and aviation networks with wide coverage, enhance the connectivity between the ports and other transport modes, improve the oil and gas transportation channel and the reserve system, vigorously develop combined transport between river and sea, main and branch lines, and rail-water, air-rail, highway-water multimodal transport.

Chongqing represents the core of the economic circle in the upper reaches of the Yangtze River economic belt, the integrated transportation hub and the starting point of 5,000 tons navigable channel of the Yangtze golden waterway. With the construction of the Yangtze River economic belt, southwest region will witness rapid economic development, with further improvement in railway lines, high level and wide coverage of highway and aviation network, closer connections between different transport modes and ports. With the status as the waterway departure point of cargos in the whole southwestern China, Chongqing will leap to the logistics center with waterway transport dominance in this region with substantial increase in freight volume.

(2) Strategy of the development of the five major functional zones in Chongqing

Based on the development strategy of “one circle and two wings”, a basic form of the five zones today, the idea behind the five functional zones is to further define the strategy of “functional orientation and differential development”. The first three functional zones including the urban core zone, urban extended functional zone, urban new development zone, is a refined version of the previous “one circle”, aim to further promote the development with expanded urban space and optimized resource allocation within the urban area. The establishment of the rest two zones, namely, ecological conservation development zone of northeast Chongqing, ecological protection and development zone of southeast Chongqing, aims to address the relations between economic development and ecological protection. In general, the purpose of the five zones is to drive integrated development of Greater Chongqing as a whole with a clear, specialized regional function and development goal for each zone, which are complementary to each other in terms of resource allocation and efficiency.

According to the development plan of the five functional zones, the industrial allocation of
Chongqing will mainly concentrate on the urban new development zone and the urban extended functional zone upstream of Fuling. Industrial output value of these two zones will reach RMB 4.45 trillion under the plan by 2020, accounting for 89% of the total of Chongqing. The ecological conservation development zone of Northeast Chongqing lies along the Yangtze River downstream of Fuling. It stresses the protection of ecological environment and development of special economic corridor in the upper reaches of the Yangtze River. The focus of Chongqing’s freight market will shift to the urban new development zone and Urban extended functional zone, and thus the development layout will be more reasonable which will promote the reasonable development of Chongqing freight market.

(3) The “One Belt and One Road” Initiative

Chongqing is located on the junction point of the Silk Road Economic Belt, the 21st Century Maritime Silk Road and the Yangtze River Economic Belt. The “One Belt and One Road” proposed by the State has endowed Chongqing with new strategic opportunities and historical missions for opening up and development. Smoothly implementing “One Belt and One Road” strategy and building the Yangtze River Economic Belt is the new strategic opportunity and mission for the development of Chongqing. It is beneficial to speed up implementing the Five Major Functional Zones strategy of Chongqing, reinforce the role of Chongqing as a transport hub, and enable Chongqing to play its role as an important economic growth pole in West China as well as the economic centers on the upper reaches of the Yangtze River to its fullest potential; it is also beneficial for Chongqing to build itself as a pioneer city during the opening up of the inland area, improve the level of opening up towards East and West, to domestic regions and foreign countries, and play the supportive function of the strategy of developing and opening up West China to its fullest potential. The significance of “the Belt and Road” Initiative mainly includes: first, the supporting capacity of the strategy of developing and opening up West China will be notably improved, Chongqing will better play its role as a strategic pivot, speed up building Chongqing as a pioneer city during the opening up of the inland area, form a network of channels for opening up towards East and West, to domestic regions and foreign countries, upgrade in all aspects the level, scope and depth of opening up to domestic regions and foreign countries, accelerate the process of improving the regulatory system of the Customs, and keep innovating and expanding the fields and forms of trade; second, facilitate building Chongqing as the central hub in West China on the Yangtze River Economic Belt, promote railway-waterway multimodal transport, river-ocean multimodal transport and vessel-to-vessel transfer, further enhance the function of inland waterway shipping exchange service and the aggregation capabilities of the essential elements of inland waterway transport; and third, foster the formation of the important ecological barriers on the upper reaches of the Yangtze River.
The “One Belt and One Road” strategy will promote the growth of freight volume by waterway in Chongqing, especially the growth of foreign trade volume, and will facilitate the development of railway-waterway transport and other modes of multimodal transport.

### 3.2 Forecast of freight volume in Chongqing

(1) Forecast of the total freight volume for major transport modes

Rational forecast of transport demand and viable planning of the transport development is necessary for pushing forward economic development, which serves as major rationale for policy making regarding scale of infrastructure construction and relevant policies and decisions. The change of demand for freight transport is not only closely linked to the industrial manufacturing, but also subject to the different stages of economic development. The cargo volumes of industrial output value at each unit vary greatly according to the different levels of industrial manufacturing, and cargo demand tends to slow down with the economic development. In this section, a regression model by Chongqing GDP and the cargo volume in the past nine years will be created, which is used to identify the linear relation between GDP and cargo volume by testing the correlation of GDP and cargo volume so as to predict the total cargo volume of major transport modes.

Chongqing has been taking the lead in GDP throughout the country in the past nine years. This fast-paced economic growth has slowdown in past two years. However, it is justifiable to say that the average rate of economic growth will not be less than 10% by the end of The Thirteenth Five-year Plan which references the national goal of economic development with a growth of over 7.0%. In this section, the average GDP increment is set as 10% to predict the cargo volume of Chongqing from 2015 to 2020.

The forecasted total freight volume for major transport mode in 2020 is shown in the following table:

**Forecast of total freight volume interval for major transport modes in Chongqing in 2020**  
*(unit: 10,000 tons)*

<table>
<thead>
<tr>
<th></th>
<th>Total volume</th>
<th>Waterway</th>
<th>Railway</th>
<th>Highway</th>
</tr>
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</table>
| Minimum freight volume  
*(in pessimistic scenario)* | 135,879      | 23,522   | 8,556   | 103,801 |
| Intermediate freight volume  
*(in neutral scenario)* | 167,775      | 25,482   | 9,513   | 132,780 |
| Maximum freight volume   | 199,672      | 27,441   | 10,171  | 162,060 |
It is estimated that in 2020 the freight volume via waterway will be 254.82 million tons, accounting for 15.19% of the total freight volume, increasing by 1.35% than 2014. It is suggested to take policy measures to guide waterway-suitable cargos to go waterway, and a controlling goal of 18% can be put forward, and a waterway freight goal of 302 million tons has been proposed to promote the development of waterway transport.

(2) Forecast analysis of freight volume passing the Three Gorges hub

According to the statistics from 2004 to 2014 from Waterways administration of the Three Gorges, the growth rate of shipping volume passing the Three Gorges hub was 10.7%. Referring to this growth rate, the shipping volume passing the Three Gorges will be 217 million tons in 2020. However, considering the acceleration of shipping channel construction and cascade development of the trunk and branch streams on the upper reaches of the Yangtze River, as well as the favourable policies about the Yangtze River Economic Belt, the development of waterway transport on the upper reaches will be maintained at a high speed, with a forecasted growth rate of about 12%. Calculating based on a growth rate of 12%, by 2020 the volume of freight passing through the Three Gorges Ship Lock will be 237 million t.

(3) Analysis of terminals throughput

In 2014, the throughput of terminals in Chongqing maintained a steady growth; the annual cargo throughput of terminals achieved 147 million tons, with a year-on-year growth of 7.3%; the cargo transported out of Chongqing achieved 57.18 million tons, with a year-on-year growth of 13.1%; the cargo transported into Chongqing achieved 89.67 million tons, with a year-on-year growth of 4.0%; the throughput of containers achieved 1.015 million TEU, with a year-on-year growth of 11.5%; the throughput of dangerous chemicals reached 11.10 million tons, with a year-on-year growth of 19.5%; the throughput of truck ro-ro achieved 323,000 trucks, with a year-on-year growth of 9.9%; The throughput of automobile ro-ro achieved 387,000 cars, with a year-on-year growth of 15.5%;

In this section, a regression model between Chongqing’s GDP in nearly 9 years and the throughput of terminals will be established. According to the correlation test between GDP and the throughput of terminals, the linear relation between GDP and freight volume will be confirmed, to predict the throughput of major terminals in Chongqing. It can be proved by calculating that the linear dependence of GDP in Chongqing and throughput of terminals is viable and appears significant correlation, the equation of linear regression is also correct. The growth of GDP in Chongqing from 2014 to 2020 is also calculated as the average 10%, and it can be forecasted that the throughput of terminals in Chongqing in 2020 will reach the amount of
240.81 million tons.

(4) Analysis of the development of multimodal transport

Multimodal transport is a profitable and effective transport mode, which reduces the transport time, improves the utility rate of transport tools, simplifies the relevant procedures and provides the “one-stop” logistics service. The key of multimodal transport construction is the coordination of the facilities construction of and the combined transportation systems. The development of multimodal transport of Chongqing mainly faces problems including shortage of multimodal transport infrastructure, inadequate coordination of multimodal transport systems, incomplete information system, low economic development level and over-tightened policy control, etc.

In 2014, the total freight volume via waterway-railway multimodal transport in Chongqing was 6.60 million tons, accounting for 0.65% of the total freight volume of Chongqing, 4.68% of the total freight volume via waterway and 9.8% of the total freight volume via railway. It is suggested to take policy measures to achieve a 15.0% proportion of multimodal transport freight volume in the total freight volume of Chongqing, and a target of 38.22s million tons of multimodal transport freight volume has been put forward.

4. Inland waterway transport structure adjustment strategy in Chongqing

4.1 Plan for restructuring inland waterway transport and multimodal logistics in Chongqing

4.1.1 Construct a smooth and efficient channel system with artery interacting with tributaries

Actively seek for approval from the State about starting the construction of the new channels in the Three Gorges in order to eliminate the bottleneck constraints of the Three Gorges as soon as possible. Actively seek for support from the State about accelerating the regulation and management of Jingjiang channels on the middle reaches, so as to solve the blockage problem as soon as possible. Vigorously promote the regulation of artery channel sections from Fuling to Chaotianmen, Chaotianmen to Jiulongpo, Jiulongpo to Yongchuan, so as to improve the passing capacity of channels on the upper reaches of the Yangtze River. Accelerate the regulation of Lize channel on the Jialing River, Baima hub and Kuwei channel on the Wujiang
River; strengthen inter-province coordination and interaction, comprehensively smoothen the skeleton tributary channels on the Jialing River and Wujiang River, improve the radiating capacity of the “one artery and two tributaries” (one artery: the artery of the Yangtze River; two tributaries: Jialing River and Wujiang River) national high-grade skeleton channels. Complete the development and utilization of 6 major tributary channels including Xiaojiang River in the Three Gorges Reservoir, actively carry forward the regulation of the Qujiang channels, cascading channelization of the Fujiang River; conduct preliminary research on upgrading the Jinkou hub on the Jialing River, the Wujiang River channel and navigation power development on the Daning River, and strive to spread the tentacles of tributary shipping channels.

4.1.1.1 Improve the trunk stream

(1) Actively apply for national policy to resolve capacity issue of the Three Gorges ship lock

Alleviation of insufficient capacity of the Three Gorges ship lock can be implemented into two phases: long-term and short-term. In short term, measures can be taken to tap the potential capacity, in the long term, a national policy should be implemented at the earliest time possible to build a new navigation channel for the Three Gorges and Gezhouba lock’s capacity issues should be considered altogether, so that the lockage can satisfy the need of economic development in the long term.

(2) Actively apply for national policy to resolve the low-class issue of Jingjiang River in the middle reaches of the Yangtze River

After renovation during the “10th and 11th Five Year Plan”, the basic pattern of the Jingjiang River has been within control; substantial progress has been made in its capacity-building and further improvement of the Jingjiang River navigation capacity has been a matter of course. Recently, the feasibility report of Jingjiang River Channel Improvement Project (3.5 meters) in the middle reaches of the Yangtze River has passed the review by the National Development and Reform Commission, and a construction standard of 3.5-meter-deep navigation channel is expected in 2015. After years of exploration and research on the Jingjiang River, technology has become mature. From a practical perspective, some difficult passages that severely hinder navigation have reached a 4 to 5 meters’ depth in the whole year. So long as efforts can be done to identify the evolution pattern of the river, seize the favorable opportunity and follow scientific plans, it is technically feasible to further increase the minimum depth of 3.5 meters to 4 to 5 meters. Therefore, the national policy should be applied as soon as possible to resolve the low-grade issue of Jingjiang River in the middle reaches of the Yangtze River.

(3) Vigorously promote the regulation of Fuling-Yongchuan section, Chaotianmen-Jiulongpo section and Jiulongpo-Yongchuan section of the Yangtze River waterway in Chongqing
Affected by backwater area of the Three Gorges, the phenomenon of "one harbor with three scales" occurs in the Yangtze River’s three sections in Chongqing, namely, a minimum depth of 4.5 meters in the waterway after Chongqing Fuling, 3.5 meters in the channel from Fuling to Chaotianmen, and 2.7 meters in the section before Chaotianmen. When water level falls in the Three Gorges Reservoir, the depth of navigation channel of backwater section before Fuling will be insufficient. As a result, for about three months each year, large ships and luxury cruises cannot travel up to urban Chongqing. Therefore, it is urgent to accelerate construction and regulation of Fengdu-Yongchuan section of the Yangtze River waterway in Chongqing for capacity upgrade of the upper reaches of the Yangtze River waterway.

4.1.1.2 Smoothen tributaries

(1) Accelerate the whole canalization of national high-grade channel including the Jialing River and Wujiang River
As national high-grade channel, Jialing River and Wujiang River is yet to be fully canalized, greatly restricting waterway development.

1) Jialing River: Caojie Shipping Hub has been completed, and Lize Shipping Hub has become the biggest bottleneck for whole canalization of Jialing River. Sichuan province and Chongqing Municipality should promote communication and cooperation to increase financial compensation of the Lize Hub, so that the project owner can start the project as soon as possible.

2) Wujiang River: Baima Shipping Hub is the planned last section of Wujiang River leading to the Yangtze. The canalization of its 45.3-km channel will greatly improve its waterway conditions. The project is indispensable and of great significance for Wujiang River’s development in that it opens up the Wujiang River to the Yangtze golden waterway. Meanwhile it will significantly promote economic development and resource development of Wujiang River hinterland. As the project is about to kick off, efforts should be made to follow and speed up its progress and prepare adequately for Baima Shipping Hub during its construction.

(2) Accelerate the pace of building regional key waterways
Key waterways in Chongqing City include "one main river, two branches and six lines". The "six-lines" are Qujiang River, Fujiang River, Qijiang River, Daning River, Meixi River, and Xiaojiang River. Qujiang River and Fujiang River, as tributaries of Jialing River, have good navigation conditions after their initial canalization and renovation and impoundment of Caojie Shipping Hub along Jialing River. The next step should be strengthening following fairways.

1) Develop Qijiang River to create a new green channel linking Chongqing and Guizhou
Qijiang River is a tributary of the Yangtze River. Historically it has been an important waterway for energy resources connecting Chongqing Nanshan District and Guizhou province. Due to the fact that its existing canal lock is of low-grade and some section is even not navigable, its shipping
capacity cannot be utilized. It is suggested to cooperate with governmental departments of water conservation and electricity should seize such opportunity to re-plan Qijiang River development with the focus on the establishment of transportation, and create this new channel of green energy resources.

2) Extend the Daning River to build logistics channel in Qinling-Dabashan Mountain Area

Daning River basin connects the transportation and commerce of Chongqing, Hubei and Shaanxi provinces. However, for a long time, due to transportation infrastructure bottleneck, Qinling-Dabashan Mountain Area is one of the 18 clusters of poverty-stricken area. As part of the area, Wushan County and Wuxi County in Chongqing are also national-level impoverished counties. With the impoundment of the Three Gorges reservoir and completion of the Hekou-Xujiawan Waterway Improvement Project, Hekou-Xujiawan Waterway at the end of the Three Gorges 145-meter backwater area has reached third-grade standard. But waterway from Xujiawan up to Miaoxi in Daning River is the backwater fluctuating section, and waterway in the upper stream of Miaoxi is the natural river with a small capacity, which remains substandard grade and difficult to pass through. The backward water and land transportation facilities in the basin have greatly restricted the development and transport of hinterland resources. If a canal can be built at the end of the Three Gorges Reservoir’s 145-meter backwater that leads to Wuxi County, it will undoubtedly become a large logistics channel in the Qinling-Dabashan Mountain Area with huge social and economic benefits.

3) Prioritize development of the Three Gorges Reservoir’s tributary waterways

Tributary waterways of the Three Gorges Reservoir can be roughly divided into four categories in their development. First, those of strategic socio-economic significance to the nation, such as the Jialing River and Wujiang River; second, those that play an important role in promoting the regional economy, such as the Xiaojiang River and Daning River; third, those directly facilitating the development of mineral resources in the basin, such as Baolong River and Meixi River; fourth, those that play an important role in promoting tourism of the Three Gorges, such Daning River, Longhe River, and so on. Development of different tributary waterways should be prioritized based on actual needs.

4) Accelerate research and formulation of navigation standard and waterway grade for tributaries of the Three Gorges Reservoir

After completion of the Three Gorges Reservoir, waterway conditions and capacity of its tributaries are substantial improved. Yet given the great differences of scale and conditions between these tributaries and natural rivers, although these tributaries’ channel depth and flow conditions are no longer problems, the bending radius of these waterways cannot meet current regulatory requirements, and these tributaries’ navigation standards in many respects is unsuitable.
Therefore research of navigation standard and formulation of waterway grade for tributaries of the Three Gorges Reservoir should be accelerated based on the actual channel conditions and ship types. The grade should focus on ships of 3,000 to 5,000 tons in order to facilitate direct link between the main river and its tributaries and lay a good foundation for tributary channel development.

4.1.1.3 Link trunk stream and tributaries

(1) Scientifically Innovating on the Mainstream-Tributary Linkage Transfer

Most of the Yangtze River tributaries in Chongqing can only be upgraded to level VI to level III after renovation, which can normally pass 1,000-ton-level ships. Currently, for a ship to travel from Chongqing to Shanghai, the break-even point is above 3,000-ton-level, plus the fact that self-propelling ships of 5,000-ton-level are gradually becoming the major ship type on the Yangtze River mainstream, thus it requires small ships on the tributary channels to come to the mainstream and ship cargoes with other ships. However, if the transfer is through a port, a doubled port charge has to be paid. If the transfer is through barge transportation, it will change the common transportation model. Thus, it requires awareness of the different conditions of different tributaries and scientific verification to determine the best way of making transfer transportation. A wise way of handling this might be properly constructing transfer ports for those suitable for port transfer, and setting reasonable ship type standards for those suitable for barge transfer.

(2) Set Mainstream and Tributary Operating Standards through Scientific Planning in Accordance with Local Conditions.

The Three Gorges Reservoir has brought fundamental changes to the reservoir area tributary channels, helping them pass more ships. Nonetheless, in channel renovations, major difference in the navigation standards of the mainstream and tributaries has been seen, which can be elaborated as follows.

Technical standards of the navigation dimensions of the mainstream and tributaries vary much. In channel renovations, tributary channels’ waterway width and bending radius are much lower than those of the same level mainstream.

Technical standards of the bridges along mainstream, tributary channels are not unified. With the water storage of the Three Gorges Reservoir reached 175-meter-deep, a waterway network of direct mainstream-tributary connection has generally been established. Nonetheless, in the *Navigation Standard of Inland Waterway (GB50139-2004)*, the set headroom of restricted level III waterways and non-restricted level III waterways vary 8 meters. Now most of the tributary channels in the reservoir area are restricted level III channels. And the bridges on them are low-level bridges built as on rivers without navigation. It is surveyed that on Chongqing’s
reservoir area tributary channels, over 10 bridges don’t qualify their corresponding navigation headroom standard. And since most ships working in this area are above 1,000-ton-level and are entering the tributary channels for discharging or loading, the disunity of navigation standards actually poses serious safety threat to the bridges on tributaries.

(3) Actively Facilitate Mainstream-Tributary Internet Connection through interconnection and information sharing.

The Yangtze Channel is building its digital channel, and is now preparing to upgrade the digital channel to an intelligent channel. Ships can travel safe with an electronic 3D channel map. The Yangtze mainstream is now fully covered by advanced VHF communication system and video monitoring system. But now communication and information systems for tributaries are far from complete. Most tributaries are not equipped with VHF communication system or video monitoring system, not to mention an electronic channel map. Even for the Daning channel recently renovated and equipped with VHF system and video monitoring system, it failed to connect with the Yangtze mainstream network because of the administrative system. Information systems of the Yangtze mainstream including VHF communication and data transmission cannot be at full play, and the integration of shipping information of the mainstream and tributaries cannot be achieved. Thus, R & D work should be intensified and administrative system obstacles should be removed to bring about the mainstream-tributary internet connection, and to create more convenient conditions and a safer environment for all ships.

4.1.2 Build a port cluster with reasonable structure and complete functions

Relying on railway and highway network, based on the principle of combining “port, logistics and industry”, build up a “1+3” railway-waterway multimodal hub port formed up by the Guoyuan Port in the city proper and Jiangjin Luohuang, Fuling Longtou and Wanzhou Xintian. Build nine major specialized key ports including the Cuntan Port in the city proper, Yongchuan Zhutuo, Yubei Luoqi, Changshou Huijaping, Fengdu Shuitianping, Zhongxian Xinsheing, Fengjie Anping, Hechuan Weituo and Wulong Baima. Actively conduct the construction of LNG refueling ports. Strengthen the degree of anchorage construction to preliminarily relieve the contradiction of insufficient anchorage. Combining with the urban construction plan, speed up the consolidation, transformation and function adjustment of old wharfs in the city proper. Strictly implement the planning of port, reinforce the orderly development and reasonable utilization of port shoreline resources; improve the intensive level of ports, tighten the operation and monitoring of dangerous chemical terminals, so as to ensure the safe production of ports.
4.1.2.1 Control Port Scale and Set Construction Priorities

The analysis of Chongqing freight ports shows an overall adaptability of 1.16, slightly less than the reasonable figure of 1.4. After the rapid development of Chongqing’s ports in recent years, its capacity bottleneck has been preliminarily eased, yet in general remains insufficient, and should continue to grow steadily. For future ports development, the scale should be controlled and construction priorities should be set based on cargo-specific ports. General principle is as follows: prioritize new ports construction along the deep waters of the Yangtze River as per 5,000-ton standard and limit those as per less-than-3,000-ton standard. Before 2020: control the approval of new container terminals; encourage current non-specialized container terminals capable for both containers and general cargo to switch to those for general cargo; control approval of new ro-ro terminals for trucks; encourage moderate development of ro-ro terminals for commercial automobiles based on market demand; prioritize development of ports for dangerous chemicals; accelerate transition of dry bulk ports from small, scattered and chaotic ones to large-scale specialized ones.

(1) New ports construction along the deep waters of the Yangtze River should prioritize as per 5,000-ton standard and limit those as per less-than-3,000-ton standard. Freight ship’s breakeven point in Chongqing corresponds to a continuously increasing dwt, due to the rise of operating costs including ship crew’s wages, fuel prices etc. It was estimated that in 2014 transportation business from Chongqing to middle and lower reaches of the Yangtze River cannot be profitable unless bulk carriers have a capacity of more than 4,000 tons or container ships have that of more than 250 TEUs. In recent years, almost all the new ships of shipping companies in Chongqing have a tonnage of more than 5,000. Therefore new ports construction along the deep waters of the Yangtze River should prioritize as per 5,000-ton standard and limit those as per less-than-3,000-ton standard.

(2) The capacity of container terminal in 2014 was 3.7 million TEU with a adaptability as high as 3.66, greater than the reasonable figure of 1.8. Given such a large capacity surplus, its development should be controlled. A reasonable adaptability of 1.8 in 2020 will guarantee the container terminal’s capacity of 5 million TEU. The following measures should be taken for the container terminals:

① Encourage current non-specialized container terminals capable for both containers and general cargo to switch to those for general cargo, which can absorb a container capacity of 260,000 TEU; ② Control approval for new container terminals before 2020; ③ Restructure a number of old ports including Jiulongpo and Fuling Kangkewan, due to the fact that they are located in the urban area of Chongqing City, which can reduce container throughput capacity of 240,000 TEU; ④ Encourage ports with excessive container capacity to include throughput
capabilities of general cargo through technical innovation.

(3) Dry bulk terminals in 2014 had a capacity of 116.9 million tons and a throughput of 101.65 million tons. The port capacity was basically sufficient with an adaptability of 1.23, slightly less than a reasonable degree of 1.3. However, large scale terminals for dry bulk, with 43 berths, have a capacity of only 32.87 million tons, accounting for only 28% of the total capacity, and the rest is done by small and scattered terminals. Therefore, the focus for the dry bulk terminals development should be transition from small, scattered and chaotic ports to large-scale specialized ones. It is recommended to renovate functions of current and planned ports’ operational areas, build a batch of standard and low-cost operational areas for dry bulk, and shut down some illegally operating areas, so as to adapt to the transport need of large scale dry bulk such as sands, ores and coals, reduce handling costs as well as improve operational safety and quality.

(4) Terminals for dangerous chemicals had a capacity of 7.84 million tons and a throughput of 11.11 million tons in 2014. Therefore the adaptability of dangerous chemicals terminals was only 0.71, far lower than the reasonable adaptability of 1.6 and ports’ capacity is insufficient. With a reasonable adaptability of 1.6 in 2020, capacity for dangerous chemicals should reach 28.98 million tons, and a gap of 21.14 million tons should be filled. Although currently some of the less dangerous chemicals in the throughput of 11.11 million tons have been handled as ordinary general cargo, with further standardization of terminal handling of dangerous chemicals, priority should be given to the development of such ports. Based on the reasonable adaptability in 2020, a throughput of 21.14 million tons which means 21 berths should be added by 2020, calculated based on one berth for one million ton on average.

(5) Ro-ro terminals for commercial automobiles had a capacity of 760,000 vehicles and a throughput of 362,400 in 2014, with an adaptability of 2.27, slightly higher with a adaptability, slightly higher than the reasonable figure of 1.6; but in 2020, with a adaptability of 1.6, the passing capacity for ro-ro terminals for automobiles should reach 1.07 million. Therefore its moderate development should be encouraged based on market demand.

(6) Ro-ro terminals for trucks had a capacity of 730,000 and a throughput of 347,100 in 2014, with an adaptability of 2.10, slightly higher than the reasonable figure of 1.2; in 2020, with a adaptability of 1.2, ro-ro dock capacity for trucks should reach 46 million, still less than the current actual capacity. Therefore approval of new ro-ro terminals for trucks should be controlled before 2020.

4.1.2.2 Optimize functional layouts

(1) Adhering to the Industry Layout Planning, Scientifically Arranging Port Functional
Act in accordance with the national strategy for the Yangtze river economic belt, Chongqing’s development strategy of five major functional areas, relevant layout plannings for industries, customs supervision, review Chongqing’s operating ports and planning in a comprehensive way, and make timely, reasonable arrangements for port functions and planning of port functional layouts, thus, to gradually comprehend the developing and operating model of integrated parks of “ports, logistics and industries”, raise major industry levels and increase driving force for development.

(2) Improving Ports’ Cluster Functions, Offering Better Services.

Gradually complete and improve industry planning including storing, distributing and processing according to the different functions of current and to-be-constructed port operation areas, attract industry clusters with favorable policies, continuously better port services and hinterland industry services.

(3) Establishing a Complete System for Old Port Areas’ Transformation and Retirement.

Basing on the conditions of old port areas, form plans for their transformation and retirement in time and establish a complete system to maximize their social and economic benefits.

4.1.3 Promote interconnected and efficiently connected multimodal transport

Coordinate the construction of shipping center on the upper reaches of the Yangtze River with industrial layout planning; promote the construction of channels in development zones, industrial parks, logistics parks and scenic spots along the River; exert the function of the market to push forward the construction of container transit storage yard outside the port areas; strengthen the sound interaction between shipping and industries. Combining with the construction of highway and railway network, speed up the transport and distribution channels in hub ports such as Wanzhou Xintian, Fuling Longtou and Jiangjin Luohuang, etc., as well as key port-entry railway and highway such as Hechuan Weituo and Zhongxian Xinsheng, etc., so as to form a seamlessly connected distribution and transport system. Build a data platform which can promote the intelligence and collaboration of railway-highway-waterway multimodal transport; speed up the development of railway-waterway, highway-waterway, river-sea, waterway-waterway transit and other types of multimodal transport; conduct river-sea direct transport and waterway-highway drop and pull pilot projects; provide integrated transport service for clients, attract cargos from surrounding provinces and cities to transit in Chongqing and then transport to sea via the Yangtze River; attract cargos from provinces and cities on the middle and lower reaches of the Yangtze River to be directly transported to the Europe via the Yangtze River golden waterway and the “Chongqing-Xinjiang-Europe” railway channel; expand cargo trade
between regions along the River and countries along the “Chongqing-Xinjiang-Europe” railway; seek for support from the State to construct a railway along the River as soon as possible and further improve the concentration and radiation capacity of the shipping center.

4.1.3.1 Comprehensively utilizing different transportation means with in-depth integration

Coordinate the planning and construction of inland waterway transportation and other means of transportation. Comprehensively review Chongqing’s current ports and planning with reference to the construction of hinterland roads, railways and highways. Viewing from a comprehensive transportation system, with a principle of improving transportation efficiency and lowering transportation cost, make wise choices of the best port positions and scales. And propose reasonable plans of transformation to port operation areas with underprivileged layouts.

The key node of the Yangtze River Economic Belt lies in “port nodes plus distribution and transportation network”, and railway and golden waterway these two modes of transportation can form an integrated system with wide spread, large transport volume, seamless connection and complementary advantages. However, how to realize the complementary advantages and reduce overlap competition in terms of the layout of railway and golden waterway, it needs detailed research in order for Chongqing to integrate into the Yangtze River Economic Belt. A railway parallel with the golden waterway can connect all the ports together, but the hinterlands expanded for ports by the railway are limited, and the railway will be a competitor to the waterway to some extent. While a railway vertical or skewed to the golden waterway can significantly increase the hinterland area of ports and it will not compete with waterway transport, which can realize complementary advantage. Therefore, this project has put forward that a “fish-skeleton type” railway-waterway multimodal transport is the best development mode for the locating the key nodes of the Yangtze River Economic Belt, which is an innovative exploration in deeply integrating various transport modes.

4.1.3.2 Focus on developing multimodal transportation ports of railway, road and waterway transportation

In order for Chongqing to integrate into the Yangtze River Economic Belt strategy, and while implementing the national strategy to seize the opportunity of developing itself, comprehensively building up the shipping center on the upper reaches of the Yangtze River, constituting an inter-connected integrated three-dimensional transport system which integrates railway, highway and waterway all together, smoothens domestic transport and connects to the outside, apart from a smooth golden waterway, the key also lies in port nodes and a distribution and transportation channel network efficiently connected with the nodes, particularly strengthen the connections between railway and port, form up key notes for logistics transition with wide coverage and big transport volume, and expand the strategic influence of the Yangtze River
golden waterway to the national economy.

Vigorously develop railway-highway-waterway multimodal ports, not only enabling ports to boast an economic hinterland with a diameter of 500 km, but also enabling the Yangtze River golden waterway to connect with national key railway arteries, so as to form a logistics network where waterway and highway are integrated together to exert complementary advantages and radiate into all directions. Take the Guoyuan Port in the city proper as an example, it connects with the “Chongqing-Xinjiang-Europe” railway, the Yangtze River golden waterway and the Chongqing-Huaihua Railway, of which the “Chongqing-Xinjiang-Europe” railway is connected with the Silk Road Economic Belt, the Yangtze River golden waterway is the strategic carrier of the Yangtze River Economic Belt, and the Chongqing-Huaihua Railway is an important part of the sea-entry channel of Chongqing-Hunan-Fujian channel which is then connected with the 21st century Maritime Silk Road.

4.1.3.3 Develop new transportation models of multimodal logistics

Work on new models of multimodal transportation. Research on amphibious drop and pull transport, which is an integration of ro-ro shipment and drop and pull transport for raising the turnover rate of vehicle transportation and facilitating cargo loading. Research on dry port, which refers to the inland logistics center with port services including customs clearance, inspection and issuing B/L. And work on further policy supports for ports’ waterway transfers.

4.2 Plan of improving shipping capacity and shipping organizations

4.2.1 Continue to facilitate the shipping capacity towards large scale, standardization and specialization of vessels

1) Continue to modernize the shipping capacity structure and improve the overall performance of enterprises. The standardization of vessel types is of great significance in terms of improving the vessel building technology, reducing operational cost, enhancing operational benefits, increasing the passage efficiency and passing capacity of the Three Gorges ship lock, cutting the environmental pollutions as well as maximizing the values of the Golden waterway of the Yangtze River.

2) Reinforce the control over standardization policy and actively seek for capital to expand the scope of subsidies for vessel standardization.

Over the past decade, Chongqing government has issued policies which facilitate the phasing out of the old vessels and the development of large, standardized, specialized vessels featuring energy saving and standardization. As a result, the standardization rate has been raised from 30% to 72%, with a standardized shipping capacity of 75%. There is great room for
improvement regarding standardization. In the future, efforts should be made to continue with the standardization work to develop large, standardized and specialized vessels.

**4.2.2 Facilitate the building of new generation of vessels featuring high tech and green energy**

Low carbon and green energy have become the trend of the global shipping industry. Under this circumstance, China is vigorously developing the new generation of vessels featuring high tech and green energy to keep up with the time. The special focus is given to the development of the Three Gorges Vessel form and new energy vessels, e.g., LNG vessels.

1) **Formulate controlling policy and continue deepening the development of the Three Gorges vessel type.** At present, the passing capacity of the Three Gorges Vessel lock has hit the maximum limit 20 years ahead, which cannot meet the needs of the Yangtze River shipping. Research shows that the Three Gorges Vessel form has great adaptability to the vessel lock with features of speediness, easy control, lower EEDI than current vessels and remarkable economic benefits. On the other hand, this type of new vessels requires larger investment in the early stage, therefore, government should give policy support through vessel lock passage, tax incentives, fee waiving, finical subsidies, in order to promote its use.

2) **Conduct further research on the safe and efficient application of LNG in shipping industry and promote the development of LNG new energy vessels.** Priority should be given to the development of the LNG new energy vessels with greater environmental friendliness and economic safety, representing the future trend of vessels. Currently, there are some standing technical issues and problems of the constructions of complementary gas station, such as inadequate regulations, standards and safety management, as well as the lack of relevant policies regarding the fuel shipping. In particular, the limit to the LNG vessel passing the vessel lock has posed great impact on the development of the vessels. In order to facilitate the development of new energy vessels, relevant departments of the government should carry out research to stipulate rules, standards and policies, simplify the approving procedures of building new gas stations, solve the difficulty in passing the vessel lock and transferring the new fuels like LNG by waterway.

**4.2.3 Develop new transport model and enhance organization efficiency**

1) Speed up research on the development of new type shipping logistics and explore multimodal logistics organizational method with better energy consumption performance and efficiency. Developing new transport model is in accordance to the trend of modern shipping logistics which is of great significance of improving waterway transport efficiency, expanding the shipping radius, raising the competitiveness of waterway transport as against the railway and
high transport. Shipping enterprises can develop a variety of modern transport means, such as trunk-tributary direct transport, river-sea direct transport, land-water drop-and-pull transport, water-to-water transport and dry ports construction, in order to realize the door-to-door transport service with greater organization efficiency by reducing the intermediate links, cutting the transport time and the cost, increasing the transport service quality, lowering the goods damage and loss.

2) Conduct research on supportive policies for new type logistics transport organizational method as soon as possible and carry out research and construction of supportive equipment and facilities, so as to be well prepared for implementing highly efficient logistics organizational mode. Vessel fleet transport organizational mode is an energy-saving and environment-friendly transport mode with strong loading capacity. It is suggested to research and innovate in the ship lock-passing policies, safe operation and monitor, vessel fleet transport technology and energy types, etc. to improve transport efficiency. Drop-and-pull transport refers to a tractor dropping a trailer in a cargo loading area and unloading. Currently, this mode is still faced with policy obstacles and application barriers, so it is suggested to formulate related supportive policies and conduct technological research as soon as possible. For river and sea through transport, river and sea intermodal transport, trunk and tributaries intermodal transport and other multimodal transport organizational modes, related policy and technology research should also be carried out as soon as possible so as to improve the practicability.

5. Policy notes

5.1 Suggestions on developing Chongqing freight market

(1) Strengthen the construction of multimodal infrastructure and intermodal transport system to develop multimodal transport

Strengthen the planning of a comprehensive traffic network for the multimodal transportation of railway, highway, and inland waterways. Since the central government implemented “super-ministry” system, railway, highway, waterway and aviation have been in charge by the Ministry of transport and its subsidiaries, which will facilitate the building of a national comprehensive transport system. Efforts need to be made to enhance the connectivity among the regional comprehensive transport systems, especially the connections among regional waterway transport, enabling IWT to play the dominant role in the comprehensive multimodal transport network, with most ports having the direct access to railway and highway, so as to enable ports to play a crucial role of transfer hub in the whole transport system.

The emergence of multimodal transport does not mean a birth of a new transport mode. It
indicates more about the innovation of an organizational form. As an advanced transport organizational form, multimodal transport optimizes different transport modes and takes advantage of the respective technological strengths of the modes. It implements the integrity of cargos based on a reasonable overall transport cost. The key to this innovative transport system is the construction of the transport system.

In 2014, the total freight volume via waterway-railway multimodal transport in Chongqing was 6.60 million tons, accounting for 0.65% of the total freight volume of Chongqing, 4.68% of the total freight volume via waterway and 9.8% of the total freight volume via railway. It is suggested to take policy measures to achieve a 15.0% proportion of multimodal transport freight volume in the total freight volume of Chongqing has been put forward.

(2) Further speed up building Chongqing into the shipping center on the upper reaches of the Yangtze River

Chongqing is the junction node of the “Y”-shaped grand passage formed up by the “One Belt and One Road” and the Yangtze River Economic Belt, so it enjoys a unique location advantages of connecting west with east, linking north and south. It is an important strategic support for the Silk Road Economic Belt, the central hub on the west part of the Yangtze River Economic Belt, an industrial hinterland of the Maritime Silk Road as well a one of the three major shipping centers on the Yangtze River designated by the State. In recent years, waterway transport in Chongqing has maintained rapid development. The cargo throughput capacity of ports within the whole municipality reached 170 million tons, the proportion of cargo generated from peripheral regions transiting in Chongqing reached 43, container throughput broke through 1 million TEU, and the shipping center on the upper reaches of the Yangtze River has taken shape. Further speeding up the construction of the shipping center on the upper reaches of the Yangtze River will benefit fully playing the unique location advantages of Chongqing, constructing an interconnected comprehensive three-dimensional transport system railway-highway-waterway multimodal transport; smoothen the grand river-sea passages leading eastwards to the ocean and land passage leading westwards, forming a grand landscape of “One Belt and One Road” and the Yangtze River Economic Belt; implementing the five major functional areas strategy of Chongqing, promoting regional interconnection and integrated development within the municipality; concentrating industries through ports, thriving the municipality with ports, strengthening the driving forces of shipping industry to industrial development and the supporting function of industries to the development of shipping and promote the healthy and rapid development of Chongqing’s economy while better servicing the national “One Belt and One Road” strategy and the Yangtze River Economic Belt.

(3) Actively seek for government solution towards the insufficient capacity of the
(1) The navigation conditions of the upper reaches of the Yangtze River have been greatly improved since the successful impoundment of the Three Gorges, providing greater shipping benefits than expected. A large volume of cargos in Chongqing, Sichuan, Hubei, Guizhou and other areas are transported via waterway, which directly drives the reservoir areas to take a great leap forward. The improved navigation conditions and capacity of port has effectively reduced the overall transport cost in the upper reaches of the Yangtze River, which leads to an optimized transport industrial layout. More cargos are transported by waterway, which leads to a sharp increase of cargo volume. In 2013, the volume of waterway transport of Chongqing reached 0.144 billion tons, while the two-way freight transport capacity of the Three Gorges ship lock only allows 0.1 billion tons per year according to the design requirement. Although a variety of measures can be taken to exploit its passing capacity potential, the Three Gorges ship lock remains the key bottleneck that limits the development of the waterway freight market of the upper reaches of the Yangtze River.

The excavating approach has its ceiling capacity to improve the navigation throughput of the ship locks in the long run, so that another alternative methodology shall be adopted including the early commencement of the new channel construction for the Three Gorges. Meanwhile, the passing capacity of the Gezhou Dam deserves careful consideration so as to meet the further capacity demand created by the economic development in the future.

(4) Learn from the experience of developed European countries and issue policies that support the development of waterway transport

The white paper on transport policies issued by European Union in 2001 initiated preferential strategies of the development of waterway, followed by relevant policies. In recent years, IWT of European Union has prominent advantages in the middle and long distance transport of bulk cargos and particular containers, especially the transport between coastal ports and hinterland. The proportion of the dry bulk transported by waterway in the 27 countries of EU represents 25% to 30% of the total volume. In 2010, the volume of waterway transport in the Netherlands, Germany and Belgium took up 34.7%, 12.3% and 15.8% respectively of the total volume of their respective countries.

Since the waterway transport features low consumption, large volume, low cost and small occupation of land, the promulgated policy states the big ambition of developing waterway transport, improving the waterway proportion and enacting the transference plan on the transport volume of highway. For example, by 2030, 30% of the freight volume of highway (>300km) is expected to be transferred to other transport modes (waterway and railway). By 2050, this figure is estimated to be 50% (>300km). The purpose of the plan is to ease the issues such as street
traffic congestions, noises, traffic accidents and environmental pollution.

Based on the analysis of data, it is forecasted that by 2020 the proportion of freight volume via waterway transport in the freight volume of comprehensive transport in Chongqing will be 15%, which is still relatively low. It is suggested to take policy measures to guide cargos suitable for waterway transport to go via waterways to achieve a target proportion of 18%, so as to enhance the development of waterway transport.

5.2 Suggestions on the infrastructure development and management planning of inland waterways

(1) Strengthen organizational guarantee

Establish a municipal-level joint conference system; actively establish and complete the mechanism of consultation and cooperation between regional governments and municipal departments; jointly study and solve major matters during the process of constructing the shipping center on the upper reaches of the Yangtze River; coordinate the organic connection among urban development, industry, parks, terminals, railway, highway and environmental protection, etc., so as to push forward construction in a well and rapid manner. Complete the green channel mechanism for the approval of key projects, reasonably simplify the formalities of approving terminal and navigation construction projects; ensure the efficient and orderly progress of key project planning, land use, environmental protection and other preliminary works. Establish and complete the supervision and assessment to key projects and important tasks, and implement the responsibility system and accountability system. Each district and county should center on the construction of the five functional areas and combine it with the planning of the shipping center on the upper reaches of the Yangtze River to timely optimize the layout of industrial parks and logistics, so as to promote the development of port-vicinity industry.

(2) Fully exert the function of the market

Speed up reform and innovation, deepen the reform of waterway transport administration mechanism, further streamline administration and delegate power to the lower levels, reduce approvals, implement online administrative approval, cancel approval projects which hinder equal market entry and limit foreign capital; improve service quality and stimulate market vitality. Actively seek for policies from related Central departments to reduce the fee burden of shipping enterprises and strengthen the competitiveness of waterway transport enterprises. Actively push forward PPP mode in the construction of terminals and navigation power hubs.

(3) Provide more policy support for the development of waterway transport
The municipality shall continue to arrange a designated fund of RMB 500 million every year for developing waterway transport, and provide more support for the waterway transport construction projects of hub ports, key ports, shipping service system and navigation power hubs, etc.

Continue to implement supportive policies to help the development of shipping after the reform of “changing business tax into value-added tax”, provide fiscal subsidy for the locally retained value-added tax paid by shipping, shipping service industry and shipping insurance through the Chongqing Shipping Exchange.

Continue to provide financial support for cargos from outside Chongqing attracted by logistics enterprises to be imported and exported through Xiyong Comprehensive Bonded Area, Lianglu Cuntan Bonded Port Area as well as Huoyuan Port, etc., and are incorporated in the municipality’s trade statistics.

Continue to implement preferential highway toll fee for container trucks, and provide per container charge refund of road and bridge toll fees in city proper for trucks entering and exiting ports in Chongqing and loaded with international standard-sized containers; charge no city proper road and bridge toll fee from container trucks entering and exiting port areas belonging to Chongqing Port Affairs Group.

Continue to implement fiscal subsidy policy for the operating fees of container terminals, and subsidize containers via waterway-waterway transit.

Implement subsidy policy for containers via railway-waterway multimodal transport and expand the radiation hinterland of the shipping center.

Continue to provide a 15% preferential enterprise income tax for shipping enterprises whose businesses belong to the Catalogue of Encouraged Industries in West China established by Chongqing Municipality and 70% of total enterprise revenue comes from encouraged business types.

Provide more support for the construction of terminal distribution and transportation channels; coordinate the planning of organic connection of terminal distribution and transportation channels with urban roads, roads, highways and railways in parks; coordinate the reasonable utilization of construction fund of urban construction, transportation, migration and parks on terminal distribution and transportation channels.
5.3 Suggestions on developing vessel shipping capacity and shipping organizations

(1) Facilitate the coordinated shipping capacity and market demand through policy guidance and market regulation

Currently, there is an overall imbalance between supply and demand of vessels in Chongqing, and the market is in a structural and periodic surplus, so it is still digesting its shipping capacity, resulting in the fierce market competition with a low utilization rate of vessels and economic loss of the shipping enterprises, which acts as a hindrance to the healthy development of the shipping market. In order to promote the healthy development of waterway transport market, the following measures have been suggested:

1) Optimize shipping capacity structure and vigorously develop advantageous shipping capacity. Shipping enterprises should make greater efforts to phase out the outdated vessels and backward production capacity and develop large, specialized and standardized vessels with better profits and shipping quality in response to the changing market.

2) Expand market scope and improve the utilization rate of shipping capacity. Shipping enterprises should follow the market law and divert the excessive capacity to the neighboring area, in order to enhance the utilization rate by maximizing the preferential policies and exploring new markets.

3) Formulate policies on controlling shipping capacity and promote the balance between supply and demand on the shipping market. The government should issue relevant policy which put restrictions on the input of new shipping capacity and direct updating of the old vessels. Policies should be made to encourage the elimination of non-standard and outdated vessels and optimize the production capacity of enterprises.

(2) Complete vessel pollution prevention system

Regulatory bodies should strengthen regulations, issue corresponding vessel pollution prevention methods as soon as possible, establish and complete vessel pollution joint prevention mechanism, increase investment to pollution emergency response equipment and raise the environmental protection awareness of staff working on waterways.

1) Set up an examination and review mechanism to prevent low standard vessels transporting poisonous and hazardous materials from entering the operating market

Vessel examination bodies and maritime management bodies should set up an examination and review mechanism, based on which the vessel examination bodies should examine the
discharge of cleaning water and controlling equipment, and firmly grade vessels failed to reach
the standards as low standard vessels; maritime management bodies should strengthen safety
check on vessels, and take corresponding correction measures on low standard vessels
unequipped with up-to-standard vessel cleaning equipment or vessels failed to effectively use
cleaning equipment or equipped with unqualified cleaning staff. The above vessels failed to
reach standards shall be expelled from the transportation market by transportation management
department, so as to ensure the shipping ability of dangerous liquid goods vessels.

2) Prevent vessel household pollution and channel more social capital investment into this
business

It is suggested that related departments can label vessel household wastewater treatment as
a public welfare course and provide proper subsidies based on related standards. Meanwhile,
through holding hearings and discussions, charge a lump-sum “vessel household wastewater
treatment fee” quarterly or annually from operating vessels based on their tonnage, and will not
charge additional fees for collecting vessel wastewater household wastewater. Spend more effort
in promotion and monitoring, incorporate vessel household wastewater into institution and
realize “0 discharge” of vessel household wastewater.

3) Reinforce legal construction and improve the capability of response to pollution
accidents

Only by continuously reinforcing legal construction on vessel pollution prevention, strictly
implementing regulations and standardizing management can the vessel pollution treatment and
the emergency response ability towards vessel pollution accidents be improved. Currently, the
handling capability for large scale pollution accidents is still insufficient, particularly for possible
accidents of dangerous chemical transportation, there is a lack of necessary emergency response
plan and facilities. Therefore, related safety management departments should actively promote
the research and formulation of vessel pollution emergency response plan as well as complete the
construction of pollution emergency response system, urge vessels to equip pollution emergency
response equipment and improve the ability of preventing pollution accidents.

(3) Further improve the adaptability of passing ship locks

1) Continue to push forward and encourage shipping enterprises to build standardized
vessels such as the “Three Gorges vessel type” and improve the utilization rate of the Three
Gorges Ship Lock. The “Three Gorges vessel type” is a new vessel type with a great
length-to-width ratio based on the requirement of navigation in the Three Gorges Ship Lock and
development of shipping market in the reservoir area. Compared with traditional vessel types, it
can not only significantly improve the efficiency of vessels passing the ship lock but also
conserve more energy. So it is suggested to expand the degree and scope of government’s subsidy to shipping enterprises over the newly-built “Three Gorges vessel type”, so as to encourage more enterprises to update their shipping capacity.

2) Functional departments should issue regulations as soon as possible to further optimize the lock-passing management mechanism. The Three Gorges Ship Lock already reached its designed capacity in 2011, 20 years earlier than planned. In 2014, its passing capacity was improved to 119 million tons, which means the freight volume via the Three Gorges Ship Lock has been increasing year by year, and waiting for an excessive time to pass the ship lock will become a normal state within a long period of time. So it is suggested to research and propose methods for improving the efficiency of passing the lock, so as to relieve the traffic congestion at the ship lock.

(4) Release shipping market regulatory mechanism

Strictly prevent malicious and unfair competition in the shipping market, and further improve the quality of shipping service. Currently, the shipping market is not highly concentrated and in fierce competition, resulting in an overly-low shipping price and little profit for shipping enterprises. The unhealthy development of the shipping market further led to low quality of shipping service in both passenger and cargo transportation. Therefore, it is suggested to formulate price limit policies, set a bottom line of price to prevent attracting cargo owners with extremely low prices, guarantee the quality of shipping service through controlling price and ensure the healthy and sustainable development of the shipping market.

(5) Comprehensively promote the modern, large scale and integrated development of shipping enterprises, enhance the development of integrated logistics and logistics throughout journey.

Guide leading shipping enterprise to merge and restructure, extend the logistics chain and improve market competitiveness. Guided by the principle of sustainable development with quality and economic returns, the industry should perfect its modern enterprise institutional system in response to the changing market, in order to develop the modern comprehensive shipping logistics. Key enterprises are suggested to gain greater power of bargaining and speech with enhanced core competiveness through resource integration such as cooperation, merger, and acquisition. Under this circumstance, it is expected to have higher market concentration with economies of scale.
5.4 Suggestions on the next-step development of Chongqing Shipping Exchange’s business

(1) Improve information service, gradually develop into a public logistics information platform on the upper reaches of the Yangtze River

Start from expanding traded products to realize the development of shipping towards integrated logistics. Construct the term-II project of shipping transaction e-commerce platform and realize the online payment settlement and clearing function of shipping transaction; complete the function of transport e-port which covers railway, highway, waterway, airway and interconnects with the Customs and other port units as well as provinces and cities along the Yangtze River; on the basis of shipping transaction and vessel transaction, conduct shipping insurance, travelling to the Three Gorges, products for vessels and other e-commerce transactions, learn and borrow experiences from European RIS, research on the establishment of Chongqing Inner River Logistic Public Information Platform and consolidate integrated allocation capability of logistic resources to realize complex logistic transaction function.

(2) Continue to Explore and Expand Shipping Service Measures, to Bridge the Government and Market and Further Enhance Serve Capability to Provide Value-added Service to the Shipping Market

The Exchange will utilize financial service as the starting point to enhance financing and risk prevention capabilities. Chongqing Ship-owners Mutual Assurance Association will be included in the efforts to continuously reduce insurance cost of shipping companies, enlarge guarantee scope, improve the quality of indemnity service and enhance anti-risk capacity; The Chongqing Shipping Financing Guarantee Corporation will help companies to address financing difficulties rising from the standardization program of the Three Gorges vessel types; develop financial products for logistic transaction, shipping investment and financing, shipping industry foundation-related business and establish and improve shipping financing service system.

(3) Intensify the Strategic Study to Provide the Third Party Consulting Service to the Shipping Market

Expand the influence of Shipping Exchange with focuses on index, research and forum. The publication of Inner River Shipping Development White Paper, the Yangtze River typical route freight index, guaranteed rates, market freight rates have become the signal of market trends and enhanced market leading capabilities; beef up research capabilities on the priorities, hot topics and difficulties of shipping economy to provide intelligence to the government's macro decision-making; organize Chinese Inland Shipping SME Development Forum, information
exchange on market dynamics, promote and expand the influence of inland shipping.

5.5 Suggestions on further work to be conducted in terms of inland shipping safety and security

(1) Safety-related Risk Assessment of Inner River Region, Chongqing

The waters under the jurisdiction of Chongqing Municipality features large area, complex and variable route conditions, widely distributed potential risk sources influencing the navigation safety. Accompanied by the rapid growth of transportation volume of dangerous cargo including liquefied chemicals in Inner river of Chongqing in the recent years, it is undeniable to say that navigation in Inner river faces urgent safety issues and difficulty rises to assess the potential hazards brought to life and property safety. Therefore, it is a must to give first priority to safety-related risk assessment of inner rivers of Chongqing in order to build a feasible and efficient water safety emergency response monitoring system in the area.

(2) Establishment of Emergency Response Monitoring System, Operational Mechanism and Relevant Emergency Plan

A sound safety-related emergency monitoring system is an imperative guarantee to enhance the navigation safety of inner rivers of Chongqing. Based on the status quo of city, there is a lack of infrastructure construction, operational mechanism and emergency plan and thus, a subjective evaluation should be first conducted on the current infrastructure of emergency monitoring system and relevant mechanism and the next step is to formulate infrastructure construction plan based on the evaluation results and the following implementation, study on the establishment of a smooth operational mechanism and formulation of a robust emergency plan.

(3) The Establishment of a Quick Response Emergency System

Apart from a sound emergency infrastructure system and an operational mechanism, it is also necessary to have corresponding technology and management methods to ensure fast response in an all-round manner including mechanism and hardware in the aftermath of accidents to minimize the loss. Therefore, a research should be carried out to ensure that the established mechanism enables a balanced consideration of emergency monitoring in both normal and abnormal situations and also stability, reliability and efficiency in information monitoring, acquisition and transmission. It is paramount to study and set up a water safety emergency response monitoring information system and oil spilling monitoring and data acquisition system.

(4) Strengthen the Operational Qualification Management and Credit System of Port
and Shipping Enterprises and Personnel and Beef up the Function and System of Safety Monitoring of Passenger and Hazardous Article Transportation

Chongqing has already carried out a large amount of work concerning the transportation safety supervision of passengers and hazardous articles and fruitful results have been achieved. However, the Oriental Star shipwrecking and Tianjin Aug.12 explosion accidents are the constant reminder to us that the safety management work is far from completion and steps should be further made to evaluate the regulations of passenger and dangerous cargo transport safety management and supervision needs to be further strengthened. Furthermore, the State Council and Ministry of Transport have included credit system establishment into their 13th Five-year Plan and Chongqing should respond to the call to reinforce credit system establishment and qualification management of shipping companies and personnel, which will be one of the efficient methods to elevate safe operation.

5.6 Suggestions on further work to be conducted in terms of training of inland shipping talents

(1) Construct port and navigation talents training base

To address the lack of talents of inner river shipping in the long run, it is suggested that the Chongqing Shipping Exchange takes the leading role to coordinate the current resources from academic and training institutions and set up training centers in cooperation with foreign advanced organizations to nurture shipping personnel in Chongqing to provide training service to Chongqing, Yangtze River and the country.

(2) Improve the living conditions and cultural environment of crew members

The government departments need to set up specialty funds and work plans and hold events via multiple medial to promote inner river shipping to boost the culture environment of inner river shipping and attract more young people into this industry. Additionally, with the progression of the standardization of vessel types, the government needs to adopt measures to improve the on-board working and living conditions and strengthen the efforts of the formulation of preferential policies to lift the salary and welfare for crew members.

(3) Systematic study on the training, employment and salary of inner river crew

Difficulties faced by the talent development of inner river shipping are not restricted by one specific factor, instead is closely associated with the current global shipping dynamics, national economic development environment, industrial transport capacity structure and governmental qualification approval and supervision. Therefore, a sustainable measure is needed to carry out
systematic research on the discovery of troubles faced by the crew.

(4) Study on the psychological health assessment of inner river crew

The psychological wellness of crew members from inner rivers exerts remarkable influence on the shipping safety, but research on this area remains blank in China. It is suggested to carry out the front research on the psychological health evaluation of inner river crew and pave the foundation for the promotion of this practice from Chongqing to the whole nation by borrowing experiences from other industries and study and formulate assessment indicator system and evaluation mechanism.

5.7 Suggestions on further work to be conducted in terms of environmental protection of inland waterway transport in Chongqing

(1) Policy study of the development of new energy green vessels

As China tightens up its control on emission of ships, research on new energy green vessels has witnessed an increasing urgency and a growing daily demand. The MOT has drawn up supporting polices of LNG-powered inner river ships and is encouraging local governments to come up with corresponding measures. It is suggested that Chongqing should promote its local policies to support the development of new energy green vessels including LNG-powered ones.

(2) Study on pollution control of vessels and ports in Chongqing

The MOT issued designated action plans on pollution control of vessels and ports prior to 2020 in August, 2015, which clearly stipulates the action targets and requirements for each indicator. As a major player of inner river shipping, Chongqing shall study and formulate goals and specific tasks for contamination control of vessels and ports in the city in an active and targeted manner and provide concrete suggestions on the feasibility of the tasks.

(3) Study on waste recycle and treatment system of inner river vessels

Be it MOT or Chongqing side, laws and regulations regarding waste recycle and disposal system of inner river vessels is complete, but the deployment of needed infrastructure, supporting monitoring measurements and enforcement are falling short, resulting in poor execution effects. It is suggested to carry out study on the waste recycle system of vessels, including infrastructure distribution, long term operational mechanism and supporting policies.

(4) Study on the capacity building of water pollution accident emergency response

With the rapid growth of shipping volume of liquefied chemicals and the intensified attention of the society on pollution accidents, the potential threat caused by oil spills or
chemical pollution due to vessel accidents has become increasingly severe. The exiting emergency rescue facilities, equipment and staff provision fail to accommodate the new safety requirements, as a result of which it is urgent to conduct research on capacity building to improve water pollution emergency response.

5.8 Suggestions on learning from international experience to promote the development of inland waterway transport in Chongqing

5.8.1 Overview

The four outputs which are produced in the study contain the overview, analysis and recommendations of the freight market, the infrastructure and management plan, the fleet and organization, and the shipping exchange. In order to present a sound, sustainable and future proof strategy for restructuring inland waterway transport and multimodal logistics in Chongqing, policy notes have been drafted.

The policy notes present a number of key issues in addition to the other outputs, and describe the developments in the Chinese IWT system as a whole and the international situation. By doing so the best practices are taken into account in drafting the strategy plan, and at the same time provide the basis for discussion to further strengthen IWT development and multimodal transport policies and present a plan for further research and capacity building that could be implemented under a future ADB financed loan or TA project.

During the project, the study tour to Western Europe has been carried out, and the visits and meetings that have taken place have provided additional insights which are now included in the strategy plan and the recommendations for further work. Originally the policy notes focused at three areas: the safety and security needs in IWT; the energy saving and environmental protection; and human resource development in IWT. These issues are considered to be the main areas where substantial improvements in the IWT system in China as a whole and in Chongqing in particular are needed to really realize a sustainable and future proof system.

Following the recent developments in China and the study tour, the topic of multimodal connectivity was added to the policy notes output. Developments of logistics corridors and improved multimodal connections and services have become priorities in China for the coming years. The regions visited in Europe are good examples of how integrated multimodal zones can be developed, combining industrial and economic planning with seamless multimodal connections in corridor concepts.
5.8.2 Safety and security needs in IWT

Although IWT is generally considered to be the safest mode of transport, the analysis has shown that many improvements are still possible and needed to further improve the situation in IWT, both in the ports and terminals as well as related to the vessels. Problems identified have to do with the risks of handling and transporting dangerous cargoes, spills, lack of qualifications in the companies and crews, and missing emergency response systems, so that in case of unforeseen events proper measures can be taken to minimize the losses. Part of the improvements relate to the other two elements in the policy notes, namely the human factor and the environmental conservation, and will be addressed there as well.

A good information system can supply the basic data on types of cargoes being transport, number of crew members on board, so that accurate measures can be taken in case of unforeseen events. Trained crew, being able to deal with smaller and basic situations is a prerequisite, and so is the basic equipment on board of the vessels and in ports and terminals, but at the same time a safety and emergency response system has to be in place to deal with large incidents. In this field the situation in China needs improvements. The international best practices illustrate which kind of systems are in place in other countries and how they will lead to an improvement situation, and provide higher and acceptable safety and security risks.

In order to improve the safety and security in IWT in Chongqing, further research is needed in order to determine the best possible solutions in the specific situation. The main priorities are:

- a study to evaluate the risks in ports, terminals and vessels;
- construction of an emergency response system, based on risk analysis, and aimed at minimum losses in case of incidents;
- qualification of enterprises and crews;
- an information system (RIS – River Information Services) providing reliable and accurate information on vessels, cargoes and crews.

5.8.3 Energy saving and environmental protection

This aspect is of course strongly related to the previous topic, where it concerns minimizing the spills and losses due to incidents. Again, like in safety and security, IWT is generally considered to be the cleanest mode of transport. On the whole and looking at emission factors per ton of cargo transported and energy use, this is true, all studies in the field point to that, but many improvements are possible and needed. In IWT, diesel fuel is used containing sulphur, engines are running when vessels are in terminals and ports where shore power could be used, waste is not properly collected and treated, only to name a few areas for improvement. Again the
international best practices show examples on what can be done to improve the situation, for example in field of proper waste collection facilities and schemes, education of crews and workers, and greening the fleet. An important additional element gaining ground in other countries is the changing philosophies with regards the sustainable and integrated development of waterways. In China the deepening of the waterways by means of dredging and creating physical structures such as dams and locks is the main method for improving the navigation conditions. The concept of “working with Nature” where waterways as much as possible are kept in their natural position and solutions are found in the logistic field are gaining ground in other waterway countries.

Much attention is given in China to the development of clean vessels, notably by moving from diesel fuel to LNG, where emission factors are much lower. However, Chongqing is lagging behind in this development. LNG at present is seen as the main technology for greening the inland fleet, and as such also Chongqing also needs to be connected to this development and conditions have to be in place for allowing and promoting this change.

Although legislation is in place for the collection of waste related to IWT (ship generated waste (oil, bilge water, rags, filters, engine coolant and contaminated packing materials), cargo-related waste (residues, slobs, washing water, ballast water), other waste such as garbage, plastics, wood (non-dangerous) and sanitary waste water. The current practice however is that collection and treatment facilities for IWT waste are missing.

The following points are identified as important elements for future study and implementation:

• the change to clean and green vessels, notably by moving to LNG as fuel;

• control of pollution related to terminal activities;

• lay out of a waste collection and recycling scheme related to terminals and vessels;

• emergency response plans for water pollution (spills) in ports;

• study to determine the possibility of alternatives for dredging.

5.8.4 Human resource development in IWT

In general the situation of the workers and crews in the IWT industry in China is perceived as very poor. Under the pressure of the sluggish shipping market and poor business performance, the income level of shipping personnel especially crew members lags far behind that of other sectors, lacking comparative advantages, and leading to a bad working and living conditions of crews. The well trained and educated crew members and staff leave the IWT sector and move to other more promising sectors of the shipping industry, further deteriorating the sector. The
entrance threshold of inland waterway market is low. A large number of crew with low-level education can get posts after receiving simple training, so the salary that vessel companies can offer to low-level crew is limited.

The universities and colleges in Chongqing that are qualified for shipping professional education, only enroll 840 people in 2013, failing to meet the needs of the IWT enterprises. Moreover, the number of those who worked in shipping industry after graduation accounts for less than 1/3 of the total, highlighting the difficulties of the shipping enterprises in attracting qualified crew members. Poor working environment, low income and social status lead to high turnover of crew.

Where at the same time crew requirements are increasing, due to the increasing number of new technologies is being adopted in Inland River shipping to ensure the safety of navigation. The widespread use of technologies like VTS, AIS and GPS are demanding higher technical qualification for the crew. Along with the state requirements for the elimination of old ships, construction of standardized ships and gradual application of LNG ships, the current crew qualification is lagging behind the needs of technological development. The growth of dangerous cargo transports and the increasing safety requirements, further increase the need for better trained crews.

In the EU the Platina project has identified “jobs and skills” as one of the priority areas for the future, as issues identified in China also are present there, and supporting programs for the industry have been developed.

The following points are earmarked as priorities:

• setting up a training base specifically for the IWT sector;
• improvement of the working and living environment of the crews;
• set up a program to keep people in the industry.

Multimodal logistics and transport corridors

Chongqing has good multimodal connections, e.g. the location along the Yangtze River, the highway network, as well as the rail connections in all directions, including the railway land bridge to Western Europe. However, the direct links between the modes are limited both from physical viewpoint, but more important from service point of view. In general in China, Chongqing is no exception to that, water-rail linkages are not well developed and for that reason NDRC is strongly promoting studies in this field that can improve the situation.

An important element to take into account is the link between the multimodal facilities and the location of economic zones and industrial areas. Logistic and economic zones more and more
are connected through multimodal transport corridors which are planned, and developed from in an integrated manner, and with governance over the corridor. Inland ports and extended gates are important elements in this new development, by functioning as facilitator for multimodal connections and as platform for the region. There are several good examples on how this development was taken up in other countries, and the study tour included several of these regions. In and outside the EU multimodal transport corridors are developed, where new governance models are being applied.

For Chongqing, the challenge is to create multimodal connections, not only by creating railway links into water terminals, but by setting up multimodal services in a corridor perspective. This is a relatively new issue for China, and the conditions in Chongqing are such that it could serve as an example region for China. In the recommendations for further study, a project in this field has been included:

- identification of multimodal zones in Chongqing area and study of the possibilities to set up real multimodal services with close connections to industry and logistic companies.

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6. The proposed projects for ADB

6.1 Investment project

6.1.1 Infrastructure construction

1. Jinkou Navigation Hub

Jinkou Navigation Hub is the first level of the channelized cascading development from the upper reaches to the lower reaches on the Jialing River. It is a comprehensive project mainly focusing on navigation and power generation, combining with irrigation, water supply and tourism. The hub is 21 km away from Chaotianmen, 65 km away from the urban area of Hechuan District and 47 km down the lower reaches of the Caojie Hub. According to the Special Research Report on the Development Plan of Jinkou Hub on the Jialing River compiled by the Yangtze River Survey, Planning, Design and Research Co., Ltd, the static investment of the project is about RMB
7 billion.

The implementation of this project is of great significance: The implementation of this project can firstly notably improve the shipping conditions of the 38.5 km-long channels on the Caojie-Jinkou section of the Jialing River, significantly improve the grade of shipping channels, the depth of channels throughout the section can basically satisfy the depth requirements of Grade-III channels, and also greatly improve the navigable guarantee rate and shipping basically will not suspend even in dry season; it will fully connect the waterway transport channels from Chongqing to Guang’an, Suining and Nanchong in Sichuan Province; secondly, it can improve the landscape in the reservoir area and particularly in Beibei District, raise the quality of the city and lift the value of Chongqing. Thirdly, it can adjust the ratio between hydropower and thermal power in Chongqing, relieve the shortage of electricity supply in Chongqing, particularly the development of Chongqing Liangjiang New Area which consumes a huge amount of power and suffers an extreme shortage of electricity supply; so the newly-generated volume of power will play an important role in developing the national economy of Chongqing and facilitating fundamental industries. Fourthly, it complies with the National industrial policies. Waterway transport and hydropower are both industries encouraged by the State. With the up-going energy prices, the advantages of waterway transport will be further highlighted; hydropower is a clean energy, while the increased electricity price is an irreversible trend, hydropower also holds great significance to energy conservation and emission reduction.
2. Xinsheng Terminal in Zhongxian County and Guang’an-Zhongxian-Qianjiang Railway project

Xinsheng Terminal is located in Xinsheng Town, Zhongxian County, Chongqing. It is one of the key terminals planned under the concept of “four hubs and nine key terminals”, with fourteen planned 5000-tonnage cargo berths and a total investment of RMB 6.4 billion.
Guang’an-Zhongxian-Qianjiang Railway is a newly-added connecting line between the Lanzhou-Chongqing Railway and Chongqing-Huaihua Railway, and it passes by 8 districts (counties) and cities including Huaying, Lingshui, Dianjiang, Zhongxian County, Fengdu, Shizhu, Pengshui and Qianjiang. The railway is 300km long, and 230km of the total mileage is located within the jurisdiction of Chongqing including 63km within the jurisdiction of Zhongxian County. There are 23 stations along the whole line (including 2 track connection stations), and among the 23 stations, 21 of them are newly-built and the remaining 2 are transformed from old ones (Gaoxing Station and Qianjiang Station). The total investment of the project is RMB 14.3 billion. The newly-built branch line connecting to the terminal is about 15km long with a total estimated investment of RMB 1 billion.

The strategic significance of the “Xinsheng Terminal and Guang’an-Zhongxian-Qianjiang Railway” project: it will build the second starting point of the Chongqing-Xinjiang-Europe Railway and reinforce the strategic support to the Silk Road. The project takes Xinsheng Terminal of Chongxian County as the hub node, plans to construct a railway from Guang’an to Qianjiang via Zhongxian County, which connects with the branch line of Lanzhou-Chongqing Railway in Guang’an and further connects to the existing Langzhou-Chongqing Railway in Nanchong, so as to integrate with the Silk Road Economic Belt and enable cargos transported
from the middle and lower reaches of the Yangtze River via waterway to be transferred to railway and directly connect to Chongqing-Xinjiang-Europe Railway via terminals, forming up the second starting point of Chongqing-Xinjiang-Europe Railway which is the best choice for cargo transport on the middle and lower reaches of the Yangtze River. Based on the waterway-railway multimodal transport framework formed up by Xinsheng Terminal of Zhongxian County, a “Y-shaped” channel and node is actually added in the hinterlands of the Three Gorges reservoir area that connects the Yangtze River Economic Belt, the Silk Road Economic Belt and the Maritime Silk Road, making it of great significance to support and promote Chongqing’s active participation in the three major national strategies.

3. Fuling Longtou Port Waterway-railway Multimodal Logistics Center

Fuling Longtou Port Waterway-railway Multimodal Logistics Center is located in Fuling District of Chongqing. It is planned with 13 arriving and dispatching railway lines (including the main track), freight yard is in a transversal layout, and from inside to outside are successively bulk cargo operating area, container operating area as well as large, long and heavy freight operating area. The Chongqing terminal station is equipped with an operating area for cargos which must be kept dry, and 1 designated line in Baishiyi for supplying oil to the airport as well as a separate line connecting to the terminal operation area for loading and unloading containers so as to realize the seamless connection of waterway-railway multimodal transport for container cargos. According to the Demonstration Plan of Fuling Longtou Port Waterway-railway Multimodal Logistics Center compiled by China Railway Eryuan Engineering Group CO. LTD, the total investment of this project is roughly RMB 3 billion.

Fuling Longtou Port Waterway-railway Multimodal Logistics Center is a cargo transit hub on the upper reaches of the Yangtze River, in the Wujiang River basin and West China; it is a cargo exchange node between the logistic hubs in Chongqing and northeast Chongqing with southwest Chongqing areas; it is also a gateway for multimodal logistics hub and exchange with the outside for Fuling District. Relying on the sound waterway transport conditions of Longtou Port operating area, it is suggested to consolidate multiple transportation modes including railway, highway and waterway, conduct transit-through transport, distribution and delivery logistics service for regional commodities and cargos, relying on Chongqing-Huaihua Railway, Nanchuan-Fuling Railway as well as the highway along the Yangtze River, Changshou-Fuling Highway and Nanchuan-Fuling Highway, etc., radiate into Fuling District, southwest Chongqing, northern Guizhou and southeast Sichuan Province, vigorously develop the traffic of large commodities including coal, phosphate ore and cargos suitable for container transport; meanwhile relying on the sound local industrial foundation, strive to develop the storage, processing, delivery and logistics business of steel, construction material, grain and agricultural byproducts, etc.
The construction of this project is firstly out of the requirement of constructing an integrated transportation system along the Yangtze River to support the development of the Yangtze River Economic Belt; secondly out of the requirement of getting through the logistic passage in eastern Chongqing, implementing the Five Major Functioning Areas Strategy and supporting the function of Fuling District as a strategic node; thirdly out of the need of accelerating building up the integrated three-dimensional and interconnected transportation system in Fuling District which combines railway-highway-waterway all together, smoothens internal transportation network and connects with the outside regions; fifthly out of the need of satisfying the demand for freight transportation in Fuling District and supporting the local industrial and economic development; and sixthly out of the need of completing the freight layout in Fuling region and relieve the pressure on regional railway freight yard.

4. Railway Distribution and Transportation project at Xintian Operating Area

The railway distribution and transportation project at Xintian Operating Area is located in Wanzhou District of Chongqing, and the railway route is about 17.6 km. According to the document of *Xintian Operating Area Railway Distribution and Transportation Project* compiled by China Railway Eryuan Engineering Group CO. LTD, the total investment of this project is roughly RMB 1.8 billion.

Xintian Operating Area Railway Distribution and Transportation Project will shoulder the cargo transportation and transition in Wanzhou and its peripheral regions, and it is a railway-highway-waterway multimodal logistics platform planned by Chongqing Municipality and serves as a hub node that connects east with west and links north and south. Its radiation area encompasses the northeast Chongqing region centering on Wanzhou, eastern Sichuan Province including Nanchong, Dazhou and Bazhong, northwest China centering on Lanzhou and Xi’an as
well as part of western Hubei Province.

The construction of his project will satisfy the need of building up an integrated transportation system along the Yangtze River to support the development of the Yangtze River Economic Belt; it is out of the requirement of speeding up building integrated three-dimensional and interconnected transportation system in Chongqing Municipality which combines railway-highway-waterway all together, smoothens internal transportation network and connect with the outside regions; and it is out of the need of satisfying the freight transportation demand in Wanzhou District and supporting the local industrial and economic development.

6.1.2 Construction of supporting and guarantee system

1. Inland comprehensive information service system of Chongqing

In 2011, the Chongqing Port and Navigation EDI Center maintained by the former Chongqing Port Logistics Group was transferred to Chongqing Shipping Exchange under the guidance of Chongqing Municipal Government, and thus it converted from an enterprise data exchange platform into a public inland waterway transport data exchange platform. On the basis of the EDI, through function upgrade, the exchange and sharing of information among port transportation participants such as terminals, vessel companies (vessel agencies), tallying companies and customs brokers as well as among regulatory bodies including the Customs and inspection and quarantine departments, and it has also exchanged data with Shanghai electronic port information service platform, which has laid a foundation for building whole-course logistics or containers.
In order to further promote the construction of an integrated logistics system in Chongqing and learn from the experience of RIS system development in Europe, it is very necessary to set up the integrated inland information service system based on the existing foundation and consolidate the existing vessel monitoring system, data exchange platform, shipping transaction and vessel transaction platform, etc., to dynamically exchange and share the information about cargo, shipping forces and market price among different participating institutions and different transportation modes, so as to provide a whole course integrated logistics service for clients.

2. Inland shipping talents training center

With the deepening of the opening up and reform policy, China has achieved high-speed economic development, and the salary levels across industries have been improved considerably. However, the inland waterway transport industry which once provided relatively high salary levels has now gradually lost its competitive advantages, resulting in a large number of senior crew flowing to coastal and ocean shipping industry; while at the same time, the posts of low level crew can hardly attract young people, and consequently the inland waterway transport industry is more and more faced with shortage of talents and it is increasingly difficult or enterprises to recruit staff. In addition, the capability of inland waterway transport industry in terms of professional education and training is developing slowly and lagging far behind the industry’s demand for talents. Moreover, with the gradual application of modern technologies in inland waterway transport industry, a large number of current inland crew can hardly effectively operate the existing technological equipment due to their limited education degree.

In order to solve the shortage of inland shipping talents from a long-term perspective, it is suggested to conduct a research project on building a training center for inland waterway transport talents. It may consider the Chongqing Shipping Exchange as the leading unit for implementation, consolidate the existing resources of colleges and training institutions, and cooperate with foreign advanced institutions to jointly build the shipping talents training base in Chongqing, so as to provide corresponding training services for inland transportation in Chongqing, on the Yangtze River and even the whole China; but it needs in-depth research to put forward some key issues that need to be solved in order to build the training center, for example, the long-term development goals of the training center, the contents and method of training, institutions available for cooperation, the composition of human resource and material resources equipped for the operation of the entity as well as operating mode and profitability, etc.

6.2 The TA projects

1. An innovative solution plan for the sustainable development of the Jialing River

The projects proposed for implementation contain a number of navigation hubs and channel
improvement projects; this is in line with common practice in China and many other countries. The concept of “working with Nature” where waterways as much as possible are kept in their natural position and solutions are found in the logistic field are gaining ground in other waterway countries.

It is proposed to carry out a study to look at the possibilities of applying logistic solutions, e.g. shallow draft vessels in combination with smart transfers, as an alternative for further dredging.

The Jialing River is the ultimate waterway to involve here. For many years, due to the construction of the channelized hub, only partial sections of the waterway have been under operation. Based on the concept of “working with nature”, it will hold great significance to study and put forward an innovative plan for solving the navigation problem on Jiangling River.

2. Policy measures on attracting freight flows for inland waterway transport and multimodal logistics

Inland waterways transport is still limited to specific cargo types and shippers. Many shippers are not aware of the benefits that IWT can offer to their supply chains, and active support is needed to move these shippers and cargoes to the waterways. Learning from the practice of Europe, Chongqing needs to formulate an action plan to facilitate feasible policy measures attracting cargos to waterways, such as inviting a logistics consultant to assist companies to implement inland waterway transport, providing supportive measures for new services, covering up initial losses, providing preferential loans or guarantee system.

Meanwhile, it is suggested to learn from the experience of developed countries and combine the local characteristics of Chongqing, conduct research on the construction of Chongqing comprehensive logistics center, operation and service model based on its advantages in waterway transport, put forward systematic solutions in PPP finance construction and operation and management software, etc., so as to improve the efficiency of multimodal transport and support the construction and operation of Chongqing logistics center.

3. A safety-regulation and emergency-response system based on risk analysis

Ensuring safety of inland waterway transport is an important foundation for sustainable development, while a complete waterway transport safety regulation and emergency response system is still absent in Chongqing; risk analysis is an important theoretical cornerstone of safety regulation, so conducting research on a safety-regulation system based on risk analysis is of considerable significance to strengthening safety and emergency management. The purpose of this project is to learn from the experience of developed countries, put forward a method for safety risk analysis, evaluate the shipping safety risk in Chongqing and propose a plan for a safety-regulation and emergency-response system based on risk analysis as well as related contingency plans.
4. An action plan on preventing and controlling vessels and terminals wastes in Chongqing

Pollution of terminals and vessels is an increasingly prominent problem in Chongqing, which has aroused wide concern in society. The Ministry of Transport recently published the Designated Action Plan on Preventing and Management of Terminal and Vessel Pollution and put forward related policy measures. Chongqing is a shipping center on the upper reaches of the Yangtze River, so it is necessary to study and formulate an action plan on preventing and controlling vessels and terminals wastes in Chongqing, so as to facilitate the sustainable development of inland waterway transport. This study aims at analyzing the current status and problems of pollution of terminals and vessels within this region, learn from the experience of developed countries, analyze the ways and solutions for reducing pollution emission and put forward the action plan on preventing and controlling vessels and terminals wastes in the 13th “Five-year plan” period in Chongqing.