2014
ANNUAL REPORT

2014 ANNUAL REPORT OF THE INSTITUTE OF TRANSPORTATION, MOTC

交通部運輸研究所 103年年報

中華民國103年

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INSTITUTE OF TRANSPORTATION, MOTC

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103 年年報

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所長的話

面對資通訊科技的快速進步，產業全球化分工佈局，全球氣候變遷，以及我國自由經濟示範區以及航空城等重大建設計畫即將陸續啟動，交通業務發展需以更創新、前瞻的思維進行規劃，以配合政府政策並因應外在環境變遷對運輸部門造成的衝擊與影響。

本所長期以來扮演交通部智庫的角色，協助交通部政策擬訂、統合協調運輸決策與執行計畫、支援各級運輸行政技術與研發創新，以及建立運輸產官學研溝通橋樑等。近年來除因應內外在環境的最新變化，結合創新與專業化思維，積極辦理整體運輸系統相關研究外，亦持續配合交通部重大施政方針，辦理相關研究並提供專業意見。

在本所三大研究主軸中，「支援交通部擬訂重大運輸政策」重要成果包括完成研訂「運輸政策白皮書 (2)」，賡續提出運輸安全、海運與空運政策白皮書、協助推動院頒「道路交通秩序與交通安全改進方案」、辦理「交通部門中長程各次類別計畫」年度預算之審議及個案計畫審查、協助交通部推動「公路公共運輸提昇計畫」、擬定「交通建設氣候變遷調適策略與行動方案」與「運輸部門節能減碳政策與推動策略」、進行「整體運輸規劃」與運輸策略系列研究；在「協助部屬機關及地方政府落實運輸政策」方面，本所推動執行包括執行橋梁維護管理作業評鑑、辦理「臺灣地區易肇事路段改善計畫」以及「山地原住民鄉（區）交通改善計畫」、協助臺鐵局建立列車排點之資訊化及系統化、推動「觀光遊憩區導入智慧型運輸系統計畫－ i3 Travel 愛上旅遊」、辦理「與 IMO 海運安全公約及國際海事案件處理規範調和之研究」；在「建立運輸系統技術標準與資訊平台」方面，包括提供交通服務 e 網通服務、辦理「交通部門配合推動 LED 路燈照明成本效益之研究」、辦理「混合車流情境之機車交通安全工程設計方法研究」、協助推動東部地區自行車道示範計畫並編定自行車道系統規劃參考手冊、推動及執行臺灣沿岸與進出港口智慧化領航系統以及碼頭與港灣構造物維護管理手冊等。

展望未來，本所將以更前瞻的研究與規劃，發揮業務統合協調之功能，扮演交通部智庫的使命與角色，進一步補強政策與技術需求的面向與強度，掌握內外在環境變化，積極推展相關業務，以奠立我國交通建設長遠發展之堅實基礎。

交通部運輸研究所 所長

林志明

Director's Words

Facing rapid advancements in information and communication technology, industrial globalization, global climate change, and the imminent launch of Taiwan's Free Economic Pilot Zones, Aerotropolis, and other major projects, the development of the transportation business must conduct planning with more innovative and forward-looking ways of thinking to coordinate with government policy and respond to the impact of changes in the external environment on the transportation sector.

This institute has long acted as the think tank of the Ministry of Transportation and Communications (MOTC), assisting the ministry in formulating policy, integrating and coordinating transportation strategies, executing plans, supporting administrative technology and innovative research for transportation on all levels, and establishing a bridge for communication between the transportation industry, the government, academia, and research institutions. In recent years, in addition to responding to the most recent changes in internal and external environments, integrating innovative and specialized thinking, and actively conducting research on the overall transportation system, this institute has also continued to collaborate with the MOTC in accordance with its major policy guidelines to conduct relevant research and provide professional advice.

Among the three main axes of research within this institute, major achievements in "supporting the MOTC in formulating major transportation policy" include completing the White Paper on Transportation Policy (2). The institute continues to present white papers on transportation safety, maritime, and air transportation policy, to assist in promoting the MOTC's Improvement Program for Traffic Order and Safety, to conduct reviews of the annual budget and individual case reviews for the Mid- and Long-Range Plans for Each Subcategory of the Transportation Sector, to assist the MOTC in promoting the Upgrade Plan for Highway Public Transportation, to formulate the Climate Change Adaptation Strategy and Action Plan for Transportation Construction and the Carbon Reduction Policies and Promotion Strategies for the Transportation Sector, and to conduct a series of studies on overall transportation planning and strategy. In regard to assisting subordinate agencies and local governments in implementing transportation policy, this institute has promoted the implementation of evaluations of management planning in bridge maintenance, conducted the Improvement Program for Accident-Prone Roads in Taiwan and the Improvement Program for Transportation in Aboriginal Townships (Areas), assisted the Taiwan Railways Administration in establishing information technology and systematization in rail scheduling, promoted the Program to Import Intelligent Transportation Systems Into Tourism and Recreation Areas—i3 Travel Falling in Love With Traveling, and conducted the Study on Reconciling IMO Maritime Safety Conventions and International Norms for Maritime Case Processing. In regard to establishing technical standards and information platforms for transportation systems, the institute has provided online transportation services, conducted the Study on the Cost-Effectiveness of Promoting LED Streetlights in the Transportation Sector, conducted the Study on Motorcycle Traffic Safety Engineering Design Methods for Mixed-Traffic Situations," assisted in promoting the pilot project for bike lanes in eastern Taiwan and formulating a reference manual for bike lane system planning, and promoted and implemented an intelligent navigation system for Taiwan's coasts and ports and maintenance management manuals for piers and harbor structures.

Looking toward the future, this institute will conduct more prospective research and programs to assist in business integration and coordination, fulfilling its mission and role as a think tank for the MOTC. This institute will further reinforce the orientation and intensity of policy and technical requirements, mastering internal and external environmental changes and actively promoting related business to lay a solid foundation for the long-term development of transportation construction in Taiwan.

Tyh-Ming Lin

Director-General of the Institute of Transportation, MOTC

01 Organization and Human Resources
INSTITUTE OF TRANSPORTATION, MOTC

壹 組織及人力

一、沿革

臺灣地區自政府播遷來此，經歷長年的勵精圖治，各項建設莫不欣欣向榮，經濟發展更是突飛猛進。在此期間，有關運輸部門的投資比重及其成長速度，雖亦因之與時俱增，但仍始終趕不上社會經濟快速發展及人民生活水準大幅提高的需要。因此運輸主管部門為解除擁擠、疏通瓶頸、提高容量，除當設法擴充及充分利用現有運輸設施外，更需妥善擬訂中長期運輸發展計畫，以適應未來的需求。

由於運輸方面所需要的投資甚為龐大，且在整體經濟的考量下，其可供應用的資金究屬有限，因此對於投資決策的研提及優先順序的釐定，便須由一個統一的運輸規劃機構來承擔；其次，由於運輸事業係屬公用事業，政府對其費率、加入、退出、能量等等，均有必要加以參與管理，而參與的方法是否適當、是否需加修正，亦須由一個統籌的運輸規劃機構來研究；再次，各種運輸事業彼此均具有競爭性，如何減少其相互間的競爭性而加強其輔助性，以完成最具效益的整體運輸系統，更須由一個運輸規劃機構來統籌。交通部基於上述三項考慮，乃於民國 59 年 8 月 1 日成立運輸計劃委員會專司其事。14 年中已完成諸多的運輸研究規劃工作，其舉舉大者計有：臺灣地區整體運輸規劃、高速公路交流道連絡道路系統整體規劃、臺北地區大眾運輸系統初步規劃、臺北市區鐵路改善計畫、臺北都會區大眾捷運系統計畫及高雄都會區大眾運輸系統長期發展計畫等等，皆已次第竣事。此外，該委員會並隨時配合政策需要，進行各項專案研究規劃，逐一付諸實施。

1.HISTORY

Since its relocation to Taiwan, the Central Government of the Republic of China has been actively engaged in infrastructure development. This effort has brought prosperity to Taiwan and transformed Taiwan into an economically dynamic force. However, although the investments in transportation have experienced substantial growth over the years, they lag consistently behind the overall growth of the economy and the rise in living standards. Consequently, transportation infrastructure is inadequate and traffic congestion is worsening. Therefore, government authorities have the responsibilities to develop strategies to better utilize existing transportation facilities and to prepare medium-range and long-range plans to satisfy future transportation demand.

The development of transportation infrastructure requires huge capital outlays, while available manpower and monetary resources are always limited. Under the circumstances, there is a need to charge a single transportation planning agency with the responsibilities of setting priorities and programming for investment. Furthermore, transportation services are mainly regarded as public utilities and, as such, are subject to government regulations in connection with fare structure, capacity, formation and dissolution of firms, etc. To ensure that regulations are stipulated and implemented to the best interest of the nation, there is also a need for a single transportation planning agency to review existing and pending regulations for possible revisions. Finally, transportation services can complement each other but they can also be entangled in a counterproductive struggle to serve the same sector of market. In order to develop an efficient, integrated transportation system, it is imperative that a planning agency be dedicated to the development and coordination of transportation services. Because of these various concerns, the Ministry of Transportation and Communications established the Transportation Planning Board on August 1, 1970. Over a period of fourteen years since its inception, the Transportation Planning Board had completed a number of planning projects. Notable examples of such projects include: Taiwan Area Integrated Transportation Systems Planning Study; Plan for Integration of Freeway Interchanges and Connecting Highway Systems; Preliminary Plan of Taipei Area Public Transportation Systems; Taipei City Area Railway Improvement Plan; Plan of Taipei Metropolitan Area MRT System; and Long-range Development Plan of Kaohsiung Metropolitan Area Public Transportation System. In addition, the Transportation Planning Board was also instrumental in conducting studies to assist the government in the formulation and implementation of policy decisions.

運輸計劃委員會係屬臨時編制單位，在行政運作上，在在受到經費及人力運用上的限制，委實無法因應日益遽增的運輸研究規劃業務。嗣乃奉令於民國 74 年元月 5 日，與原負責一般交通學術研究、交通幹部訓練、戰備器材管理運用及大陸交通資料蒐集研判等業務的交通研究所，合併改制為運輸研究所，成為政府常設機關，藉以健全編制，擴大規模，從而將經費與人力的運用納入常軌。

民國 80 年元月 30 日，因業務大幅增加，奉准修改組織條例，增置副所長 1 人，並增設綜合技術組及加強中級研究規劃人力，以資因應。民國 88 年 7 月 1 日，因臺灣省政府功能業務與組織調整，原臺灣省政府交通處港灣技術研究所改隸本所，更名為港灣技術研究中心。民國 90 年 8 月 1 日，本所組織條例修正案，奉行政院核定施行，港灣技術研究中心與本所整併，並為本所之派出單位。

二、組織及人力

本所設運輸計畫、運輸工程、運輸經營管理、運輸安全、運輸資訊、綜合技術 6 個組與港灣技術研究中心等計 7 個業務單位，及秘書室、人事室、會計室等部門。

依照本所組織條例，編制員額計 177 人，預算員額 135 人。另約聘人員 5 人，技工及工友 33 人。

The Transportation Planning Board, however, was a provisional organization; it had very limited funding and manpower to tackle the increasingly complex transportation problems. Therefore, the Institute of Transportation was created on January 5, 1985 by merging the Transportation Planning Board with the former Institute of Traffic Research, which had the mandate to conduct traffic research and personnel training, manage battlefield equipment and supplies, and collect intelligence on Mainland China. Being a formal branch of the government, the Institute of Transportation is funded through a normal budgeting process.

Because of the increased demand for its services, the organizational structure of the Institute was expanded, on January 30, 1991, by adding a Deputy Director-General, an Interdisciplinary Research Division, and intermediate-level planners. And since July 1, 1999, due to the adjustment of government functions, the Institute of Harbor and Marine Technology has become affiliated to the Institute of Transportation and renamed as Center of Harbor and Marine Technology. It was originally affiliated to the Department of Transportation of the Taiwan Provincial Government. As part of the entire government agency reorganization, the Institute of Transportation's organization adjustment has been approved by the Execute Yuan, and since August 1, 2001 the organization level of the Center of Harbor and Marine Technology has again been adjusted. According to the new arrangement, the Center is incorporated with the Institute of Transportation and becomes a supporting unit.

2.ORGANIZATION AND HUMAN RESOURCES

The Institute of Transportation comprises seven divisions and a Secretariat, a Personnel Office, and an Accounting Office. The seven divisions include Planning, Engineering, Operations and Management, Safety, Information Systems, Interdisciplinary Research and the Harbor and Marine Technology Center.

According to the organization act of IOT, the total authorized staff is 177 and the budgetary staff is 135. In addition, there are 5 contracted research employees and 33 technicians and office workers.

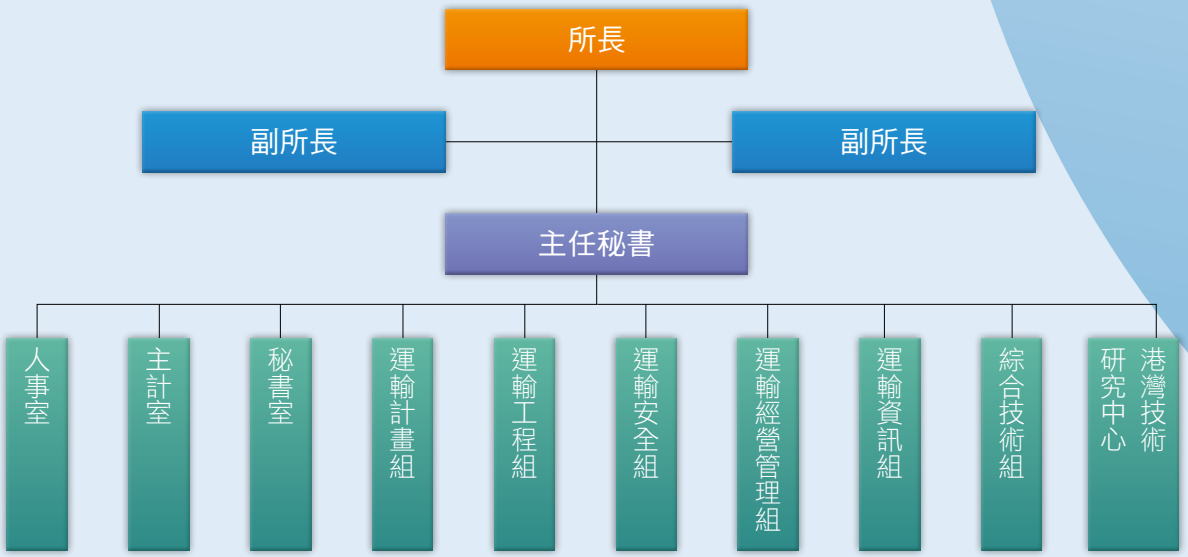
三、本所職掌

依據本所組織條例第二條規定，本所掌理下列事項：

1. 運輸政策之研究及建議事項。
2. 運輸系統規劃配合及運輸計畫之研擬、評估事項。
3. 運輸發展與政治、經濟、國防及社會關係之研究與配合事項。
4. 運輸工程之設計、研究及發展事項。
5. 運輸經營及管理效率之研究發展事項。
6. 運輸安全之研究及規劃事項。
7. 運輸研究成果之應用及指導事項。
8. 國內外運輸研究之聯繫及合作事項。
9. 運輸資料之蒐集、整理、編譯及提供事項。
10. 港灣技術之研究及建議事項。
11. 其他運輸研究事項。

四、組織架構

本所組織架構如下：



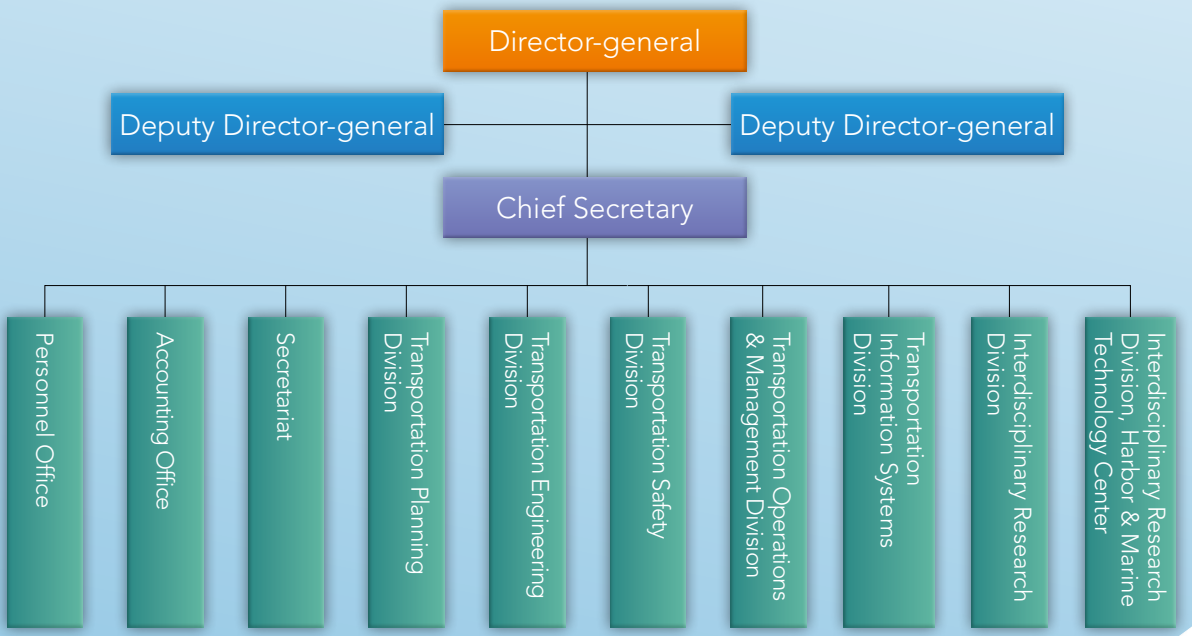
3.FUNCTIONS

According to Article 2 of the organization act of IOT, the missions of IOT are as follows:

1. Studying transportation policies and providing suggestions;
2. Coordinating planning, evaluation and project programming of transportation systems;
3. Studying the interrelationships among transportation development, political functions, socio-economic activities, and national defense;
4. Designing, researching and developing transportation engineering systems;
5. Studying the efficiency of transportation systems operation and management;
6. Studying and planning of transportation safety;
7. Applications of transportation research findings and guidance;
8. Liaison and cooperation of local and foreign transportation research;
9. Collection, compilation, translation and dissemination of transportation information;
10. Studying harbor and marine technologies and providing suggestions;
11. Other matters related to transportation research.

4. ORGANIZATION FRAMEWORK

The organizational structure of this institute is as follows:



02 Annual Policy Fact Sheet
INSTITUTE OF TRANSPORTATION, MOTC

貳 年度施政概況介紹

以下分別從運輸系統研究規劃、運輸工程研究發展、運輸安全研究發展、運輸經營管理研究發展、運輸資料蒐集與資訊應用之研發推動、綜合技術研究發展以及港灣技術研究發展等 7 大項重要業務，概略說明本所 103 年施政計畫之實施狀況。

一、運輸系統研究規劃

- 大客車動態能源消耗與溫室氣體排放參數資料庫擴充與模式檢討
- 103 年度中長程計畫審議決策支援系統與整合資料庫維護
- 第 5 期整體運輸規劃研究系列 - 城際旅次特性調查與初步分析
- 單線連續區段軌道容量模式分析暨整體容量軟體改版研究 (1/2)
- 公路坡度路段模擬模式之發展及應用 (2/3)
- 臺灣公路容量分析與軟體 (THCS) 維護計畫 (2/2)
- 雙車道公路路口等交通特性調查
- 103 年度臺灣地區橋梁管理資訊系統
- 第二代臺灣地區橋梁管理資訊系統建置規劃 (二)
- 橋梁檢測作業效率提升計畫
- 交通設施影像資料建置示範計畫
- 北部區域整體交通系統改善方案
- 中部區域整體交通系統改善方案
- 南部區域整體交通系統改善方案
- 自行車事務之行政法制規範原則探討
- 高鐵營運對西部城際運輸市場消長之觀察 (96-102 年)
- 交通海量資料分析先期探討

The section below briefly describes the implementation status of this institute's 2014 policy programs in seven critical areas: transportation systems planning, research and development in transportation engineering, research and development in transportation security, research and development in transportation operations and management, research, development, and promotion in transportation data collection and information application, research and development in integrated technology, and research and development in harbor technology.

1. Transportation Systems Planning

- Review and improvement of model for energy consumption and greenhouse gas (GHG) emissions for buses by using an enlarged database
- Plans to enhance the decision support system and integrated database for transportation infrastructure deliberations (2014)
- The 5th overall transportation planning research series - intercity trip characteristic survey and preliminary analysis
- Development of capacity model for continuous single-track sections and update of rail capacity software (1/2)
- Development and applications of a model for simulation of traffic on highway grade segments (2/3)
- The plan for maintaining Taiwan Highway Capacity Analysis Software (2/2)
- The survey of intersection traffic characteristics on two-lane highways
- 2014 Taiwan bridge management information systems
- Planning and implementation of the second generation of Taiwan bridge management information system (II)
- Bridge inspection and operating efficiency improvement plan
- Demonstration project for the establishment of image data for transport facilities
- Overall transportation system improvement plan for northern region
- Overall transportation system improvement plan for central region
- Overall transportation system improvement plan for southern region
- The legislative principles of administration law for bicycles
- The market share changes of intercity public transportation after HSR in operation (2007-2013)
- A preliminary study of big data analysis on traffic

二、運輸工程研究發展

- 「國際海運資料庫」建置管理及資料分析服務
- 國籍航空公司競合問題之研究
- 「國際空運資料庫」維護管理及分析服務

三、運輸安全研究發展

- 辦理「道路交通安全改善方案之發展與評估方法之研究」研究計畫
- 辦理「大客車節能且安全駕駛行為推廣機制」研究計畫
- 辦理「汽機車安全駕駛教育訓練平台整合及維護－機車風險感知學習素材及應用」研究計畫
- 辦理「混合車流情境之機車交通安全工程設計方法研究與驗證」研究計畫
- 辦理「風險式與自主式鐵路安全管理制度之實務調查與分析」研究計畫
- 辦理「第 32 期臺灣地區易肇事路段改善計畫」
- 辦理「103 年春節疏運計畫績效檢討」暨「104 年春節疏運計畫」
- 辦理 103 年交通部「金路獎」用路人資訊類複評作業
- 辦理「弱勢用路人交通安全行動方案之研訂」研究計畫
- 辦理「高齡駕駛與安全管理課題研究」研究計畫
- 辦理「臺灣花東地區鐵路電氣化潛在危害分析與其防治對策」研究計畫
- 辦理「易肇事路段改善分析技術之應用」研究計畫
- 建置「美好生活的連結：愛的關懷 - 無障礙設施經驗分享」網站系統
- 辦理「高齡者之駕駛模擬儀學習效果與作業負荷」研究計畫

2. Research and Development in Transportation Engineering

- Establishment, management, and data analysis services for the International Maritime Database
- Study on concurrence in national airlines
- Maintenance management and analysis services for the International Air Transport Database

3. Research and Development in Transportation Security

- Conducting the Study on the Development of and Assessment Methods for Road Traffic Safety Improvement Programs
- Conducting the research project Promotion Mechanisms for Energy Efficiency and Safe Driving Behavior in Buses
- Conducting the research project The Integration and Maintenance of a Motor Vehicle Driving Safety Platform—Motorcycle Risk Perception Learning Materials and Applications
- Conducting Study and Validation of Traffic Safety Engineering Design Methods for Motorcycles in Mixed-Traffic Situations
- Conducting the research project Practical Investigation and Analysis of Risk-Type and Autonomous Railway Safety Management Systems
- Conducting the 32nd Improvement Plan for Accident-Prone Roads in Taiwan
- Conducting the Performance Review for the 2014 Chinese New Year Distribution Plan and the 2015 Chinese New Year Distribution Plan
- Re-evaluating road user information categories for the 2014 MOTC Golden Road Award
- Conducting the Study on and Formulation of Traffic Safety Action Programs for Vulnerable Road Users
- Conducting the Study on Elderly Drivers and Safety Management
- Conducting the research project Potential Hazard Analysis and Countermeasures for Railway Electrification in Taiwan's Hualien and Taitung Regions
- Conducting the research project Application of Analytical Techniques for the Improvement of Accident-Prone Roads
- Establishing the website system Links to a Better Life: Loving Care—Accessibility Experience Sharing
- Conducting the research project The Learning Effectiveness and Workload of Driving Simulators for the Elderly

四、運輸經營管理研究發展

- 辦理「軌道運輸系統營運統計資料與績效評量指標整合規劃」研究計畫
- 辦理「公路公共運輸電動客車經營與運作績效調查」研究計畫
- 辦理「建立我國常態貨物流向統計與物流競爭力分析機制」研究計畫
- 辦理「國家區域公共運輸服務指標調查示範計畫 (2/2) 」研究計畫
- 辦理「先進公共運輸系統整合資料庫加值應用系統維運及推廣計畫」研究計畫
- 辦理「中央推動公路公共運輸永續發展之財務機制研議」研究計畫
- 辦理「計程車新式計費表規範與實施規劃」研究計畫

五、運輸資料蒐集與資訊應用之研發推動

- 辦理「i3 Travel 愛上旅遊－低碳智慧觀光複合運輸服務示範計畫」
- 辦理「創新交通科技研發成果之智財權研究與知識分享」
- 辦理「103 年度參與 APEC 運輸部門相關國際事務與資訊管理」
- 辦理「近完全資訊下運輸建設導入市場經濟機制之分析」
- 辦理「我國智慧型運輸系統之車路整合應用發展探討」
- 辦理「103 年度 APEC 運輸領域重點議題發展觀察分析」
- 辦理「公共運輸資訊服務整體規劃」

4. Research and Development in Transportation Operations and Management

- Conduct the "Integrating the Statistical Data and Performance Index of Railway Systems" Project.
- Conduct the "The Survey for Management and Performance of Electric Bus" Project.
- Conduct the "Developing the Mechanisms for Analyzing Statistics of General Goods Flow and Logistics Competitiveness" Project.
- Conduct the "Taiwan's Regional Public Transportation Service Indicators Survey and Demo P Project (2/2)"
- Conduct the "The Maintenance, Operation and Promotion Plan of the APTS Value-Added Application System with an Integrated Database" Project.
- Conduct the "The Proposal of The Financial Mechanism for The Central Government to Implement The Sustainable Development of Highway Public Transportation" Project.
- Conduct the "The project of Implementing Next Generation Taximeter"

5. Research, Development, and Promotion in Transportation Data Collection and Information Application

- Conducting i3 Travel Falling in Love With Traveling—Pilot Project for Compound Transportation Services for Low-Carbon Smart Tourism
- Conducting Intellectual Property Research and Knowledge Sharing for Innovative Research and Development Results in Transportation Technology
- Conducting Related Affairs and Information Management for the 2014 Participation of the Transport Sector in APEC
- Conducting An Analysis of Economic Mechanisms for Introducing Transportation Infrastructure into the Market With Nearly Complete Information
- Conducting An Investigation Into Carriageway Integration and Application for Intelligent Transportation Systems in Taiwan
- Conducting Development, Observation, and Analysis of 2014 APEC Key Issues in the Transportation Sector
- Conducting Overall Planning for Information Services for Public Transportation

六、綜合技術研究發展

- 辦理「運輸部門因應氣候變遷政策決策支援系統之應用」研究計畫
- 辦理「我國運輸部門運具別能耗與溫室氣體排放推估與作業手冊」
- 辦理「省道丘陵區 LED 路燈測試計畫與成本效益分析」
- 辦理「我國公路貨運服務申請碳足跡標示之課題研析」
- 辦理「交通部綠運輸節能減碳成果及未來推動方向之研究」
- 辦理「智慧型運輸系統節能減碳與成本效益評估工具暨資料庫之示範與推廣」
- 辦理「重大鐵公路建設氣候變遷風險評估機制與調適資訊平台之研究 (1/2)」之研究
- 辦理「運輸部門調適策略成效評估方法初探」研究計畫辦理「電動公車、油電公車與柴油公車之成本效益分析」

6. Research and Development in Integrated Technology

- Conducting the research project Application of Policy Decision Support Systems for the Transportation Sector in Response to Climate Change
- Conducting The Estimation and Operations Manual for the Energy Consumption and Greenhouse Gas Emissions of Transportation Tools in Taiwan's Transportation Sector
- Conducting Planning and Cost-Benefit Analysis for LED Light Testing in Hilly Areas of Provincial Highways
- Conducting Research and Analysis on the Carbon Footprint of Applications for Road Freight Service in Taiwan
- Conducting A Study on the Carbon Reduction Achievements and Future Promotional Directions of the MOTC's Green Transportation
- Conducting Demonstration and Promotion of Carbon Reduction and Cost-Benefit Assessment Tools and Databases for Intelligent Transportation Systems
- Conducting A Study on Climate Change Risk Assessment Mechanisms and Adaptation Information Platforms for Major Railway Construction (1/2)
- Conducting the research project Methods of Assessing the Effectiveness of Coping Strategies in the Transportation Sector and conducting A Cost-Benefit Analysis of Electric Buses, Hybrid Buses, and Diesel Buses

七、港灣技術研究發展

- 編印出版：港灣季刊第 97~99 期
- 辦理『臺灣港務公司之監督與公司治理績效評估研究 (2/2)』研究計畫
- 辦理『臺灣綠色港埠建置之研究 (4/4)』研究計畫
- 辦理『港灣與濱海地區構造物現況調查與維護之研究 (4/4)』研究計畫
- 辦理『港灣地震模擬監測及工程基本資料庫更新之研究 (4/4)』研究計畫
- 辦理『臺灣港埠節能減碳效益提升之研究 (4/4) 』研究計畫
- 辦理『港灣構造物耐震性能設計架構及安全檢查評估之研究 (4/4) 』研究計畫
- 辦理『道路及橋梁災害防救災系統建置之研究 (4/4)』研究計畫
- 辦理『臺灣港灣長期性海氣象調查及資訊應用系統建置之研究 (2/4)』研究計畫
- 辦理『水波時頻分析之優化 (2/4)』研究計畫
- 辦理『港灣構造物與波流互制研究 (2/4)』研究計畫
- 辦理『創造綠色港埠之新技術研發 (2/4)』研究計畫
- 辦理『整合臺灣海岸及港灣海氣地象模擬技術之研究 (4/4)』研究計畫
- 辦理『港灣海氣象環境資訊整合及統計分析研究 (2/4)』研究計畫
- 辦理『全球暖化引致臺灣海域海面水位昇降變動率之評估研究 (2/4)』研究計畫辦理「兩岸直航後臺灣港埠之因應與發展研究 (3/4) 」

7. Research and Development in Harbor Technology

- Compiled and published: Harbor Quarterly, Volumes 97 to 99
- Conducted An Evaluation Study on the Supervision and Corporate Governance Performance of Taiwan International Ports Corporation (2/2)
- Conducted A Study on the Establishment of Green Ports in Taiwan (4/4)
- Conducted A Study on the Investigation and Maintenance of Harbors and Coastal Structures (4/4)
- Conducted A Study on Updating the Basic Database for Harbor Seismic Modeling, Monitoring, and Engineering (4/4)
- Conducted A Study on Improving the Benefits of Energy Saving and Carbon Reduction in Taiwanese Ports (4/4)
- Conducted A Study on the Inspection and Evaluation of the Seismic Performance Design Architecture and Safety of Harbor Structures (4/4)
- Conducted A Study on the Establishment of a Disaster Prevention and Relief System for Roads and Bridges (4/4)
- Conducted A Study on the Establishment of a System for Long-Term Marine Weather Forecasts and Information Applications in Taiwanese Harbors (2/4)
- Conducted the research project Optimization of Wave Frequency Analysis (2/4)
- Conducted A Study on Harbor Structures and Wave-Current Interaction (2/4)
- Conducted the research project New Technological Research and Development for Creating Green Ports (2/4)
- Conducted A Study on Simulation Technology for the Integration of Coastal and Harbor Marine and Land Weather Forecasts in Taiwan (4/4)
- Conducted the research project Information Integration and Statistical Analysis of Harbor Marine Meteorological Environments (2/4)
- Conducted an Assessment of the Changes in the Taiwanese Sea Level Caused by Global Warming (2/4) and A Study on the Development of Taiwanese Ports in Response to Direct Flights Across the Taiwan Strait (3/4)

03 Introduction of Key Research INSTITUTE OF TRANSPORTATION, MOTC

參 重點研究介紹

本所配合交通部當前重點政策及國內交通問題，研擬及執行相關研究計畫，以協助完成國內交通政策之推動，並提供研究成果作為中央及地方政府交通單位施政之參考，這些當前交通政策重點包含：(一) 整體運輸發展；(二) 人本永續；(三) 節能減碳；(四) 安全與風險管理；(五) 災害防救；(六) 智慧運輸；及 (七) 交通資訊服務。以下即針對本所配合執行之重點研究項目擇要進行介紹。

一、整體運輸發展

(一) 中長程計畫審議決策支援系統與整合資料庫之維護與效能提升

本所長期協助交通部進行交通建設計畫審議作業，並自 89 年起協助交通部辦理年度軌道、公路、港埠等次類別先期作業審查，隨著節能減碳風潮，推動公共運輸、軌道建設、自行車系統等建設，此項任務日益繁重，需長期與持續，方能快速有效支援因應。爰奉行政院 98 年 9 月 7 日院臺交字第 0980056191 號函，自 98 年起開始執行「運輸部門中長程公共建設發展作業評估」，配合國家政策及國土發展方向，辦理整體運輸發展藍圖規劃及相關決策支援系統之建置。

為利於探討我國未來運輸系統發展可能面臨之課題，並從各種不同面向考量運輸需求、財政資源限制、能源與環保、行政組織、技術層面、管理整合等各種內外環境因素與課題，進而分析未來運輸系統發展的方向，本所繼於民國 96 至 98 年完成計畫審議決策支援系統與階段性整合資料庫之建置後，為進一步累積相關資料及經驗與知識，並使此一系統及資料庫功能更為完備，乃於民國 100 年起接續辦理為期 3 年之「中長程計畫審議決策支援系統與整合資料庫之維護與效能提升計畫」，以強化支援決策品質與速度。

This institute has cooperated with the current major policies of the MOTC and domestic traffic problems to develop and implement related research programs. These programs have helped promote domestic traffic policy and provided results for the reference in the policies of the traffic units and central and local governments. Current focuses of traffic policy include the following: (1) overall transportation development; (2) humanism and sustainability; (3) energy saving and carbon reduction; (4) safety and risk management; (5) disaster prevention and relief; (6) intelligent transportation; and (7) traffic information services. Key research projects executed by this institute are introduced below.

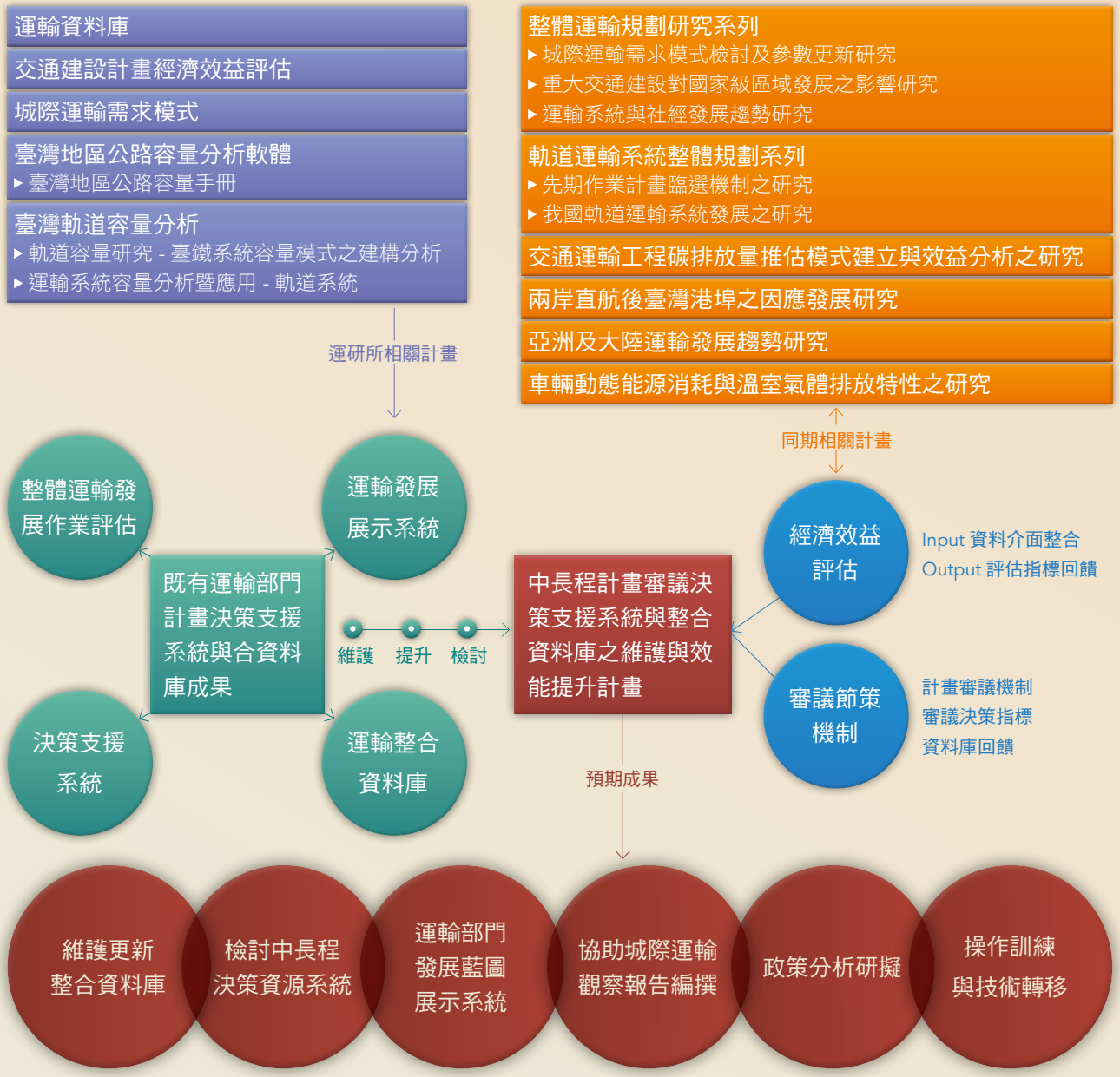
1. Overall Transportation Development

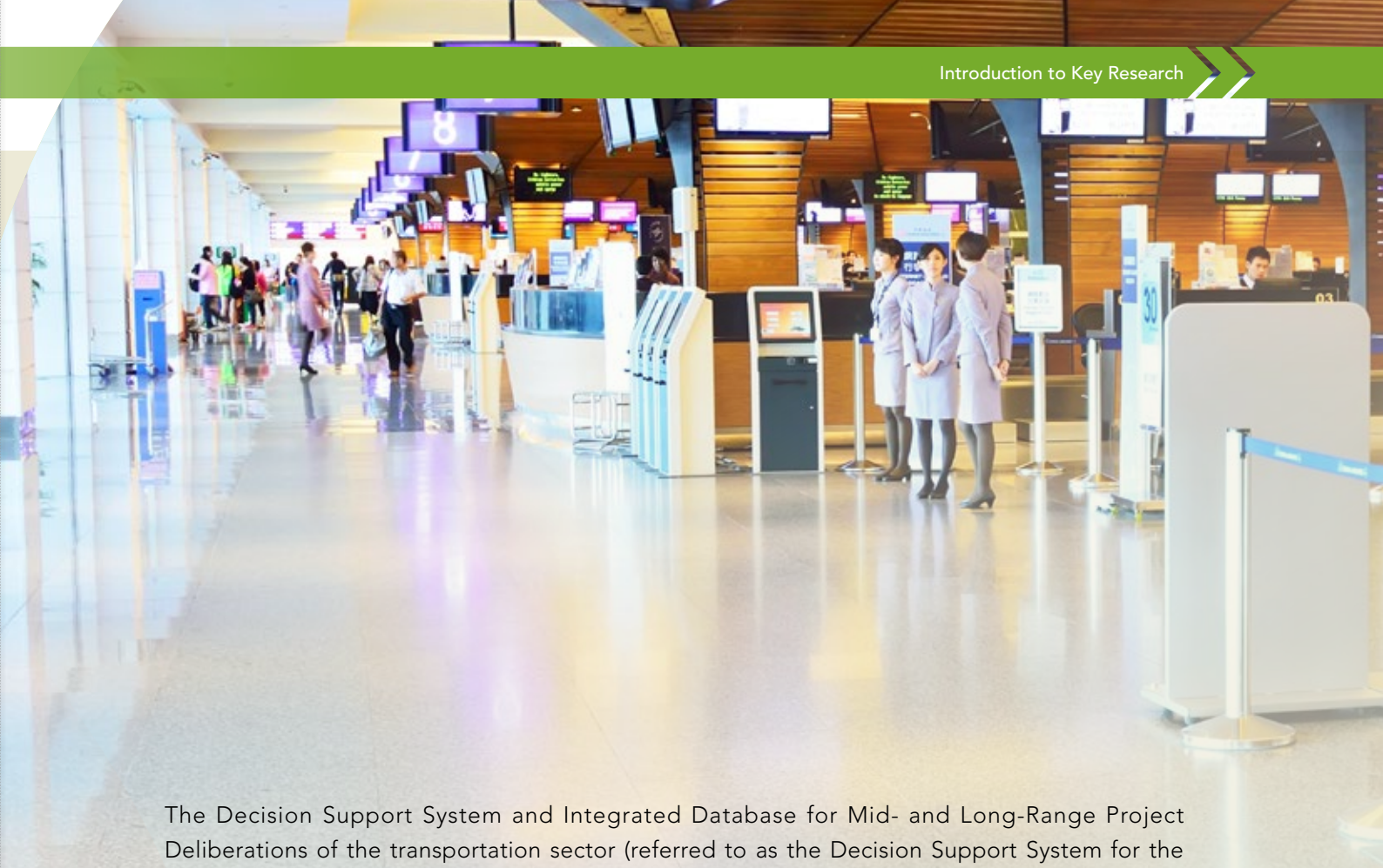
(1) Plans to Enhance the Decision Support System and Integrated Database for Transportation Infrastructure Deliberations

This institute has long assisted the MOTC in considering transportation construction projects. Since 2000, this institute has assisted the MOTC in conducting annual advance operation reviews for railways, roads, harbors, and other sub-categories. Following trends in energy saving and carbon reduction, this institute has promoted public transportation, track construction, bicycle systems, and other projects. These tasks are increasingly onerous and must be long-term and sustained to provide effective support and responses quickly. In accordance with Letter Tai-Jiao-Zi-Di No. 0980056191 issued by the Executive Yuan on September 7, 2009, this institute began conducting Assessments on the Mid- and Long-Term Development of Public Works in the Transportation Sector in 2009. In accordance with national policy and Taiwan's direction and development, this institute has established development blueprints for overall transportation and related decision support systems.

To facilitate investigation of the issues that may be faced in the future development of Taiwan's transportation system, this institute has considered transportation needs, limitations in financial resources, energy and environmental protection, administrative organization, technical dimensions, management integration, and other internal and external environmental factors and issues on a variety of levels and analyzed the future directions of development for the transportation system. After establishing the decision support system and the phased integrated database for project deliberations between 2007 and 2009, to accumulate further information, experience, and knowledge and to make the functions of the system and the database more complete, this institute continued to conduct the 3-year Plan of Maintenance and Performance Improvement of the Decision Support System and Integrated Database for Mid- and Long-Range Project Deliberations in 2011 to strengthen the quality and speed of decision support.

運輸部門中長程計畫審議決策支援系統與整合資料庫 (以下簡稱為運輸部門決策支援系統) 主要包含四項系統：(1) 運輸規劃整合資料庫；(2) 運輸部門發展展示系統；(3) 整體運輸發展評估作業；(4) 計畫審議決策支援系統，此系統與資料庫整合了本所既有之資料庫與相關規劃工具箱，包括「城際運輸系統需求模式」、「交通建設計畫經濟效益評估作業」、「臺灣地區公路容量分析軟體」、「臺鐵軌道容量分析」…等研究成果。同時也結合與運輸議題相關之資訊系統，如交通部所屬各機關之資訊系統、國土資訊系統、行政院中長程計畫制度相關之作業系統與研考作業系統等，並考量運輸部門之規劃分析、展示、決策與政策說明等需求，亦建置一國家運輸多功能整合資訊決策支援系統平臺，支援運輸發展展示、發展評估、輔助運輸部門中長程計畫審議決策分析，可配合規劃及運輸政策白書檢討之需要，提供相關圖表分析資料。





The Decision Support System and Integrated Database for Mid- and Long-Range Project Deliberations of the transportation sector (referred to as the Decision Support System for the transportation sector below) comprises four primary systems: (1) an integrated database for transportation planning; (2) a development demonstration system for the transportation sector; (3) assessment operations for overall transportation development; and (4) decision support system for project deliberations. These systems and database integrate this institute's existing databases and related planning toolboxes, which include "the demand model of the intercity transportation system," "economic assessment operations for transportation construction planning," "Taiwan highway capacity analysis software," and "Taiwan railway track capacity analysis." The systems also combine information systems on related transportation topics. These include the information systems of the subordinate agencies of the MOTC, the National Geographic Information System, and the operating system of mid- and long-term planning system of the Executive Yuan and the research and evaluation operating system. In consideration of the needs of planning analysis, demonstration, decision making, and policy statements for the transportation sector, this institute has also established a multifunctional integrated information decision support system platform for national transportation. This system supports the development and exhibition of transportation, development assessment, and decision-making analysis of mid- and long-range project deliberations for the transportation sector. This system can meet the needs of planning and white paper reviews of transportation policy and provide relevant chart analysis data.

◀ 運輸部門中長程計畫審議決策支援系統與相關研究之關聯及研究範疇

Correlations between and research categories of the decision support system for mid- and long-range project deliberations and related research for the transportation sector

102 年度計畫主要成果包括：

1. 計畫審議機制與議題檢討

(1) 運輸部門中長程計畫相關作業規定更新

新增修訂行政院所屬各機關 103 年度施政計畫編審作業注意事項、政府公共建設計畫先期作業實施要點、跨域加值公共建設財務規劃方案、軌道類公共建設之審議流程及作業機制、公共建設計畫及周邊整合規劃申請與審查作業要點、行政院內部控制制度共通性作業範例—「公共建設計畫編審」等 6 項作業規定。

(2) 行政院組織改造法案資訊蒐集及配套與施政計畫

蒐集各部會署及所屬組織法案與立法作業進度，以及組織改造之配套與施政計畫，例如國家發展計畫、交通部中程施政計畫（102 至 105 年度）施政重點與施政焦點等。

(3) 系統審議功能調整因應

因應「行政院政府計畫管理資訊網 (GPMnet 2.0)」調整「年度概算審議模組」功能，建構年度審議計畫查詢、年度核列預算查詢、歷年審議結果比較，同時檢討與調整個案計畫審議功能與項目，並將蒐集計畫審議相關資料回饋至系統資料庫。

▲ 系統計畫審議支援工具頁面
System Project Deliberation Support Tool Page

運輸發展藍圖展示系統資料更新頁面

Data Update Page for the Transportation Development Blueprint Display System

The primary achievements of the 2013 projects include the following:

A. Project Deliberation Mechanisms and Topic Review

(A) Stipulation and Updating of Related Operations for Mid- and Long-Range Projects for the Transportation Sector

Six operating provisions were added for the subordinate agencies of the Executive Yuan: the 2014 editorial operating notes for governance planning, the advance enforcement guidelines for government public construction projects, the financial planning program for cross-domain added-value public works, deliberation processes and operational mechanisms for railway public works, operational guideline for planning application and review for the integration of public construction projects and surrounding areas, and commonality operating paradigms for the internal control of the Executive Yuan—"public construction project editing."

(B) Information Gathering, Supporting, and Governance Plan for Executive Yuan Organizational Reform Bills

This institute collected the progress of bills and legislative operations from the commissions and subordinate organizations of each ministry and organized support and governance plans for organizational transformation. These included key policies and governance focuses for the national development plan and the MOTC mid-range governance plan (2013 to 2016).

(c) Adjustment of and Response to Systematic Review Functions

In response to the adjustment of the "annual budget deliberation module" in the Executive Yuan Governance Project Management Information Network (GPMnet 2.0), this institute constructed annual review plan inquiry, annual audit budget inquiry, and comparison of the results of deliberations over the years, while simultaneously reviewing and adjusting case project deliberation functions and items. In addition, data related to project deliberations were collected and fed back to the system database.

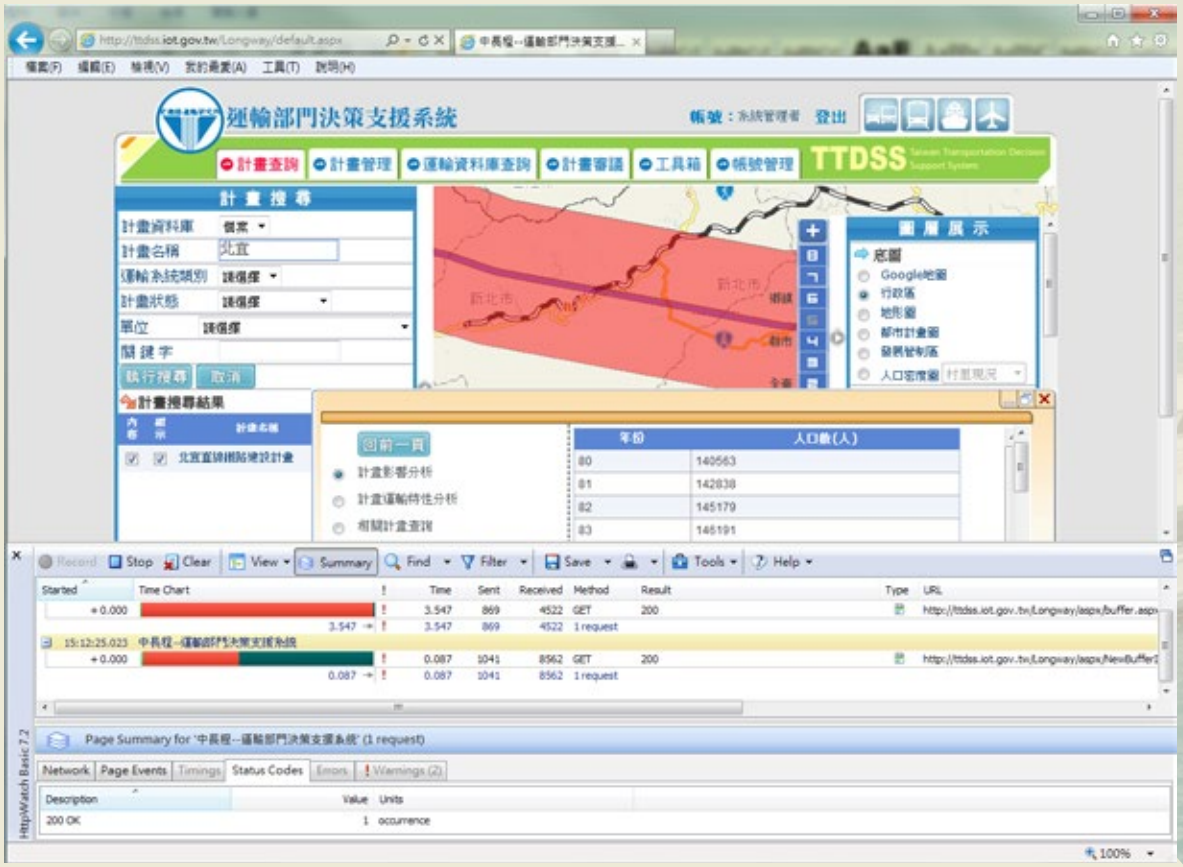
2. 系統效能提升

(1) 軟硬體調整與規劃：配合 SuperWebGIS 3 軟體完成升級調整。

(2) 運輸部門決策支援系統功能提升：新增連結「行政院政府計畫管理資訊網 (GPMnet 2.0)」、配合組織再造調整系統審議功能、強化計畫管理功能建立計畫自動化檢核機制、整合國土資訊圖資服務平台提升展示與資料查詢檢索功能、考量部屬機關需求並回饋整合至系統、整合與更新研究成果與分析工具並提供上傳下載。

(3) 運輸發展展示系統功能提升：完成運輸發展藍圖展示系統、運輸規劃圖展示及出圖作業系統年度更新，加入自由貿易港區類別並提升客製化風格編輯功能。

3. 系統檢測與資料合理性驗證：完成系統效率及系統資安弱點檢測，並針對權限控管開放運輸查詢和計畫查詢權限，確立計畫管理資訊、交通運輸及社經資訊、圖形資訊和分析評估資訊等各類型資料合理性審核機制。



▲ 「進階分析 _ 計畫影響 (2000m)」效率測試頁面
Efficiency Test Page for "Advanced Analysis_Plan Impact (2000 m)"

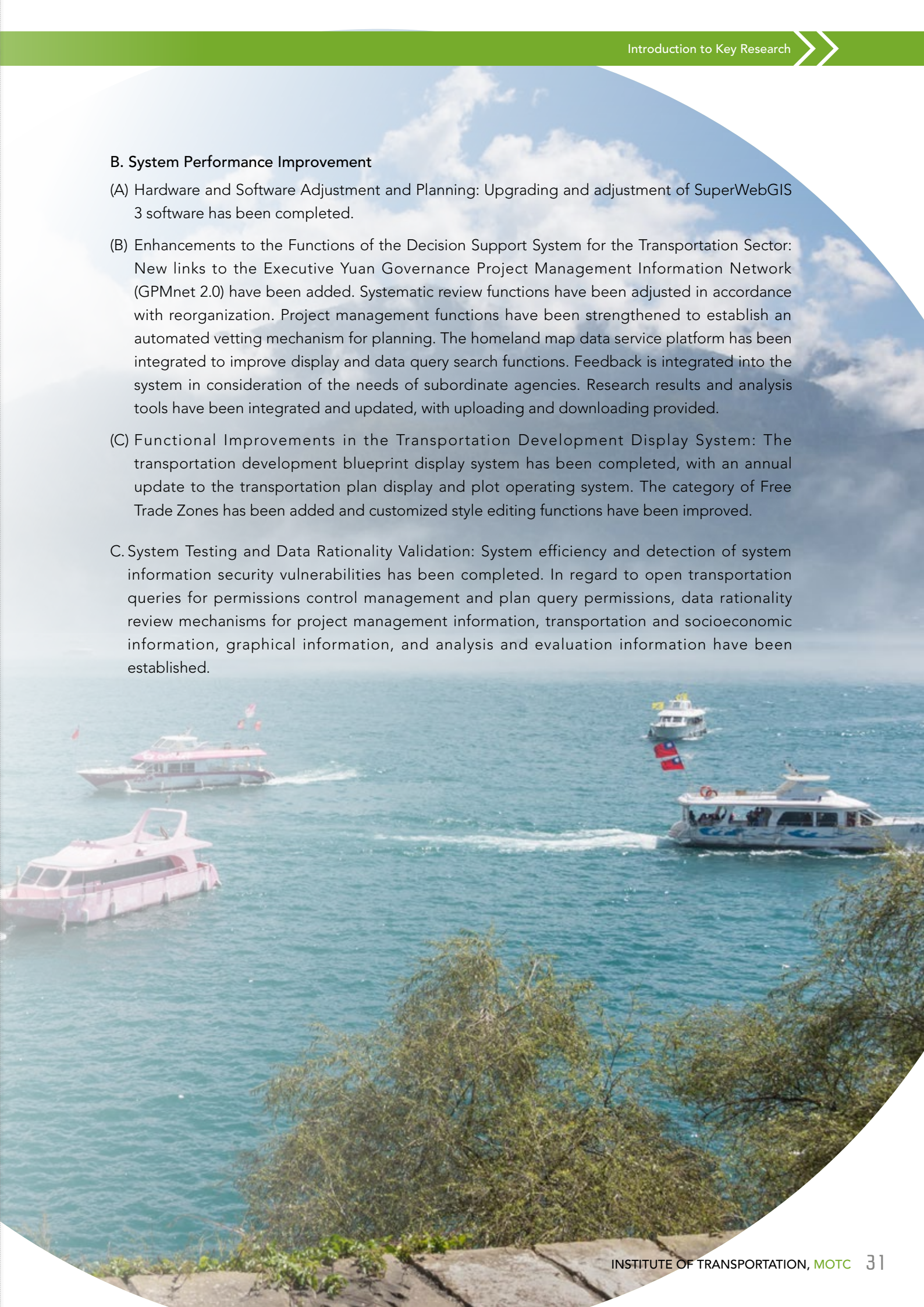
B. System Performance Improvement

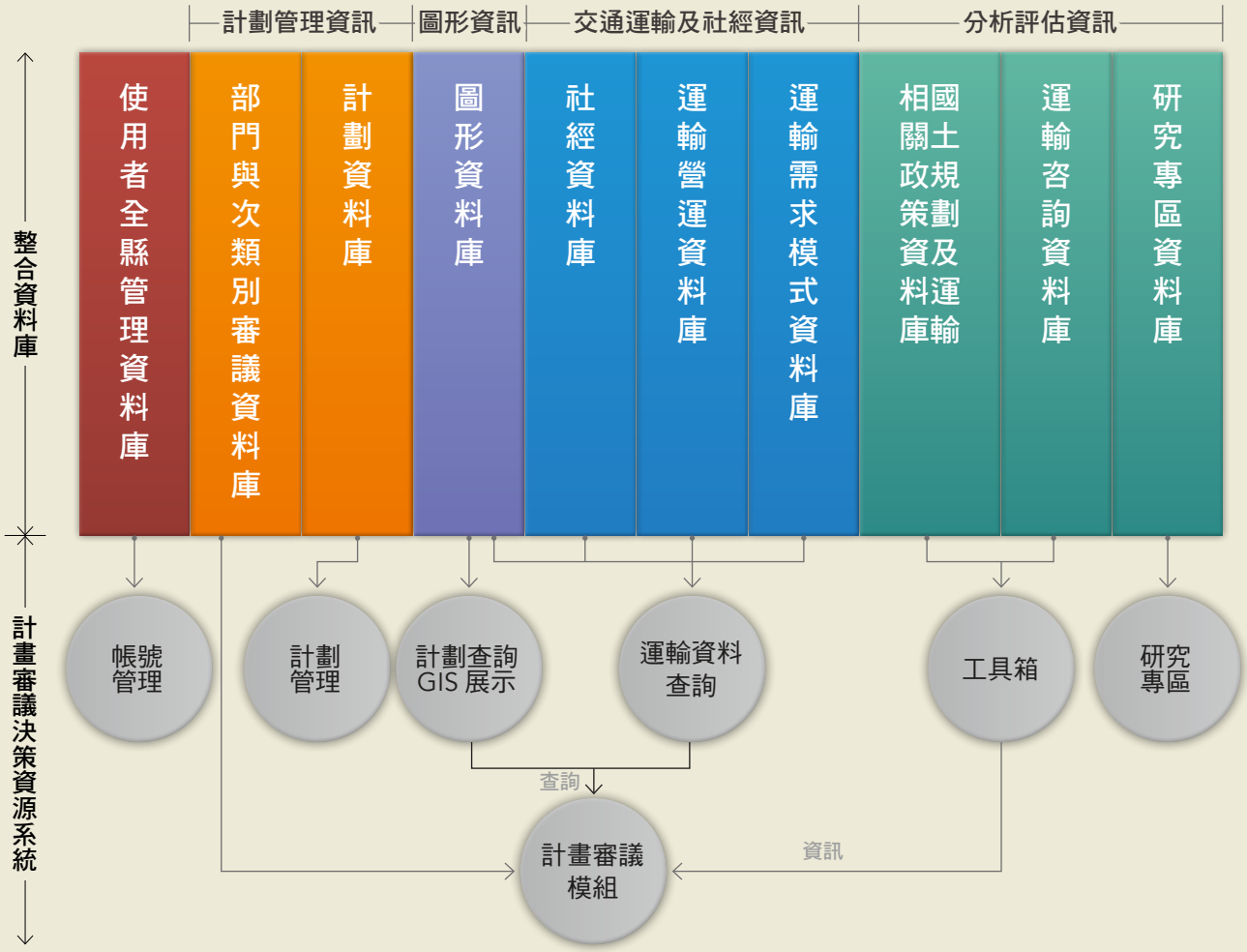
(A) Hardware and Software Adjustment and Planning: Upgrading and adjustment of SuperWebGIS 3 software has been completed.

(B) Enhancements to the Functions of the Decision Support System for the Transportation Sector: New links to the Executive Yuan Governance Project Management Information Network (GPMnet 2.0) have been added. Systematic review functions have been adjusted in accordance with reorganization. Project management functions have been strengthened to establish an automated vetting mechanism for planning. The homeland map data service platform has been integrated to improve display and data query search functions. Feedback is integrated into the system in consideration of the needs of subordinate agencies. Research results and analysis tools have been integrated and updated, with uploading and downloading provided.

(C) Functional Improvements in the Transportation Development Display System: The transportation development blueprint display system has been completed, with an annual update to the transportation plan display and plot operating system. The category of Free Trade Zones has been added and customized style editing functions have been improved.

C. System Testing and Data Rationality Validation: System efficiency and detection of system information security vulnerabilities has been completed. In regard to open transportation queries for permissions control management and plan query permissions, data rationality review mechanisms for project management information, transportation and socioeconomic information, graphical information, and analysis and evaluation information have been established.





▲ 整合資料庫架構與系統功能圖
Integrated Database Architecture and System Function Diagram

4. 資料庫更新與功能提升：於研究專區資料庫整合納入亞洲與大陸資料、鐵道網資料；於社經資料納入全國人口性別比例、年齡結構、歷年經濟成長率、國民生產毛額、國內生產總值、個人經常性收入及家戶可支配所得等資料，並更新整合資料庫之資料至 101 年底、部分至 102 年 8 月。

5. 研提「102 年運輸市場觀察與環境變化趨勢分析」，並協辦「城際運輸觀察報告」，同時配合完成臺灣北部、中部、南部地區整體交通系統改善方案之探討等報告與檢視各項數據之合理性。

6. 協助辦理政策分析檢討，包括「高鐵營運對西部城際陸路公共運輸市場消長之觀察」課題分析、城際運輸需求分析、運輸系統服務範圍人口分析、運輸市場結構與趨勢探討、山地原住民社經資料分析。

D. Database Updating and Functional Improvement: Asia and continental information and railway network have been integrated and included in the research area library. The sex ratio, age structure, historical economic growth rates, GNP, GDP, personal recurring income, and household disposable income of the national population have been included within the socioeconomic data. In addition, data up to the end of 2012 and some data up to August 2013 have been updated and integrated in the database.

E. The 2013 Transportation Market Observations and Environmental Trend Analysis has been completed. This institute assisted in the Intercity Transportation Observation Report. The institute also assisted in completing the investigative report on the overall transportation system improvement plan for northern, central, and southern Taiwan and reviewed the rationality of a variety of statistics.

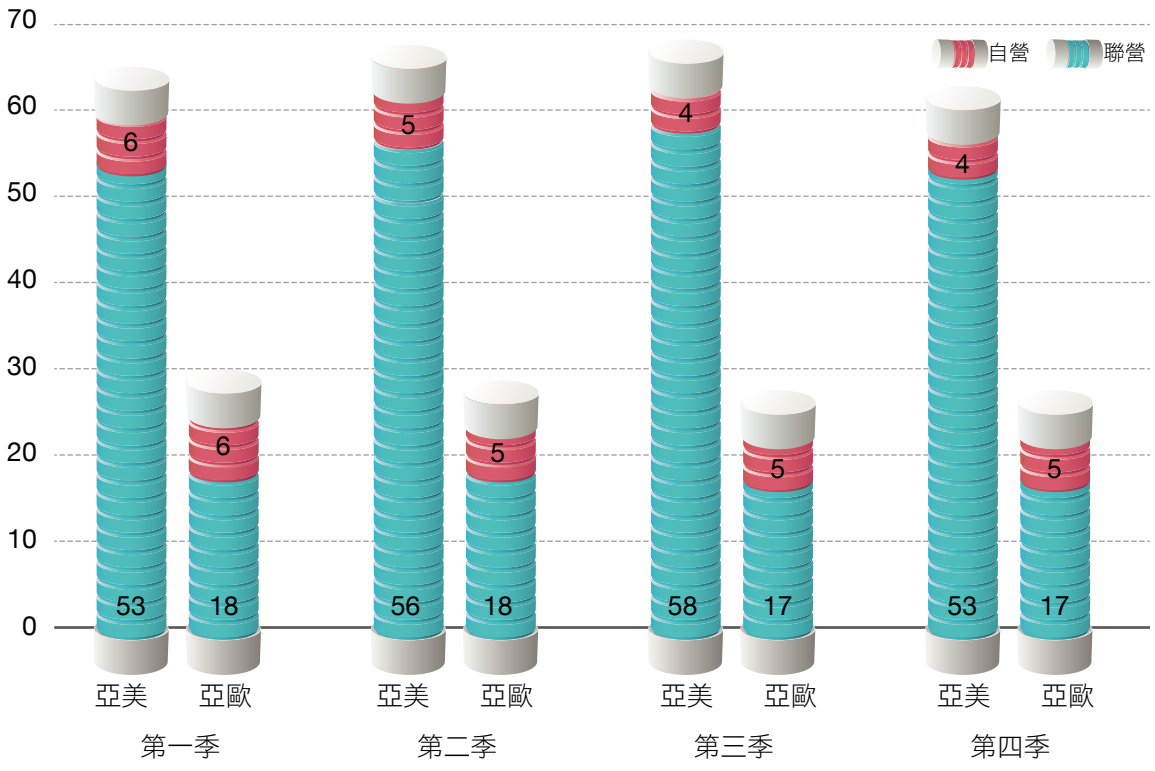
F. This institute has assisted in conducting policy analysis and review, including topic analysis for the Observations on the Dynamics of the Public Transportation Market for Western Intercity HSR Operations, intercity transportation needs analysis, demographic analysis for the range of services of the transportation system, exploration of the structure and trends of the transportation market, and analysis of aboriginal socioeconomic data.

(二) 我國及亞洲主要港口之主航線及運能資料建置案

海運貨櫃輪運輸市場中，洲際之定期航線反映出主要航商之資源部署，與貨源起迄與轉口規劃相關。從港口角度觀之，主航線數多寡，反映該港在國際海運運輸網絡中的地位及重要性。近年來海運市場運力供過於求，為降低營運成本、提升競爭力，航商間遂有各式聯盟、聯營、共同派船、租用倉位等營運方式，在各類營運模式下，常出現不同航商之公告航線但實際營運為同艘船舶情形，主航線數因此常被高估，而無法正確反映供給狀況。本所蒐集 2013 年主要航商所公告之亞歐、亞美主航線資料，建立主航線及其營運船舶資料庫，以實際運送船舶進行檢核，整理出各航線真正的運能，並依據航線密集度分析港口間之競合如下：

1. 航商聯營情形普遍

2013 年亞歐、亞美航線採聯營比例者分別達 70% 與 86%，詳圖 1，說明在目前船舶運能過剩之情形下，各航商多採聯營方式以降低成本及分攤風險。



▲ 圖 1　2013 年亞歐 / 美航線自 / 聯營航線數比較

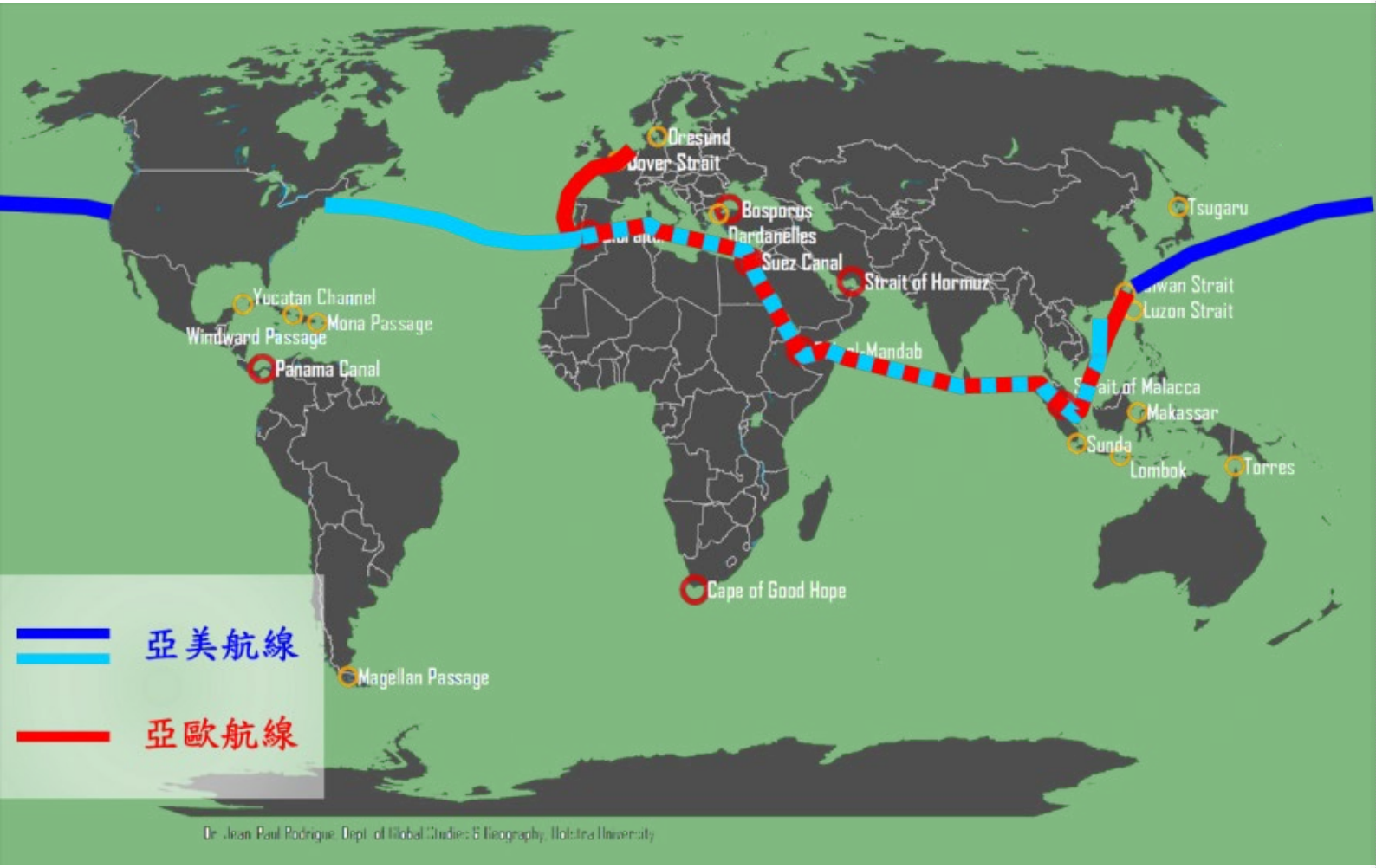
Figure 1　Comparison of the number of solo and joint ventures in Asia-Europe and Asia-America routes in 2013

(2) Establishment of Main Route and Transport Capacity Data for the Major Ports of Taiwan and Asia

In the shipping container vessel transport market, regular intercontinental routes reflect the resource deployment of the main shipping companies. This deployment is related to supply origins and destinations and re-export planning. From the port perspective, the number of main routes reflects the position and importance of a port within the international maritime transport network. In recent years, the transport capacity of the shipping market has exceeded demand. To reduce operating costs and improve competitiveness, shipping companies have established a variety of alliances, joint ventures, joint sending of vessels, position renting, and other modes of operation. Within these operating models, routes announced by different shipping companies are often actually operated with a single ship. Thus, the number of main routes is often overestimated, and actual supply condition cannot be reflected accurately. This institute collected data on the main Asia-Europe and Asia-America routes announced by the primary shipping companies in 2013 to establish a database of main routes and their operating ships. Vetting of actual delivering ships was used to compile the true transport capacity of each route. The concurrence between ports based on intensive route analysis was as follows:

A. Shipping Associations Are Widespread

In 2013, the percentage of Asia-Europe and Asia-America routes adopting joint ventures was 70% and 86%, respectively. Figure 1 shows that the majority of shipping companies have adopted joint ventures to reduce costs and share risks in response to the current overcapacity in shipping.



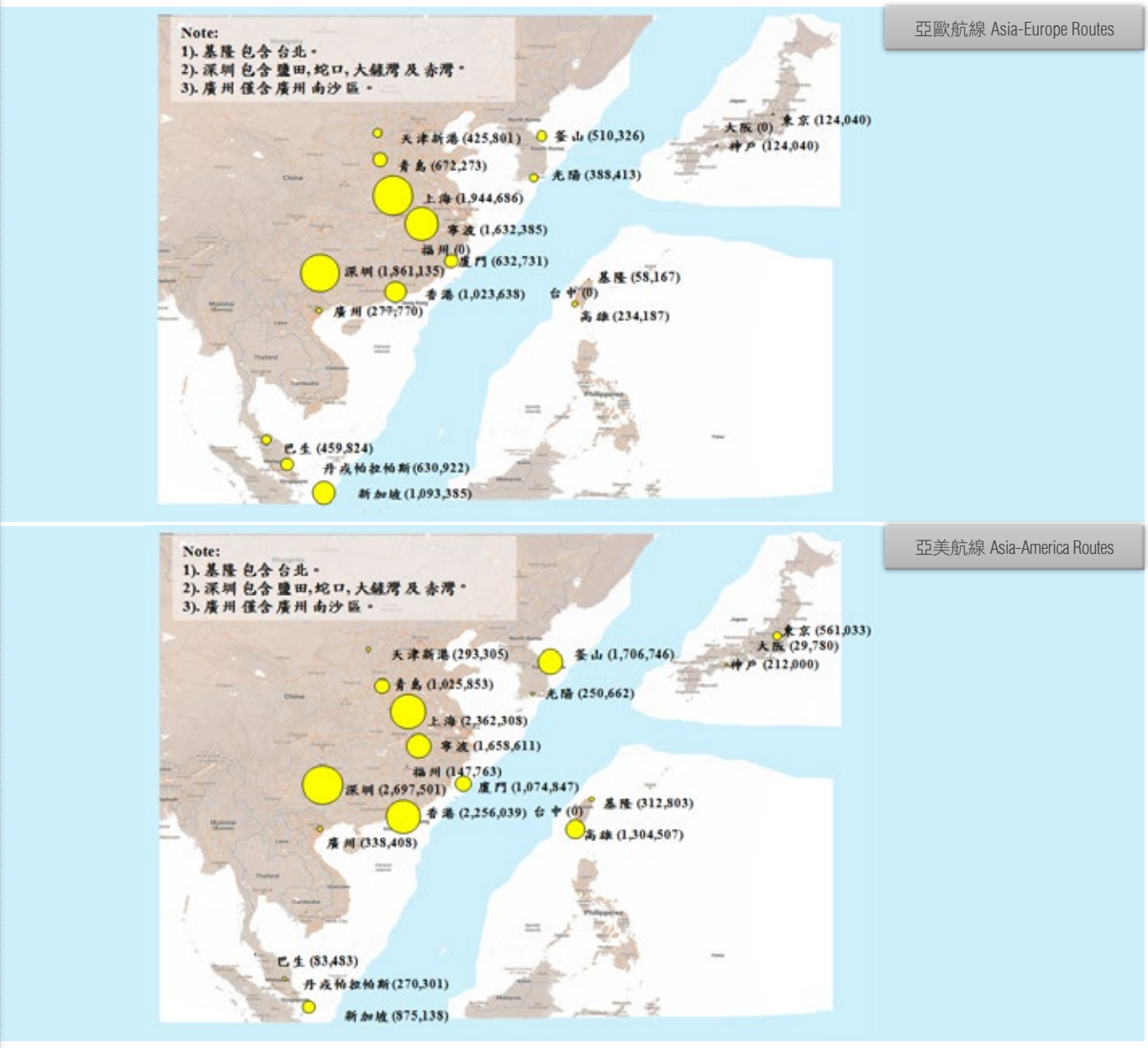
▲ 圖 2　亞歐航線及亞美航線示意圖
Figure 2　Schematic of Asia-Europe and Asia-America routes

2. 亞歐與亞美航線型式不同

圖 2 為亞歐航線及亞美航線示意圖，由圖知，亞歐航線為序列型 (或稱鐘擺型) 航線，由亞洲前往歐洲之航線由北而南通過新加坡水域及蘇伊士運河後前往歐洲，船舶在亞洲地區由緯度較高之港口航向緯度較低之港口；亞美航線因船型較小，航程及靠泊港口較少，航線配置上形成平行態勢。在靠泊港的選擇上，仍以貨源與區位為主要考量，詳圖 3，高雄港在亞美航線上具有區位優勢。

B. Different Types of Asia-Europe and Asia-America Routes

Figure 2 is a schematic of Asia-Europe and Asia-America routes. The figure indicates that Asia-Europe routes are sequential (also referred to as pendulum) routes. Routes from Asia to Europe pass through Singapore waters from north to south and the Suez Canal before reaching Europe. Ships navigate from ports with higher latitudes in Asia toward ports with lower latitudes. In contrast, because the ships of Asia-America routes are smaller, and the voyage is shorter and includes fewer berthing ports, route configurations form parallel trends. In regard to the selection of ports for berthing, supply and location remain primary considerations. Figure 3 shows that the Port of Kaohsiung has geographical advantages for Asia-America routes.



▲ 圖 3　亞歐 / 美航線之港口運能分配

Figure 3 Port capacity allocation for Asia-Europe and Asia-America routes

3. 主航線靠泊港口仍集中於大陸

2013 年亞歐、亞美主航線之靠泊港口，主要集中於大陸之長江三角洲 (包括上海、寧波等港口) 與珠江三角洲 (包括深圳、香港、廣州等港口)，新馬地區 (新加坡、丹戎帕拉帕斯、巴生等港口) 與韓國 (釜山、光陽等港口) 則因航線序列關係，亦分別為亞歐、亞美航線主要靠泊港。我國港口之靠泊航線數分別是亞歐航線 4 條、亞美航線 23 條。

4. 亞歐航線船舶大型化趨勢明顯

2013 年亞歐航線之營運船型主要為 8,500 TEU 及 13,500 TEU，平均為 10,948 TEU(平均船寬 46.8m、吃水 14.9m)；亞美航線之營運船型主要為 4,500~6,500 TEU 及 8,500 TEU，平均為 6,202 TEU(平均船寬 38.6m、吃水 13.6m)。亞美航線受巴拿馬運河之船寬限制，大部份航線以美西為終點，且由於越太平洋航程中並無運量較大之港口值得靠泊，致其航程較短，靠泊港口較少。

圖 4 2013 年第四季亞歐 / 美航線數

Figure 4 Number of Asia-Europe and Asia-America routes in the fourth quarter of 2013

C. Berthing Ports for Main Routes Remain Concentrated in China

The berthing ports of Asia-Europe and Asia-America lines in 2013 were concentrated primarily in China's Yangtze River Delta (including Shanghai and Ningbo) and Pearl River Delta (including Shenzhen, Hong Kong, and Guangzhou). Because of route sequences, the Malaysia-Singapore region (Singapore, Tanjung Pelepas, and Klang) and South Korea (Busan and Gwangyang) are the primary berthing ports of Asia-Europe and Asia-America lines, respectively. Taiwan has 4 berthing routes for Asia-Europe lines and 23 berthing routes for Asia-America lines.

D. Clear Large-Scale Trends in the Ships of Asia-Europe Routes

The primary ship types operating Asia-Europe routes in 2013 were 8,500 TEU and 13,500 TEU. The average was 10,948 TEU (average breadth of 46.8 m and draught of 14.9 m). The primary ship types operating Asia-America routes were 4,500-6,500 TEU and 8,500 TEU. The average was 6,202 TEU (average breadth of 38.6 m and draught of 13.6 m). Asia-America routes are limited to the breadth restrictions of the Panama Canal. The majority of routes terminate in the Western United States. In addition, because the Pacific voyage lacks ports with higher traffic that are worthy of berthing, the voyage is shorter and includes fewer berthing ports.

5. 高雄港主要競爭對手為鄰近之廈門港

如前所述，航線上靠泊港之競爭除貨源多寡外，主要為港口區位。亞歐航線為序列型，航線上靠泊港區位相近具競爭性的港口，如上海與寧波；高雄與廈門、珠三角之港群；新加坡與丹戎帕拉帕斯。亞美航線為平行型，航線上與高雄港區位相近為廈門港。換言之，無論亞歐或亞美航線，高雄港主要競爭對手均為鄰近之廈門港，兩者主航線比較如表 1.1 所示。高雄港與廈門港之區位十分接近，目前廈門港在亞歐航線上較占優勢，高雄港則在亞美航線上略占上風，惟其差距均有限。

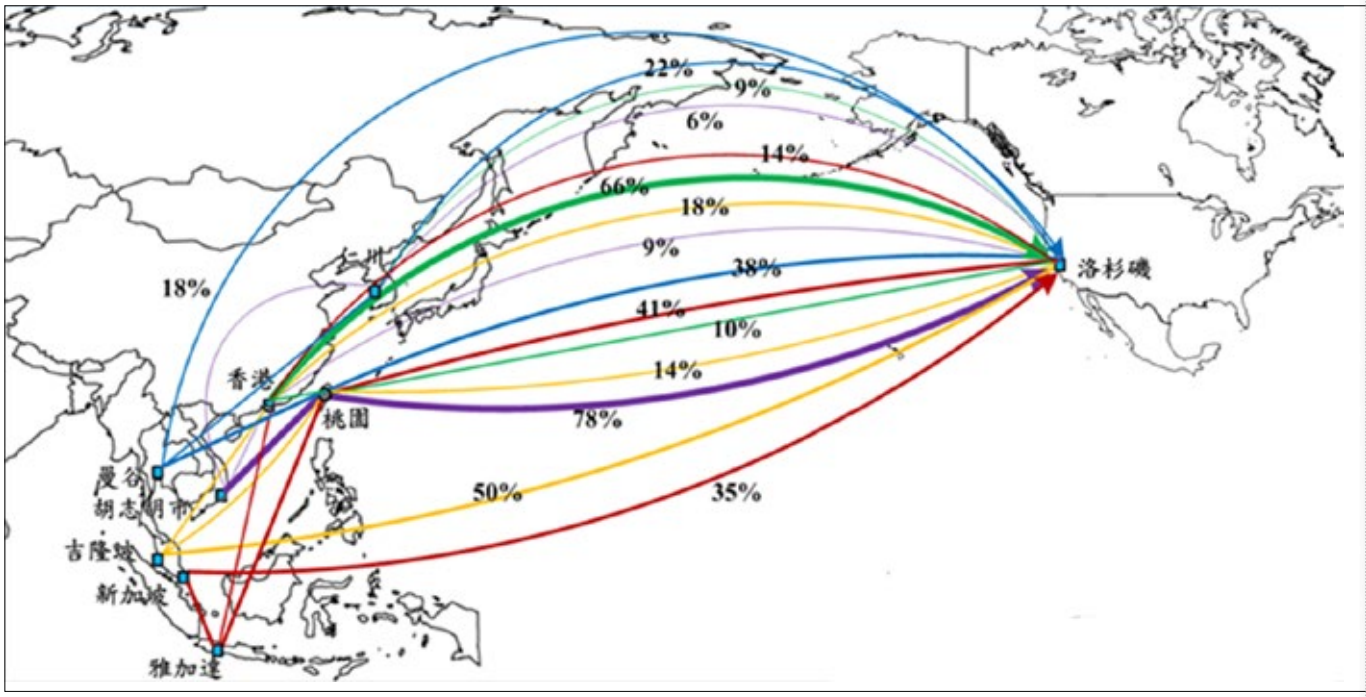
表 1　高雄港與廈門港亞歐、亞美航線比較

Table 1　Comparison of Asia-Europe and Asia-America routes for the Port of Kaohsiung and the Port of Xiamen

比較項目	亞歐航線 Asia-Europe Routes		亞美航線 Asia-America Routes	
	高雄 Kaohsiung	廈門 Xiamen	高雄 Kaohsiung	廈門 Xiamen
每週航線數 Number of Routes Per Week	3	7	16	14
派船之航商數 Number of Shipping Companies Sending Ships	6	10	15	17
每週船舶靠泊數 (雙向) Weekly Number of Berthings (Bidirectional)	6	9	28	18
每週單向之運能 Weekly One-Way Transport Capacity	4,651	11,713	21,181	20,165
亞洲地區最終出發港航線數 Number of Asian Routes as Final Port of Departure	--	--	5	2

E. Kaohsiung's Primary Competitor Is the Nearby Port of Xiamen

As described above, in addition to supply amounts, competition for berthing points in routes focuses primarily on port location. Asia-Europe routes are sequential. Ports located near other berthing ports on routes are competitive, such as with Shanghai and Ningbo, the port group of Kaohsiung, Xiamen, and the Pearl Delta, and Singapore and Tanjung Pelepas. Asia-America routes are parallel types. The port located near the Port of Kaohsiung on the routes is the Port of Xiamen. In other words, the primary competitor of the Port of Kaohsiung is the nearby Port of Xiamen for both Asia-Europe and Asia-America routes. Table 1.1 compares the primary routes of these two ports. The Port of Kaohsiung and the Port of Xiamen are located near each other. The Port of Xiamen currently has a more dominant position for Asia-Europe routes, whereas the Port of Kaohsiung has a slight upper hand for Asia-America routes. However, the differences between the two are limited.



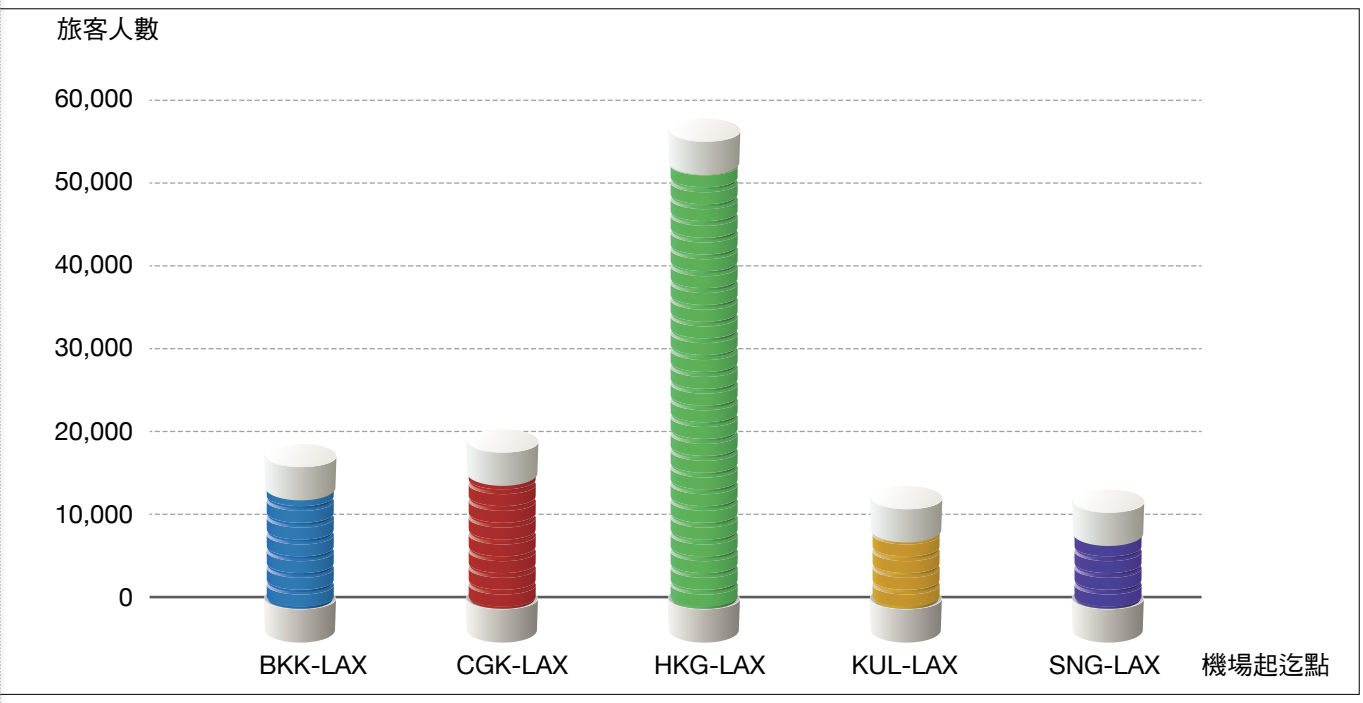
▲ 圖 5　東南亞赴洛杉磯旅客旅行路徑與客量百分比分析
Figure 5 Percentage analysis of the traveling paths and volume of travel between Southeast Asia and Los Angeles

(三) 國際航空客貨起迄資料鏈結之研究

本研究自航空客貨運之資訊流分析，探索可提供起迄客量與貨量之國內外蒐集管道，並分析其資料潛在的優點與限制，經逐步尋找真正可供資料串接與擷取的平台後，透過實際的接洽，確認最適合本研究的資料擷取來源，以進行國際客貨起迄運量的分析。最後藉由對空運物流體系的瞭解與航空貨運主要品項的分析，做為本研究對空運供應鏈的探索。

1. 國際航空客運起迄之分析部分

藉由 IATA MarketIS 2012 年全年資料發現，在 2012 年之 46 個機場對資料的分析結果中發現，從桃園出、入境之旅客絕大部分均選擇直接抵達目的機場，經從桃園機場公司所瞭解的資訊，此亦有相同之處。在所分析的航程上，比例上最高的是往返香港與日、韓的旅客，其次是往返東南亞主要機場。長程航線的旅行路徑選擇較多，香港扮演中轉最重要的角色，上海、仁川、成田也是部分旅客喜歡轉機的機場。進出上海與北京或東南亞若要轉機，香港仍是首選。透過東南亞主要機場往返洛杉磯之旅客進行桃園機場中轉地位分析時，發現桃園機場扮演舉足輕重的角色，尤其是往返胡志明市、雅加達和曼谷的旅客，而香港也是頗受偏好的轉機機場，雖目前轉機客量桃園機場略多於香港，但其仍是未來桃園機場的最大競爭對手。



(3) A Study on Data Links in International Air Passenger Origins and Destinations

This study used information flow analysis of air passengers and cargo to explore domestic and international channels that can provide origin and destination passenger and shipment volume. Potential advantages and limitations of these data were analyzed to gradually find platforms that can truly provide data concatenation and retrieval. Actual contact was then used to confirm the data acquisition sources most appropriate for this study to analyze the origin and destination traffic of international passengers. Finally, an understanding of air cargo logistics systems and an analysis of primary cargo items were used to explore air supply chains.

A. Analysis of International Air Passenger Origins and Destinations

The 2012 IATA MarketIS annual data include data analysis results from 46 airport pairs in 2012. These results indicate that the vast majority of travelers departing from and arriving in Taoyuan opted to arrive directly at their destination airports. This is consistent with data from the Taoyuan Airport Corporation. In the analyzed routes, the highest proportion were people traveling to and from Hong Kong, Japan, and South Korea. These were followed by journeys to and from the main airports of Southeast Asia. The number of choices of travel paths for long-range routes is relatively high. Hong Kong played the most important role in transit. Shanghai, Incheon, and Narita were also airports favored for transit by some passengers. Hong Kong remained the top choice for transit to and from Shanghai and Beijing or Southeast Asia. Analysis of the transit position of Taoyuan Airport for travel between the main airports of Southeast Asia and Los Angeles indicates that Taoyuan Airport played a pivotal role, particular for travel to and from Ho Chi Minh City, Jakarta, and Bangkok. Hong Kong was also a preferred transit airport. Although Taoyuan Airport currently has more transit passengers than Hong Kong does, Hong Kong remains the biggest future competitor for Taoyuan Airport.

2. 國際航空貨運起迄之分析部分

藉由關貿網路公司之 2012 年全年資料發現，我國出口貨量多於進口貨量，但價值相近。不論進、出口，一般貨物之總量均佔八成五以上，但出口貨物價值的比重勝於進口一倍。自貿港區之貨量較輕，但貨物價值比重高出甚多，進口比重又遠勝於出口，而快遞專區是貨重與價值比例相近的類別。

中國大陸為我最大之出口國，尤其是在自由貿易港區的貨量遠勝於排名第二以後之國家甚多，而快遞貨物則以美國居冠，貨量也是高出第二名之香港近一倍；出口之機場則是直送至上海浦東機場最多，其次為香港。進口部分，日本是最大貨物之匯聚國，自由貿易港區則是美國，但快遞進口主要匯聚於香港，香港同時也是進口裝機最多貨量之機場。

表 2　關貿網路資料中 2012 年我國出口貨物主要之機場流向

Table 2 Primary airport flow of Taiwanese exported goods in 2012 from Trade-Van data

出發地點 (裝機機場) Departure Location (Installed Airport)	目的地點 (目的機場) Destination (Destination Airport)	重量 (公斤) Weight (kg)	價值 (新臺幣) Value (NTD)	價值 / 重量 Value/Weight
TWTPE	HKHKG	46,476,870	12,229,363,582	263.4
TWTPE	CNPVG	43,525,396	6,908,157,566	158.7
TWTPE	JPNRT	18,355,422	1,191,356,397	64.9
TWTPE	KRICN	14,588,253	2,199,047,305	150.7
TWTPE	SGSIN	12,106,593	2,969,807,428	245.3
TWTPE	USLAX	11,760,169	636,976,716	54.2
TWTPE	JPKIX	10,205,220	574,462,260	56.3
TWTPE	USORD	8,557,716	366,461,485	42.8
TWTPE	THBKK	7,654,093	742,639,892	97.0
TWTPE	DEFRA	7,308,672	389,525,081	53.3
TWTPE	GBLHR	6,246,295	282,511,509	45.2
TWTPE	NLSPL	5,247,733	267,922,156	51.1
TWTPE	USSFO	5,059,960	462,619,240	91.4
TWKHH	HKHKG	4,621,648	549,480,725	118.9
TWTPE	USJFK	4,610,064	298,113,817	64.7
TWTPE	CNXMN	4,231,232	313,024,975	74.0

B. Analysis of Origins and Destinations of International Air Cargo

According to 2012 annual data from Trade-Van, Taiwanese export volume was greater than import volume, but the values were similar. In both imports and exports, the total amount of general cargo comprised more than 85%. However, the proportion of export good value was twice as higher as that of imports. Shipments from Free Trade Ports were relatively light. However, the proportion of the value of goods was far higher. The proportion of imports was also far greater than the proportion of exports. Express areas were a category with a similar ratio of cargo weight and value.

China was the greatest exporter to Taiwan. In particular, shipments to Free Trade Ports from China were far greater than those of countries ranked second and below. The United States ranked the highest in express cargo. U.S. shipments were nearly twice as high as those from Hong Kong, which ranked second. In regard to direct exports to airports, exports to Shanghai's Pudong Airport were the highest. Hong Kong was second. In regard to imports, Japan was the convergence country with the most cargo. The Free Trade Port was the United States. However, express imports primarily converged in Hong Kong. Hong Kong was also the airport with the highest installed import volume.

出發地點 (裝機機場) Departure Location (Installed Airport)	目的地點 (目的機場) Destination (Destination Airport)	重量 (公斤) Weight (kg)	價值 (新臺幣) Value (NTD)	價值 / 重量 Value/Weight
TWTPE	RUPEK	3,644,890	329,545,657	90.4
TWTPE	USSDF	3,529,685	531,608,374	150.6
TWTPE	DESGN	3,169,822	42,462,895	13.4
TWTPE	USDFW	3,117,832	220,031,643	70.6
TWTPE	ITMXP	2,960,213	88,771,297	30.0
TWTPE	MYKUL	2,883,307	271,676,708	94.2
TWKHH	CNPVG	2,707,063	216,922,267	80.1
TWTPE	IDCGK	2,689,838	39,254,144	14.6
TWTPE	USATL	2,663,839	96,937,960	36.4
TWTPE	USSEA	2,634,689	66,799,926	25.4
TWTPE	PHMNL	2,581,861	397,080,873	153.8
TWTPE	CNFOC	2,569,901	1,302,445,327	506.8
TWTPE	CNTAO	2,441,883	81,839,838	33.5
TWTPE	JPNGO	2,418,616	76,639,737	31.7
TWTPE	FRCDG	2,405,816	107,526,045	44.7
TWTPE	LULUX	2,251,963	234,308,459	104.0
TWTPE	AUSYD	2,165,665	151,083,832	69.8

(3) 空運貨物品項之分析部分

從關貿網路公司之資料分析中可知，不管一般進出口貨物或快遞貨，第 16 類貨品「機械用具電機設備、電視影像錄音機」之比重最高，此與民航資料中桃園機場佔總量最多的貨種為「電力與電氣產品」，應有相同之處，而此類貨品之總價值也最高，且遠遠超過其他各類產品。不過，從其他類別之資料顯示，貨量與貨物並沒有直接的關係，以第 18 類貨品「光學照相電影計量檢查儀器，鐘錶樂器」佔進出口快遞貨的總重量雖不高，但其價值排名進出口快遞貨的總價值皆在前三名的位置。

C. Analysis of Air Cargo Items

Data analysis from Trade-Van indicates that the proportion of the 16th category of goods (mechanical appliances, electrical equipment, and television video recorders) was the highest in both general import and export goods and express cargo. This is consistent with civil aviation data, which indicate that the cargo type with the highest total volume at Taoyuan Airport was electric and electrical products. The total value of this category of goods was also the highest and far higher than that of other categories of products. However, data from other categories indicate that shipments and cargo are not directly related. Although the gross weight of the 18th category of goods (optical and photographic film measurement inspection instruments, watches and clocks, and musical instruments) among import and export express cargo was low, the value of this category was in the top three for total value of import and export express cargo.

二、人本永續

(一) 永續發展綠運輸

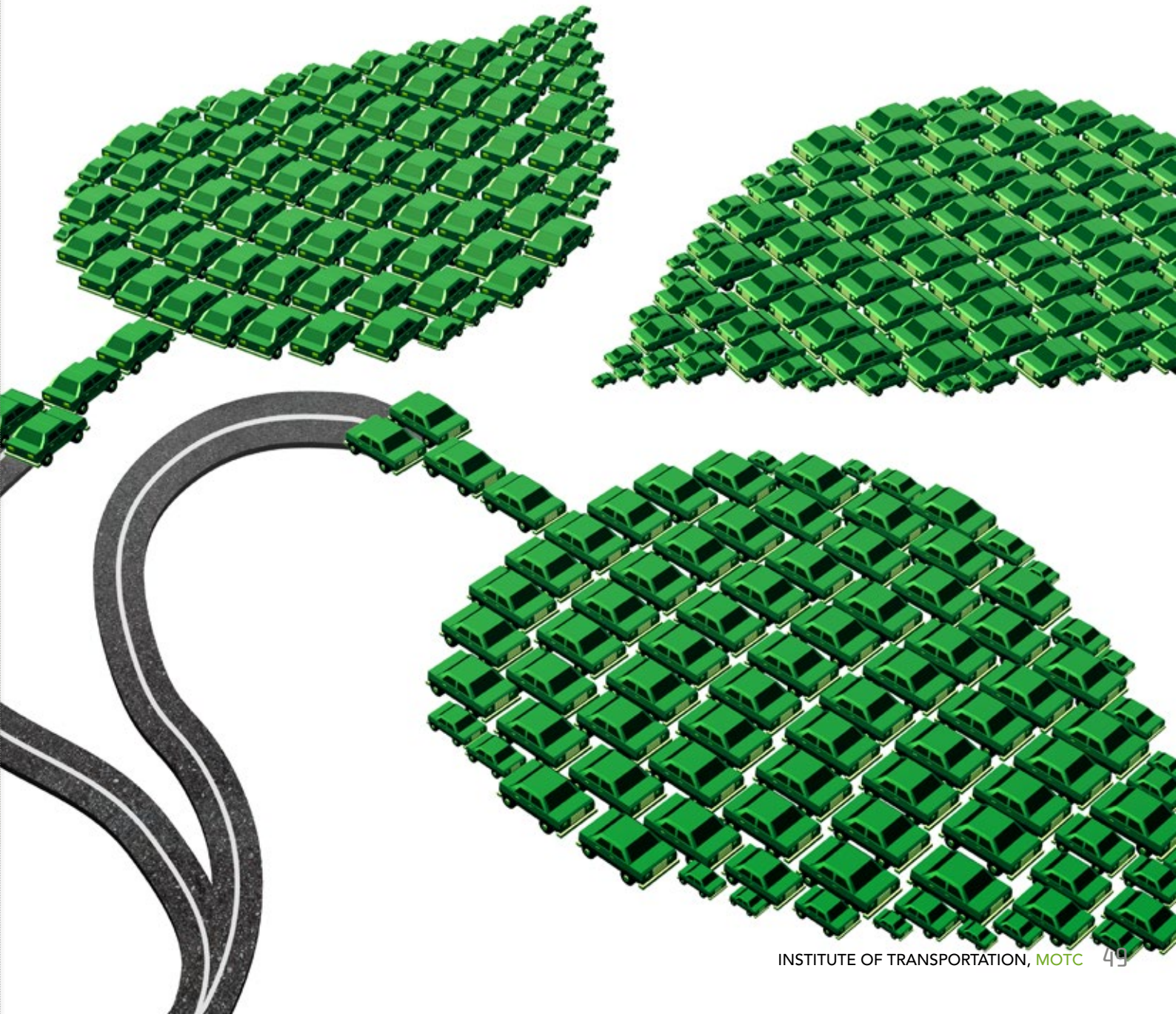
自 1997 年京都議定書通過以來，國際上推動節能減碳以因應氣候變遷的行動即如火如荼的展開。身為國際村的一員，我國配合國際節能減碳發展趨勢，召開三次「全國能源會議」，並配合推動相關行動方案。行政院於 97 年 6 月 5 日第 3095 次院會中通過「永續能源政策綱領」，揭櫫我國二氧化碳排放量於 2025 年要回到 2000 年的水準，並於 98 年 12 月成立「節能減碳推動會」(於 103 年 5 月 20 日更名為「綠能低碳推動會」)，督導落實「國家節能減碳總行動方案」，並於 100 年 9 月訂定各部門之 CO2 排放量管制目標。

▲ 圖 6　我國能源政策發展歷程
Figure 6 Development process of Taiwanese energy policy

2. Humanism and Sustainability

(1) Sustainable Development of Green Transportation

Since the Kyoto Protocol was passed in 1997, energy saving and carbon reduction has been promoted internationally to promote full action in response to climate change. As a member of the international village, Taiwan has held three National Energy Conferences in accordance with international development trends in energy saving and carbon reduction and cooperated in promoting related action programs. During the 3095th Yuan meeting on June 5, 2008, the Executive Yuan passed the Sustainable Energy Policy Program, which aimed to reduce Taiwan's carbon dioxide emissions to their 2000 level by 2025. In December 2009, the Energy Saving and Carbon Reduction Promotion Association (renamed as the Green Energy and Low-Carbon Promotion Association on May 20, 2014) was established to supervise the implementation of the National Energy Saving and Carbon Reduction Overall Action Plan. The association also set CO2 emission control targets for all departments in September 2011.

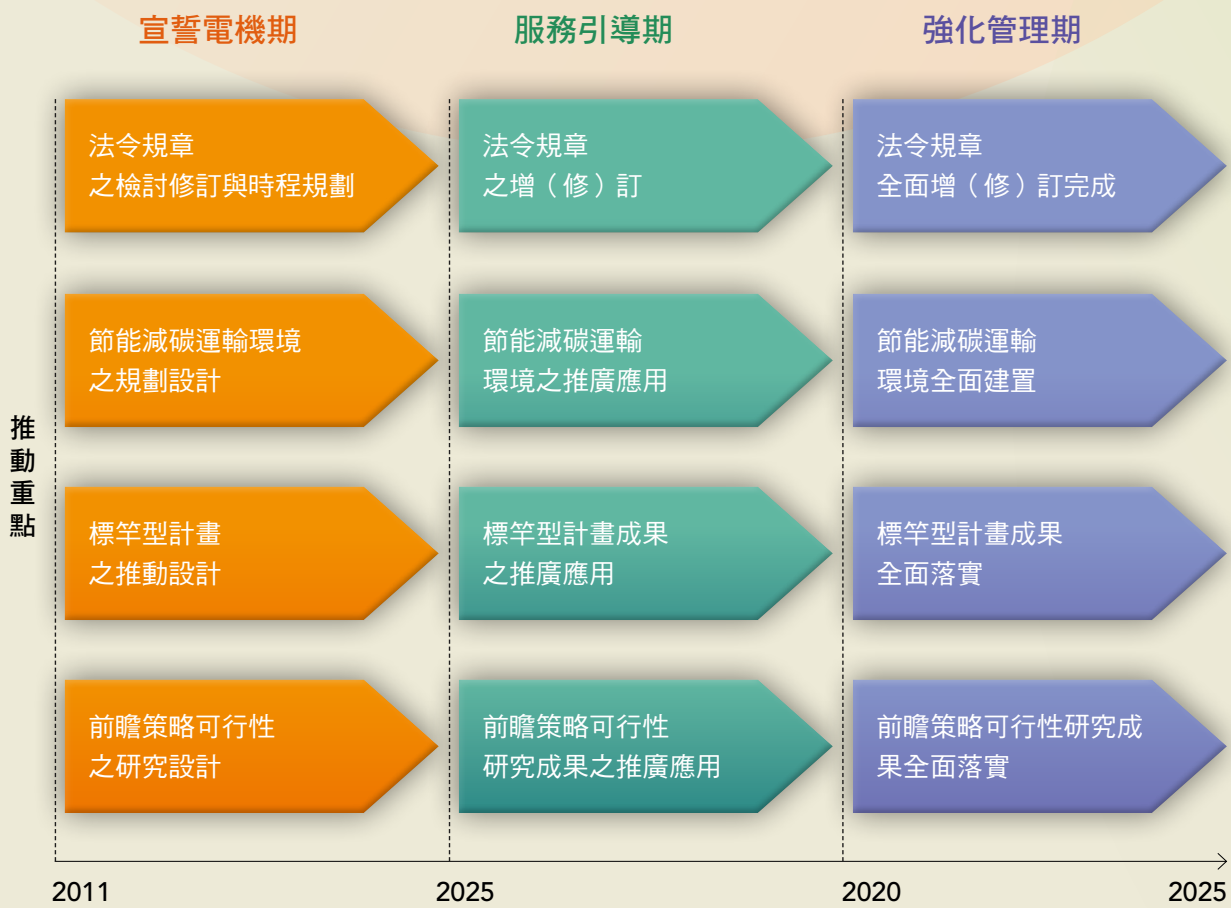


為實踐交通部「推動永續綠色運輸，落實節能減碳政策」之施政方針，本所自 96 年起，已著手建立運輸部門各項節能減碳策略之評估模型，可同時納入經濟、能源策略與措施，以及運輸需求等相關變數，綜合評估運輸部門節能減碳策略與措施之成效，以作為我國運輸部門溫室氣體減量目標與因應策略之政策評估工具。以歷年之研究成果為基礎，本所於 102 年著手開發「運輸部門因應氣候變遷政策決策支援系統」，可針對非運輸部門可改變的外部政策，例如國際原油價格變動、核能政策、能源稅等，以及針對運輸部門設計的節能減碳政策，例如公共運輸票價補貼、汽燃費隨油徵收、電動車補助等策略，進行政策組合評估分析。在此計畫中，並持續維護已建置之「運輸部門能源消耗與溫室氣體排放整合資訊平台」，該平台整合本所「車輛動態能源消耗與溫室氣體排放特性之研究」、「智慧型運輸系統節能減碳與成本效益評估工具暨資料庫之規劃」、「臺灣港埠節能減碳效益提升之研究」及「安全駕駛行為與節能策略之研究」等相關能源科技研究的成果，並提供我國歷年各部門與各運輸系統之能源消耗估算資料，除可供相關專家學者掌握最新的運輸節能減碳相關統計及研究資訊外，同時也是運輸節能減碳政策研究之重要參考依據，亦肩負作為各界專家學者之資訊分享與交流平台之責任。

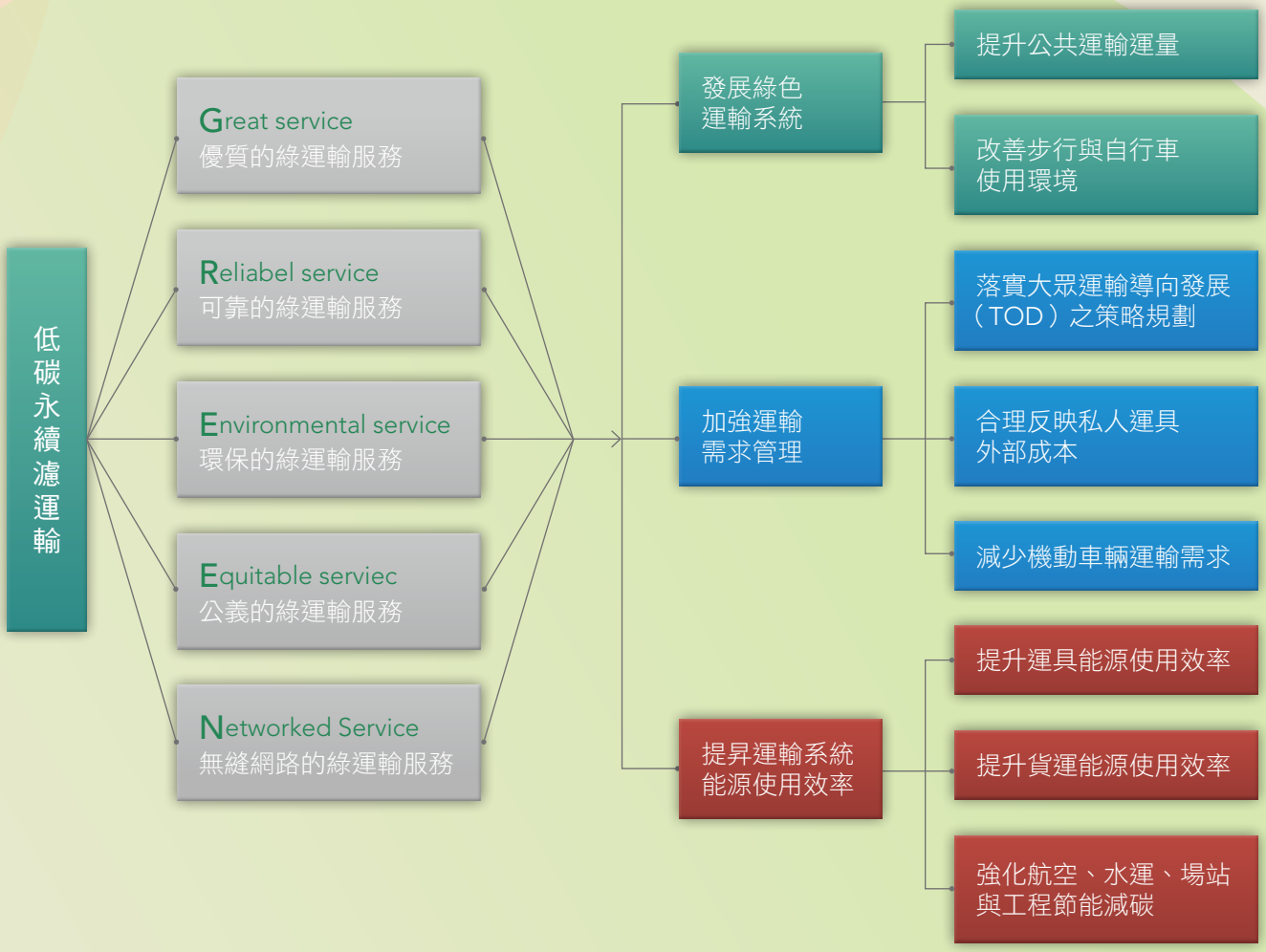
▲ 圖 7　政策決策支援系統介面
Figure 7 Interface of the policy decision support system

To fulfill the MOTC's policy objectives of "promoting sustainable green transportation and implementing energy saving and carbon reduction policy," in 2007, this institute began to establish assessment models for a variety of energy saving and carbon reduction strategies for the transportation sector. These models also include variables related to economics, energy strategies and measures, and transportation demand to provide comprehensive assessments of the effectiveness of energy saving and carbon reduction strategies and measures in the transportation sector. The models serve as policy assessment tools for greenhouse gas reduction targets and coping strategies in Taiwan's transportation sector. Using past research results as a foundation, in 2013 this institute began the development of the Policy Decision Support System for the Transportation Sector to Respond to Climate Change. This system can be used to conduct policy package assessment analysis for changeable external policies outside of the transportation sector, such as international crude oil price changes, nuclear energy policy, and energy taxes, and energy saving and carbon reduction policies designed for the transportation sector, such as subsidies for public transportation fares, taxes based on fuel consumption, and subsidies for electric cars. Within this project, the institute also continues to maintain the established Integrated Information Platform for Energy Consumption and Greenhouse Gas Emissions in the Transportation Sector. This platform integrates research results in energy technology from this institute, such as A Study on Vehicle Dynamic Energy Consumption and Greenhouse Gas Emission Characteristics, The Plan for Energy Saving and Carbon Reduction and Cost-Benefit Analysis Tools and Databases for Intelligent Transportation Systems, A Study on Improving the Effectiveness of Energy Saving and Carbon Reduction in Taiwan's Ports, and A Study on Safe Driving Behavior and Energy Policy, to provide historical estimated energy consumption data for all of Taiwan's government departments and transportation systems. In addition to helping professionals and scholars grasp the newest statistics and research information on energy saving and carbon reduction in transportation, the platform is also an important reference basis for research on energy saving and carbon reduction policies in transportation. The platform also serves as an information sharing and exchange platform for experts and scholars in a variety of fields.

為落實運輸部門節能減碳政策，尋求成本有效的方式推動減量策略，建立運輸部門能源消耗與溫室氣體減量評估模型成為決策之重要工作。「運輸部門因應氣候變遷政策決策支援系統」計畫在　能源國家型科技計畫　之架構下，擔負運輸部門節能減碳決策支援之重要任務，亦為形塑交通部綠運輸政策之重要研究基石。



▲ 圖 8　我國綠運輸發展之階段定位與推動重點
Figure 8 Stage positioning and promotion focuses in the development of green transportation in Taiwan.



▲ 圖 9　我國綠運輸發展策略
Figure 9 Taiwan's green transportation development strategy

To implement energy saving and carbon reduction policies in the transportation sector, cost-effective methods have been sought. The establishment of assessment models for energy consumption and greenhouse gas reduction for the transportation sector is a critical task in decision making. The plan for the Policy Decision Support System for the Transportation Sector to Respond to Climate Change shoulders an important task in supporting energy saving and carbon reduction decisions in the transportation sector under the framework of the National Energy Program. This system is also a major research cornerstone for the formulation of green transportation policy in the MOTC.

(二) 臺灣綠色港埠建置之研究

港埠為國家重要物資及資訊進出的門戶，近十年來，由於全球化經濟體系的影響，加上船舶及港灣科技技術的日益精進，許多以傳統經濟發展為目標之港埠，開始無法面對日趨複雜化的港埠管理及環境議題之挑戰，逐漸面臨轉型或衰退、沒落的命運。往昔，港埠的發展與營運皆以貨物流量的競爭及經濟發展為優先考量，甚少關切生態環境議題，因而港域環境承受大量的船舶進出、貨物裝卸和貨櫃車流等影響，加上港市間頻繁的交通流量，港灣地區往往成為空氣、水質、噪音和底質汙染的對象，不僅嚴重影響環境及生態體系，同時也危害港埠之永續經營及周邊社區的健康發展。

在全球港埠擴張或轉型再生的演進過程中，隨著永續議題的推廣與延伸，建構環境友善之港埠已成為全球各大航運國家重點發展的目標。「綠色港埠」(Green Ports) 或「生態港埠」(Eco Ports) 的概念已成為歐、美、日、澳等全球先進港埠選擇的核心策略和港埠經營的未來趨向。臺灣港埠未來之發展，在提升經濟效益的同時也應調整港埠營運模式及改善港區環境，發展減低污染、提高生物多樣性、復育環境、結合周邊社區利益等多目標的綠色港埠。

(2) A Study on the Construction of Green Ports in Taiwan

Ports are major access portals for materials and information for countries. Over the past ten years, the impact of the globalized economic system and constant progress in ship and harbor technology have made a number of ports targeting conventional economic development unable to face the increasingly complex challenges of port management and environmental issues. These ports are gradually facing restructuring, recession, or decline. In the past, port development and operation gave priority consideration to cargo traffic competition and economic development. Few ports were concerned with environmental issues. Thus, the large numbers of ships entering and exiting, cargo handling, and container traffic have affected port environments. The frequent traffic within port cities has also often made bay areas subject to air, water, noise, and sediment pollution. Not only has this severely affected the environment and ecosystem, but it has also harmed the sustainable management of ports and the healthy development of their surrounding communities.

In the evolutionary process of global port expansion or transformation and regeneration, as sustainability issues are promoted and extended, the establishment of environmentally friendly ports has become the focus of development for major shipping countries around the world. The concept of green or eco ports has become the core strategy selected by advanced ports around the world and a future trend in port operations in Europe, America, Japan, and Australia. In the future development of Taiwan's ports, in addition to improving economic efficiency, the operating models of the ports should be adjusted and port environments improved to develop green ports with reduced pollution, increased biodiversity, and restored environments that integrate the interests of surrounding communities.

為保護海洋，同時增加港埠城市之競爭力，以因應全球港埠環境之發展趨向，臺灣港埠之發展需同時考量營運、環境、經濟社會等不同面向之議題，在規劃國家經濟發展的當下，亦需一併考量環境永續性和社會公義性，藉由港市界面有效的整合，以活絡的港埠活動和環境友善的港埠空間來帶動都市繁榮。冀望臺灣港埠未來的發展能同時兼顧對環境治理的承諾及社區居民的責任，期使臺灣港群邁入「綠色港埠」的嶄新紀元。

「綠色港埠」之研究範圍涉及環境面、技術面、經濟面及政策 / 組織面、對象則包括港埠管理、港埠空間之業者、居民等不同之權益關係人等，本研究以建構台灣綠色港埠為目標，藉由港埠永續規劃、港埠永續建設、港埠永續經營管理及港埠永續社會結構四個面向之論述來建立臺灣推廣「綠色港埠」之架構，期使臺灣國際港埠提昇至世界級之「綠色港埠」。

To protect the oceans and increase the competitiveness of port cities, in response to development trends in global port environments, the development of Taiwan's ports must consider issues on a variety of levels, including operations, the environment, economics, and society. While planning national economic development, environmental sustainability and social justice must also be considered. Through the effective integration of the port city interface, vibrant port activities and environmentally friendly port spaces are used to drive urban prosperity. The future development of Taiwan's ports will hopefully consider both commitments to environmental governance and responsibility toward community residents to allow Taiwan's ports to step toward a new era of green ports.

The scope of research on green ports touches on the environment, technology, economics, and policy/organization. Subjects include port management, the proprietors of port spaces, residents, and people with other rights and interests. In this study, we aimed to establish green ports in Taiwan. We used discourse in the four dimensions of sustainable port planning, sustainable port constructions, sustainable port operation and management, and sustainable port social structures to establish a framework for Taiwan to promote green ports. We hope to upgrade Taiwan's international ports to become world-class green ports.

港埠永續規劃

由港埠整體規劃探討如何減輕對環境的影響，包含港埠環境長期監測之機制，及港式介面空間之改善

- 港埠體檢表
- 港埠規劃操作手冊
- 港埠規劃藍圖
- 港埠親水空間規劃
- 港埠空中攝影
- 港埠動畫展示

港埠永續建設

藉由環境友善及節能之評估架構，整合港埠之水資源、敷地、能源、材料及資源、港埠室內環境等系統，建置港埠環境及人為設施必須符合之準則

- 高雄港埠資料庫
- 永續港埠指標
- 綠色港友善行動方案

港埠永續社會結構

以港埠周邊社區為基礎，提供港埠與社區良好的互動，及促進居民優良的生活品質

- 友善港埠企業自評表
- Eco Port 認證初步研究

港埠永續經營管理

以經營管理模式為基礎，建置「綠色標準經營管理流程」，以達到最低之環境影響

- 社會結構評估模式
- 港埠對社會之影響
- 民眾參與活動
- 各級機關合作機制

1. 港埠永續規劃

包括綠色港埠發展藍圖、分區發展願景及策略、工業遷廠後之棕地復育機制、生態補償機制、港市界面營造、綠色港生態保育及棲地營造策略、港區內聯外運輸道路及不同使用者之動線規劃、分區分期機制、綠色港埠發展永續性之評估指標。

2. 港埠永續建設

包括港埠閒置空間再利用、分區綠色建設之強度規劃、水岸空間之改善、新設廠區空間及綠建築準則、舊廠區空間、設施改善策略及綠建築準則、港區水資源管理計畫、港市綠廊串聯及生物多樣性空間建置、港區環境品質改善。

A. Sustainable Port Planning

This includes green port development blueprints, subdivision development vision and strategy, restoration mechanisms for brownfield lands after industrial relocation, ecological compensation mechanisms, the creation of interfaces for port cities, green port conservation and habitat creation strategies, roads for transportation within and outside of ports and line planning for different users, subdivision staging mechanisms, and assessment indicators for the sustainability of green port development.

B. Sustainable Port Construction

This includes the reuse of vacant space in ports, strength planning of subdivided green construction, improvements to waterfront space, guidelines for new factory spaces and green buildings, old factory space, guidelines for facility improvement strategies and green buildings, harbor water management planning, links to the green corridors of port cities, the establishment of spaces with biological diversity, and improvements to the environmental quality of ports.

港赴永續建設 - 能源及環境設計領導系統 LEED
Leadership in Energy and Enviromental Design, LEED

永續之敷地計畫（Sustainablie Sites）	
SSp1	工程活動之污染防治計畫
SSc1	計畫基地選址
SSc2	發展密度與連結性
SSc3	棕地（Brownfield）再利用
SSc4	替選性交通方案 (包括低排放運具 / 大眾運輸等)
SSc5	基地發展計畫（棲地保護及復育 / 開放空間）
SSc6	暴雨管理
SSc7	熱島效應
SSc8	光害減低
有效之水資源管理（Water Efficiency）	
WEc1	有效性之環境用水
WEc2	創新之污水減量技術
Wec3	總用水量降低
能源及大氣系統（Energy & Atmosphere）	
EAp1	成立能源系統委員會
EAp2	減少能源耗損
EAp3	冷媒管理計畫
EAc1	最佳能源效能
EAc2	現地再生能源使用
EAc3	強化能源系統委員會效力
EAc4	強化冷媒管理計畫
EAc5	能源測量及驗證技術
EAc6	綠能應用

材料及資源（Materials & Resources）	
MRp1	收集可回收之物資
MRc1	保留 / 再利用現有之材料
MRc2	營建廢棄物管理
MRc3	材料再利用
MRc4	使用可回收式材料
MRc5	使用地區性材料
MRc6	使用迅速可再生之材料
MRc7	使用經認證之木材
室內環境（Indoor Enviromental Quality）	
EQp1	最佳室內空氣品質效能
EQp2	環境菸害防制
EQc1	室內空氣流通偵測
EQc2	增加通風
EQc3	建立室內空氣品質管理計畫
EQc4	使用低揮發性材料
EQc5	室內化學物質管理及污染源管理
EQc6	系統控制性（燈光及溫度調控系統）
EQc7	溫度調控之設計及驗證
EQc8	自然光之應用及視覺通透性
創新制度（Innovation in Design）	
IDc1	創新技術及設計
IDc2	計畫具有 LEED 執照之專業人員（LEED AP）

3. 港埠永續經營管理

包括分區綠色港埠之推動機制、航商及企業自發性之推動及獎勵機制、港市空間資料之整合、港區長期監測系統之架構、港市「綠色港埠」發展之推動策略、綠色港埠基礎研究之建置及整合、建立綠色港埠指導方針、災害應變及風險評估、綠色港埠成本效益評估系統。

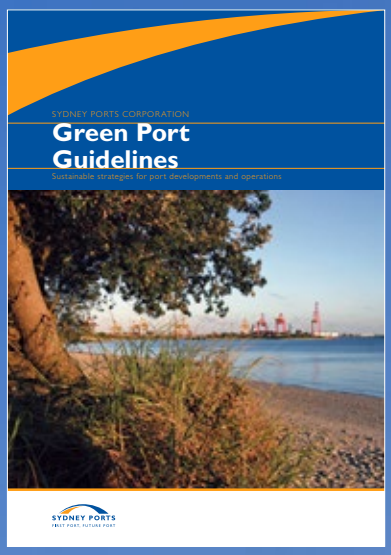
4. 港埠永續社會結構

包括分區風險評估及管理機制、港區多元化社會評估模式、綠色港區社會支援系統、綠色港埠之環境教育計畫、休閒及環境解說系統、社區、學校、團體之參與機制、綠色港埠宣導及互動機制、建置企業社會之責任和提升航運公司及港埠使用者對環境的友善意識。

港埠永續經營管理

制度面

1 管理與營運界線
2 民營化經營挑戰
3 自由貿易港區計畫不易
4 港、市管轄衝突等面向



操作機制面 - [綠色港灣指導方針]（Green Port Guidelines）

1 資源消耗
- 材料選擇
- 廢棄物管理
- 水資源消耗
- 能源使用

2 環境品質
- 室內環境
- 氣體及噪音排放
- 水質
- 土地使用
- 環境管理

港埠永續社會結構

互動參與機制

- 綠色港灣節慶（Green Port Festival）
- 港埠導覽計畫（Let's Talk Port）
- 港埠環境教育計畫
- 港埠環境獎學金機制
- 港埠研究計畫

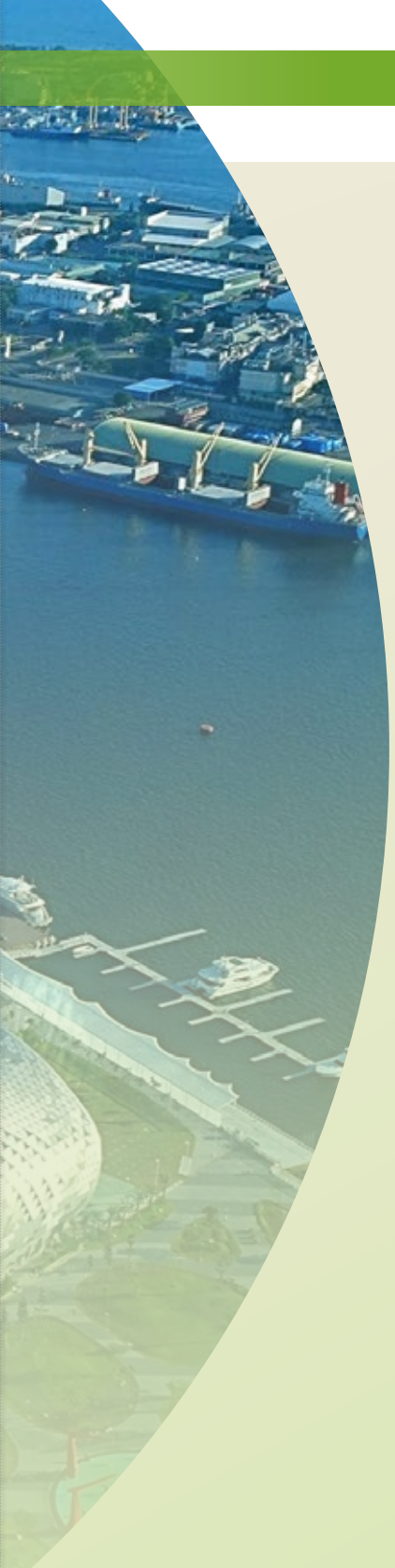
C. Sustainable Port Management

This includes promotion mechanisms for the partitioning of green harbors, spontaneous promotion and reward mechanisms for shipping companies and enterprises, the integration of spatial port city data, the architecture of long-term harbor monitoring systems, strategies for promoting the development of "green ports" in port cities, the establishment and integration of basic research on green ports, the establishment of guidelines for green ports, disaster response and risk assessment, and systems for assessing the cost-effectiveness of green ports.

D. Sustainable Port Social Structures

This includes zoning risk assessment and management mechanisms, pluralistic social assessment models for ports, support systems for green port communities, environmental education planning for green ports, leisure and environmental interpretation systems, community, school, and group participation mechanisms, green port advocacy and interaction mechanisms, establishing corporate social responsibility, and improving the environmental friendliness and consciousness of shipping companies and port users.

綠色港埠的建置為臺灣邁向海洋國家之重要施政項目之一，交通部依據高雄自由貿易及生態港、零碳城市、低碳運輸等上位政策，擬訂「重建國際門戶、提升國家競爭力」及「推動永續綠運輸，符合節能減碳」等施政方向，全面推動交通建設節能減碳之工程。本所配合國家政策進行臺灣綠色港埠的建置研究，計畫執行期間，本所於 102 年 9 月協助高雄港取得了歐洲海港組織所規範的生態港埠第一階段認證，即自我檢視方式 (Self Diagnosis Method, SDM) 認證，成為亞太地區第 1 個獲得歐盟海港組織生態港 SDM 認證之港埠；同期間於 102 年 10 月 29 日至 11 月 1 日，舉辦「2013 綠色港發展研討會」，並邀請歐洲海港組織生態港專家 Prof. Christopher Wooldridge 來台，針對歐盟海港組織生態港第二階段 PERS(Port Environmental Review System) 認證，主持「PERS 認證高階主管講習會」，及為期 3 天的「PERS 認證工作坊」，講授 PERS 港埠環境檢測系統教育訓練課程，邀請航港局、臺灣港務公司及各分公司推派 33 名學員參與訓練，此舉有利於交通部推廣綠港政策及協助高雄港和各港務分公司未來取得 PERS 認證，俾使整體臺灣港埠邁向「綠色港埠」的新紀元，達成和國際生態港標準接軌，提昇臺灣港埠至世界級之「綠色港埠」。



The establishment of green harbors is a critical governance project for Taiwan to become an ocean country. The MOTC has formulated the policy directions of "rebuilding international gateways and enhancing national competitiveness" and "promoting sustainable green transportation to save energy and reduce carbon" based on the top-level policies of the Kaohsiung Free Trade and Ecology Harbor, the zero-carbon city, and low-carbon transportation to promote comprehensive energy-saving and carbon-reducing engineering in transportation construction. This institute conducted A Study on the Establishment of Green Ports in Taiwan in accordance with national policy. During this project, this institute assisted the Port of Kaohsiung in obtaining the first-stage certification of ecological ports provided by the European Sea Ports Organization (ESPO) in September 2013. This was the self-diagnosis method (SDM) certification. The Port of Kaohsiung became the first port in the Asia-Pacific region to obtain the SDM certification for ecological ports from the ESPO. Between October 29, 2013, and November 1, 2013, this institute conducted the 2013 Green Port Development Seminar and invited the ecological harbor expert Professor Christopher Wooldridge from the ESPO to Taiwan to perform the second-stage certification of ecological ports, namely the Port Environmental Review System certification (PERS), and to host the PERS Certification Executive Seminar and the three-day PERS Certification Workshop. Professor Wooldridge gave education and training courses on port environmental monitoring systems. A total of 33 trainees from the Maritime and Port Bureau and Taiwan International Ports Corporation, Ltd. and its branches were invited to participate in training. This measure has helped the MOTC promote green port policy and will assist the Port of Kaohsiung and port branches in obtaining the PERS certification in the future. In this way, Taiwanese ports as a whole can step toward a new era of "green ports," meeting standards for international ecological ports and upgrading Taiwan's ports to become world-class "green ports."

三、節能減碳

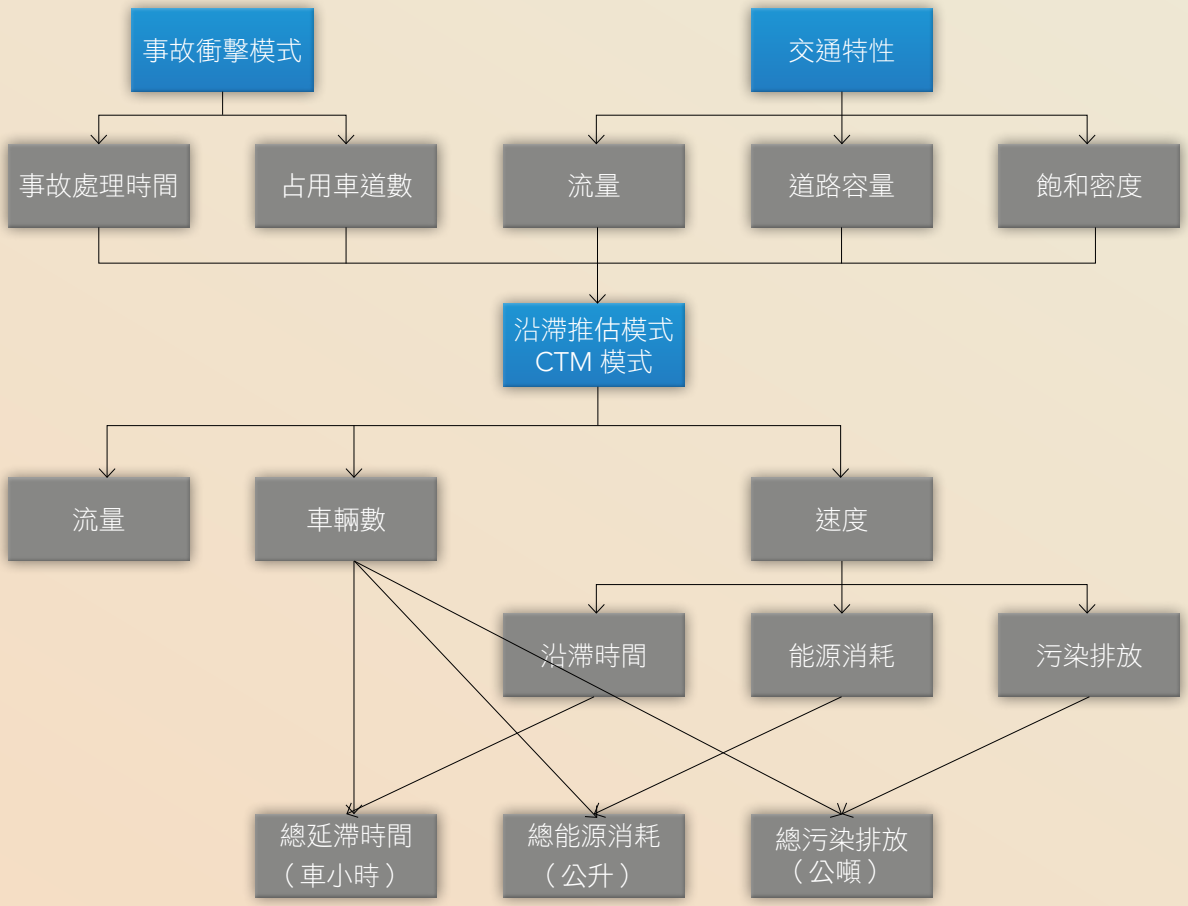
(一) 減少車禍發生也可以幫助地球節能減碳

我們每天去上班、上學、看病、購物等，多需要配合進行搭乘公車、騎機車、駕駛汽車等交通活動。這些交通活動所使用的車輛，或多或少都會消耗能源、排放二氧化碳，而這些交通活動也會產生每個人都不想發生的結果，例如車禍。一旦發生車禍，除了會受傷、死亡，以及車輛受損以外，也會因車禍造成車禍地點附近交通擁塞，以及附近車輛的行駛速度降低或停等 (如圖 10 中所拍攝到的 2 件高速公路車禍地點附近狀況)，而使得這些受阻車輛消耗更多能源、排放更多二氧化碳。因此，為推估車禍對環境的影響程度，交通部運輸研究所以一個系統性的分析架構 (如圖 11)，來整合多個推估模式，包括車禍次數與嚴重程度模式、車禍衝擊模式、車流延滯推估模式，以及車流能耗與排污模式，並透過資料蒐集、文獻彙析、問卷調查及模式推估等程序，建立本土化的模式，以推估在不同交通環境下，發生不同類型車禍所可能對環境產生的衝擊。

100 年 10 月 20 日國 1 泰山收費站公車與小貨車相撞，23 人受傷。(http://www.ettoday.net/news/20111020/2539.htm)

102 年 6 月 24 日國 1 頭份交流道段 2 小客車與 1 工程車相撞，2 人受傷。http://www.appledaily.com.tw/realtimenews/article/local/20130624/215331/applesearch/

▲ 圖 10　高速公路車禍發生時周邊的交通狀況案例
Figure 10 Traffic conditions near highway traffic accidents



▲ 圖 11　車禍衝擊評估模式架構

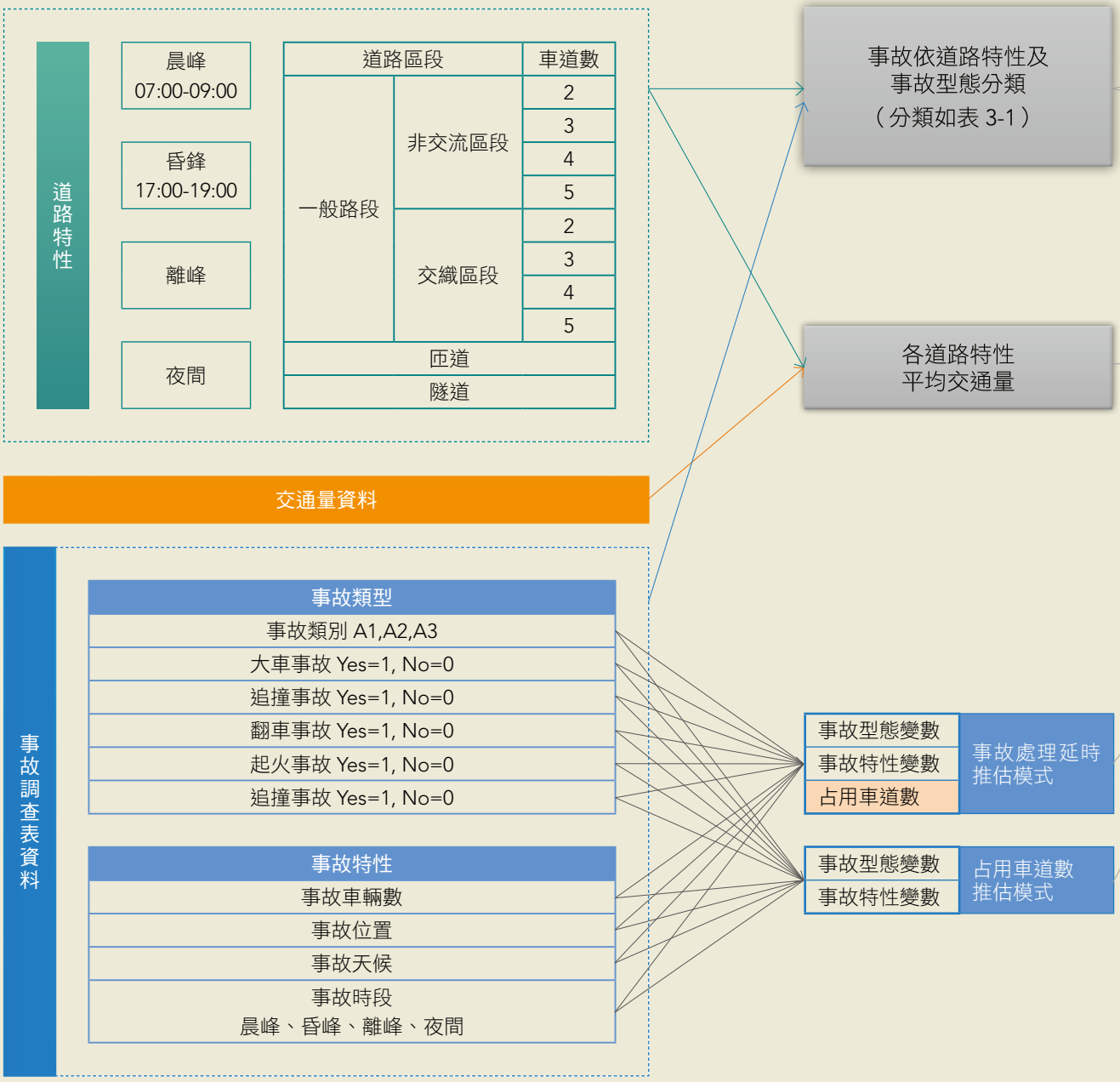
Figure 11 Framework of the accident impact assessment model

3. Energy Saving and Carbon Reduction

(1) Reducing Traffic Accidents Can Help the Planet Save Energy and Reduce Carbon Emissions

When we go to work, school, the doctor, or shopping every day, we must generally engage in transportation activities, such as riding buses and driving scooters and cars. The vehicles used for these transportation activities for the most part consume energy and emit carbon dioxide. These transportation activities also result in undesired consequences, such as traffic accidents. When traffic accidents occur, in addition to injuries, deaths, and vehicle damage, traffic jams occur near the sites of the accidents, and nearby cars slow down or stop (such as the situations near two accident sites on highways pictured in Fig. 1-1). This causes these blocked vehicles to consume more energy and emit more carbon dioxide. Therefore, to estimate the impact of traffic accidents on the environment, the Institute of Transportation, MOTC, used a systematic research framework (Fig. 1-2) to integrate a number of assessment models, including accident frequency and severity models, crash impact models, traffic delay estimation models, and traffic consumption and emission models. The institute collected data, reviewed the literature, distributed questionnaires, and performed model estimation to establish a localized model for estimating the potential impact of various categories of traffic accidents in different traffic environments on the environment.

高速公路在民國 99 年共發生 13,676 件車禍、損失 74 位駕駛者及乘客的寶貴生命、造成 1,525 位駕駛者及乘客受傷。由於發生這些車禍，車禍地點附近的交通擁塞與行車速度降低，而較低的行車速度會產生較多的燃油消耗，以及排放較多的二氧化碳。交通部運輸研究透過模擬估測方式，推估各種不同類型之車禍發生後，可能需要的車禍處理時間，及車禍對道路造成的阻塞狀態，並同時推估車禍周邊可能的交通狀況，然後估測因車禍所可能產生的速度降低狀況，最後再依據推估的速度，計算因車禍而增加的能源消耗及二氧化碳排放數量。透過圖 12 這個模擬模式，未來可以用來評估車禍發生次數因改善而減少時，對環境所產生的效益。



A total of 13,676 traffic accidents occurred on freeways in 2010, with 74 drivers and passengers losing their lives and 1,525 drivers and passengers suffering injuries. These accidents caused traffic jams and reduced speeds in nearby areas. Reduced speeds lead to more fuel consumption and more carbon dioxide emissions. The Institute of Transportation, MOTC, has used simulated estimation methods to estimate accident processing time after various types of accidents occur, the traffic jams caused by accidents, the potential traffic conditions near accidents, and the degree to which accidents reduce speeds. The institute has also calculated the degree to which accidents increase energy consumption and carbon dioxide emissions because of reduced speeds. The simulation model in Fig. 1-3 can be used to estimate the environmental benefits of reducing the number of traffic accidents through transportation improvements.

◂圖 12 高速公路車禍衝擊分析架構

Figure 12 Freeway accident impact analysis framework

▲ 圖 13　高速公路車禍對環境的整體衝擊推估
Figure 13　Estimation of the overall impact of freeway accidents on the environment

依據交通部運輸研究所的研究推估，這些車禍使我們的地球，又多消耗了 16,536,000 公升的燃油，如果以現今油價每公升 34.77 元計算，相當於全國增加超過 5 億元的燃油支出 (如圖 13)。同時，這些車禍也使地球多增加了 37,400,000 公斤的二氧化碳，如果以 1 株 20 年生的林木 1 年約可吸收 11~18 公斤二氧化碳的能力，採平均數 15 公斤計算，相當於全國 1 年需要再增加種植 2,500,000 棵樹。

這些數據代表每發生一件高速公路上的車禍，全國需要因燃油消耗而多付出約 42,000 元、需要再多種約 180 棵樹 (圖 14)。雖然我們每天的交通活動無法避免，但是，車禍是可以不用發生的。請大家一起來維護道路上的行車安全，除了可以保護個人的身家財產安全，也可為保護地球環境盡一份心力。

▲ 圖 14　每件高速公路車禍對環境的衝擊推估
Figure 14 Estimation of the impact of each freeway accident on the environment

Based on research estimations from the Institute of Transportation, MOTC, these traffic accidents increased fuel consumption by 16,536,000 liters. Based on the current oil price of NT$34.77 per liter, this is equivalent to increasing national fuel expenses by more than NT$500 million (Fig. 13). At the same time, these accidents also contributed 37,400,000 kg of carbon dioxide to the world. A 20-year-old tree absorbs between 11 kg and 18 kg of carbon dioxide each year. Based on an average of 15 kg, 2,500,000 trees would have to be added in Taiwan to absorb these emissions within 1 year.

These statistics indicate that a single freeway accident increases fuel consumption by approximately NT$42,000 nationwide and requires planting approximately 180 more trees (Fig. 14). Although our daily traffic activities are unavoidable, accidents need not occur. Everyone must maintain the safety of our roads. In addition to protecting yourself and your property, you can also contribute to protecting the global environment.

(二) 綠色能源 · LED 路燈照明

行政院為使我國得於 10 年內發展成為能源產業大國，並引領臺灣社會邁入低碳化與產業高值化目標，已於 98 年 4 月 23 日宣布啟動「綠色能源產業旭升方案」，其中在 LED 照明方面，已設定在 2015 年成為全球最大 LED 光源及模組供應國，產值達到新台幣 5,400 億元之國家目標。

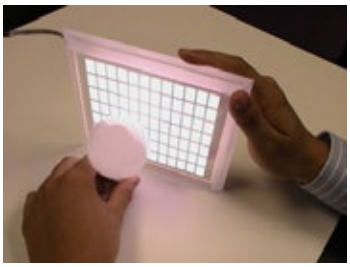
我國路燈多數仍為水銀路燈，數量約 94 萬盞，每年總耗電量超過 9 億度，其發光效率僅 35 lm/W，且有汞污染之問題，不符合目前環保、節能之訴求。目前經濟部能源局透過擴大公共建設應用 LED 照明產品方式，推動 LED 路燈應用示範計畫，97 至 102 年累計推動 28.4 萬盞以上之水銀路燈汰換為 LED 路燈，節能效果可達 60%，每年可節省道路照明用電約 1.8 億度，減少 11 萬噸 CO2 排放量。道路照明主要係提供交通安全、方向識別、減少事故及行人安全等 4 項服務，就交通部所主管之國道與省道而言，可各自區分為平原區、丘陵區、山嶺區及都市計畫區之路線，上開各種道路類型所需之照明需求各有差異。由於 LED 路燈與傳統路燈在光源特性、方向性、演色性、色溫、二次光學、燈桿高度、燈頭重量、維護方式及成本等部分，均有一定程度之差異，因此將對道路照明設計產生極大衝擊。

▼ 圖 15　照明技術演進
Figure 15 The evolution of lighting technology
Data Source: http://www.pida.org.tw

(2) Green Energy—LED Street Lighting

On April 23, 2009, the Executive Yuan announced the launch of the Dawning Green Energy Industry Program to develop Taiwan into a country with a leading energy industry and to lead Taiwanese society toward low-carbon and high-value industry objectives within 10 years. This program has set a goal for Taiwan to become the world's greatest LED light and module supplier by 2015, with output reaching a national target of NT$540 billion.

The majority of streetlights in Taiwan comprise 940,000 mercury streetlights. Their annual total power consumption is more than 900 million kWh. Their luminous efficiency is only 35 lm/W and they pose problems with mercury pollution. They do not comply with current environmental and energy-saving requirements. The Bureau of Energy, Ministry of Economic Affairs, has promoted the application of LED lighting to public construction through demonstration projects. Between 2008 and 2013, more than 284,000 mercury streetlights were replaced with LED streetlights, with energy savings reaching 60%. Approximately 180 million kWh in electricity can be saved every year from streetlights, with CO2 emissions reduced by 110,000 tons. Road lighting supports transportation safety, direction identification, and pedestrian safety and reduces accidents. The national freeways and provincial highways managed by the MOTC can be divided into plains areas, hilly areas, mountainous areas, and urban planning areas. The lighting requirements of these different road types vary. LED road lights differ from conventional road lights in regard to source characteristics, directionality, color rendering, color temperature, secondary optics, light pole height, lamp weight, maintenance methods, and cost. Thus, they will affect road lighting design greatly.



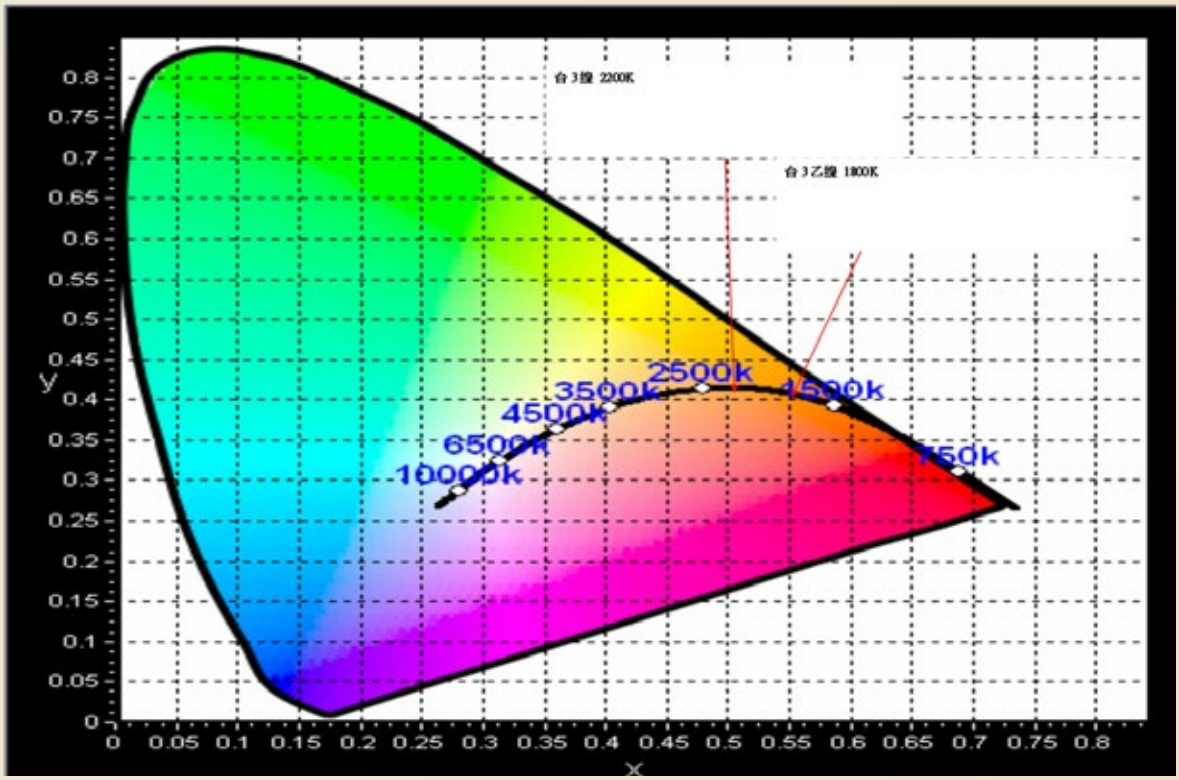
LEDs → OLED Lighting → Flexible OLED lighting

世界各先進國家如美國、日本等，目前均仍以示範建置方式，累積相關經驗，以作為未來全面建置之參考。為配合暨因應經濟部未來 LED 路燈汰換計畫，交通部門如何在兼顧交通安全、節能減碳及照明設備維運管養成本等目標下，預為研擬交通部門相關配合推動作法與配套措施，係刻不容緩之課題。

本研究於 102 年完成 LED 路燈之成本效益初步分析，並規劃 103 年 LED 路燈測試計畫，預計實際點燈測試 6,000 小時，並紀錄分析其實際使用成本效益，做為交通部及經濟部推動 LED 路燈政策之參據。

經現場勘察之後，選擇台 3 乙線作為 LED 路燈驗證測試計畫之地點。台 3 乙線道路幾何條件如后 :

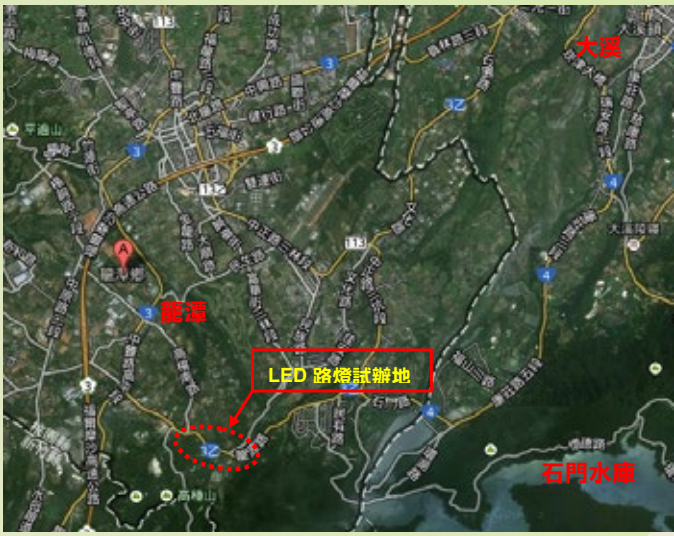
1. 道路屬丘陵區或山嶺區，為雙向四車道。
2. 直線路段約 300 公尺。
3. 交通量不大屬公路總局管養範圍。



▲ 圖 16　現況燈具光源色溫 (CIE 1931)
Figure 16 Current status of lamp source color temperature (CIE 1931)

▲ 圖 17　台 3 乙線 9.5k 處現勘路況

Figure 17 Current road conditions at position 9.5k on Provincial Highway 3B



▲ 圖 18　台 3 乙線 9.5k 處 LED 路燈測試地點

Figure 18 LED streetlight testing position at position 9.5k on Provincial Highway 3B

A number of advanced countries around the world, including the United States and Japan, continue to use demonstration projects to accumulate experience for comprehensive construction in the future. To cooperate with and respond to the Ministry of Economic Affair's LED road light replacement program, the transportation sector cannot delay in formulating promotional methods and supporting measures while considering traffic safety, energy savings, carbon reduction, and the cost of maintaining and operating lighting equipment

Preliminary analysis of the cost-effectiveness of LED streetlights was completed for this study in 2013. A 2014 LED streetlight test project was planned. Actual lighting is expected to be tested for 6,000 hours. The actual cost-effectiveness of usage will be recorded and analyzed to serve as a basis for the promotion of LED streetlight policy by the MOTC and the Ministry of Economic Affairs.

After on-site investigation, Provincial Highway 3B was selected to serve as the site for the LED streetlight verification and testing project. The roads of Provincial Highway 3B have the following geometric characteristics:

1. The roads belong to hilly or mountainous areas. They are bidirectional with four lanes.
2. They have approximately 300 m of straight sections.
3. The volume of traffic is low, falling within the custody of the Directorate General of Highways.

照明系統概況：

1. 採 250W 高壓鈉氣路燈，燈桿高度 7 公尺 (燈具距地約 8 公尺)，懸臂 2 公尺。
2. 每 35 公尺配置一盞，採雙邊交錯排列配置。
3. 燈桿設置位置距車道外側邊緣線左側約 2.8 公尺，左側約 4.0 公尺，懸臂仰角 15 度。

研究進行中辦理 1 場次之交通部門推動 LED 路燈照明學習專家研討會及 1 場次 LED 路燈適用性及未來發展課題研討會，邀請國內照明、道路交通及替代能源等相關學者專家、中央部會及地方政府，就我國 LED 路燈與傳統路燈替代性、適用性與維護性等具體作法、配套措施及管養等內容提出相關建議並凝聚共識。

▼ 圖 19　LED 路燈適用性及未來發展課題研討會實況 1
Figure 19 Seminar on the applicability of LED streetlights and future development issues. Picture 1.

▲ 圖 20　LED 路燈適用性及未來發展課題研討會實況 2
Figure 20 Seminar on the applicability of LED streetlights and future development issues. Picture 2.

Lighting System Overview:

1. 250 W high-pressure sodium vapor streetlights are used. Pole height is 7 m (distance between lamp and ground is approximately 8 m). Cantilever is 2 m.
2. A lamp is installed every 35 m in a bilateral staggered configuration.
3. The distance between the pole installation position and the left edge of the vehicle lane is approximately 2.8 m. The distance to the left edge of the vehicle lane is approximately 4.0 m. Cantilever elevation is 15°.

When conducting this study, a learning expert seminar for promoting LED street illumination in the transportation sector and a seminar on the applicability of LED streetlights and future development issues were held. Domestic scholars and experts on lighting, road traffic, and alternative energy, central ministries, and local governments were invited to propose recommendations and form a consensus on specific practices, supporting measures, and custody regarding the ability of LED streetlights to replace conventional streetlights and their applicability and maintenance.

(三) 機車動態能源消耗與溫室氣體排放特性研究

因應全球氣候變遷，加強管制溫室氣體排放已成為國際趨勢。以往有關車輛能耗或排放模式皆由實驗室觀測值為建構基礎，以定速或法定駕駛行程 (driving cycle) 來量測能耗或排放量。而近年來，動態車載排放量測設備技術成熟，美國與歐盟均採用道路實測資料作為模式建構基礎，且其成果顯示實車量測「瞬時速率」排放較實驗室「平均速率」建構的模式預測能力更為準確。

本所自 96 年起辦理「車輛動態能源消耗與溫室氣體排放特性」系列研究，研究對象迄今計有小客車、大客車及機車等三大類，運用先進動態車載量測設備取得車輛運轉實測資料。研究目的除建立充分反映本土油品、氣候、車輛、道路與用路人各方面特性之能耗 / 排放模式，並與本所多年發展之運輸規劃模式整合，對於運輸部門相關節能減碳之政策評估有極大助益。

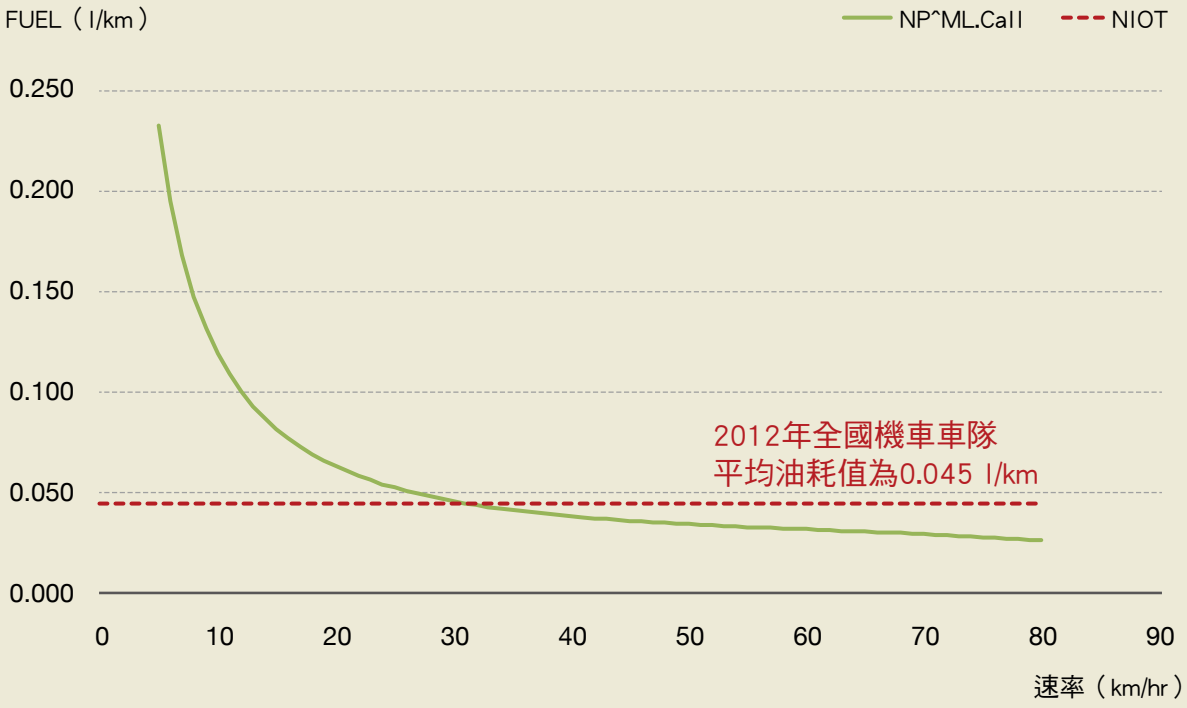
本系列研究辦理過程中，積極努力與國際接軌，以期研究成果與世界先進國家的研究動向及成果一致。依照規劃進程，本所於 101~102 年針對都會地區占比最大的個人交通工具 - 機車進行實車測試與實驗分析，構建機車動態能耗 / 排放推估模式，研究成果對於機車管理有重要貢獻，且有助於提升都會區的節能減碳成效。

(3) A Study on the Dynamic Energy Consumption and Greenhouse Gas Emissions Characteristics of Scooters

In response to global climate change, strengthening the control of greenhouse gas emissions has become an international trend. Earlier models on vehicle energy consumption and emissions have been based on laboratory testing. Constant speeds or legal driving cycles have been used to measure energy consumption and emissions. In recent years, dynamic automotive emissions testing equipment and technology have matured. The United States and the European Union use road measurement data to construct models. The results of these models indicate that "instantaneous speeds" from actual vehicle testing yield emissions results that are more accurate than the predictions of laboratory models constructed with "average speeds" are.

In 2007, this institute began conducting a series of studies called "Vehicle Dynamic Energy Consumption and Greenhouse Gas Emissions Characteristics." Research subjects up to now include small buses, large buses, and scooters. Advanced dynamic automotive measurement equipment is used to capture vehicle operation measurements and data. In addition to establishing energy/emission models that reflect local oil, climate, vehicle, road, and user characteristics fully, these studies also integrate with the transportation planning models developed over a number of years by this institute. These studies will greatly assist the transportation sector in assessing energy saving and carbon reduction policy.

In the process of conducting this series of studies, international standards were pursued vigorously in hope of achieving results in line with the research directions and results of the advanced countries in the world. In accordance with the planning process, real vehicle tests and experimental analysis were performed in 2012 and 2013 on the most common personal transportation tool in urban areas, the scooter. A scooter dynamic energy consumption/emission estimation model was constructed. The results of these studies make an important contribution to scooter management. These results will also facilitate more effective energy saving and carbon reduction in urban areas.



綜整 2 年期的機車研究，具體研究成果如下：

1. 本計畫運用車載量測設備蒐集 5 部機車行駛瞬間之能耗 / 排放資料，近 39 萬筆道路逐秒排放數據，涵蓋不同環保期別、不同車齡的車輛，以及 6 種重要道路類型，並構建速率與耗油量、CO2 排放值曲線與模式，俾利推估機車行駛於各類路型之能耗量與 CO2。
2. 由本計畫蒐集之機車實測資料得知，當環保期別越高、標準趨嚴，其能耗、CO2 排放表現越佳，實驗結果顯示 4 期車較 5 期車耗油多約 2 成。
3. 由本計畫構建之機車動態能耗 / 排放曲線發現，機車行駛速率在 30km/hr 以上部分平緩，在 0~30km/hr 間，能耗隨速率變化明顯 (速率 30km/hr 之燃油效率為 10km/hr 之 2.6 倍)，若能善用交通管理手段使機車維持 30km/hr 以上的速率行駛，將可獲得較佳的節能減碳效果。
4. 本年度以 3 案例進行能耗 / 排放模式之應用探討，各案例及其重要發現包括：

(1) 機車實施怠速熄火之能耗影響：研究調查發現，當機車騎士看到前方號誌為紅燈時，會以低速滑行巡航狀態接近停等區，在安全無虞的情況下，就能耗觀點而言，會比低速加油接近路口省油，而略高於怠速狀況。實驗並發現，若機車駕駛遇到紅燈停等時主動進行「怠速熄火」，總油耗可節省 1/4，可見實施怠速熄火對於降低能耗與 CO2 排放確有助益。此外，研究觀察得知，怠速熄火後車輛再起動瞬間，並無油耗明顯飆高情形。

The two-year scooter study had the following concrete results:

A. This project used onboard measurement equipment to collect instantaneous energy consumption/emissions data from five scooters. Nearly 390,000 pieces of second-by-second on-road emissions data were collected. They covered vehicles of a variety of ages meeting different environmental standards and six major road categories. Curves and models of speed, fuel consumption, and CO2 emissions were established to estimate the energy consumption and CO2 of scooters in different categories.

B. The scooter measurement data collected during this project indicate that scooters that meet newer and stricter environmental standards perform better in energy consumption and CO2 emissions. The experimental results indicate that scooters meeting the stage-four environmental standards consumed approximately 20% more fuel than scooters meeting the stage-five environmental standards did.

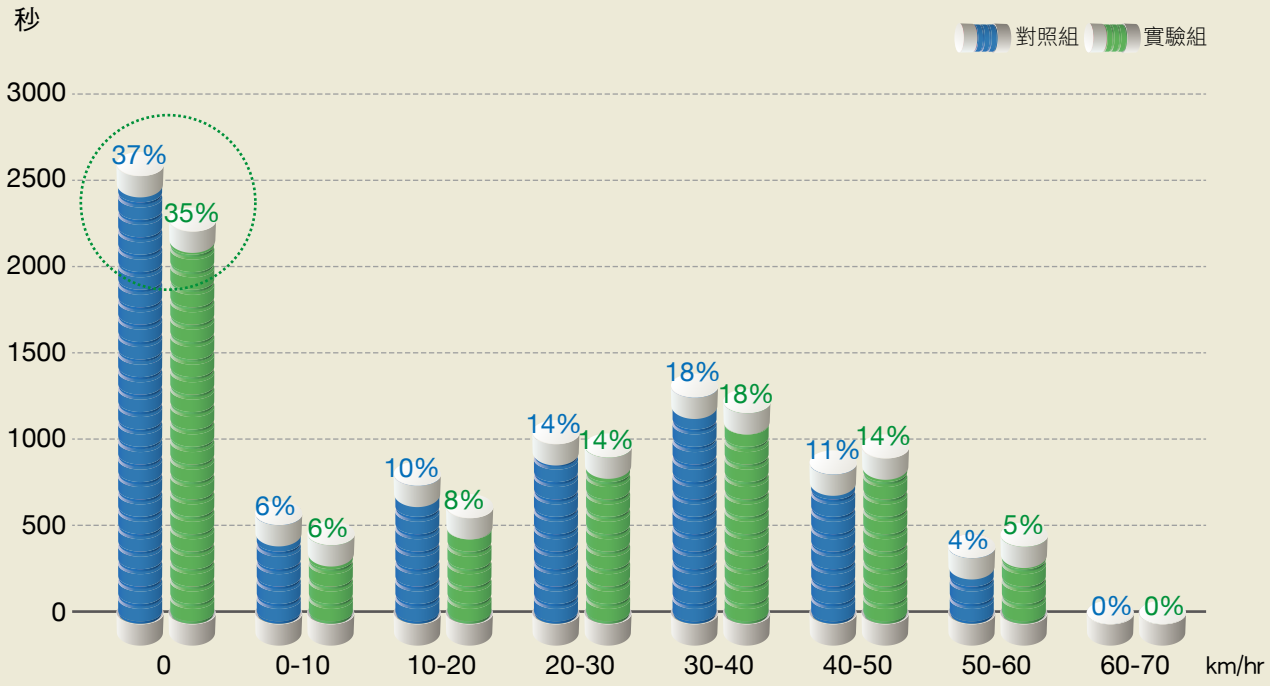
C. The scooter dynamic energy consumption/emission curve established for this project is flat at scooter speeds over 30 km/h. Between 0 km/h to 30 km/h, energy consumption follows changes in speed clearly (fuel efficiency at a speed of 30 km/h is 2.6 times greater than fuel efficiency at 10 km/h). The use of management methods to keep scooters driving at speeds over 30 km/h would result in more effective energy saving and carbon reduction.

D. The energy consumption/emission model was applied to three cases this year. Descriptions of and major findings from each case are as follows:

(A) The influence of implementing start-stop in scooters: This study indicates that when scooter drivers see red lights in front of them, they cruise toward the stopping area at low speeds. In safe and secure situations, from the perspective of energy consumption, this uses less fuel than accelerating toward intersections at low speeds does and slightly more fuel than idling does. The tests indicate that if scooter drivers actively engage in "start-stop" when waiting at red lights, they can reduce total fuel consumption by one-fourth. This shows that implementing start-stop can help reduce energy consumption and CO2 emissions. In addition, the observations of this study revealed that fuel consumption does not increase significantly during the instant when vehicles start again after start-stop.

(2) 不同運具行駛於相同路徑的實際能耗比較：以能耗率來看，機車明顯優於小汽車和市區公車；若納入乘載率以能源密集度的觀點而言，公車的能源密集度最佳，小汽車最差。

(3) 各車種 CO2 排放當量：依據本計畫構建之 CO2 排放推估模式，以臺北市晨峰時段各類型道路交通量為基礎，估算結果發現臺北市機車 CO2 平均排放值為小汽車之 0.46 倍，而國道客運為小汽車之 2.4 倍，市區公車則高達小汽車之 4 倍，此相對值可為各車種 CO2 排放當量之參考。



- 未實施怠速熄火，停等耗油占比達 25%。
- 實施怠速熄火，停等耗油占比僅 8%。
- 實施怠速熄火累積停等約 23 分鐘，耗油節省 0.3 公升（相當於 NT$10）

實施組帶塑熄火實施時機：僅考慮路口號至停等狀況，當遇到需停等 20 秒以上號誌化路口時，駕駛員進行怠速熄火動作，於顯示剩餘 5 秒時，再次起動引擎。

實驗路線：臺北 226 公車路線（三重 - 吳興街）

項目	對照組（無怠速熄火）	實驗組（怠速熄火）
行駛距離 (km)	34	34
停等時間佔比 (%)	37%	35%
熄火時間佔比 (%)	-	23%(23 分鐘)
平均速率 (km/hr)	18.8	20.7
累積耗油量 (l)	1.60	1.19
平均油耗 (km/l)	21.2	28.5
累積 CO_2 排放量（kg）	3.63	2.64
平均 CO_2 排放 (kg/km)	0.1059	0.0765
停等耗油量 (l)	0.40	0.09
停等耗油占比 (%)	25%	8%

臺北市各車種行駛同路線之能耗比較

行駛路線：臺北 226 公車路線（三重 - 吳興街）

	機車	市區公車	小汽車
行駛時間（含停等）	6620 秒 （1.8 小時）	9379 秒 （2.6 小時）	7558 秒 （2.1 小時）
平均速率（km/hr）	18.5	13.1	16.2
燃油效率 (km/l)	21.2	1.8	5.1
能源密集度 （公升油當量 / 延人公里）	0.032	0.031	0.073

註： 平均乘載率採用運研所運輸部門運具排放清冊，大客車（公車 + 客運）17 人、自用小汽車 2.30 人、機車 1.27 人。
臺北捷運能源密集度：0.012（公升油當量 / 延人公里）

- 行駛時間：市區公車 > 小汽車 > 機車
- 燃油效率：機車 > 小汽車 > 市區公車
- 能源密集度：市區公車最佳，小汽車最差

- 以小汽車能源密集度為比較基礎
  捷運：公車：機車：小汽車：=0.16:0.42:0.44:1

(B) Comparison of the actual energy consumption of different forms of transportation on the same routes: Scooters are clearly superior to small cars and city buses in energy consumption. If considering loading rates from the perspective of energy intensity, buses have the best energy intensity and small cars have the worst.

(C) CO2 emissions equivalents for each vehicle type: Based on the CO2 emission estimation model constructed for this project, estimation results using traffic volumes for each type of road during the morning peak in Taipei City as a foundation indicate that average CO2 emissions for scooters in Taipei City are 46% percent of those of small cars. Buses on national freeways had average CO2 emissions 2.4 times higher than those of small cars, whereas city buses had average CO2 emissions 4 times higher than those of small cars. These relative values can be referenced in the CO2 emissions equivalents for each vehicle type.

四、安全與風險管理

(一) 與國際規範接軌，提升航安環境及航運競爭力

海運安全為整體運輸安全中的重要課題，亦為促進臺灣地區整體運輸發展的重要工作項目之一。臺灣四面環海，依賴海運極高，大部分進出口貨物皆依賴海運運輸。但海難事故仍時有所聞，海運安全工作仍有待加強。近年發生海難船舶 (如圖 21-1 至 21-4 所示)，其中，

99.8.8 鋁合金造「海洋拉拉號」客船，搭載 311 名旅客從馬公到臺中途中，疑似受到強風巨浪拍打，造成船艏前跳板進水，約 22：30 返回臺中港，延宕 3 小時 8 名旅客靠岸後，緊急送醫，幸無大礙。

101.3.19 清晨高雄籍「海翔八號」貨船從基隆港載運土石要前往花蓮港，於上午 5 點多在基隆港東北約 9 浬處沉沒，船上 15 名船員 6 死、7 傷、2 失蹤。

103.5.16 韓國「世越號」客船在韓國珍島海域發生沉船事故，船上 476 人中，只有 172 人生還。

103.5.29 日本「聖幸丸」號油輪在日本瀨戶內海之姬路港外爆炸，引發大火，有 1 人失蹤，3 人受傷。事發位置在東京西方，大約 450 公里處，當時船上有 8 名船員，7 個人獲救，1 人失蹤。

▲ 圖 21-1 「海洋拉拉號」客船船艏進水

Figure 21-1 The bow of the passenger ship "Ocean Lala" enters the water.

▲ 圖 21-2 「海翔八號」貨輪沉沒

▲ Figure 21-2 Sinking of the freighter "Ocean Glory"

4.Safety and Risk Management

(1) Meeting International Standards and Improving the Transportation Safety Environment and Shipping Competitiveness

Maritime safety is a major issue within overall transportation safety. It is also an important facet in the development of overall transportation in Taiwan. Taiwan is surrounded by oceans on all sides. It is highly dependent on ocean shipping. The majority of import and export cargo depends on maritime transportation. However, occasional shipwrecks continue to occur. Maritime safety must be strengthened. A number of shipwrecks have occurred in recent years (as shown in Figs. 21-1 to 21-4).

On August 8, 2010, the aluminum passenger ship "Ocean Lala" is suspected to have been struck by strong winds and huge waves while carrying 311 passengers from Magong to Taichung, forcing the springboard in front of the bow into the water. It returned to the Port of Taichung at 10:30 PM, a delay of three hours. After docking, eight passengers were sent urgently to the hospital. Fortunately, no serious injuries occurred.

On March 19, 2012, the Kaohsiung cargo ship "Ocean Glory" left from the Port of Keelung early in the morning carrying debris toward the Port of Hualien. Around 5:00 AM, it sank approximately 9 nautical miles to the northeast of the Port of Keelung. Of the 15 crew members on the ship, 6 died, 7 were injured, and 2 went missing.

On May 16, 2014, the Korean passenger ship "Sewol" sank in the waters of Jindo, South Korea. Of the 476 people on board the ship, only 172 survived.

On May 29, 2014, an explosion occurred on the Japanese oil tanker "Shoko Maru" outside the Port of Himeji in the Seto Inland Sea in Japan, leading to a massive fire. One person went missing and three were injured. The accident occurred approximately 450 km to the west of Tokyo. The ship had eight crew members on board at the time. Seven were rescued and one went missing.

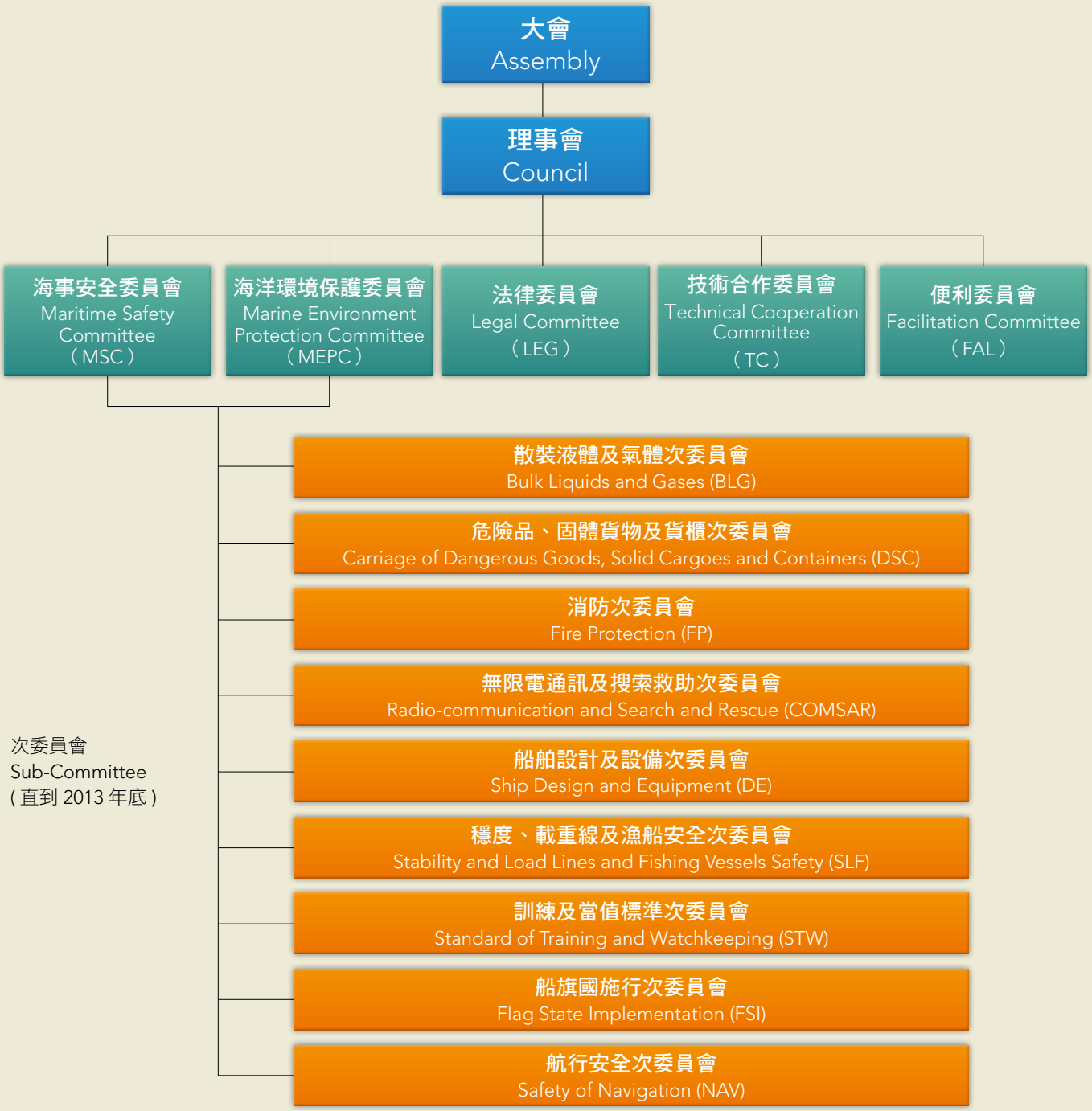
▲ 圖 21-3　韓國「世越號」客船沉沒事故

▲ Figure 21-3 Sinking of the South Korean passenger ship "Sewol"

▲ 圖 21-4　日本「聖幸丸」號油輪爆炸起火

▲ Figure 21-4 The Japanese tanker "Shoko Maru" bursts into flames.

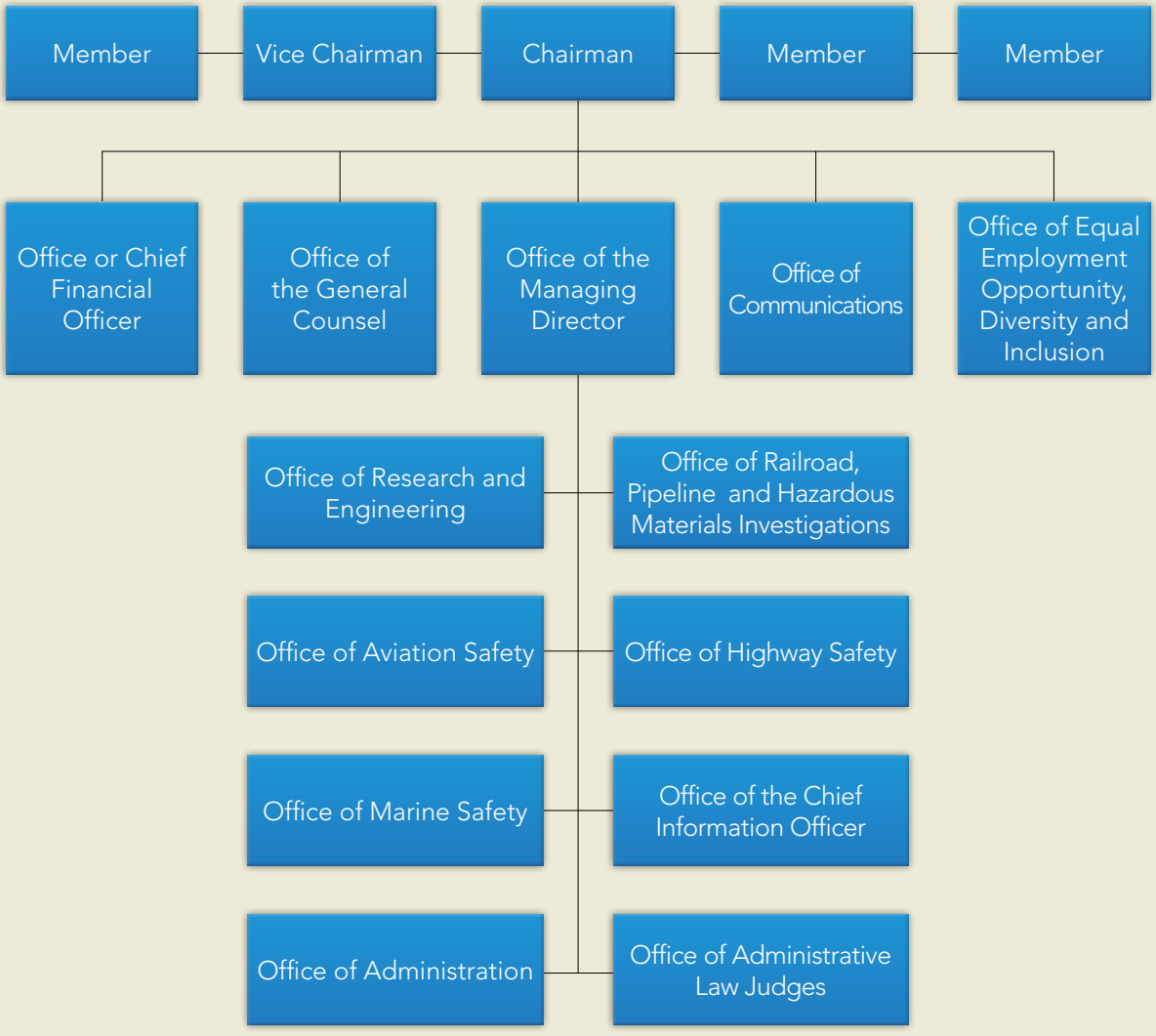
由於我國並非國際海事組織（IMO）會員國，較難和 IMO 達到資訊同步，以即時且完整地取得國際公約資料。但在國內，這些資料對交通部、海事單位、航運業者等皆相當重要。海運具有高度國際性之特性，我國無法自外於國際公約之規範，仍應採行 IMO 通過之公約規範、技術與標準。若能加強 IMO 資訊與國際公約研究，且能儘速提出國內法規改善建議，將有助於提升航安環境及航運競爭力。IMO 組織架構如圖 22 所示。



▲ 圖 22　IMO 組織架構（資料來源：IMO 網站）
Figure 22 IMO organizational structure (Source: IMO Website)

Because Taiwan is not a member of the International Maritime Organization (IMO), synchronizing information with the IMO to obtain timely and complete information on international conventions is difficult. However, domestically, certain data are extremely important to the MOTC, maritime units, and the shipping industry. Maritime transportation is highly international. Taiwan cannot remain outside of the specifications of international conventions and should continue to adopt conventions, specifications, technologies, and standards approved by the IMO. Strengthening research on IMO information and international conventions and swiftly proposing recommendations for improvements to domestic laws and regulations would help improve the maritime safety environment and the competitiveness of maritime shipping. Figure 22 shows the organizational framework of the IMO.

NATIONAL TRANSPORTATION SAFETY BOARD



▲ 圖 23　美國運輸安全委員會組織架構（資料來源：NTSB 網站，http://www.ntsb.gov/about/organization.html）

Figure 23 Organizational structure of the U.S. National Transportation Safety Board (NTSB) (Source: NTSB website, http://www.ntsb.gov/about/organization.html)

海事安全調查為海運安全議題中不可或缺之一環，IMO 於 2008 年 5 月採納 MSC.255（84）決議案通過「海上事故或海上事件安全調查國際標準及建議做法章程（CI Code）」，並納入「海上人命安全國際公約（SOLAS）」第 XI-1 章，且已於 2010 年 1 月 1 日生效實施。海事安全調查章程要求海事安全調查工作的獨立性，明確指出其目的係為防止將來類似事故之發生，而「劃分過失或確定責任」不是海事安全調查的目的，並強調海事安全調查應分離並獨立於其他類型（如民事、刑事或行政）的調查。我國現行之海事調查制度除不具獨立性，且主要業務為行政 / 監理調查，亦包括海損評議，與 IMO 對於海事安全調查之要求存在不小之差異性。美國、加拿大、英國、日本及澳洲等代表性先進國家之海事安全調查制度皆以 IMO 所要求之模式實施。

本研究成果可提供政府有關部門具前瞻性之政策參考建議，並可供交通部航政司、航港局、臺灣港務公司、學界、業界參採及應用。研究成果重點摘要如下：

1. 近年來國際間對於海上人命與財產之安全，以及對海洋環境保護之要求日益提高。為配合此要求，國際海事組織亦不斷從事這方面之研究與發展，不僅對現有之公約作大幅度之修正，且推陳出新制訂了許多之新規則或公約，希藉由各國之簽署締約共同遵守。

2. 在我國海運相關法規體系中，對於涉及國際事務部分為能符合國際公約之要求，並因應國際公約之頻仍修訂，遂於國內有關法規附則中訂定以「委任立法」方式條文，使航政主管機關（交通部）得參照有關國際公約之規定，就本法未規定且涉及國際事務者，採用施行之，俾使其能與國際公約相互配合，作為權宜之因應措施。但此種做法尚未能達到完全之周延性，且公約很多明定留待政府決定的規定，如國內航線船舶、使政府滿意的做法等，就無法源依據來執行。最好的方式應是將 IMO 相關規定轉換成我國法規，另還要考量法律保留原則，如對於涉及人民權利義務（例如罰責等）及政府組織部分則需立法規範。總之，對於國際間在航行安全管理諸多規定與要求，應以適當國內法規予以規定為宜。

Marine safety investigations are indispensable to the issue of safety in maritime transportation. In May 2008, the IMO adopted Resolution MSC.255 (84), which passed the Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation [CI] Code). The IMO also adopted Chapter XI-1 of the International Convention for the Safety of Life at Sea (SOLAS), which took effect on January 1, 2010. The marine safety investigation charter demands independence in marine safety investigations and clearly indicates that the purpose of such investigations is to prevent similar accidents from occurring again in the future. "Dividing fault or determining responsibility" is not the purpose of marine safety investigations. Instead, the charter emphasizes that marine safety investigates should be separate and independent from other types of investigations (such as civil, criminal, or administrative). In addition to lacking independence, the primary tasks in Taiwan's marine investigation system are administrative/supervisory investigations, including marine damage appraisals. Significant discrepancies exist between Taiwan's system and the IMO in regard to requirements for marine safety investigations. The marine investigation systems of a number of representative advanced countries, such as the United States, Canada, the United Kingdom, Japan, and Australia, are implemented in accordance with the IMO requirements.

The results of this study can be referenced by relevant government departments in prospective policy policies. They can also be referenced and applied by the MOTC's Department of Navigation and Aviation, the Maritime and Port Bureau, the Taiwan International Ports Corporation, Ltd., academia, and the industry. Highlights from the results of this study are as follows:

1. In recent years, international requirements for the safety of human life and property at sea and marine environmental protection have been increasing. The IMO has continually engaged in research and development directed at these requirements. Not only has it made substantial amendments to existing conventions, but it has also formulated new rules and conventions for countries around the world to sign and follow.

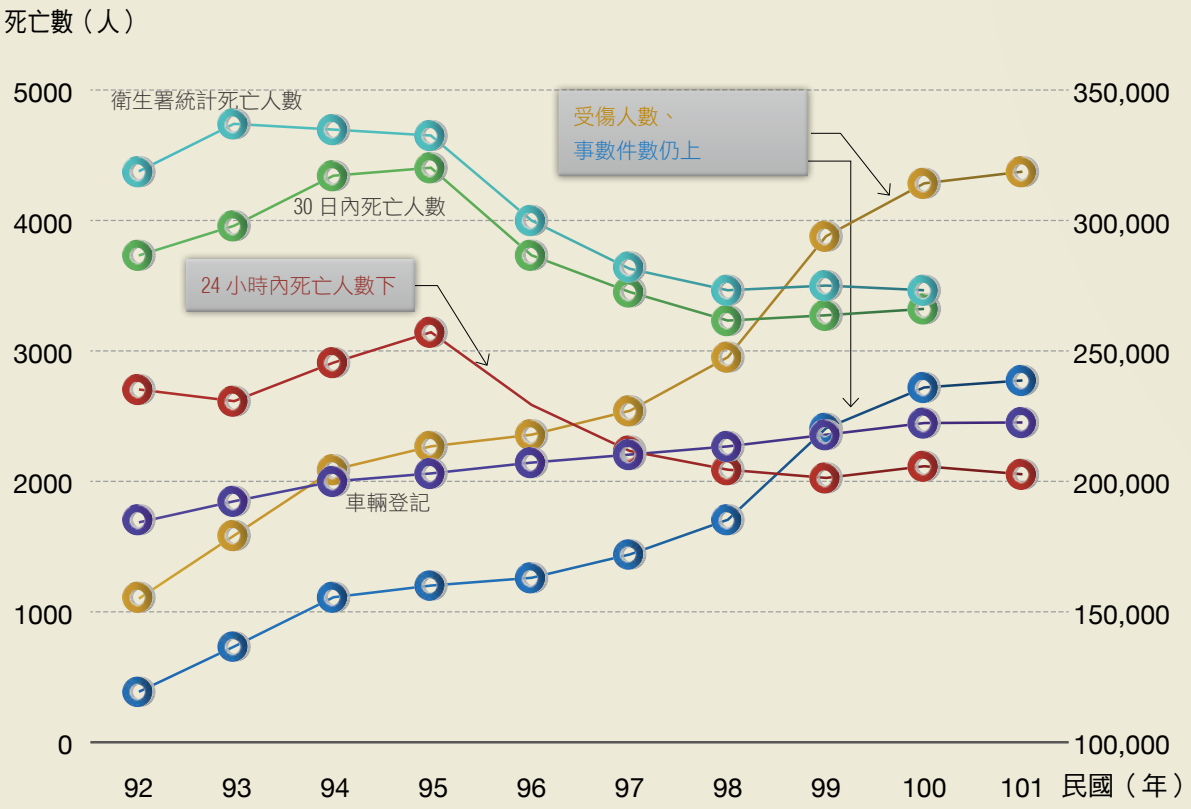
2. Within Taiwan's marine regulatory system, in regard to international affairs, to meet the requirements of international conventions and respond to their frequent revision, related domestic supplementary regulations have set provisions through the method of "delegated legislation," allowing the shipping administration authority (the MOTC) to reference the stipulations of relevant international conventions regarding international affairs not provided by Taiwanese law. The implementation of delegated legislation is an expedient response measure for Taiwan to cooperate with international conventions. However, this method cannot achieve complete distribution. In addition, a number of conventions stipulate that regulations are left for governments to decide. For example, ships on domestic routes and methods of satisfying the government have no legal basis for execution. The best method of accomplishing this is to convert IMO provisions into Taiwanese law. The principles of legal reservation must also be considered. For example, legislative norms for people's rights and obligations (such as penalties) and government organizations are also necessary. In summary, numerous international regulations and requirements for navigational safety management should be stipulated as domestic laws.

3. 為健全海運安全法規體系，幾年前已有進行研究與推動之「海上交通安全法草案」應可將我國諸多有關海運安全規定予以整合，並且適合作為尚未依循國際要求實施事項、缺乏法源授權事項，以及法源設定合適性存在疑義事項之母法，以完善我國之海運安全法規制度。最初的海上交通安全法草案係由交通部運輸研究所於 2004 年提出。而後交通部以此為基礎進行調整，且於 2008 年完成其修正版。本研究更新調整修正部分條文內容，草擬提出更新版「海上交通安全法建議草案」，可供主管機關參採。

4. 為能達成 IMO 海事安全調查目的，與國際（CI Code、各代表性先進國家等）接軌，落實海事安全調查功效，且配合 IMO 預計於 2016 年 1 月 1 日生效實施之強制性會員國稽核機制（該機制將海事安全調查列為重要項目之一），我國應需推動建立具獨立性之海事安全調查制度。而考量我國對於海事行政 / 監理調查與評議並沒有專門性的立法，亦無法源授權執行。因此討論我國海事調查制度之改善應同時兼顧兩個面向，其一為推動建立具獨立性之海事安全調查制度；其二則為建立海事行政 / 監理調查與評議之法源。

3. To improve the maritime safety regulatory system, several years ago studies were conducted and a draft of the Maritime Traffic Safety Law was promoted to integrate Taiwan's numerous provisions on maritime safety. These are appropriate for use in the future implementation of international requirements, matters lacking authorization in sources of law, and parent laws for which the appropriateness of legal sources are dubious to improve Taiwan's maritime safety rules and regulations. The initial draft of the Maritime Traffic Safety Law was proposed by the Institute of Transportation, MOTC, in 2004. The MOTC subsequently used proposal as a foundation and made further adjustments, completing the revised version in 2008. This study updates, adjusts, and revises the contents of a number of the provisions to draft and propose an updated draft of recommendations for the Maritime Traffic Safety Law for the reference of the authorities.

4. To achieve the goals of the IMO marine safety investigation, coordinate with international (CI Code, representative advanced countries) standards, implement effective marine safety investigations, and coordinate with the mandatory member state audit mechanism (this mechanism will list marine safety investigations as important tasks) anticipated by the IMO to take effect on January 1, 2016, Taiwan must promote the establishment of independent marine safety investigation systems. Considering Taiwan's lack of specialized legislation on marine administrative/supervisory investigations and appraisals, it has no legal sources to authorize execution. Therefore, discussions of improving Taiwan's marine investigation systems must consider two dimensions: first, the promotion and establishment of an independent marine safety investigation system, and second, the establishment of legal sources for marine administrative/supervisory investigations and appraisals.



▲ 圖 24　我國整體道路交通事故趨勢
Figure 24 Overall trends in road traffic accidents in Taiwan

（二）重新面對與反省．機車交通安全管理

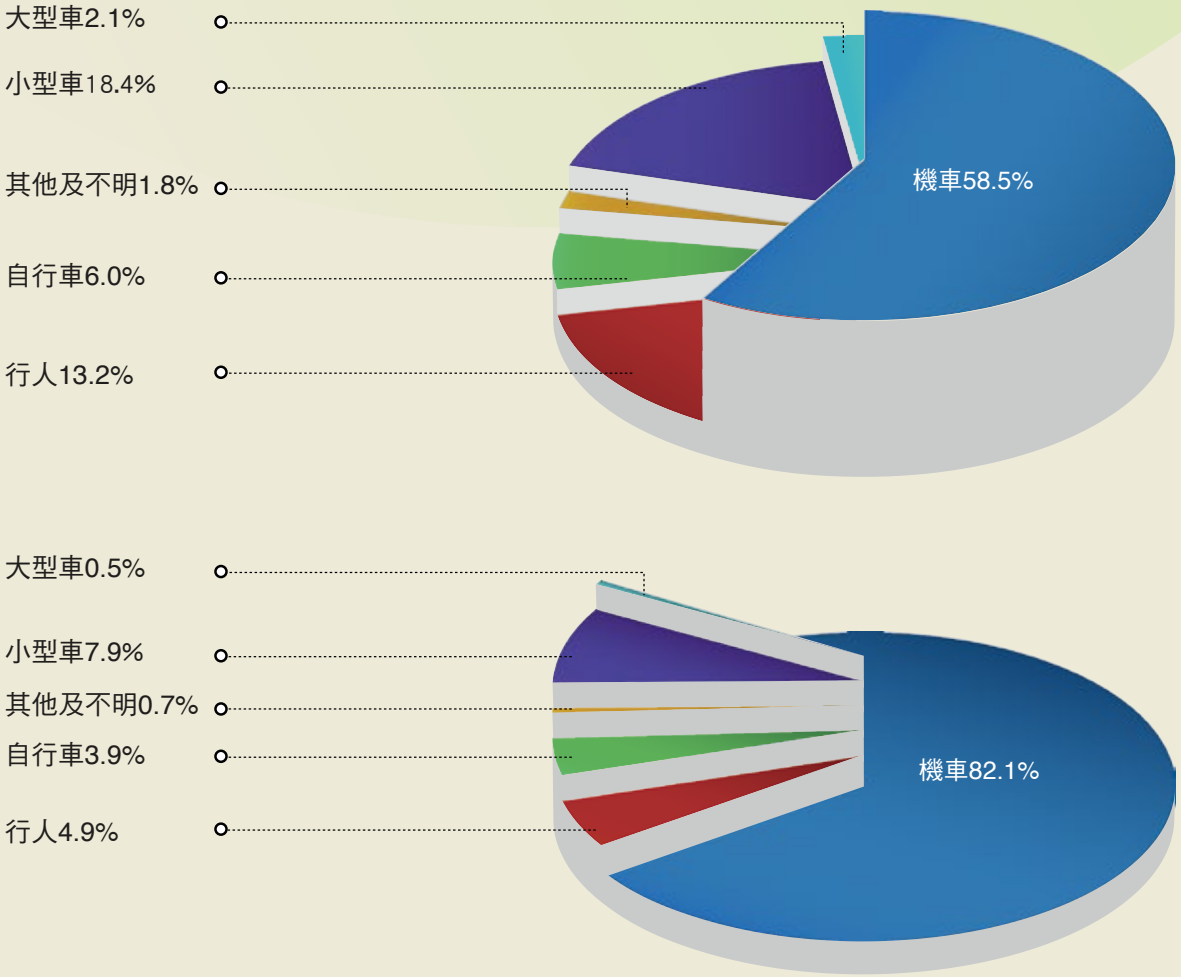
聯合國推動 2011-2020 年為「道路安全行動十年」，國際上許多先進國家均訂定長期道路安全改善目標，包括「零死亡願景」計畫的推動，以持續提升道路安全績效，改善道路交通安全已是全球性的運動。

圖 24 為我國整體道路交通事故趨勢，近年來死亡人數雖呈下降趨勢，但受傷人數及事故件數仍持續攀升，初估道路交通事故累積之全年事故成本占我國 GDP 約 1%-3%，損失十分巨大，其中機車使用者事故傷亡情形最為嚴重，圖 25 顯示近 10 年交通事故死亡人數中機車平均近 60%，受傷人數中機車更超過 80%，顯示國內道路交通安全問題的關鍵，在於改善機車安全。

(2) Facing and Reflecting on Scooter Traffic Safety Management Again

The United Nations has designated 2011 to 2020 as the "Decade of Action for Road Safety." A number of advanced countries have formulated long-term goals for improving road safety, including the promotion of the Vision Zero program, to increase road safety performance. Improving road traffic safety has become a global movement.

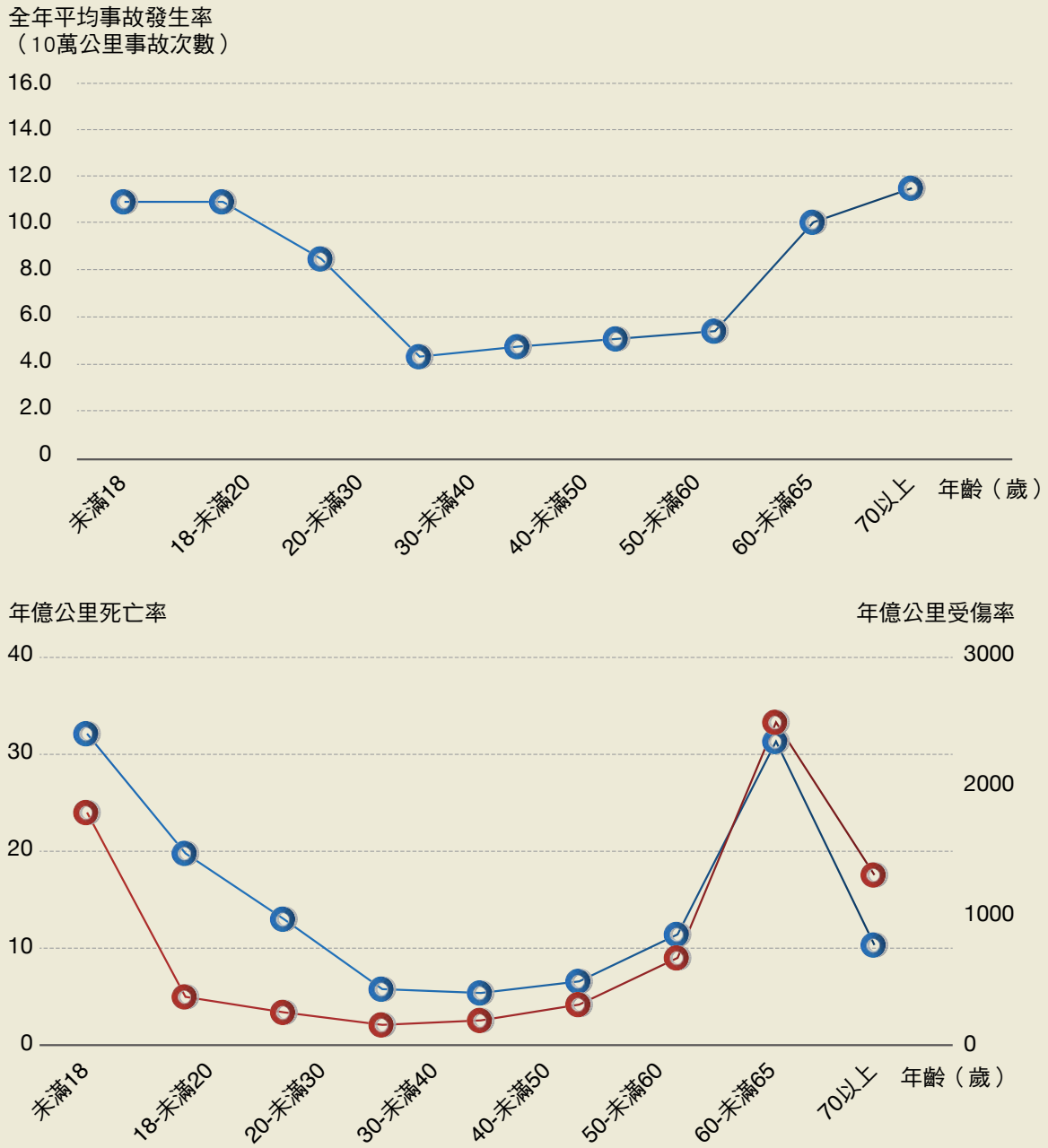
Figure 24 shows the overall trends in road traffic accidents in Taiwan. In recent years, although the number of deaths has tended to decrease, injuries and accidents continue to grow. Preliminary estimates indicate that the cumulative annual cost of road traffic accidents is approximately 1% to 3% of Taiwan's GDP. This is a substantial loss. Scooter users suffer the most severe casualties in accidents. Figure 25 shows that over the past 10 years, scooters are involved in nearly 60% of fatal crashes, and more than 80% of all injury crashes. This indicates that the key to domestic road traffic safety lies in improving scooter safety.



▲ 圖 25　92-101 年各運具使用者死亡及受傷占率

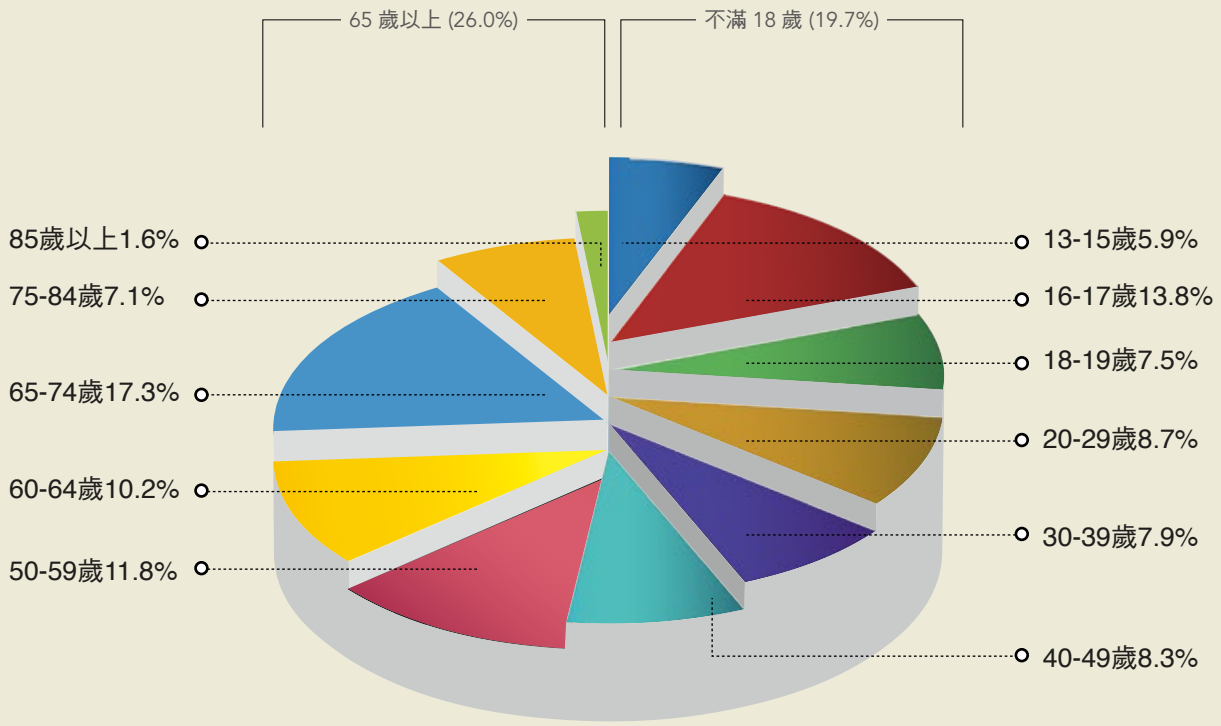
Figure 25 Percentage of death and injuries for which each mode of transportation accounted between 2003 and 2012

機車安全問題相當複雜，圖 26 顯示不同年齡層事故風險，無論是機車事故發生率或事故嚴重度，均以 30 歲以下年輕人及 65 歲以上老年人為主要 2 大高風險族群，其事故發生率最高、死傷率也最嚴重。未注意車前狀況、未依規定讓車為死傷事故的 2 大主要肇因。機車死亡事故中，撞路樹 / 電桿、路上翻車 / 摔倒等單一機車事故占 31.6%，與他車碰撞則以小客車 (35.4%) 及大貨車 (23.0%) 為主。值得注意的是，高齡者無照駕駛問題亦相當嚴重，圖 27 機車死亡事故中，65 歲以上無照者合計占所有無照者之 26%，為具考照年齡資格者中平均每歲之無照死亡機車駕駛人數最高的族群。



▲ 圖 26　不同年齡層之相對事故風險比較

Figure 26 Comparison of relative accident risk at various age levels



▲ 圖 27　無照死亡機車駕駛人之各年齡層占率
Figure 27 Age levels of unlicensed scooter drivers among fatalities

The problem of scooter safety is extremely complex. Figure 26 shows the risk of accidents at different ages. The main two high-risk groups were youths under the age of 30 and seniors over the age of 65 for both scooter accident frequency and accident severity. These two groups had the highest frequencies, casualty rates, and severity. The two main causes of accidents leading to casualties were not noting the vehicle in front and not yielding in accordance with regulations. Among fatal scooter accidents, hitting trees/utility poles along the road, vehicles rolling/falling on the road, and other single-vehicle accidents accounted for 31.6%. In regard to collisions with other vehicles, collisions with passenger cars (35.4%) and large trucks (23.0%) were the primary categories. It is worth noting that the problem of seniors driving without licenses is serious. Figure 27 shows that in fatal scooter accidents, the unlicensed drivers above the age of 65 constituted 26% of all unlicensed drivers. Compared to the percentage of the unlicensed scooter drivers to eligible licenses in all age-groups, the unlicensed scooter drivers above the age of 65 is the worst one.

以上分析可知，改善機車安全為改善國內道路交通安全刻不容緩的首要工作，依據行政院頒布「第 11 期道路交通秩序與交通安全改進方案」，騎乘機車事故防制已列為重點項目之首，交通部運輸研究所配合交通部政策，進行「機車交通安全管理行動方案」之規劃，從建立遠景、目標，以及技術之行動方案層面，作為支援交通部頒布「運輸安全白皮書」，在機車安全施政之推動方案。

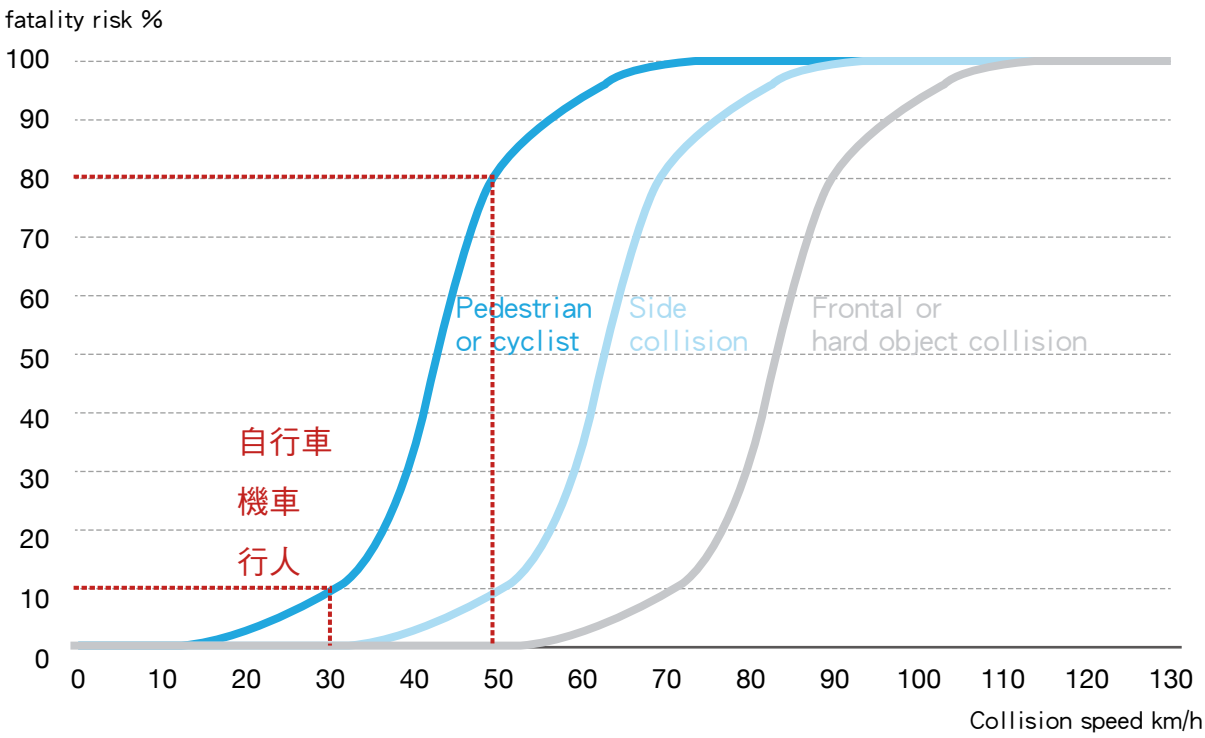
本研究提出行動方案的架構如圖 28，主要以「機車交通安全管理」為核心，所涉層面除工程、執法、教育宣導等 3E 措施外，亦包含監理、法規制度層面，甚至包括建立民眾認知機車本身之脆弱性以降低不必要使用之安全文化層次上。

▲ 圖 28　機車交通安全管理行動方案架構
Figure 28Framework of the action plan for scooter traffic safety management

The analysis above indicates that improving scooter safety is an urgent task in improving road traffic safety in Taiwan. According to the 11th Phase of the Road Traffic Order and Traffic Safety Improvement Order promulgated by the Executive Yuan, scooter accident prevention has been listed as the most important project. The Institute of Transportation, MOTC, has in coordination with MOTC policy conducted the Scooter Traffic Safety Management Action Plan, establishing visions, objectives, and technological action plans to support the White Paper on Transportation Safety promulgated by the MOTC. This is a promotion program for scooter safety policy.

Figure 28 shows the framework of the action plan proposed in this study. The core of this plan is "scooter traffic safety management." In addition to the 3E measures of engineering, law enforcement, and education and advocacy, the plan also involves supervision, rules and regulations, and establishing a safety culture in which people recognize the vulnerability of scooters to reduce unnecessary use.

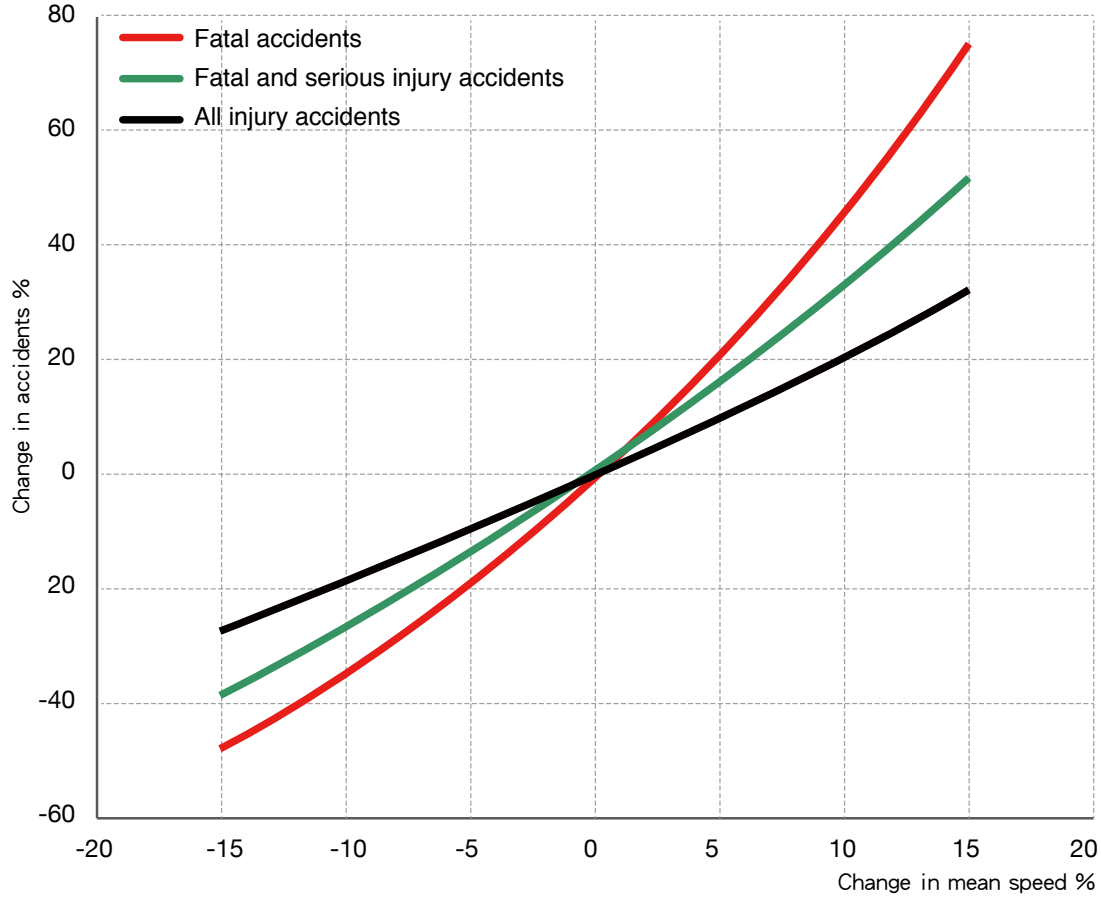
行動方案提出另一核心概念為「速度管理」。依據 OECD 研究報告指出，一旦發生撞擊，速度愈快死亡率也愈高。圖 29 顯示，由於行人、自行車及機車之保護性差，當撞擊速度由 30kph 增加至 50kph，人員死亡的機率會由 10% 大幅增加至 80%；圖 30 則顯示，當行車速度增加 5%，將增加所有傷亡事故件數將近 10%，並增加死亡事故件數 20%；反之，當行車速度減少 5%，將減少所有傷亡事故件數將近 10%，並減少死亡事故件數 20%。可知對於事故防制，「速度管理」居關鍵核心地位。因此，對於機車安全管理策略，必需將機車速度管理概念加入監理、教育及宣導、交通工程、執法等改善措施，以減少機車發生事故之機率及嚴重性。



▲ 圖 29　行車速度與事故致死率關係
（資料來源：“Towards Zero, Ambitious Road Safety Targets and the Safe System Approach”, OECD/ITF (International Transport Forum), 2008.）

Figure 29　Relationship between driving speed and accident fatality rate
(Source: “Towards Zero, Ambitious Road Safety Targets and the Safe System Approach,” OECD/ITF (International Transport Forum), 2008)

The action proposes another core concept: "speed management." An OECD research report has indicated that when collisions occur, mortality rates increase with speeds. Figure 29 shows that pedestrians, bicycles, and scooters have poor protection. When impact speed increases from 30 kph to 50 kph, the probability of death increases substantially from 10% to 80%. Figure 30 shows that when driving speeds increase by 5%, the number of all accidents with casualties increases by nearly 10% and the number of fatal accidents increases by 20%. In contrast, when driving speeds drop by 5%, the number of all accidents with casualties decreases by nearly 10% and the number of fatal accidents decreases by 20%. This indicates that speed management plays a critical role in accident prevention. Therefore, scooter safety management strategies must include the concept of scooter speed management along with supervision, education and advocacy, traffic engineering, law enforcement, and other improvement measures to reduce the probability and severity of scooter accidents.

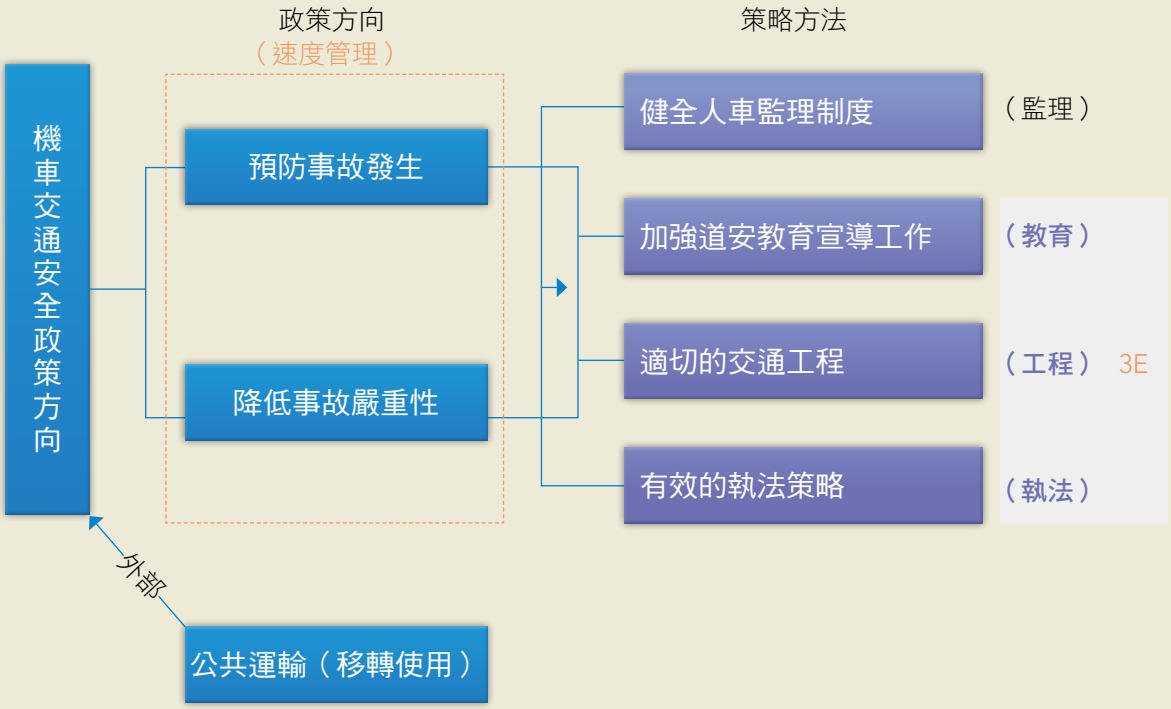


▲ 圖 30　行車速度增減對於發生交通事故之影響
（資料來源："Speed Management"，OECD/ECMT (European Conference of Ministers of Transport),2006）

Figure 30 The influence of changes in driving speed on traffic accidents
(Source: "Speed Management," OECD/ECMT (European Conference of Ministers of Transport), 2006)

由於機車之車輛加速度快、操控靈活，其行駛速度與行向常不易規範，年輕族群在駕駛經驗與自我安全行為控制不足，往往增加發生事故與嚴重度之風險；而人口高齡化速度快，公共運輸及安全步行條件尚未完整建立，目前許多高齡者以騎機車作為中短途之交通方式，亦為一大隱憂；另機車車體安全設計有其極限情況下，對乘員之保護性差，一旦發生交通事故往往導致嚴重後果；同時，部分交通工程設計以增加運行效率為主要考量，亦可能造成汽、機車衝突而犧牲整體安全。經過各面向課題的分析，研提機車交通安全管理政策方向與策略架構如圖 31，並進一步提出 4 大具體改善策略與措施內容如各表。

最後在行動方案推動機制方面，建議結合交通部道路交通安全督導委員會運作，以發揮協調、經費補助引導及定期檢討執行成果之功效。同時建議透過定期揭露各縣市機車安全相關指標，長期觀察執行成效，並調整執行策略，以達最終改善目標。



▲ 圖 31　機車交通安全管理政策方向與策略架構
Figure 31 Policy directions and strategic framework for scooter traffic safety management

Because scooters are nimble and accelerate quickly, their driving speeds and directions are often difficult to regulate. Young people are lacking in driving experience and control of safe behaviors, which often increases the risk of traffic accidents and their severity. In addition, the population is aging rapidly. Public transportation and safe walking conditions have yet to be established thoroughly. A number of seniors currently use scooters as modes of transportation for medium and short distance. This is a major concern. Scooter safety design offers little protection to passengers in extreme cases. When traffic accidents occur, they often lead to serious consequences. At the same time, some traffic engineering design is intended primarily to increase operating efficiency. This may lead to conflicts between cars and scooters, sacrificing overall safety. Analysis of a number of related topics has been performed to propose the policy directions and strategic framework for scooter traffic safety management shown in Fig. 31 Four concrete improvement strategies and measures have also been proposed, as shown in the tables below.

Finally, in regard to mechanisms for promoting the action plan, the integration of the operations of the Road Traffic Safety Committee, MOTC, is recommended for coordination, subsidy guidance, and regular review of the outcomes of implementation. Regular exposure of scooter safety indicators from each county and city is also recommended for long-term observation of the effectiveness of implementation and for adjusting implementation strategies to achieve ultimate improvement objectives.

策略一：健全人車監理制度
Strategy 1: Improving the Driver and Vehicle Supervision System

駕駛資格管理 Driving License Management	考照與訓練制度 Licensing and Training System	違規矯正 / 再教育 Violation Correction/ Reeducation	車輛及設備安全 Vehicle and Equipment Safety
1. 取消取得汽車駕照允許騎乘輕型機車規定 1. Canceling provisions that obtaining car licenses allows riding light scooters.	1. 檢討輕型機車考照規定 1. Reviewing testing provisions for light scooters	1. 強化道安講習對機車違規駕駛之矯正教育 1. Strengthening remedial education on scooter driving violations in road safety workshops.	1. 檢討機車安全納入常態管理 1. Including reviews of scooter safety in normal management.
2. 研議不適駕駛駕照管理退場機制 2. Deliberations on mechanisms for inappropriate driving license management	2. 檢討機車考照內容及項目 2. Reviewing scooter licensing content and items.	2. 強化職業駕駛人與機車安全互動之再教育 2. Strengthening reeducation on safety interactions between professional drivers and scooters.	2. 研議導入更安全、更穩定的車輛型式 2. Deliberations on introducing safer and more stable vehicle types.
	3. 建立普通重型以下機車駕駛訓練機制 3. Establishing driver training mechanisms for scooters of normal weight and below.		

策略二：加強道安教育及宣導
Strategy 2: Strengthening Road Safety Education and Advocacy

學校之交通安全教育 Traffic Safety Education in Schools	家庭、社會之交通安全教育 Traffic Safety Education in the Home and Society
1. 深化扎根學校交通安全教育 1. Deepening the roots of traffic safety education in schools.	1. 加強交通安全宣導，提升安全文化 1. Strengthening scooter speed and traffic order management.
2. 加強高中職及大專院校機車交通安全教育及宣導 2. Strengthening scooter traffic safety education and advocacy in high schools, vocational schools, colleges, and universities.	2. 強化高齡者機車交通安全宣導 2. Strengthening scooter traffic safety advocacy for seniors.
	3. 加強車廠及一般企業之社會責任 3. Strengthening the social responsibility of automakers and general businesses.

策略三：適切的交通工程
Strategy 3: Appropriate Traffic Engineering

合理分配行駛空間 Rational Allocation of Driving Space	家以道路及交通工程手段改善機車安全 Using Road and Traffic Engineering Methods to Improve Scooter Safety
1. 適當運用汽機車分流及混流策略 1. Appropriate use of car and scooter diversion and mixing strategies.	1. 加強機車速度及行車秩序管理 1. Strengthening scooter speed and traffic order management.
2. 研究汽機車混合行駛特性與管理方式 2. Researching the driving characteristics and management methods of car-scooter mixing.	2. 強化機車於交岔路口之安全性 2. Increasing scooter safety at intersections.
3. 檢討機車行駛原則之法規合宜性 3. Reviewing the regulatory propriety of scooter driving principles.	3. 減少機車於路側行駛之風險 3. Reducing the risk of scooters driving on the sides of roads.
	4. 提高道路鋪面平整度及防滑性 4. Increasing the smoothness and skid resistance of road pavement.

策略四：有效的執法策略
Strategy 4: Effective Enforcement Strategies

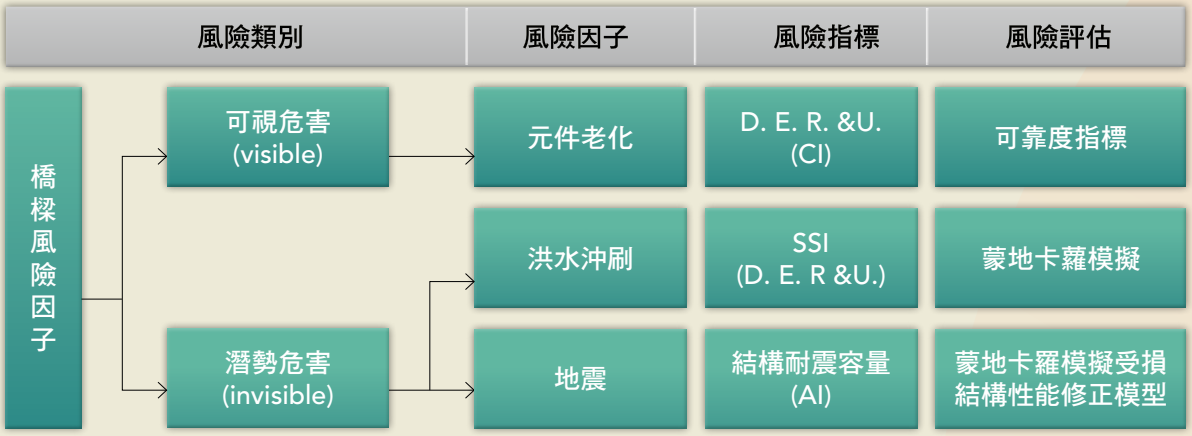
防制機車之高危險駕駛行為 Preventing High-Risk Driving Behavior From Scooters	提升機車執法的有效性 Increasing the Effectiveness of Scooter Law Enforcement
加強防制機車酒駕等高危險駕駛行為 Strengthening the prevention of scooter drunk driving and other high-risk driving behaviors.	改善動態違規 (如未依規定變換車道等) 之執法技術 Improving enforcement techniques for dynamic violations (such as failing to change lanes).
各縣市針對地區特性，擬定執法重點 Developing enforcement priorities based on the regional characteristics of counties and cities.	交流觀摩各執法單位執行成效良好之策略或作法 Exchanging and observing the implementation of effective policies and methods in law enforcement units.

八篇前瞻議題報導

(三) 橋梁殘餘壽齡與保全評估決策模式之研發

港灣橋梁飽受天然災害侵害，造成橋梁損壞及安全疑慮。如何評估現有橋梁健康度與提升橋梁壽齡是迫切的課題，國內現行檢測作業多以可視老化為主，對於地震、耐洪等潛勢危害較少著墨。要維護橋梁使用安全無虞除了定期檢測維修外，診斷橋梁健康度的評估維護模式亦非常重要。為了驗證預測模式，本研究針對 3 座橋梁之現地調查結果，進行細部評估分析後，其結果與橋梁維修預測模式相近。由於同一橋梁在不同時間點執行維護下，有不同之效益，即維修方案執行後使設施保持堪用狀態或延續壽命的程度可能會有所差異，在考量公路橋梁管理單位維護經費有限情形下，管理單位必須決定維修時間使橋梁維修經費運用達到最佳化。本研究使用共生生物演算法，加入生命週期成本導向之概念建置「橋梁維護策略最佳化模式」，將同時考量各橋梁所評估之現況及風險程度，推估未來橋梁壽齡及狀態，進而輔助公路管理機關針對單一橋梁進行維修時機及經費估計，依不同橋梁現況有效投入經費進行維護與補強工作。在施政上，本研究成果可提供交通部、橋梁管理機關在研擬橋梁維護與補強策略之參考。在實務上，可在有限維護經費下達到最佳經濟效益，節省橋梁管理機關維護補強經費。

本研究首度將風險類別分為可視危害 (visible) 與潛勢危害 (invisible)2 部份，如圖 32 所示。其中可視危害主要考量元件老化風險因子，其風險指標為平時經由目視檢測評估法 D.E.R.&U.(Degree, Extent, Relevancy, Urgency) 求得之狀況指標 (Condition Index, CI) 值，風險評估採用蒙地卡羅模擬求得可靠度指標。而潛勢危害則包括洪水沖刷與地震 2 因子，洪水沖刷採用沖刷穩定指標 (Scouring Stability Index, SSI) 值作為風險指標，在風險評估方面則採用蒙地卡羅模擬不同重現期之洪水事件，以求得橋梁因洪水造成損傷之機率。地震風險指標將使用考慮材料劣化影響之結構耐震容量 (Ay 及 Ac)，同樣應用蒙地卡羅模擬生命週期地震事件，再結合受損結構性能修正模型來評估因地震累積損傷影響之風險。



▲ 圖 32　橋梁風險評估
Figure 32 Bridge risk assessment

(3) Research and Development on Decision Models for Residual Life and Preservation Assessment for Bridges

Harbor bridges are affected deeply by natural disasters, leading to bridge damage and safety concerns. Assessing the health of existing bridges and improving bridge life are pressing issues. Current domestic testing operations focus more on visible aging and less on potential disasters, such as earthquake and flood resistance. To maintain safe and secure bridge use, in addition to regular testing and maintenance, assessment and maintenance models for judging the health of bridges are also critical. To verify the forecasting model, this study conducted detailed evaluation and analysis of on-site investigation results from three bridges. The results were similar to those of the bridge maintenance forecasting model. Because performing maintenance on the same bridge at different times results in varying effectiveness, the degree to which the usage states of facilities are maintained or the extent to which their lives are extended after executing maintenance programs may vary. The funding available to road and bridge management units for maintenance is limited. Management units must decide maintenance times that allow them to optimize their use of bridge maintenance funding. This study used symbiotic organism search (SOS) with the addition of life-cycle cost-oriented concepts to establish a bridge life cycle maintenance strategy optimization model (BMSOM). This model considers the assessed conditions and risk levels of bridges to estimate the bridges' future life and status. These estimations will help road management authorities estimate the times and costs of maintaining single bridges and invest funding based on different bridge conditions effectively to conduct maintenance and reinforcement. In regard to policy, the results of this study can be referenced by the MOTC and bridge management authorities in formulating strategies for bridge maintenance and reinforcement. In regard to practice, optimal economic benefits can be reached with limited maintenance funding, conserving maintenance and reinforcement funding for bridge management.

In this study, risks were first categorized into "visible" and "invisible," as shown in Fig. 1. The risk factors of component aging were concerned for the visible risks. The risk indicator was the condition index (CI), which is generally obtained through the visual inspection assessment method Degree, Extent, Relevancy, Urgency (D.E.R.&U.). Monte Carlo simulation was used to obtain reliability indicators for risk assessment. Two factors were adopted for the invisible risks: flood erosion and earthquakes. The scouring stability index (SSI) was adopted for flood erosion to serve as a risk indicator. In regard to risk assessment, Monte Carlo simulation was used with flood events with different return periods to obtain the probability of floods leading to bridge damage. The earthquake risk indicator was structural seismic capacity in consideration of the influence of material deterioration. Monte Carlo simulation was used to simulate lifecycle earthquake events. Structural damage was integrated to revise the model and assess the risk of the cumulative impact of earthquake damage.

依據前一階段所確認之風險因子，本階段評估各風險因子造成橋梁損壞維修之機率。根據前步驟所確立之橋梁風險因子，計算橋梁風險成本 E(Cost)，如圖 33 所示。E(Cost) 同時考量老化、洪水、地震風險下之維修成本 (Maintenance Cost) 以下簡稱 E(MC)，與橋梁在未維修狀態下須承受可能損害之重建成本 (Rebuilding Cost) 以下簡稱 E(RC)，亦即橋梁因地震或洪水造成可能損害之重新興建成本。

$$E(COST) = \overbrace{E(MC)}^{\text{風險下維修成本}} + \overbrace{E(RC)}^{\text{損害重建成本}}$$

▲ 圖 33　橋梁風險成本
Figure 33 Bridge risk costs

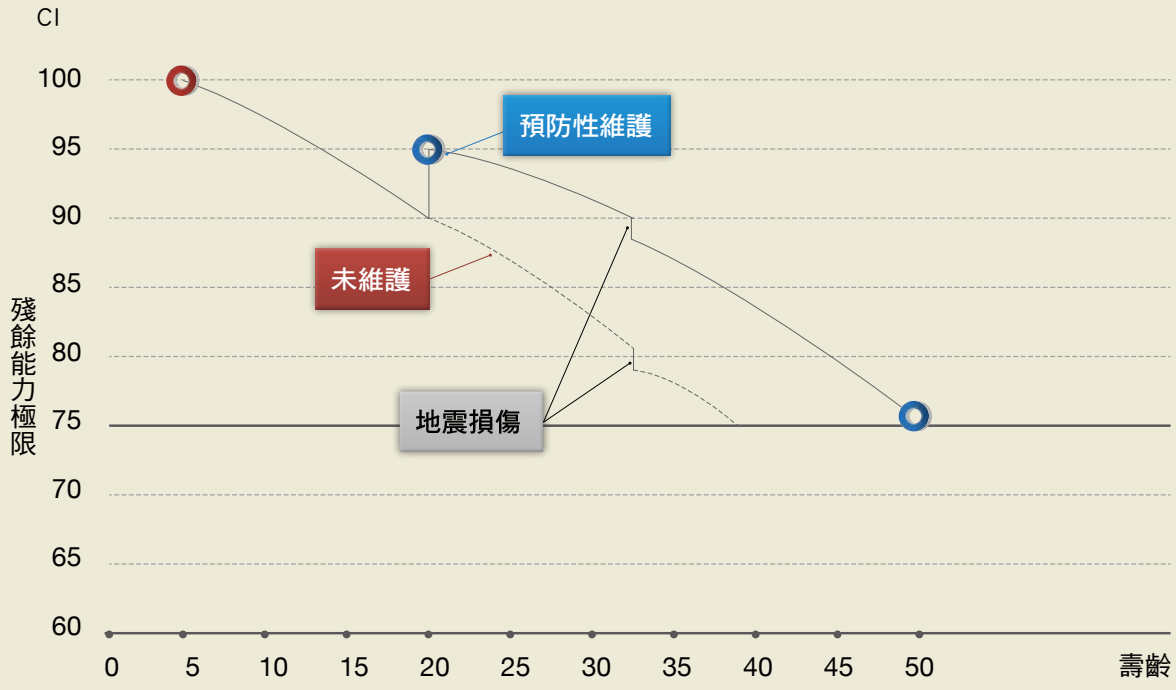
在橋梁生命週期中，不同維護時機之損壞機率與維修成本不同，其組合眾多。若以傳統試誤法等方式求解，將無法在短時間內找到答案。因此本研究擬使用生物共生搜尋演算法 (Symbiotic Organism Search, SOS) 建置「橋梁維護策略最佳化模式」(Bridge life cycle Maintenance Strategy Optimization Model, BMSOM) 分別計算不同維修時機點之風險影響衝擊程度與所需維修成本，進而找出最低生命週期成本之維修方案。由於同一橋梁在不同時間點進行維護有不同之效益，如圖 34 所示，如未進行預防性維護，在遭受多次地震或洪水影響下，橋梁可能提早進入不堪使用或破壞的狀態。如能進行預防性維護補強，並考量最低橋梁生命週期成本之條件，則能在有限維護經費條件下達到最佳經濟效益。

SOS 共使用三種策略：互利共生、片利共生和寄生模擬等自然互動的模式。由於 SOS 不使用微調的參數，相較於同類演算法其操作步驟更顯容易。另外，由於 SOS 提供了性能的穩定性，因此儘管比同類算法使用較少的控制參數，還能夠解決各種數值最佳化搜尋問題。

Based on the risk factors confirmed in the previous stage, the probability of the risk factors leading to bridge damage and maintenance was estimated during this stage. The E(Cost) of the bridge risks was calculated based on the bridge risk factors established in the previous step, as shown in Fig. 33. E(Cost) considers the maintenance costs, referred to as E(MC) below, of aging, flooding, and earthquake risks and the rebuilding costs, referred to as E(RC) below, of the potential damage that may occur if maintenance is not performed. That is, the latter is the reconstruction costs of the damage potential caused to bridges by earthquakes or flooding.

During bridge lifecycles, damage probability and maintenance costs vary depending on maintenance time, with numerous potential combinations. If calculating using conventional trial-and-error methods, answers cannot be found within short periods of time. Therefore, SOS was used in this study to establish a BMSOM to calculate the degree of influence of risk and required maintenance costs for different maintenance times and to seek maintenance programs with the lowest lifecycle costs. Because the effectiveness of maintenance on the same bridge varies with time, as shown in Fig. 34, if preventive maintenance is not conducted, under the influence of multiple earthquakes or floods, bridges may become unusable or damaged at an early stage. If preventive maintenance and reinforcement is conducted and the conditions through which bridge lifecycle cost is minimized are considered, maximum economic benefits can be achieved under conditions with limited maintenance funding.

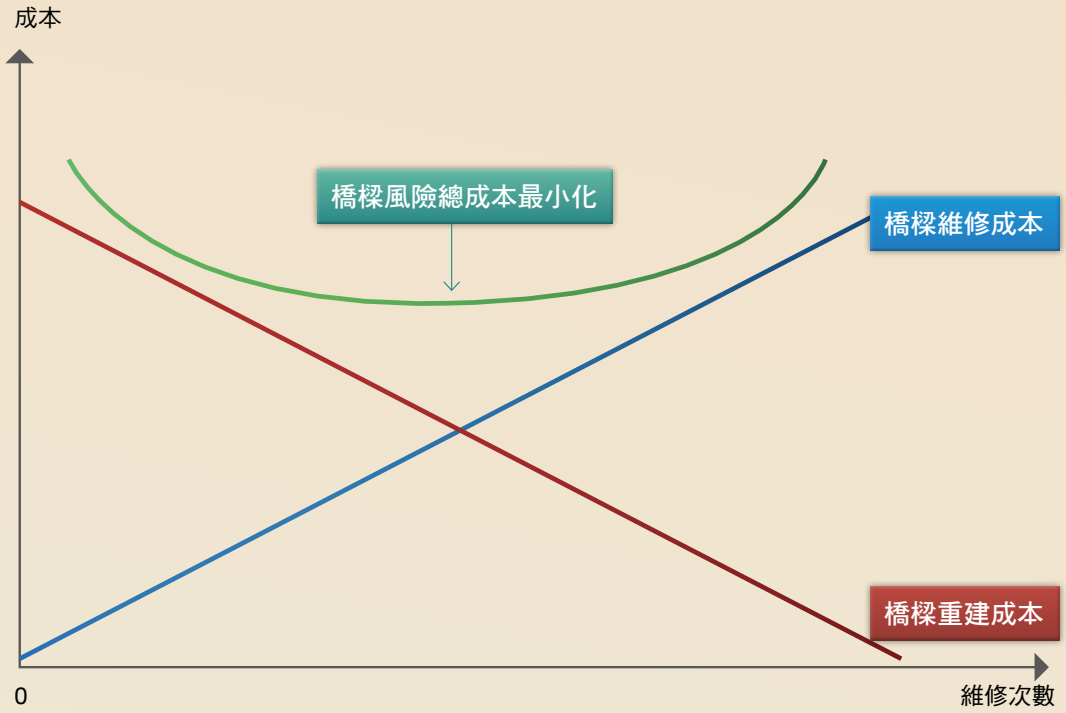
SOS uses three strategies: the natural interaction models of mutualism, commensalism, and parasitic simulation. Because SOS does not use fine-tuned parameters, its procedures are relatively simple in comparison to those of other algorithms. In addition, because SOS provides performance stability, although it uses fewer control variables than similar algorithms do, it is still capable of solving any kind of numerical optimized search problem.



▲ 圖 34　橋梁維修策略示意圖

Figure 34 Schematic of bridge maintenance strategies

本研究期望求得最佳之橋梁維修成本與橋梁重建成本組合，如圖 35 所示，如果維修次數增多，雖能降低橋梁重建風險成本，但橋梁維修成本亦會同步增加。因此本研究考量橋梁生命週期總成本最小化，找出最佳維修策略之橋梁風險期望成本 E(Cost)。



▲ 圖 35　單橋維修策略最佳化示意圖

Figure 35 Schematic of optimization of maintenance strategies for a single bridge

如圖 36 所示，SOS 將從 n 種維修組合方案中，搜尋單橋生命週期最適維護時機與成本，以作為單橋擬定最適維護策略之參考，分析結果可提供公路管理單位從生命週期成本 (LCC) 的角度，規劃單一橋梁最適維修時機及成本，在有限維護經費條件下，達到最佳經濟效益。

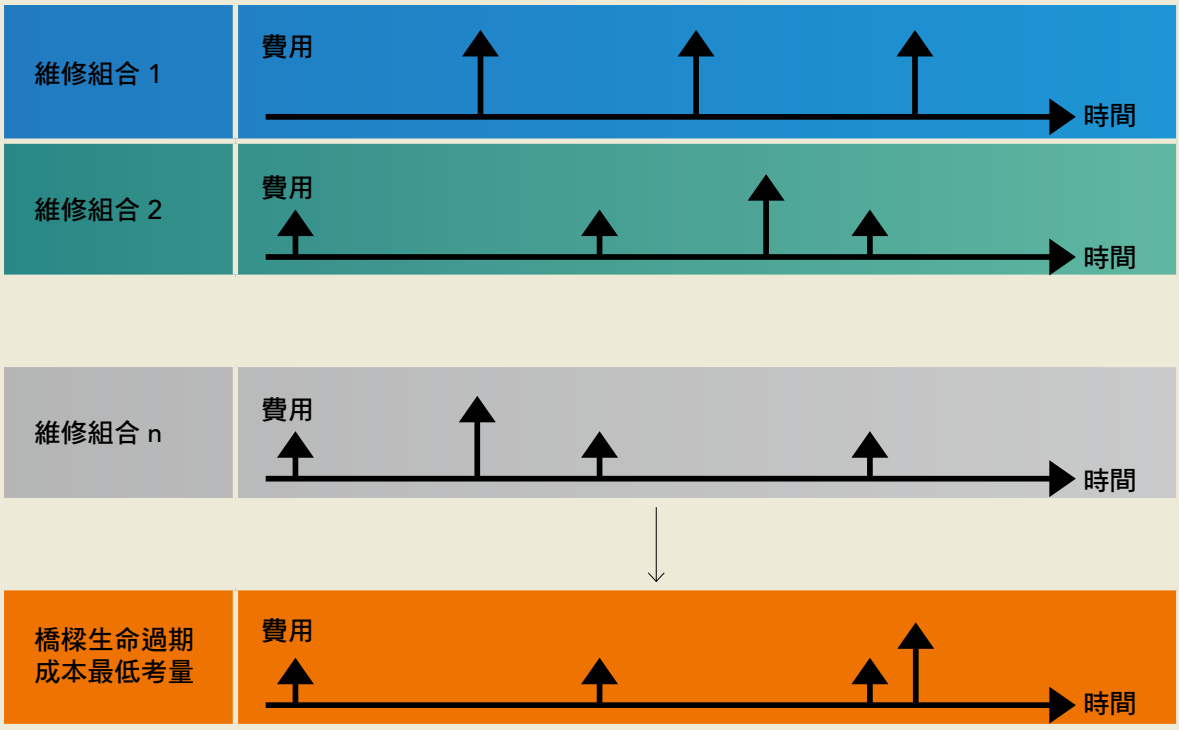
▲ 圖 37　網頁查詢結果維修策略

本研究同時考量可視劣化與潛勢危害等損壞因素，導入風險概念，並以蒙地卡羅模擬計算橋梁生命週期將遭遇之災害頻率及強度，進而評估橋梁可能風險，並輔以人工智慧推論橋梁不同維修策略之維修成本，最後使用 SOS 最佳化演算法，搜尋橋梁於生命週期成本中，保持在一定水準之上的維護最低費用。本研究建置單橋橋梁風險管理策略網頁查詢介面 (如圖 37)，可顯示各橋梁最佳化維修策略與生命周期總成本、維修風險成本與重建風險成本。

This study aimed to obtain optimal combinations of bridge maintenance costs and bridge reconstruction costs. Figure 35 shows that if the number of times maintenance is performed increases, although bridge reconstruction risk costs decrease, bridge maintenance costs increase accordingly. Therefore, this study aimed to minimize total bridge lifecycle cost and to find the maintenance strategy with the optimal E(Cost).

Figure 36 shows that SOS finds the optimal maintenance times and costs for single-bridge lifecycles out of n number of maintenance combination plans. These serve as references for formulating optimal maintenance strategies for single bridges. The analysis results can help road management units plan optimal maintenance times and costs for single bridges from the perspective of lifecycle costs (LCC), achieving optimal economic effectiveness under conditions of limited maintenance funding.

Visible and invisible damage factors were considered in this study. The concept of risk was introduced, and Monte Carlo simulation was used to calculate the frequency and intensity of disasters during bridge lifecycles and assess potential bridge risks. Artificial intelligence was used to infer the bridge maintenance costs of different maintenance strategies. Finally, the SOS optimization algorithm was used to seek minimum maintenance costs based on bridge lifestyle costs while maintaining certain standards. Figure 37 shows the webpage query interface for the single-bridge risk management strategies established in this study. This interface can display the optimized maintenance strategies, total lifecycle costs, maintenance risk costs, and reconstruction risk costs of various bridges.



▲ 圖 36　單橋維修策略與方案

Figure 36 Single bridge maintenance strategies and programs

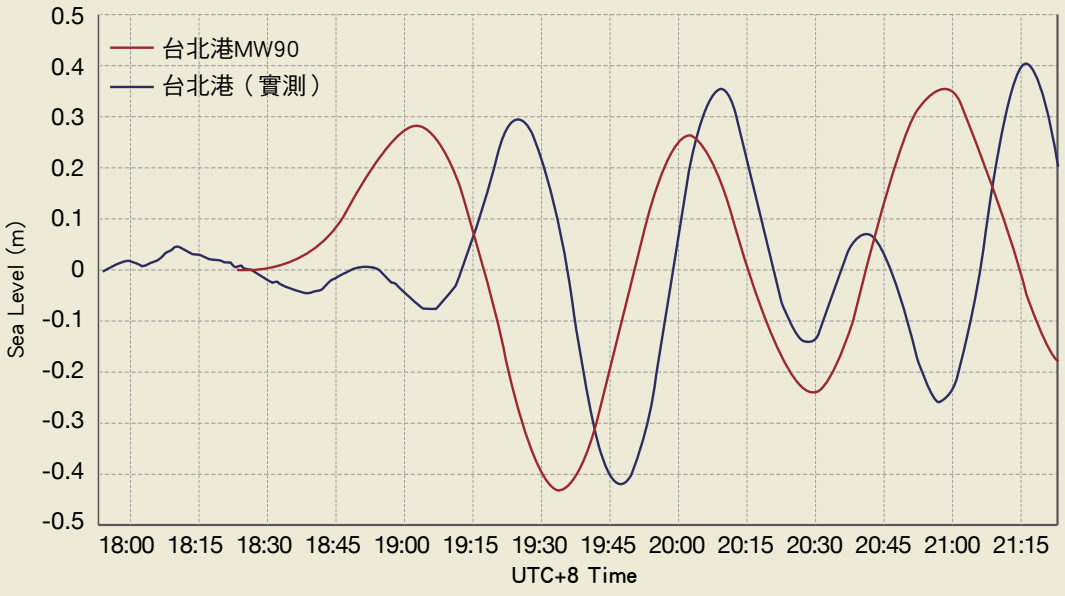
五、災害防救

(一) 港區海嘯速報及情境分析

自 2004 年南亞海嘯之後，各國開始致力研發海嘯預警系統。海嘯預警系統有區分為國際性及地域性，前者最著名的即是美國太平洋海嘯預警中心 (Pacific Tsunami Warning Center)，環太平洋地區之海嘯警報大多數即是由該單位發布警報通知鄰近諸國，我國中央氣象局即是接收該單位所傳來的訊息進行海嘯警報，僅發布海嘯抵達時間。為提升港區對海嘯災害防救能力，本所與國內專家學者著手進行一系列研究，包含臺灣海嘯速報系統及港區溢淹情境分析。

本研究所開發系統是一種較屬於遠域型態海嘯速報系統，其主要目的在於如日本或環太平洋區域海底地震所引發海嘯，便可利用歷史參數或即時地震參數，快速計算海嘯抵達時間及海嘯波水位變化，以瞭解海嘯對國內主要商港 (基隆港、蘇澳港、花蓮港、高雄港、安平港、布袋港、臺中港、臺北港) 可能衝擊，而後將資訊彙整至港埠權責單位才得憑以進行後續防災程序，其優勢為在掌握時效及有限資源，即可得出海嘯初期評估資訊。本系統由於透過數值技巧與事先完成資料庫運算及建置，故輸入地震參數即可進行運算及圖形輸出，以個人電腦等級設備僅需 20 秒內即可完成單一港口計算作業。

在日本 311 地震期間，使用地震參數輸入海嘯模擬預報系統中所得到臺北港水位變化結果與臺北港觀測水位資料比較如圖 38，已有相當良好驗證。



紅色：速報資訊，藍色：實測
Red: rapid reporting data; blue: actual observation

▲ 圖 38　日本 311 海嘯水位驗證
Figure 38 Water level verification during the Japan 311 tsunami

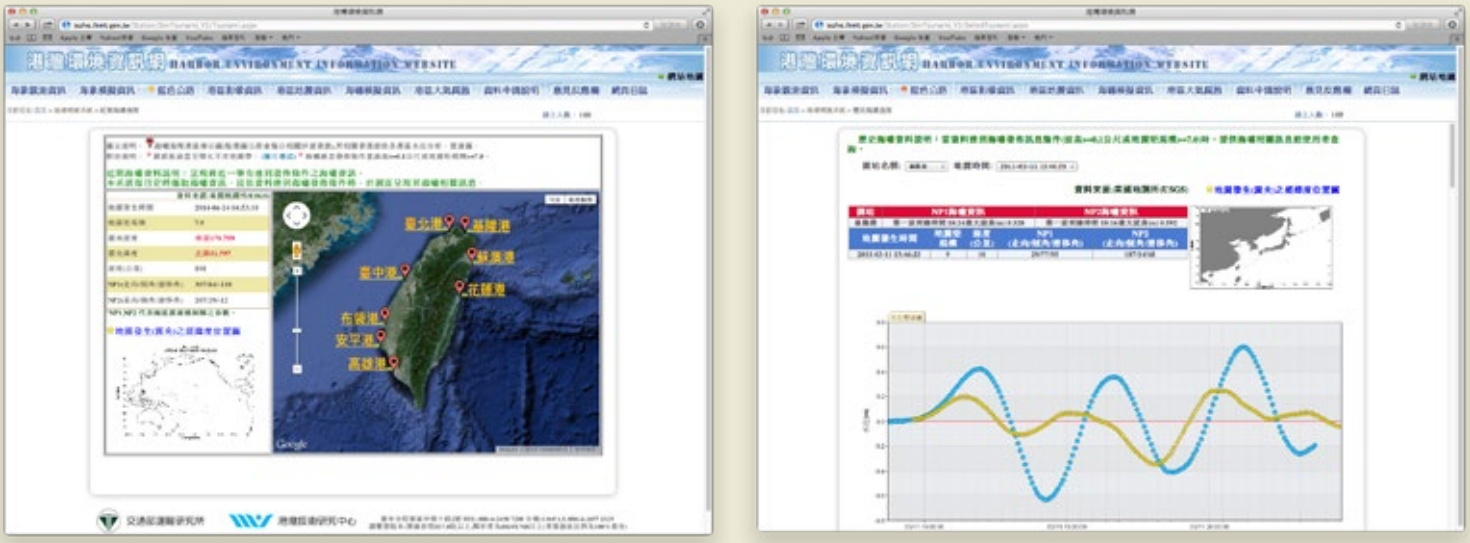
5. Disaster prevention and relief

(1) Harbor area　rapid reporting system and scenario analysis

In the aftermath of the South Asian tsunami in 2004, many countries started to develop tsunami early warning systems. Tsunami warning systems are divided into international and regional ones; the most famous of the former is the U.S. Pacific Tsunami Warning Center. Tsunami alerts around the Pacific Rim are mostly issued by this center to neighboring countries. The Central Weather Bureau (CWB) of our country receives information from this agency before it issues tsunami warnings, broadcasting only the arrival time of the tsunami. To enhance the tsunami disaster prevention and relief capability of the harbor area, this Institute initiated a series of research with domestic experts and scholars, including Taiwan tsunami rapid reporting system and the harbor area inundation scenario analysis.

The system developed in this research is a far-field type tsunami rapid reporting system. Its main purpose is that in case of a tsunami triggered by undersea earthquakes in Japan or the Pacific Rim region, historical or real-time seismic parameters will be taken to quickly calculate the arrival time of the tsunami and its wave-height changes, in order to learn its potential impacts on major domestic commercial ports (Keelung, Suao, Hualien, Kaohsiung, Anping, Budai, Taichung, and Taipei). Information are then compiled and sent to the responsible port authorities to perform subsequent disaster prevention procedures. The advantages of this system lie in its mastering of time and efficiency, and gaining early assessment information of tsunami with limited resources. As it relies on numerical scheme and the completion of database operation and creation in advance, computing can be carried out to produce graphic output with the input of seismic parameters. With PC level equipment it takes only 20 seconds to complete the computing of data for a single port.

During the 311 earthquake in Japan, seismic parameters were put in the tsunami simulation forecasting system to obtain water level change results of Taipei port, in comparison with the observed water level data, as shown in Figure 37, which produced a relatively good verification of the system.



▲ 圖 39 海嘯速報系統之作業化網頁
Figure 39. Operating webpages of the tsunami rapid reporting system
http://isohe.ihmt.gov.tw

本系統發展，一部分為建置於全自動作業化系統內固定時間 (目前設定為 5 分鐘) 於網上擷取相關地震資訊參數進行模擬並展示，如圖 39 所示，另一部分為手動可離線視窗介面程式，如圖 40 所示，由使用者自行輸入地震資訊參數，在未有確切即時地震參數時，可先以歷史參數輸入進行評估。現階段作業化系統已能自動擷取網頁資訊，包含美國地調所 USGS (United States Geological Society) 網站；日本防災科學技術研究所 Fnet (Full Range Seismograph Network of Japan)；中研院地科所 ，臺灣地區寬頻地震觀測網 BATS (Broadband Array in Taiwan for Seismology) 等來更新即時地震參數，進行海嘯模擬計算。並透過本所港灣環境資訊網 (http://isohe.ihmt.gov.tw) 即時呈現 ，以及在地震規模較大時主動針對港務公司特定人員發送相關預警資訊。

海嘯溢淹模擬情境分析最佳方式就是確切得知發生已知之震源或是斷層參數，並確認初始水位高度後據以模擬海嘯之溢淹行為及特性。但實務上，海底斷層參數除了少數較為引人注目之斷層 (例如馬尼拉海溝)，其餘甚少有較為詳盡之參數資料。且也無法確知各個可能斷層所能產生之最大地震矩規模。在許多條件均缺乏之情況下進行海嘯於近岸地區之數值模擬是相當不足的，因此，利用單一波形及情境模擬方式來進行港區溢淹模擬，除了可獲得較為保守之結果外，更可累積匯集成資料庫，在實際海嘯事件發生時，預判港區外海波高後，即可得知對應可能之海嘯溢淹區域資訊。

The development of the system includes two parts. One is to build in as part of an automatic operating system, retrieving earthquake related data and parameters online at fixed interval (currently set to 5 minutes) to perform simulation and display, as shown in Figure 39; the other is a manual offline windows interface program, as shown in Figure 40, in which the user can input seismic data and parameters. In case real-time seismic parameters are not available, historical parameters can be inputted for assessment. At present, the operating system can retrieve web information automatically, including those on the websites of the United States Geological Society (USGS), Full Range Seismograph Network of Japan (Fnet), Academia Sinica's Institute of Earth Sciences, and Broadband Array in Taiwan for Seismology (BATS). Real-time seismic parameters are updated to conduct tsunami simulation computing, and results are displayed instantly on the Harbor Environment Information Website of this Institute (http://isohe.ihmt.gov.tw). Relevant early warning information are also delivered to specific personnel of harbor companies in times of large-scale earthquakes.

The best way to conduct tsunami inundation simulated scenario analysis is to get the exact seismic source or fault parameters of earthquakes known to have occurred, confirm the initial wave-height, and simulate the tsunami inundation behavior and feature on the basis of these data. But in reality, there is little detailed information of undersea fault parameter available except for a few well-known faults (e.g. the Manila Trench). It is also uncertain to know the maximum seismic moment magnitude that various potential faults can produce. In short of a number of conditions, it is rather inadequate to perform numerical simulation of tsunami in coastal area. Therefore, using a single waveform and scenario simulation approach to perform harbor area inundation simulation not only can obtain more conservative results, but also accumulate data into a database, which allows the anticipation of offshore wave-height in harbor area during the actual occurrence of tsunami, thus making it possible to obtain information of potential overflow areas for necessary response.

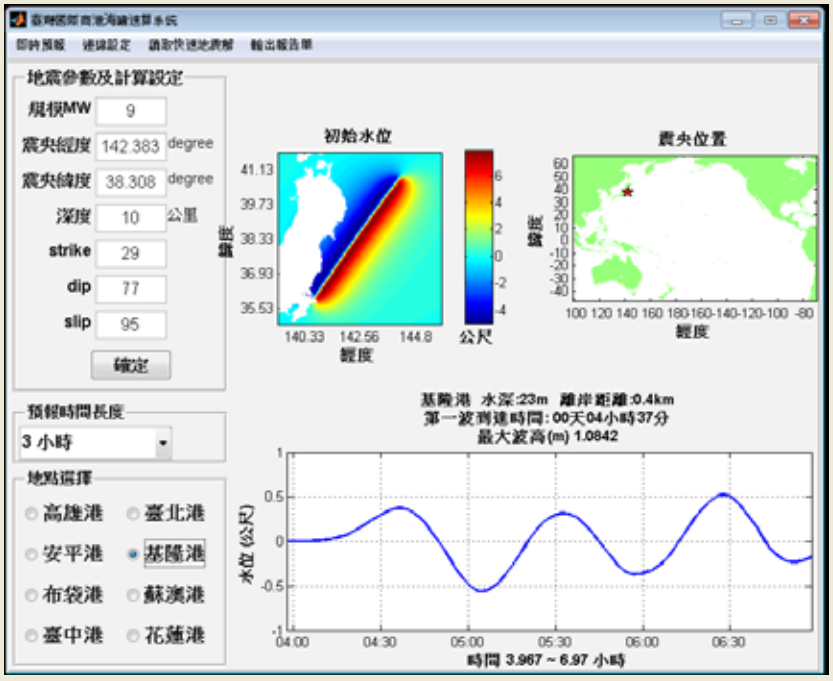
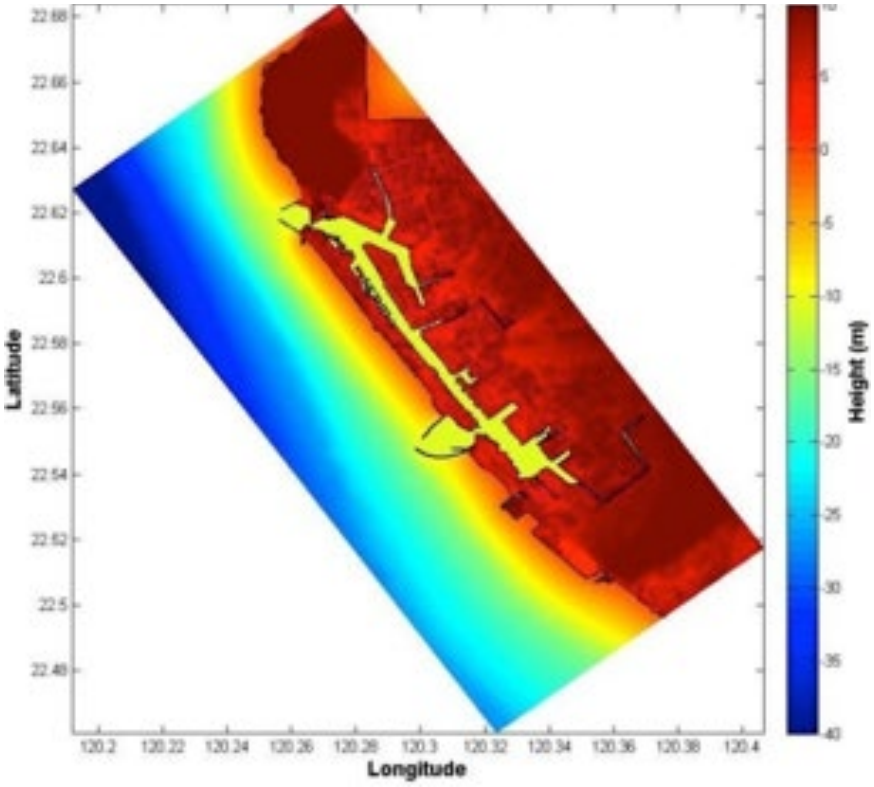
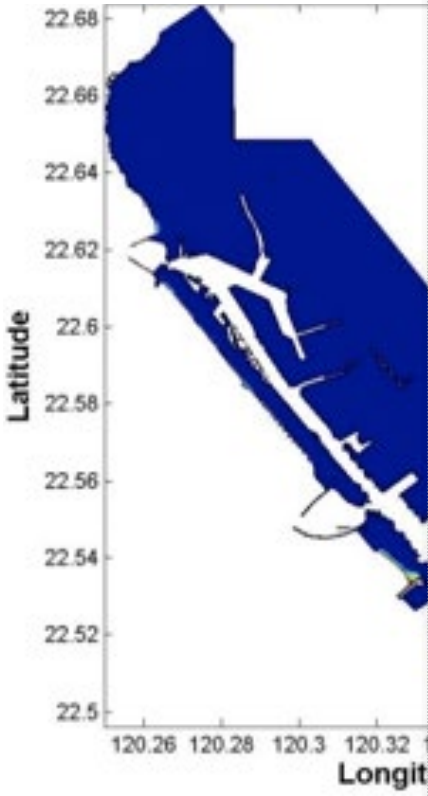


圖 40　海嘯速報系統之視窗介面

Figure 40 Windows interface of the tsunami rapid reporting system



▲ 圖 41　高雄港整合海陸域後之數值地形檔
Figure 41 Digital terrain profile of Kaohsiung port with sea-land integration



▲ 圖 42　高雄港入射波高為 2 公尺之溢淹圖
Figure 42 Inundation mapping of Kaohsiung port at 2

應用美國康乃爾大學土木與環境工程學系團隊發展出的COrnell Multigrid COupled Tsunami model(COMCOT) 溢淹模式，海域地形主要是採用海科中心網格間距為 500 公尺之水深資料，港區之水深亦採用各港務公司所提供之船測資料加以校正。陸域地形資料是由內政部地政司所提供數值地形資料，進行港區溢淹情境分析，以不同波高模擬海嘯波垂直岸線入射 (0.5m、1m、2m、3m、4m、6m、10m)，週期為 20 分鐘，以此海嘯波條件模擬此情境下陸地之溢淹狀況。現階段已完成基隆港、高雄港、安平港、布袋港、臺中港及臺北港等溢淹情形，以高雄港為例，如圖 41 為高雄港整合海陸域後之數值地形檔，圖 42 及圖 43 分別為高雄港入射波高為 2 公尺及 4 公尺之溢淹圖，在入射波高 2 公尺以下，溢淹範圍侷限於旗津堤外之沙洲。而入射波高超過 4 公尺時，旗津區市區已有大範圍超過 50 公分的溢淹高程。

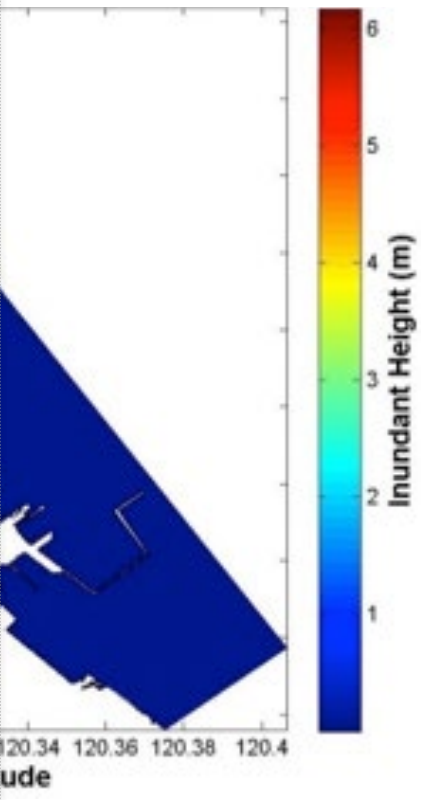
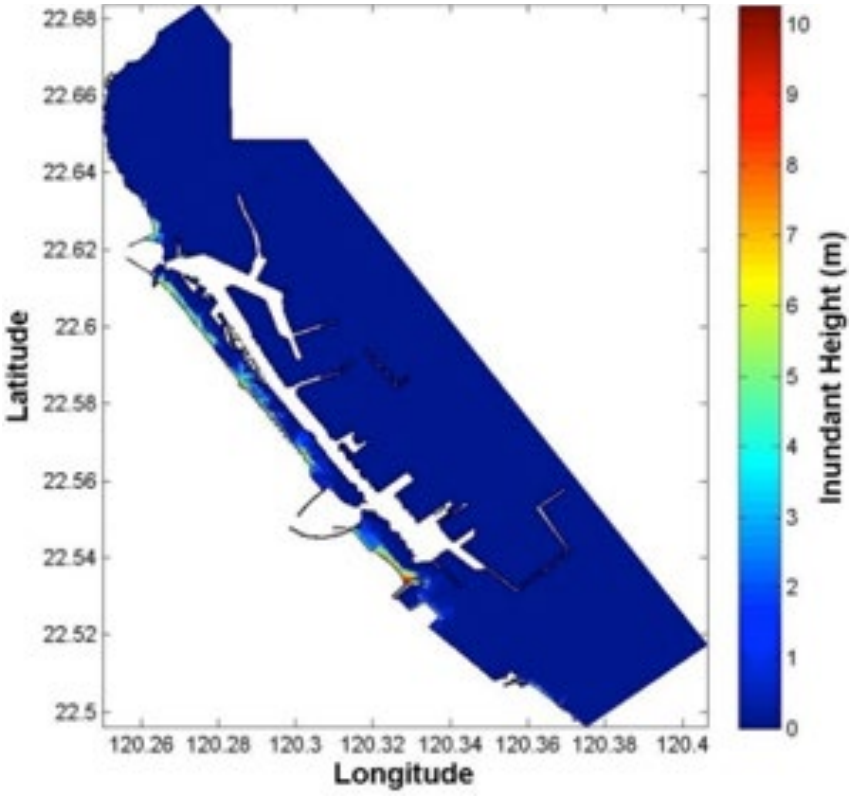


圖
2M incident wave-height



▲ 圖 43　高雄港入射波高為 4 公尺之溢淹圖

Figure 43 Inundation mapping of Kaohsiung port at 4M incident wave-height

Applying the inundation model developed by the team of School of Civil and Environmental Engineering at Cornell University in the United States, the Cornell Multigrid Coupled Tsunami model (COMCOT), and feeding water depth data provided by National Center for Ocean Research (NCOR), with a grid interval of 500 meters for sea region, harbor area water depth data calibrated from ship-based measurements provided by various harbor companies, and digital terrain data provided by the Department of Land Administration of the Ministry of the Interior (MOI) for land region, harbor area inundation scenario analysis was performed, with different wave-heights to simulate tsunami wave incidence vertical to shoreline (0.5m, 1m, 2m, 3m, 4m, 6m, 10m) in a cycle of 20 minutes, in order to simulate the inundation scenario on land under these tsunami wave conditions. At this stage a number of inundation scenarios were completed including the ports of Keelung, Kaohsiung, Anping, Budai, Taichung and Taipei. Take Kaohsiung as an example, Figure 41 is the digital terrain profile of Kaohsiung port with sea-land integration; Figures 42 and 43 are inundation maps of Kaohsiung port with incident wave-height at 2 and 4 meters respectively. When the incident wave-height is under 2 meters, the inundation area is limited to the sandbar beyond Cijin dyke. When the incident wave-height is over 4 meters, an inundation altitude of more than 50 cm is seen over a wide range of the Cijin urban district.

(二) 港灣構造物安全檢查評估

本研究為 4 年期計畫「港灣構造物安全檢查評估之研究」之第 3 期，此計畫之主軸圍繞於「檢測作業標準制訂」、「現有港灣構造物安全評估方法之檢討」與「維護管理系統建置」3 項，希望藉由港灣構造物，包含碼頭 (重力式、板樁式與棧橋式 3 種) 與防波堤等，在基隆港目前現有的研究基礎上，再進行更深入之探討與設施資料之擴充。「檢測作業標準制訂」先前的研究已針對目視檢測標準修訂部分簡化檢測內容，並藉由圖示輔助增加實用性。而儀器檢測適用性探討部分則以混凝土與鋼材兩類，撰寫其檢測原理、檢測程序、檢測注意事項與檢測內容；初步檢測安全評估方式研擬，修正單一構件評估與各設施整體狀況的整體評估，並增加構件權重問卷；詳細檢測安全評估以與目視及儀器檢測結果較為相關的碼頭岸肩鋼筋斷面損失進行分析，藉由輸入與檢測結果相關之數據，配合分析流程，檢視原始設計之需求。

今年度除修正部分目視檢測標準外，亦持續就儀器檢測內容之更新與水下檢測儀器之適用性進行相關工作。「現有港灣構造物安全評估方法檢討」先前的研究已藉由試驗之執行，研究所提破壞指標之影響性，探討設施結構破壞新型評估方式，將進一步驗證及修正、探討結構破壞之新型評估方式應用於鋼板樁碼頭與研議重力式碼頭結構破壞之評估方式。「維護管理系統建置」，將修正系統檢測標準、系統初步檢測安全評估方式與經常巡查輸入、建置防波堤維護管理系統與撰寫碼頭設施維護管理系統使用手冊，並擴大建置港灣構造物資料、研擬分析預測工具與建置檢測報告產出模組。研究成果之應用除可提供產官學研各界不同需求及應用外，亦可在經濟效益上，藉由掌握碼頭劣化異狀，有效維護，減少資源浪費。

(2) Safety inspection and assessment of harbor structures

This study is the third phase of a four-year research plan, A Study on Safety Inspection and Assessment of Harbor Structures, which focuses on three issues: 'the setting of operational standard for inspection', 'the review of existing safety assessment methods of harbor structures' and 'the building of maintenance and management system'. It is hoped that by focusing on harbor structures, including wharfs (gravity, sheet-pile and trestle type wharfs) and breakwaters, and based on the current research foundation of the Keelung port, a more in-depth exploration can be conducted to expand information of related facilities. With regard to 'the setting of operational standard for inspection', previous studies have revised some visual inspection standards to simplify their content, and improved their practicality by using assistant illustrations. As for the feasibility study of instrumental inspection, it focuses on concrete and steel materials, and describes the principle, procedures, precautions and content of the inspection. For preliminary inspection, it includes the investigation of safety assessment methods, the revision of single component assessment and the assessment of overall condition of all facilities, and the increase of component weight questionnaire; for detailed inspection, safety assessment conducts analysis on the steel bar cross-section loss in berth aprons that are associated with visual and instrumental inspection results. By feeding data relevant to inspection results and coordinating with the analysis process, the requirements of original design are reviewed.

In addition to revising some visual inspection standards, relevant tasks were also implemented this year, including updating the content of instrumental inspection and feasibility study of underwater inspecting instruments. In terms of 'the review of existing safety assessment methods of harbor structures', previous studies have explored new assessment methods on facility structural damage by running experiments and applying damage index effect proposed by research. Further verification and revision will be performed to explore the application of new structural damage assessment methods on steel sheet-pile wharf, and discuss structural damage assessment methods for gravity type wharf. As for 'the building of maintenance and management system', the efforts include the revision of system inspection standards, assessment methods for system preliminary safety inspection, and regular inspection inputs, the construction of a breakwater maintenance and management system, the writing of a user manual for harbor facilities maintenance and management system, the development of harbor structure information, the investigation and analysis of forecasting tools, and the building of an output module for inspection report. In addition to accommodating various needs and applications for the industrial, governmental, and academic sectors, the research results also help to effectively manage economic benefits by controlling abnormal deterioration of the wharfs and reducing the waste of resources.

1. 港灣構造物檢測標準、技術與程序

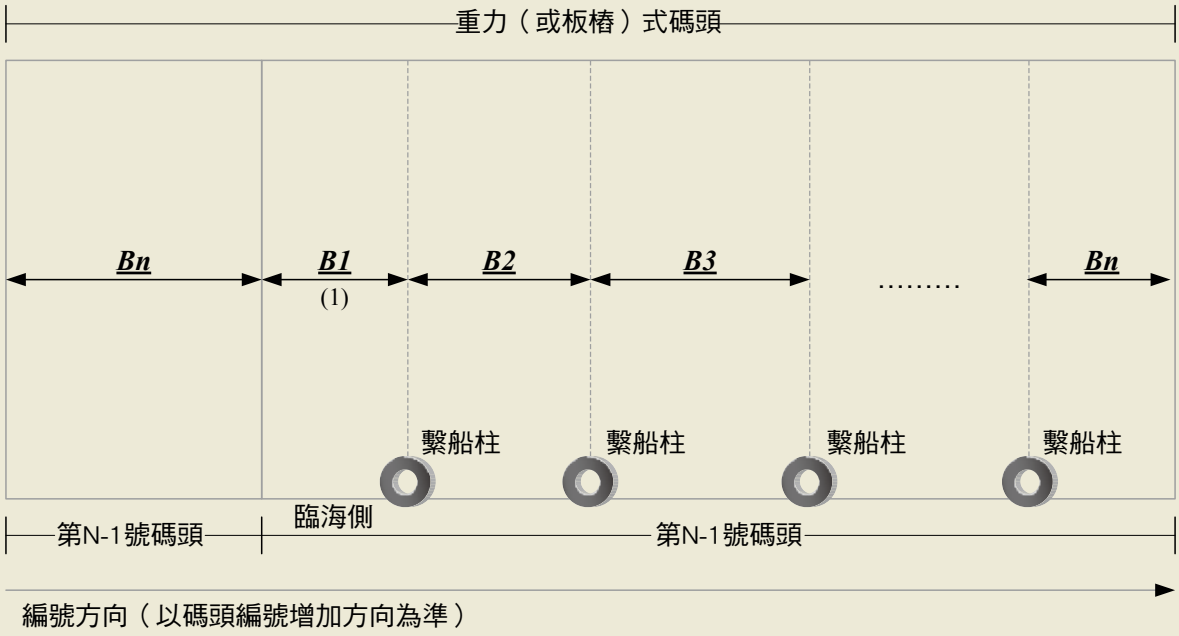
(1) 碼頭構造物構件編碼原則與檢測表格修正

A. 碼頭構造物構件編碼原則修正

重力與板樁式碼頭原以 10 m 為一單元進行編碼，惟此編碼方式單元切割較多且檢測進行時較不易判別單元，故採納第二年期專家座談會議後之建議，修正為以繫船柱進行編碼 (棧橋式因其結構型式與判別較為容易，仍維持原有方式)。故針對此兩類碼頭，以兩繫船柱間為一單元 (Block) 如圖 44 所示，各碼頭間之交界若非繫船柱，則仍須編列為一單元，如圖 44 中之 (1) 所示。各碼頭單元構件拆解分為碼頭本體、海床與附屬設施。碼頭本體再拆分成岸肩、壁體與後線；附屬設施拆分成繫船柱、防舷材、車擋與起重機軌道。

B. 碼頭構造物檢測表格修正：針對經常巡查檢測表、定期巡查檢測表與特別巡查檢測表表格修訂。

C. 目視檢測標準內容之修正：檢測標準藉由第二年期之教育訓練與歷次工作會議討論回饋修正板樁式碼頭本體－壁體之接縫開裂 (在劣化描述說明上將漏砂狀況數值予以調整，並將其名稱改為開裂深度) 與附屬設施－起重機軌道 (將「兩軌間距高差」與「鋼軌生鏽」等描述予以刪除，餘下之兩軌間距左右差與鋼軌接縫高差較容易判別) 之損壞等劣化狀況。



▲ 圖 44　重力與板樁式碼頭單元編碼方式修正
Figure 44 Revision of coding method for gravity and sheet-pile type wharf units

A. Harbor structure inspection standards, techniques and procedures

(A) The revision of coding principle for harbor structure components and inspection checklists

a. The revision of coding principle for harbor structure components

For gravity and sheet-pile type wharfs, they were originally coded on the basis of 10M as a unit. However, such a coding method divided too many units and was difficult to differentiate during inspection. Therefore, a proposal after the second annual expert forum was adopted, revising the coding system on the basis of wharf bollard (trestle type wharf is still coded using the original method, as its type of structure is simpler and easier to differentiate). So for the other two wharf types, the distance between two bollards is defined as one unit (block), as shown in Figure 1. If the borderline between two wharfs is not a bollard, it is still regarded as one block, as shown in Figure 44-(1). The components of each wharf block are divided into main body of the wharf, seabed and ancillary facilities. The main body is further divided into apron, wall and rear; and ancillary facilities split into bollard, fender, bumper and crane rail.

b. The revision of inspection checklists for harbor structures: Checklists for frequent inspection, regular inspection and special inspection are amended.

c. The revision of visual inspection standards: According to feedback from the second year's educational training and discussion on previous work meetings, inspection standards are revised regarding the main body of sheet-pile wharf – the cracks of wall joints (in terms of deterioration description, adjusting sand leakage value and changing the name to 'crack depth') and ancillary facilities – and the deterioration damage of crane rail (deleting description of 'rail gauge height difference' and 'rust of steel rails' to make it easier to differentiate rail gauge side difference and height difference of steel rail joints).

D. 修復工法之處置對策補充與單價建置

(A) 修復工法之處置對策補充

鋼構件修復工法	S1	新增鋼板焊補法
	S2	水中硬化環氧樹脂塗附法
	S3	犧牲陽極式防蝕系統
	S4	外加電流式防蝕系統
	S5	鉚釘打設工法
	S6	防蝕包覆修補法
	S7	防蝕包覆重鋪法

其他構建修復工法	O1	拋石護基工法
	O2	拋放麻袋混凝土法
	O3	新增護基方塊法
	O4	鋼軌矯正
	O5	鋼軌汰換
	O6	防蝕塗料維修
	O7	置換繫船柱
	O8	構件脫落之維修
	O9	置換防舷材

▲ 圖 45　碼頭構造物劣化處置對策表 (節錄)
Figure 45 Disposal strategy table for deteriorated harbor structures (Extract)

(B) 修復工法之單價建置：修復工法單價建置之目的乃作為各構件劣化在不同狀況等級下的對應，以便配合巡查後之劣化數量進行修復費用估算。針對此項工作，研究團隊收集工程會「公共工程價格資料庫」、交通部運輸研究所港灣技術研究中心「碼頭本體設施維護管理系統建置之研究」、財團法人臺灣營建研究院「營建物價」與臺北市政府「RC 橋梁維修補強手冊」進行彙整。

d. Disposal strategy supplement and unit price setting for repair methods

(a) Disposal strategy supplement for repair methods (Figure 45)

(b) Unit price setting for repair methods: The purpose of unit price setting is to provide a reference in response to component deteriorations under various circumstances and levels, in order to estimate repair costs corresponding to deterioration quantity found in inspection. For this task, the research team collected and compiled data from sources including 'Public Construction Price Database' of the Public Construction Commission; 'A Study on Building The Pier Facilities Maintenance and Management System' by Harbor and Marine Technology Center of the Institute of Transportation (IOT), Ministry of Transportation and Communications (MOTC); 'Construction Cost Data' of Taiwan Construction Research Institute; and 'RC Bridge Repair and Reinforcement Manual' by the Taipei City Government.

表 3 修復工法單價列表 (節錄)
Table 3 Unit price list of repair methods (Extract)

工法名稱 Name of method	單位 Unit	單價 (元) Unit price (NT$)
1. 鋼筋混凝土修復工法 (C) 1. SRC repair method (C)		
(1) 樹脂砂漿塗抹工法 (C1) (1) resin slurry coating (C1)	m	937.5
(2) 灌注環氧樹脂工法 (C2) (2) epoxy resin filling (C2)	m	2,600

2. 港灣構造物維護管理系統建置

(1) 維護管理系統更新與港灣構造物資料擴充

▲ 圖 46 檢測資料模組巡查類型之查詢與新增 - 以基隆港為例

Figure 46 Query and addition of inspection type in inspection data module – Keelung Port

▲ 圖 47 碼頭經常巡查資料列表 - 以基隆港東 2 號碼頭為例

Figure 47 Harbor frequent inspection data list – Keelung Port No. 2 east bank

▲ 圖 48 碼頭經常巡查紀錄表 - 以基隆港東 2 號碼頭為例

Figure 48 Harbor frequent inspection checklist – Keelung Port No. 2 east bank

▲ 圖 49 碼頭經常巡查紀錄編輯 -1- 以基隆港東 2 號碼頭為例

Figure 49 Harbor frequent inspection record compilation 1 – Keelung Port No. 2 east bank

A. The construction of harbor structure maintenance and management system

(A) The updating of maintenance and management system and the development of harbor structure information

▲ 圖 50 碼頭經常巡查紀錄編輯 -2- 以基隆港東 2 號碼頭為例

Figure 49 Harbor frequent inspection record compilation 2 – Keelung Port No. 2 east bank

▲ 圖 51 碼頭經常巡查基本資料編輯 - 以基隆港東 2 號碼頭為例

Figure 51 Harbor frequent inspection basic data compilation – Keelung Port No. 2 east bank

▲ 圖 52 碼頭經常巡查資料新增 - 以基隆港西 2 號碼頭為例

Figure 52 Harbor frequent inspection data addition – Keelung Port No. 2 west bank

(2) 檢測報告產出模組建置

各類型巡查可於外業或內業時，藉由網際網路於系統記錄目視檢測巡查成果，供後續查詢或將相關資料透過報告產出模組，即進入巡查報告下載頁面中。當點擊選擇，即會顯示以 PDF 格式產出之報告，報告分為兩部分，第一部分為港灣名稱、碼頭名稱與檢測時間等一般性資料與各構件劣化狀況列表，如圖 53 所示，列表資料包含劣化構件、劣化類型、劣化狀況、劣化單元、劣化位置與劣化數量；而第二部分為配合前述列表對應之劣化照片，如圖 54 所示。

(3) 分析預測工具之實例計算

經上述流程之說明，本研究引用基隆港西 14 號碼頭於 2011 與 2012 兩年之定期巡查資料，可得知各構件劣化類型、劣化程度、劣化數量 (面積或長度)，再配合各劣化類型與程度對應之修復對策與單價，估算此兩年度之估算修復費用 (CE)，如圖 55 所示。

基隆港定期巡查報告

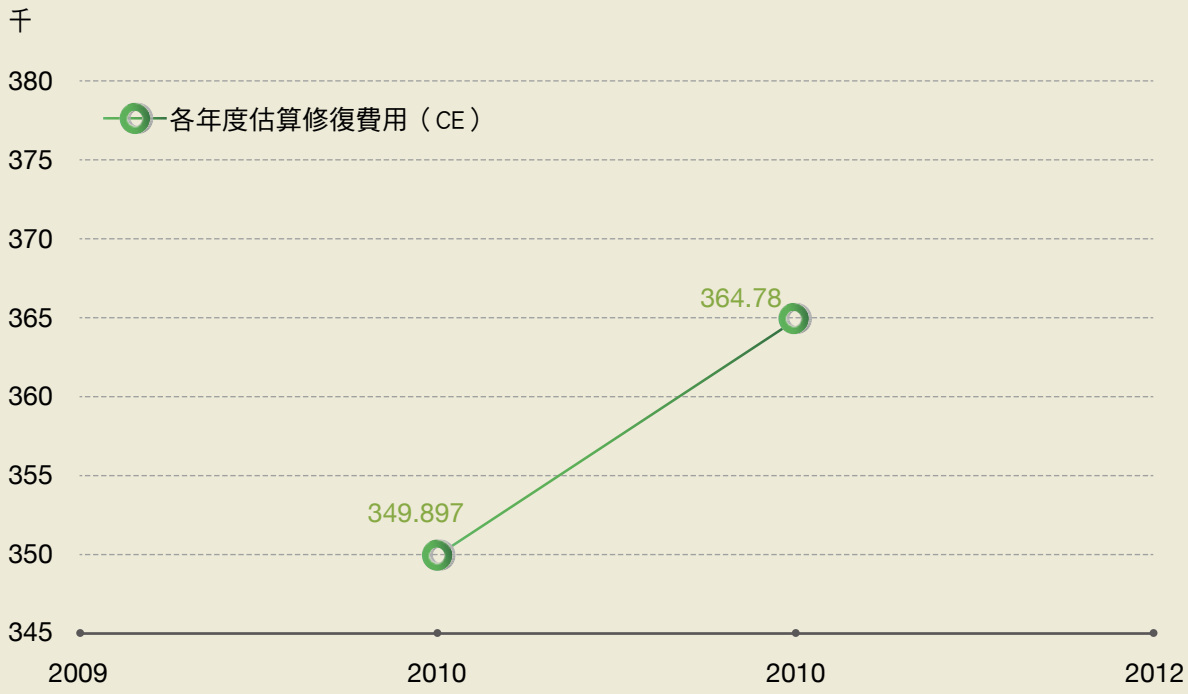
碼頭名稱：西2號碼頭			檢測時間：20080925		
劣化構件	劣化類型	劣化狀況	劣化單元	劣化位置	劣化數量
面版岸肩底部	剝落	2	E01	W3個	0.15m^2
面版岸肩底部	剝落	2	E02	W1個	0.25m^2
面版岸肩底部	剝落	2	E05	W2個	0.15m^2
面版岸肩底部	剝落	2	E06	W1個	0.15m^2
面版岸肩底部	剝落	2	E10	W4個	0.03m^2
面版岸肩底部	剝落	2	E12	W3個	0.05m^2
面版岸肩底部	剝落	2	E18	W2個	0.61m^2
面版岸肩底部	剝落	2	E20	W5個	0.61m^2
面版岸肩底部	剝落	2	E21	W3個	0.05m^2
面版岸肩底部	剝落	2	E22	W3個	0.05m^2

無檢測意見

檢測者簽章：　　審核單位簽章：

▲ 圖 53　定期巡查報告資料列表 - 以基隆港西 2 號碼頭為例
Figure 53 Regular inspection report data list – Keelung Port No. 2 west bank

▲ 圖 54　定期巡查報告照片
Figure 54 Regular inspection report photos



▲ 圖 55　各年修復費用 (C(P,i))
Figure 55　Repair cost year over year (C(P,i))

(B) The building of output module for inspection report

For various types of inspections during field patrol or office work, visual inspection results can be recorded to the system via the internet, to allow follow-up query or output module of relevant data report. When clicking select button on the inspection report download page, an output report in pdf format will be displayed. The report is composed of two parts; the first part includes general information such as harbor name, wharf name, inspection time, and a list of various component deterioration profiles, as shown in Figure 53, including the deteriorated component, deterioration type, deterioration status, deterioration unit, deterioration location, and deterioration quantity; and the second part shows the photos of deterioration corresponding to the former list, as shown in Figure 54.

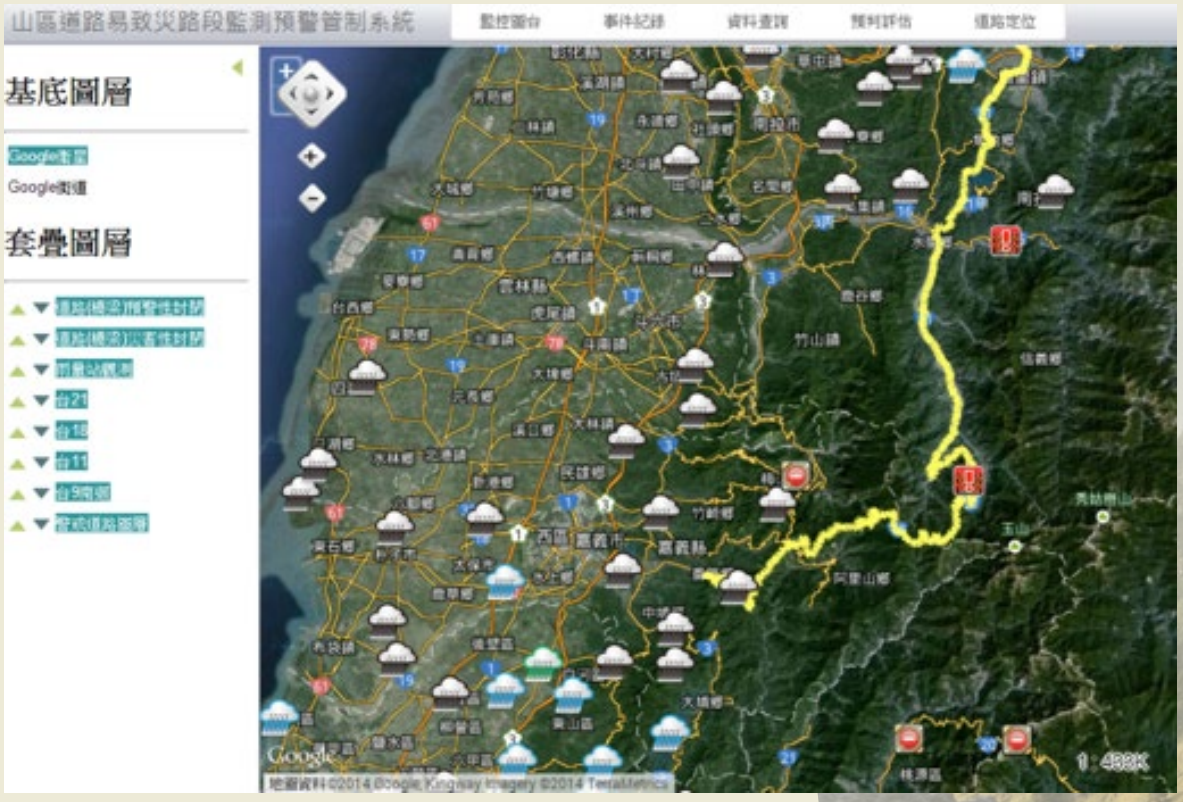
(C) Example calculation of analytical and forecasting tools

As described above, this study cited regular inspection data of No. 14 Terminal west bank of Keelung Port in 2011 and 2012, obtaining information of deterioration type, deterioration status, deterioration quantity (size or length) of various components. Together with the corresponding repair strategy and unit price, an estimation of repair cost (CE) for both years can be drawn, as shown in Figure 55.

(三) 山區道路災害預警即時通報

臺灣的山區道路沿線景緻優美，尤其是東部太魯閣、海岸山脈等更吸引山海景觀常令國內外遊客流連忘返，但臺灣山區災害的恐怖印象卻也常讓大家望山卻步。經常上山的遊客，多少會有查詢氣象變化、道路狀況等資訊作為行程規劃參考之經驗；但往往妥善計畫卻趕不上山區道路天候的變化，如果能夠隨時接收山區道路的氣候、交通阻斷甚至是未來可能發生災害的路段等即時資訊，就可以提早改變行程，以免因災害受阻而敗興而歸。

本研究所研發的「山區道路易致災路段監測預警管制系統」(圖 56)，可以提供山區道路用路人關於潛在危險路段位置與即時災害資訊。用路人只要有手持式上網設備，透過「山區道路易致災路段監測預警管制系統」，即可得知主要山區道路容易發生災害是哪個路段、最新的道路阻斷、橋樑封閉資訊、下雨的狀況、與那些路段可能發生災害，甚至是未來 1 小時可能會發生災害的路段，也都可透過地圖及簡訊進行呈現。用路人未來也可以申請系統的山區道路災害預判服務，透過此服務即可由手機接收到即時的山區道路災害預判訊息。可以讓你在規劃旅遊行程或於旅遊途中都可以隨時掌握即時山區道路狀況，安心用路、愜意旅遊。



▲ 圖 56　山區道路易致災路段監測預警管制系統介面

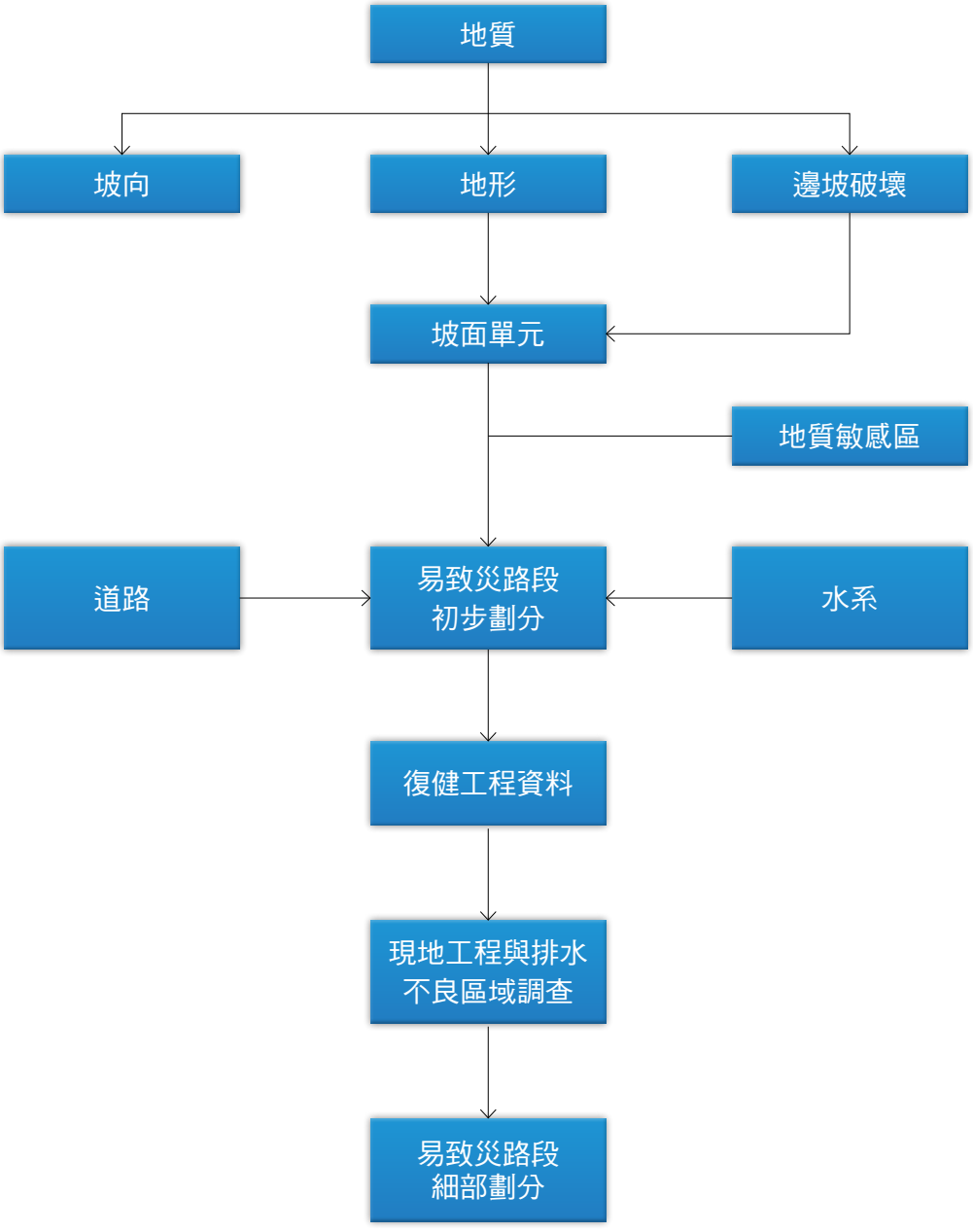
Figure 56 Interface of Early Warning System for Monitoring High-Frequency Hazard Areas of Mountain Roads

(3) Mountain road disaster early warning and instant reporting

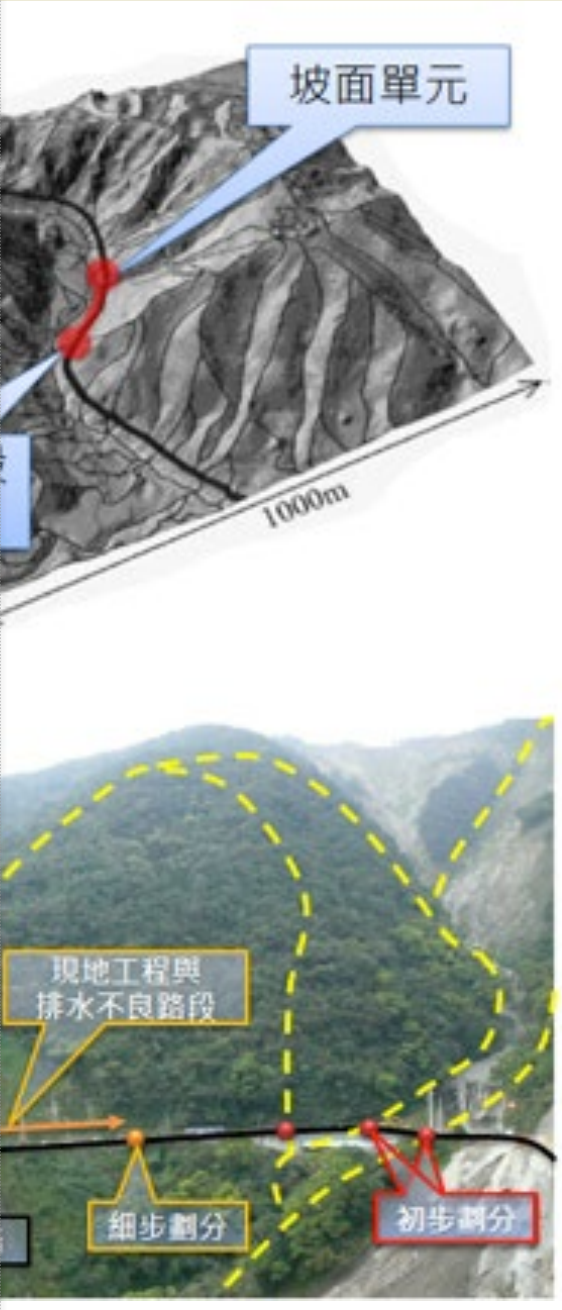
Mountain roads in Taiwan are full of beautiful scenery along the way, especially Taroko and the Coastal Range in eastern Taiwan, which often impress domestic and foreign tourists with their stunning sea view and mountain scenery. However, the terrifying memory of Taiwan's mountain disasters also deters people from visiting. Regular mountain tourists usually check for information of weather change and road condition as a reference for planning their trips; but often such well-laid plans still cannot keep up with the rapid changes of mountain weather. If instant information such as weather and road blocks of mountain roads, or even road hazards that may occur in the future, can be received anytime, people can then change their itineraries in advance to prevent their trips from disruption by disasters.

The 'Early Warning System for Monitoring High-Frequency Hazard Areas of Mountain Roads' (Figure 56), developed by this Institute, can provide mountain road users information of the location of potential hazard areas and instant message of disasters. As long as the users are equipped with handheld internet devices, they can receive information through the 'Early Warning System for Monitoring High-Frequency Hazard Areas of Mountain Roads', including high-frequency hazard sections of main mountain roads, the latest road blocks, bridge closure information, raining conditions, and potential hazard sections; even sections on which hazards may occur in the next one hour can be displayed through maps and short messages. In the future, the users can also apply for mountain road disaster forecasting service from the system, receiving instant forecasting news of mountain road disasters, in order to master instant road conditions either for advance planning or during their trips, to assure the comfort of travel.

本系統的架構包括山區道路劃分、各路段災害預警值律定、即時警戒研判服務及開放式網路地理資訊系統介面等 4 部分。以往易致災路段大部分採固定里程進行劃分，此方式劃分結果有可能發生同一災害橫跨不同路段的現象。因此有別於以往以固定里程長度劃分道路的思維，本計畫以地質特性包括地形表徵，不同之坡向與坡度，不同之邊坡災害特性來分析，因此適合以坡面單元為道路劃分 (圖 57)，如此依據同一坡面單元劃分之道路會有相近之地質、地形與災害特性。



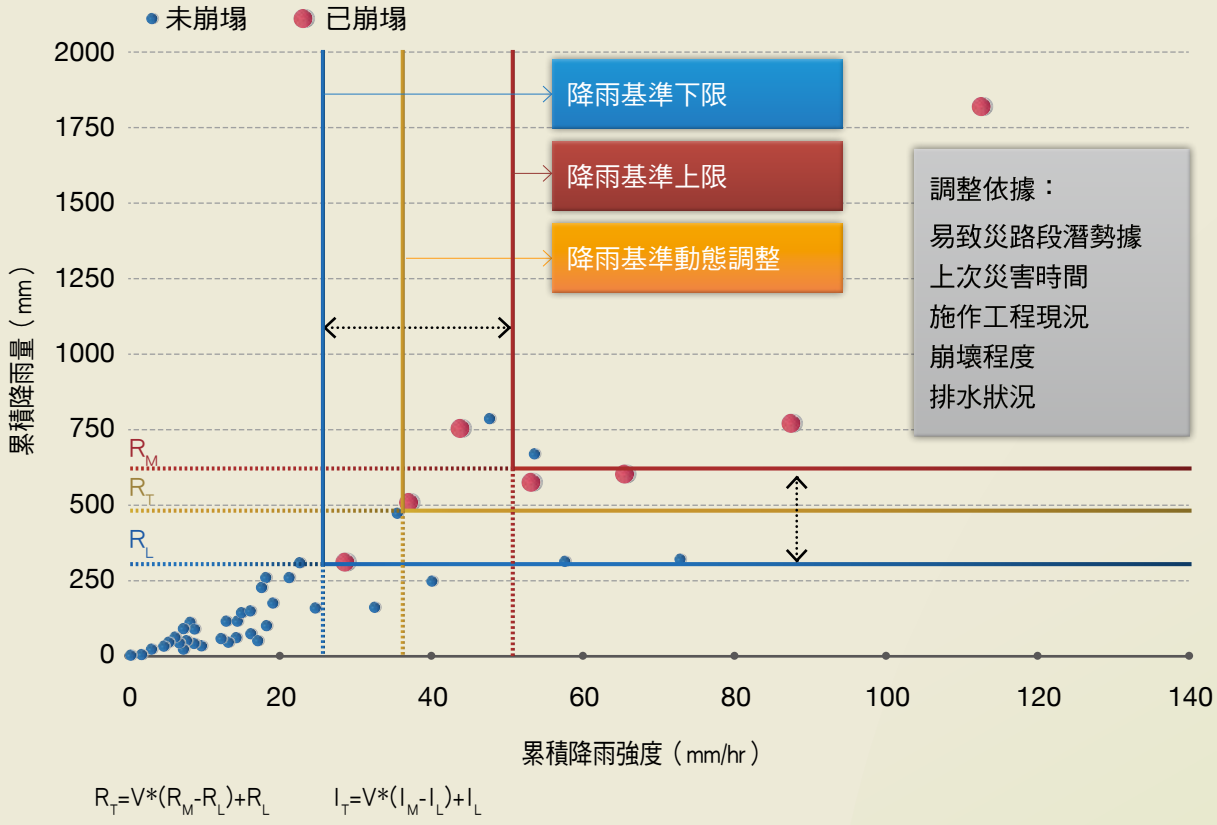
The structure of the system includes four parts: the division of mountain roads, the specification of disaster warning value of each section, instant alert judgment service, and an open network interface of geographical information system (GIS). Previous division of high-frequency hazard sections was mostly based on a fixed mileage, thus it was possible to have the same disaster across different sections. Different from the previous fixed-mileage division concept, the analysis of this project is based on geological features including surface topography, various aspects and slopes, and various slope disaster characteristics, therefore suitable to adopt slope unit for road division (Figure 57). As such, roads divided by the same slope unit will have similar geological, topological, and disaster features.



◂ 圖 57　山區道路易致災路段劃分流程

Figure 57 Flowchart of dividing high-frequency sections of mountain roads

山區道路最常發生的問題就是道路邊坡破壞，邊坡破壞之誘發因子包括降雨、侵蝕、地震及人為因素，其中降雨為主要山區道路邊坡致災之誘因。因此本計畫以降雨為最主要之致災因子進行各路段災害降雨預警值之律定分析，並將警戒區劃分為 3 個區塊，如圖 58 所示。而警戒區下邊界可作為公路總局於警戒階段之警戒值；降雨參數上邊界則進一步經由地文致災因子修正後，作為行動階段之行動值。再利用易致災路段之崩壞程度、災害潛感、距上次災害時間、施作工程現況與植生狀況等因子進行各路段之基準值調整 (圖 58)。

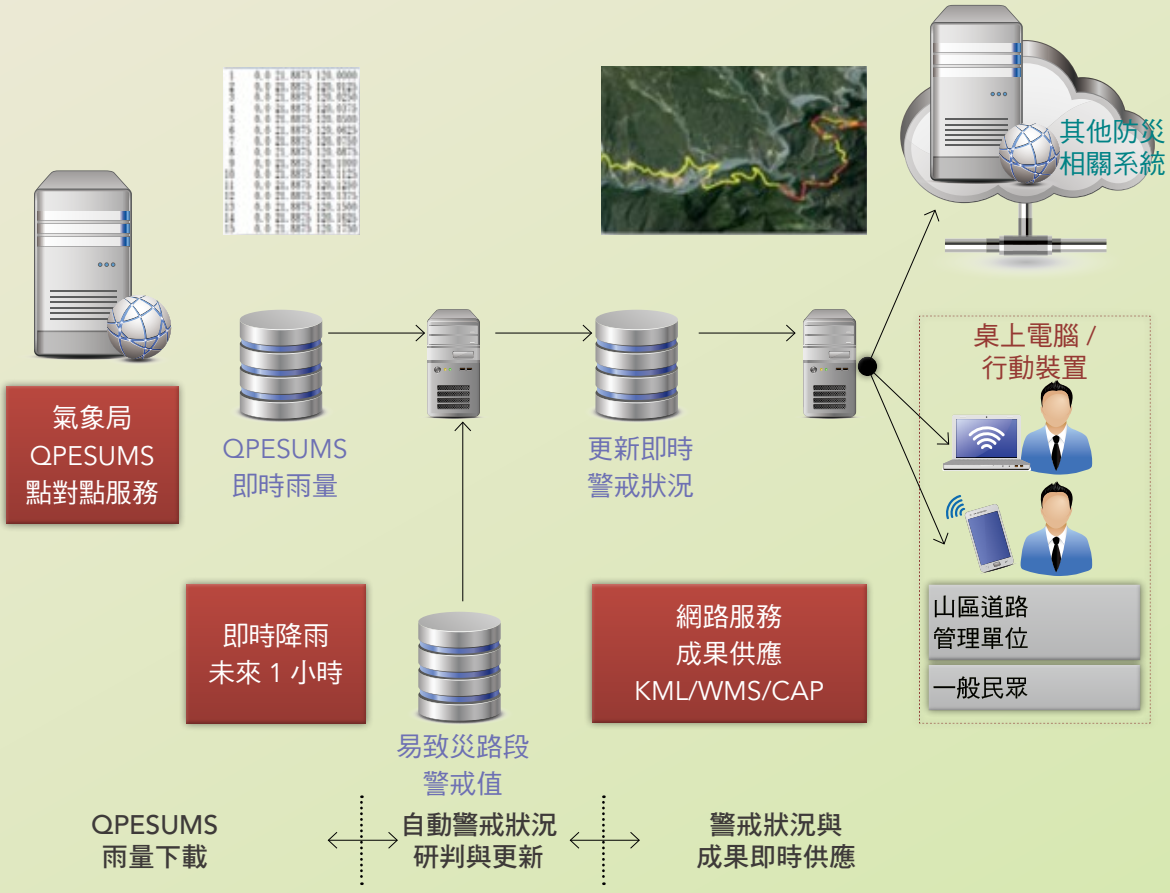


▲ 圖 58　各易致災路段降雨基準上下限與調整依據
Figure 58 High and low limits of rainfall threshold in high-frequency hazard sections and adjustment basis

即時警戒研判服務為本計畫之主要成果，本研究採中央氣象局劇烈天氣監測系統 (QPESUMS) 之降水預報產品，結合港研中心相關計畫之降水修正結果為監測預警管制之研判依據，此方式具備低成本及廣域監控之能力。而主要之方法流程包括 QPESUMS 雨量介接、自動警戒狀況研判與更新以及警戒狀況與成果即時供應 3 部分 (圖 59)。

The most frequent problem of mountain road is slope failure along the road. The triggering factors of slope failure include rainfall, erosion, earthquake and man-made factors; among them rainfall is the main cause of mountain road slope hazard. Therefore, this project selects rainfall as the main triggering factor to conduct specification analysis of disaster rainfall warning value of each section, and divide alert area into three blocks, as shown in Figure 58. Lower boundary of the alert area can be used as the warning value at the warning stage by the Directorate General of Highways (DGH); upper boundary of the rainfall parameter can be used as the action value at the action stage after further correction of topographic hazard factors. Threshold value adjustment of each section can be performed by applying factors of high-frequency hazard areas, such as collapse status, disaster potentiality, the time from the last disaster, current engineering status and vegetation status (Figure 58).

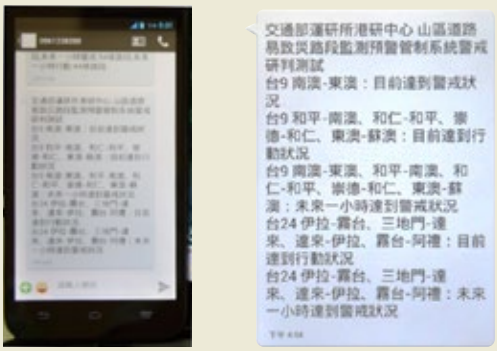
Instant alert judgment service is the main achievement of this project, which integrates precipitation forecast products from the CWB's severe weather monitoring system, Quantitative Precipitation Estimation and Segregation Using Multiple Sensor (QPESUMS), with precipitation amendments from relevant plans of the Harbor and Marine Technology Center, as the basis for making judgments in monitoring and early warning control. This method has the advantage of low cost and the ability of wide-area surveillance. Its main approaches include QPESUMS rainfall interface, automatic alert judging and updating, and instant supply of alert status and results (Figure 59).



▲ 圖 59　即時警戒研判簡訊服務流程

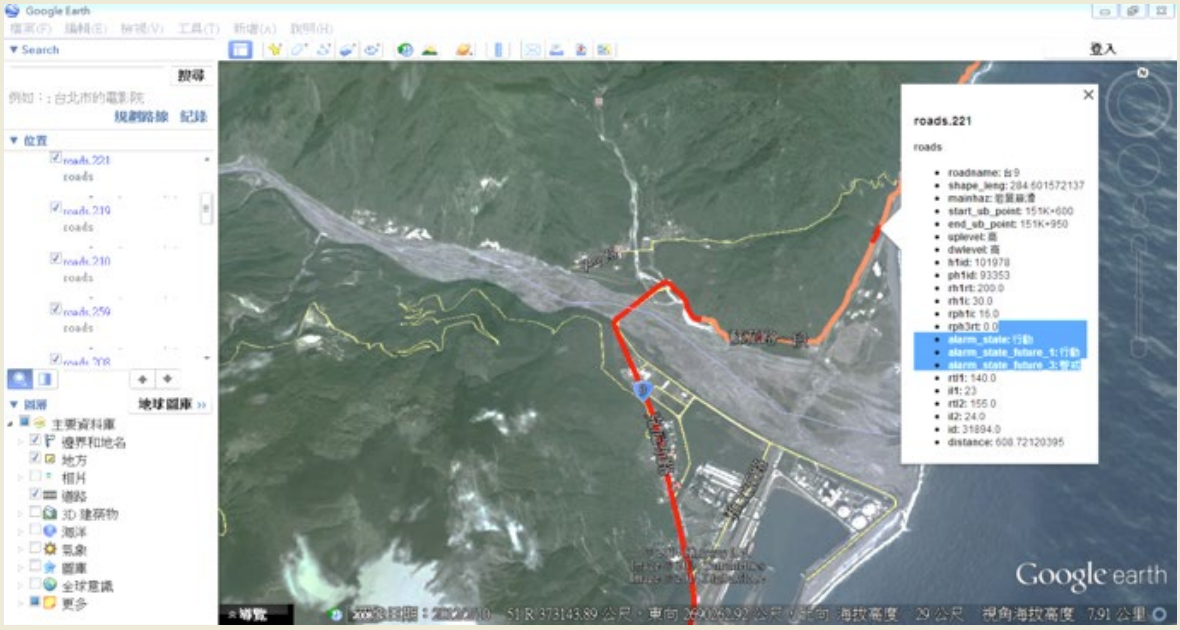
Figure 59 Flowchart of instant alert judgment messaging service

即時警戒研判服務成果，以開放源碼 (open sourece) 之網際網路地理資訊系統軟體 GeoServer(http://geoserver.org/) 發布 對外提供 KML 檔案下載與 WMS 服務連結 (圖 60)。當雨量到達警戒狀況時，系統會發送簡訊至所設定的手機號碼，提醒相關人員及用路人注意 (圖 61)。



▲ 圖 61　即時警戒研判簡訊服務接收畫面

Figure 61　Image received from instant alert judgment messaging servic



▲ 圖 60　警戒狀況成果疊合 Google Earth 圖

Figure 60　Integration of alert status results with Google Earth map

本案開發之開放式網路地理資訊系統介面，以開放式資料 (Open data) 為設計概念，並以 Google Earth KML 檔格式與 OGC(Open Geospatial Consortium，開放式地理空間協會) 的 WMS(Web Map Services ，網路地圖服務) 網路服務對外進行供應。因採開放架構 ，所以本系統可介接氣象局雨量站觀測 (.kml) 與公路總局道路災害性封閉 (.kmz) 等政府開放資料 (圖 62) ，上述兩類資料皆為即時更新之資料，因此可於本系統中顯示最新之道路通阻與降雨狀況資訊。

本系統目前上線測試的路段已有台 9 線蘇花公路、台 24 線阿禮 - 三地門段，未來配合更多山區道路段的納入、山區道路資訊的整合與行動 APP 的建置應用，將可提供更多元的服務。透過即時氣象及道路、橋梁資訊之整合，不僅提升山區道路的用路安全，也讓遊客能掌握旅途中的路況及氣象變化狀況及未來可能之災害情形。

Results of instant alert judgment service are released via the open source GIS software, GeoServer (http://geoserver.org/), providing external users KML file to download and link to WMS services (Figure 60). When precipitation reaches the alert status, the system will send SMS to pre-set hand phone numbers to alert relevant staff and road users (Figure 61).

The open source GIS interface developed in this project is based on the open-data design concept, providing data in Google Earth's KML file format, and Open Geospatial Consortium's (OGC) Web Map Services (WMS). With an open structure, the system can interface with open government data such as CWB stations rainfall data (.kml) and DGH alert message about road closure (.kmz) (Figure 62). The above two information are both instant updated data, thus able to display the latest road condition and precipitation status on this system.

Currently, the road sections that are tested online include Provincial Highway No. 9 (Suhua Highway) and Provincial Highway No. 24 between Ali and Sandimen. With the addition of more mountain road sections, the integration of mountain road information, and the construction and application of mobile APPs, more diverse services can be provided in the future. By integrating weather, road, and bridge real-time information, not only can the safe usage of mountain roads be enhanced, visitors can also master changes of road and weather conditions and potential disaster status during their journey.

▲ 圖 62　監控圖台展示政府開放資料 (道路災害性封閉) 畫面

Figure 62 Image of open government data (road closure due to hazard)shown on monitoring platform

六、智慧運輸

(一) 先進公共運輸系統整合資料庫加值應用

目前世界各先進國家對於大眾運輸系統涵蓋服務範圍指標及重要地標之旅行時間可及性指標十分重視，常用以衡量政府資源投入成效或評估社會公平性之參考。由於各項評估指標牽涉到複雜之空間分析，除了建立完整之評估指標外，尚須將 APTS 資訊結合地理資訊系統及人口分布資料等進行加值應用，構建各項評估指標之自動計算功能，以快速取得評估指標數據，協助主管機關評估各地區現行公共運輸無縫服務環境與相關資源投入之預期產出效果。本計畫針對上述需求，開發出具備公路主管機關決策支援功能之「APTS 整合資料庫加值應用系統」(以下簡稱本系統)。計畫分 2 年期辦理，第 1 年期 (101 年) 工作主要為規劃 APTS 整合資料庫加值應用之需求項目，並開發出一套具備共通功能之系統核心模組，讓相關主管機關或客運業者可直接應用該核心模組，或依其個別需求功能稍加組裝修改成為客製化系統。第 2 年期 (102 年) 工作主要為依據第 1 年期計畫之研發成果，以交通部公路總局及新北市政府交通局為示範對象，辦理示範計畫，進行系統功能測試與使用成效評估，並進行必要之系統功能修正，同時辦理教育訓練，以利研發成果之落實。

本系統主要功能有下列五項，並可將分析結果以圖表方式呈現，讓使用者可以快速診斷問題，以利研擬改善方案：

1. 基本設定：設定系統使用者權限及評估指標參數。
2. 無縫服務分析：提供 19 個大眾運輸無縫服務評估指標計算功能。
3. 審議輔助：提供 14 個評估指標用以分析新闢路線、營運計畫調整與停駛路線可能之影響。
4. 服務績效分析：含路線別成本區域比較分析、班表調整檢討分析、路線評鑑輔助與改善追蹤、補貼款自動計算等 4 項功能。
5. 年節疏運指標分析：提供運能及運量等指標值自動計算功能，以及依節日 / 年度 / 客運公司別進行統計分析之功能。

6. Intelligent Transportation

(1) Value-added application of the integrated database of advanced public transportation system

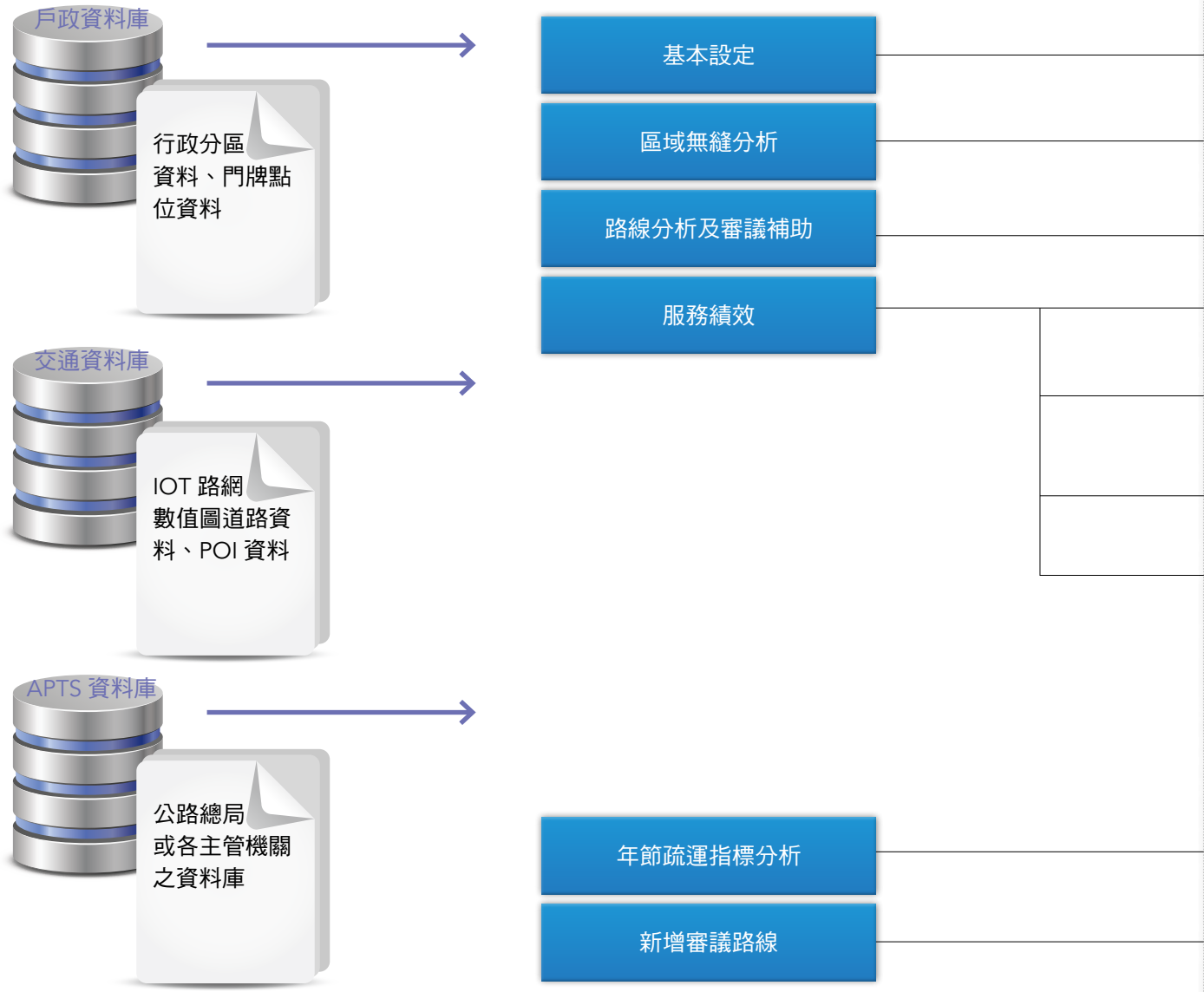
Nowadays, developed countries around the world place much importance on indicators of advanced public transportation system (APTS) service coverage and of travel time access to major landmarks, often using them as references to measure the performance of government resource input and to evaluate social equity. As many assessment indicators are involved with complicated spatial analysis, in addition to the building of comprehensive assessment indicators, it is necessary to combine APTS information with GIS and population distribution data to perform value-added application and construct automatic computing function of the assessment indicators, in order to quickly obtain index data to assist governing authorities to evaluate the expected output of current public transportation seamless service and related resource inputs in various regions. In response to the above needs, this project develops the 'APTS Integrated Database Value-Added Application System' (hereinafter referred to as the System) that possesses the function of supporting decisions made by highway authorities. For this two-year project, the main task in the first year (2012) is planning required items for the value-added application of APTS integrated database, and developing a set of core modules with common functions for the system, to allow related governing authorities or bus service operators to directly use these modules or slightly modify them to become customized systems to meet their needs. The main task in the second year (2013) is adopting research results of the previous year to present demonstration projects to the DGH of the MOTC and the Transportation Department of New Taipei City Government, conducting system functional testing and usage performance evaluation, making necessary functional adjustment and organizing educational training, to facilitate the implementation of R&D results.

The System has the following five main functions and can provide graphical displays of analytical results to allow users a quick diagnosis of problems to facilitate project improvement:

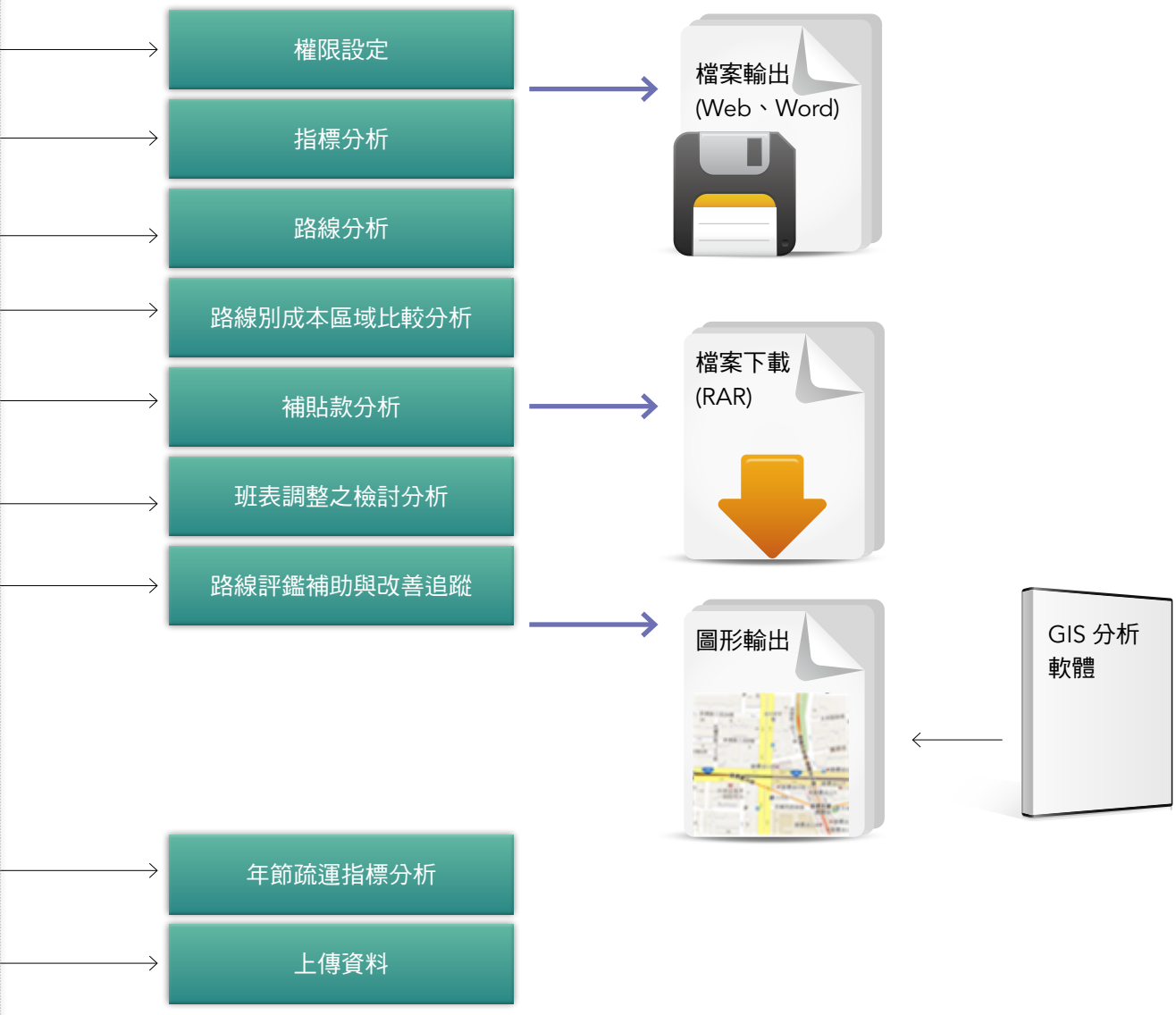
1. Basic settings: the setting of user authorization and evaluation index parameters.
2. Seamless service analysis: providing computing feature for 19 public transportation seamless service evaluation indices.
3. Review assistance: providing 14 assessment indices for analyzing potential effects of new routes, operational plan adjustment, and suspended routes.
4. Service performance analysis: providing four features including regional comparative analysis of route-based cost, review and analysis of schedule adjustments, route evaluation aid and improvement of tracking, and automatic computing of subsidy payments.
5. Holiday season dispatch index analysis: providing automatic computing functions on index values such as transportation capacity and traffic volume, and statistical analysis by holiday / calendar year / transport company.

本系統可協助交通主管機關快速瞭解某個地區之公車服務缺口狀況及運輸資源配置調整可能帶來的影響，克服過去因相關資訊不足所導致的管理盲點，可使運輸服務供給更符合民眾所需。根據試辦計畫績效評估結果，使用本系統可節省承辦人員相關行政作業時間99.5%，亦有助於提升路線審議作業及整體公共運輸服務規劃之決策品質。本計畫透過辦理示範計畫已協助公路總局進行多項實際案例分析，包括進行臺東、屏東地區及全臺 30 個山地原住民鄉之公共運輸服務現況掃描及無縫服務環境分析，藉以瞭解偏鄉及原住民部落等地區之交通可及性，以利公路總局規劃相關改善方案。

▼ 圖 63　系統功能模組架構圖
Figure 63 Architecture of system functional module



This System can assist governing authorities of transportation and communications to quickly learn the gaps of bus service in certain districts and the potential influence of transportation resource adjustment, to overcome managerial blind spots caused by the lack of information in the past, and to facilitate transport service supply for better satisfying public needs. According to the results of performance evaluation of the pilot program, using the System can save 99.5% of related administrative work time, and help to improve the decision quality of route review and the overall planning of public transport services. With program demonstrations, the project has helped DGH conduct a number of actual case analyses, including the scanning of public transport service profiles and the analysis of seamless service conditions of Taitung and Pingtung areas, and 30 aboriginal townships around Taiwan, in order to grasp the situation of transport accessibility in remote townships and aboriginal villages to facilitate DGH's planning for related improvement programs.



此外，本所於 102 年 10 月中旬前往日本東京參加第 20 屆智慧型運輸系統世界大會，設攤展示「先進公共運輸系統整合資料庫加值應用系統」研發成果，參展期間有數百位來自歐美及亞洲各國的產官學界貴賓蒞臨臺灣館攤位參觀本所展示內容，大會新聞刊物 Daily News 並以專文介紹本系統。參訪人員對本系統具備的民行便利性診斷分析功能表示肯定，認為對於大眾運輸無縫服務環境的建構與發展幫助甚大，當場有日本及大陸地區多家公司及研究機構對於引進本系統展現高度興趣。

本系統因具技術新穎性且有實際應用效益，本所已將相關技術提出專利申請。本所於 103 年將繼續就擴充本系統功能進行研討，同時成立輔導團隊，協助縣市政府應用本系統診斷當地公共運輸無縫服務環境，進而針對服務缺口規劃相關改善方案，以提昇民行便利性。

▼ 圖 64　第 20 屆智慧型運輸系統世界大會本系統參展攤位及解說人員
Figure 64 Display booth of the System and staff in the 20th ITS World Congress

▲ 圖 65　第 20 屆智慧型運輸系統世界大會日籍貴賓對本系統有高度興趣
Figure 65 Japanese visitors show great interest in the System during the exhibition

In mid-October 2013, our Institute attended the 20th ITS World Congress in Tokyo, Japan, setting up a display booth to introduce the R&D results of 'ATPS Integrated Database Value-Added Application System'. During the exhibition, hundreds of guests from the industrial, governmental, and academic sectors of American, European and Asian countries have visited our displays; the newsletter of the conference, Daily News, ran a feature to introduce the System. Visiting guests affirmed the convenient diagnostic and analytic features of the System in civil administration, and agreed that it would provide great help in building and developing public transportation seamless service environment. On the scene, many Japanese and Mainland Chinese companies and research institutes have shown high interest in importing the System.

On account of the technical novelty and practical application benefits of the System, our Institute has applied patent for related technologies. The Institute will continue the research for expanding functionality of the System in 2014, and form counseling teams to help county and city governments to apply the System on the diagnosis of local public transportation seamless service environment, targeting on service gaps to plan for improvement programs in order to enhance the convenience of civil administration.

▲ 圖 66 第 20 屆智慧型運輸系統世界大會新聞刊物專文介紹本系統

Figure 66 Feature of the System on newsletter of the 20th ITS World Congress

▲ 圖 67 第 20 屆智慧型運輸系統世界大會本系統參展攤位海報之一

Figure 67 Poster of display booth in the 20th ITS World Congress exhibition

▲ 圖 68　第 20 屆智慧型運輸系統世界大會運研所宣傳文宣封面

Figure 68　Cover of the IOT promotional material for the 20th ITS World Congress

(二)接軌國際－發展低溫運輸系統之課題與因應策略

為解決臺灣經濟面對的結構性失衡課題，行政院在產業構面上，提出「推動產業多元創新」策略，以「三業四化」政策—包括「製造業服務化」、「服務業國際化、科技化」及「傳統產業特色化」為三大主軸，並優先篩選出亮點產業，做為推動主軸的示範計畫，協助產業轉型為多元結構。而低溫物流產業目前已被列為亮點產業，可見低溫 (cold chain) 運輸之發展日漸受到重視。

▲ 圖 69　本研究之背景與目的
Figure 69 Research background and purposes

本研究蒐集國內、外低溫物流現況與發展趨勢相關資料，就技術發展、設施建置、標準與法規、產業輔導及全球運籌支援等構面做深入探討，並藉著專家訪談與專家座談瞭解產、官、學、研、協等領域內專家之意見，進而應用內容分析與 SWOT 分析等方法，探討國內低溫運輸物流產業之機會與挑戰，研提政府與產業之因應對策與建議，以因應全球低溫運輸物流發展趨勢，並實踐經濟部「三業四化」及交通部「推動永續綠色運輸，落實節能減碳政策」之施政方針，改善國內物流產業發展低溫運輸物流環境。此外，本計畫亦舉辦了 2 場教育訓練，將相關研究內容提供給相關政府單位作為未來施政之參考。

(2) Joining the international way – the subject of developing cold chain and its coping strategy

To solve the structural imbalance issue of Taiwan's economy, the Executive Yuan has proposed the strategy of 'promoting industrial diversity and innovation' in the industry dimension, adopting the 'Three Industries, Four Reforms' policy including 'the servitization of manufacturing industry', 'the internationalization and technologization of service industry', and 'the characterization of traditional industries' as three axes, and giving priority to the spotlight industry as a model to promote the three axes, to facilitate industrial transformation to plural structure. Cold chain logistics has now been listed as a spotlight industry, showing that the development of cold chain has attracted more and more attention.

This study collected domestic and overseas information related to the current status and development tendency of cold chain logistics, and conducted in-depth exploration in dimensions of technological development, facility construction, standards and regulations, industry guidance and global logistics support. Through interviews and discussions, opinions from experts in the industry, government, academia, research institutes and associations were collected. With the application of content analysis and SWOT analysis approaches, it explored the opportunities and challenges faced by domestic cold chain logistics industry, proposed coping strategies and suggestions to the government and industry in response to global cold chain development trend, and implemented the 'Three Industries, Four Reforms' policy of the Ministry of Economic Affairs, and the practices of 'promoting sustainable green transport, implementing energy-saving and carbon-reducing policies' of the MOTC, to improve the development of cold chain environment for domestic logistics industry. In addition, two training events were organized under this project to provide research results to the relevant government agencies as a reference for their future policy.

在參考低溫運輸物流發展先進之國家現況及趨勢後，勾勒出我國低溫運輸物流面臨之 5 大課題，包括：

課題 1：我國雖陸續開放自由貿易港區 / 自由經濟示範區，擴大與中國大陸與國際的交易量，但缺乏足夠的低溫運輸物流作業區容量。

課題 2：自由經濟示範區以及自由貿易港區低溫運輸物流作業區已經不足的情況下，低溫運輸物流相關設施亦明顯不足。

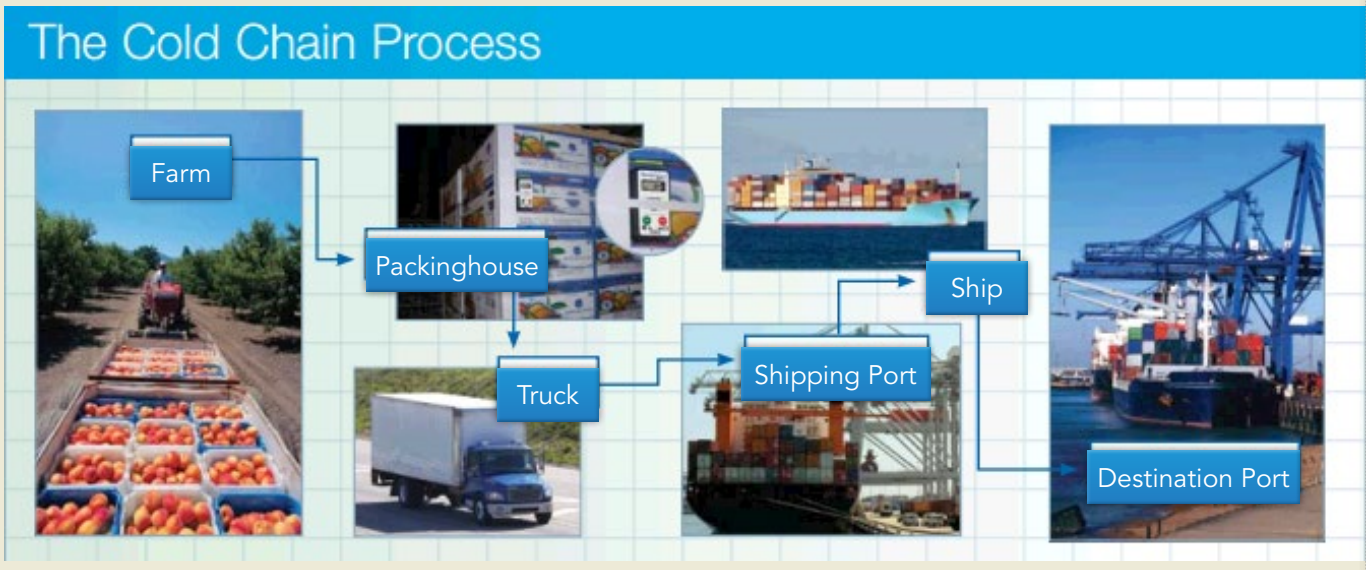
課題 3：我國低溫運輸物流資訊整合程度不高。

課題 4：低溫運輸物流通常需要複合式運輸來完成，然而我國在技術上尚未發展完全，導致在不同運具之連接上有技術上之困難，易發生斷鏈。

課題 5：我國低溫運輸物流之標準、規範等，尚無法與國際接軌。

針對面臨之 5 大課題，本研究研提 5 項策略，包括：

策略 1：促進兩岸區對區發展。以我國自由貿易港區或自由經濟示範區與中國大陸之經濟特區對接，以期在既有兩岸低溫物流聯盟的架構下，結合我國自由經濟示範區與中國大陸保稅區與自由貿易區，利用關稅降低的優惠，發展區對區的低溫物流產業。



▲ 圖 70　低溫物流流程示意圖
資料來源 : http://www.sensitech.com

▲ 圖 71　策略一區對區示範運作圖
Figure 71Strategy 1 – parallel zone operation example

In consultation of the current status and development trend of cold chain logistics in advanced countries, five major issues faced by our cold chain industry were outlined as follows:

Issue 1: Despite the continual launching of free trade ports (FTPs) / free economic pilot zones (FEPZs) and the expansion of trade volume with China and internationally, the capacity of cold chain logistics operation areas is still inadequate in our country.

Issue 2: Under the circumstance of inadequate cold chain logistics operation areas in FEPZs and FTPs, the relevant cold chain facilities are clearly insufficient.

Issue 3: The degree of cold chain logistics information integration is not high.

Issue 4: Cold chain logistics often requires intermodal transportation to achieve, but the technologies in our country are not fully developed, resulting in technical difficulties in the connection of different transport modes and liability to chain disruption.

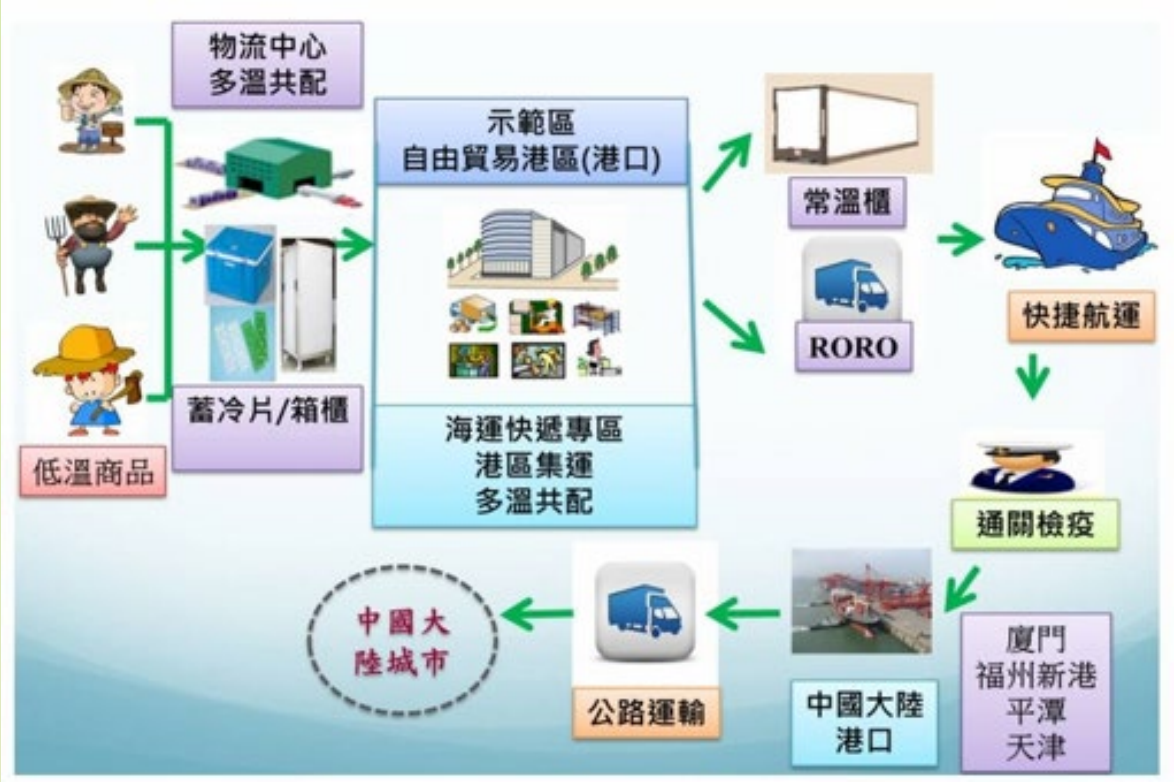
Issue 5: The cold chain logistics standards and specifications of our country are not yet connected with international practice.

In face of the five major issues above, five strategies are proposed in this study, including:

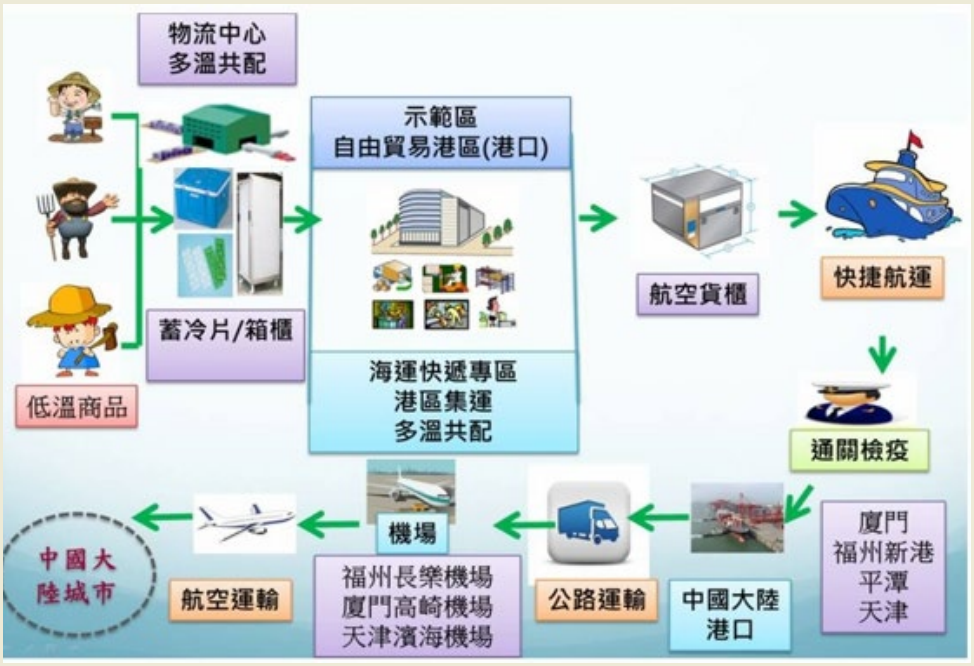
Strategy 1: Facilitating cross-strait parallel zone development. Connecting FTPs or FEPZs of our country to special economic zones (SEZs) in Mainland China, and combining our FEPZs with tariff-free zones and free trade areas (FTAs) in Mainland China under the existing framework of cross-strait cold chain logistics alliance, in order to take advantage of tariff reduction preference to develop parallel-zone cold chain logistics.

策略 2：發展多溫共配快捷快遞，因應海運快捷快遞專區之設置，本研究提出 3 項作業模式。模式 1 為使用多溫共配技術在港區集運採用快捷航運運送；模式 2 為使用多溫共配技術在港區集運採用快捷航運運送至中國大陸後，轉由航空運輸運送到中國大陸其他城市；模式 3 為在於引進國內外豐沛資金及原物料，在我國自由經濟示範區內進行農業加值活動後，透過快捷航運運送產品至中國大陸。

▼ 圖 72　策略 2 模式 1
Figure 72　Strategy 2 Mode 1



Strategy 2: Developing multi-temperature co-delivery fast express. In response to the setting up of sea express zone, this study proposes three operating modes. Mode 1 is the use of multi-temperature co-delivery technology with express ship delivery for port area freight; mode 2 is the use of multi-temperature co-delivery technology with express ship delivery for port area freight to reach Mainland China, then transport to various cities in China by air; mode 3 is bringing in copious domestic and foreign capital and raw materials to carry out value-added agricultural processing in our FEPZs, then transporting products via express ship delivery to Mainland China.



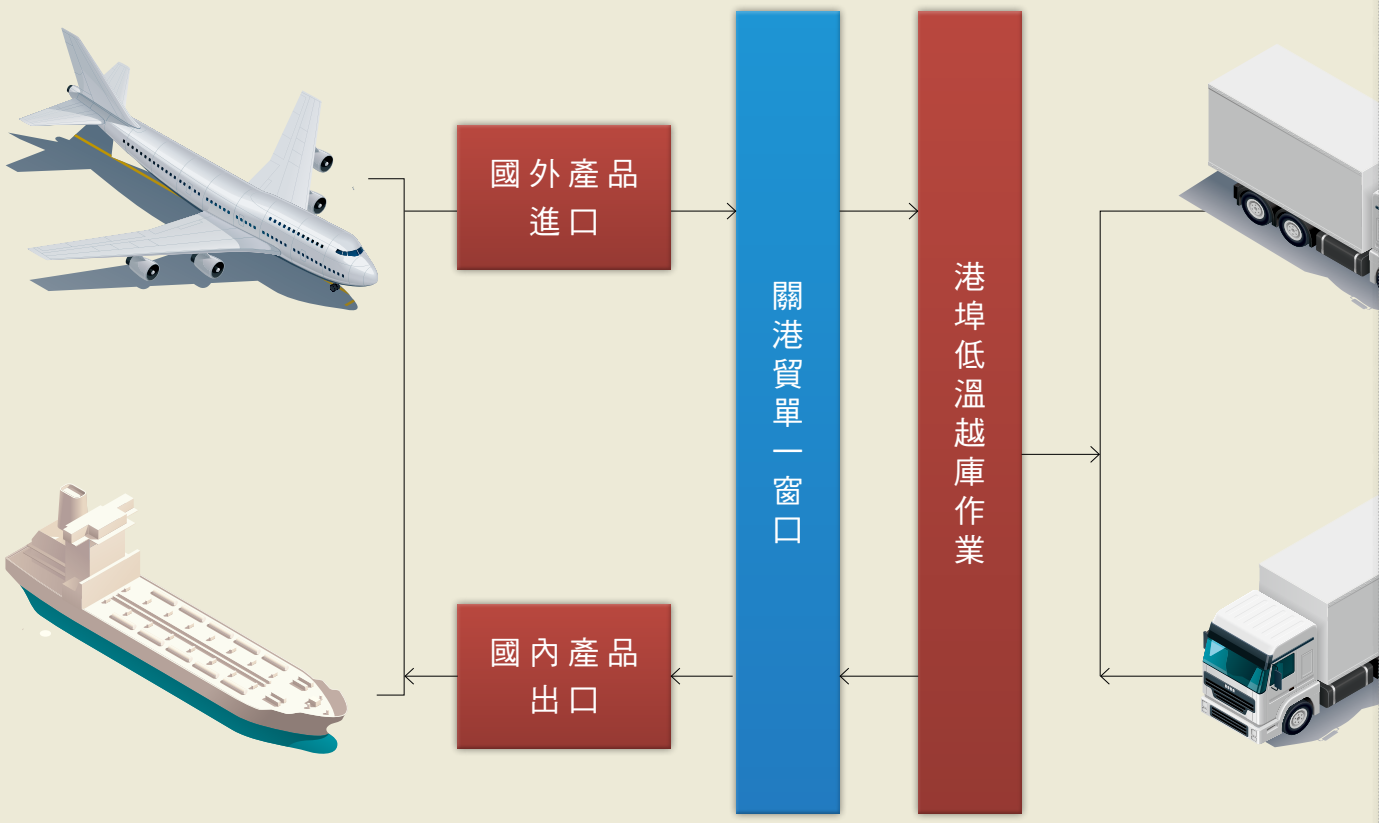
▲ 圖 73　策略 2 模式 2
Figure 73 Strategy 2 Mode 2

▲ 圖 74　策略 2 模式 2
Figure 74 Strategy 2 Mode 2

策略 3：配合資通訊及雲端整合部分。該策略則是配合關港貿單一窗口之設置，檢討因應低溫運輸物流之需求。

策略 4：引進高效率低溫越庫作業。由於採用越庫作業可增加物流作業之效率、減少貨損，故於可於自由貿易港區興建越庫作業區，可使內陸低溫運輸與港口進出口貨物停滯時間降低，有效節省物流作業時間，提升低溫運輸物流效率及競爭力。

策略 5：鼓勵標準規劃。目前國際物流組織 (CCA) 已推動低溫物流品質指標規範 (CCQI)，政府可鼓勵業者採用國際認證之標準及作業準則，或由業者由兩岸試行合作過程中累積標準運作之經驗自訂適當之準則。

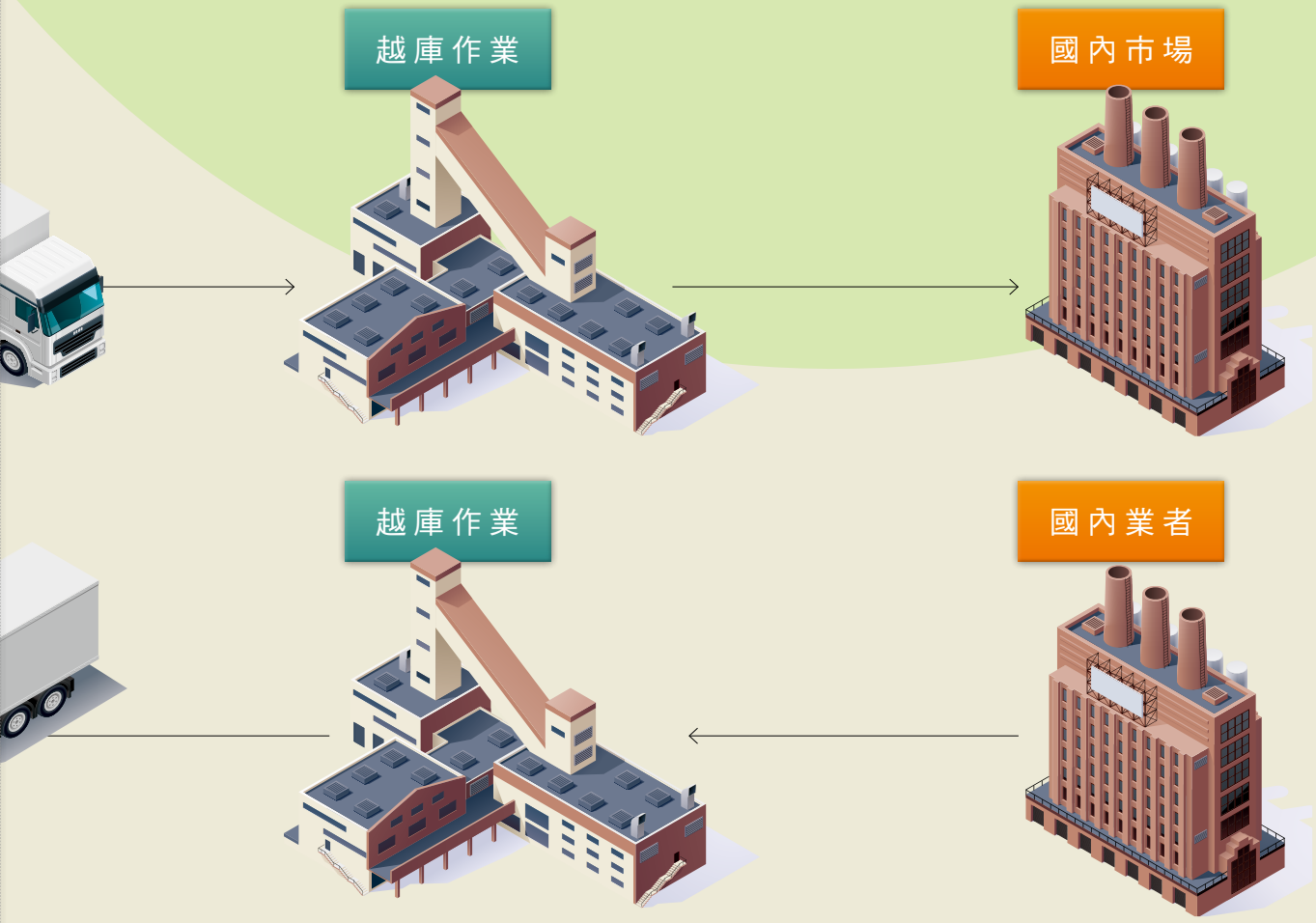


▲ 圖 75　策略四越庫作業
Figure 75 Strategy 4 – cross-docking operations

Strategy 3: Accommodating information and communication technology (ICT) with cloud integration. This strategy is to accommodate the launching of customs-port-trade (CPT) single window to review the coping of cold chain logistics needs.

Strategy 4: Bringing in high-efficiency, cold chain cross-docking operations. As cross-docking operations increase logistics efficiency and reduce cargo damages, it is possible to set up cross-docking operation areas at FTPs to reduce inland cold chain and idle time of import-export port cargo, saving logistics operation time effectively and increasing efficiency and competitiveness of cold chain logistics.

Strategy 5: Promoting the planning of criteria. The global logistics organization, Cool Chain Association (CCA), is currently promoting Cool Chain Quality Indicator Standard (CCQI). Our government can encourage the industry to adopt international accreditation standards and operating guidelines, or to customize its own appropriate guidelines from standard operating experiences accumulated during the process of trial cross-strait cooperation.



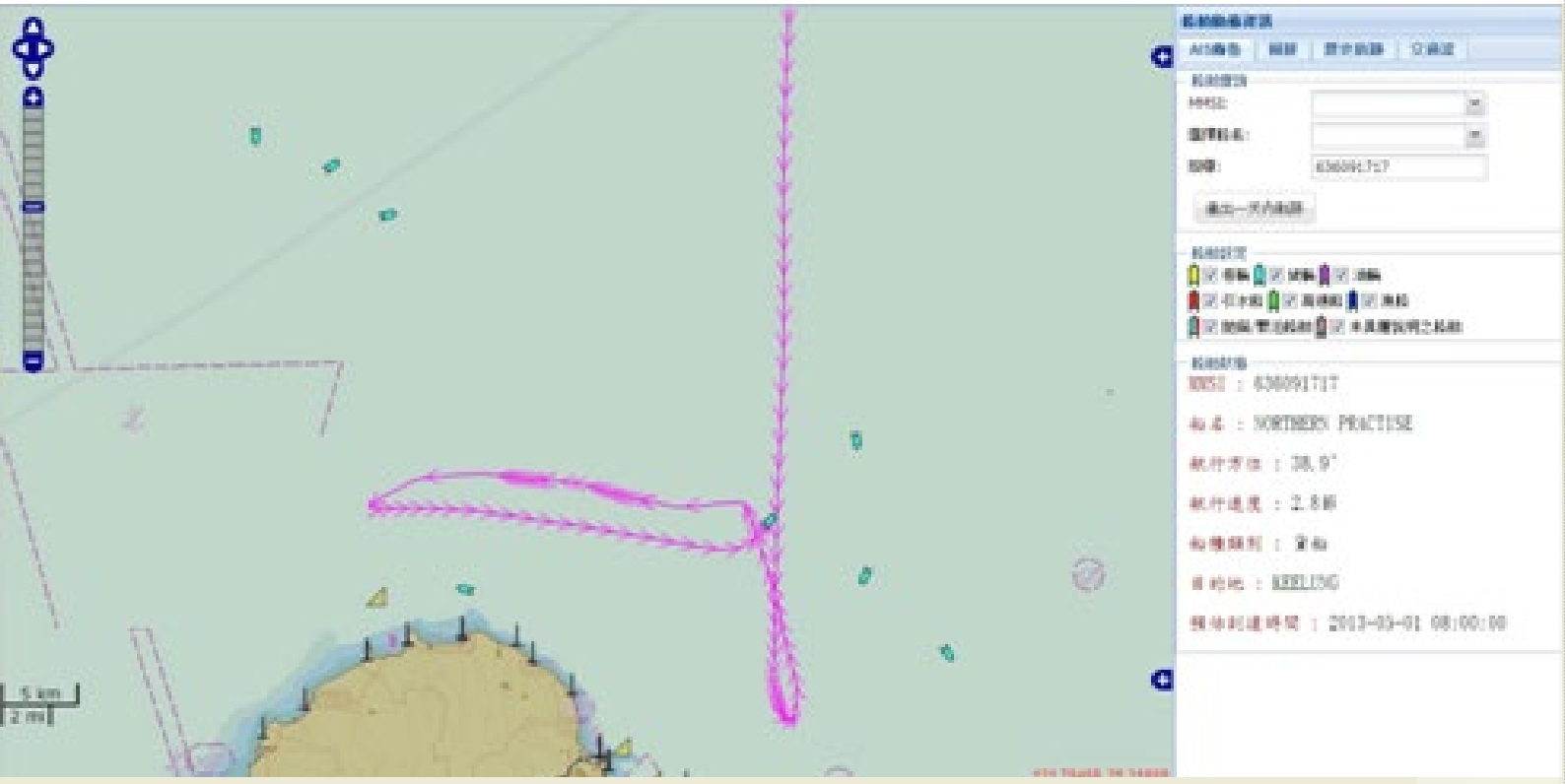


圖 76　船舶軌跡顯示平台
Figure 76 Vessel trajectory display platform

(三) 結合動態船舶資訊之智慧領航

航運與港埠在國家的經濟與發展中扮演著關鍵角色，為了管理與改善則需選擇可量測的適當指標。隨著各國船舶自動辨識系統 (Automatic Identification System, AIS) 巨量資料的累積，如何透過 AIS 資料應用於航港安全、效率與環保指標等事務，已經成為越來越受關注的研究議題。本計畫整合船舶動態與電子海圖地理資訊，進行 AIS 資料的時空分析，目的是在替航港安全與效率提供一個具體的量化指標，藉以作為交通部航港局或臺灣港務公司在航運規劃與營運效率的重要參考，並輔助現有各港務分公司的船舶服務系統 (VTS) 的效能。

本計畫採用的資料主要來自交通部運輸研究所的「臺灣海域船舶動態資訊系統」透過沿岸 AIS 接收設備蒐集的 AIS 資料庫。在發展分析方法的過程中，都必須先開發一個可顯示船舶軌跡的平台以供觀察。而此船舶軌跡顯示平台如圖 76 所示，由圖 76 可觀察到有某些船舶早已抵達卻在港外徘徊，遲遲無法進港的情形。

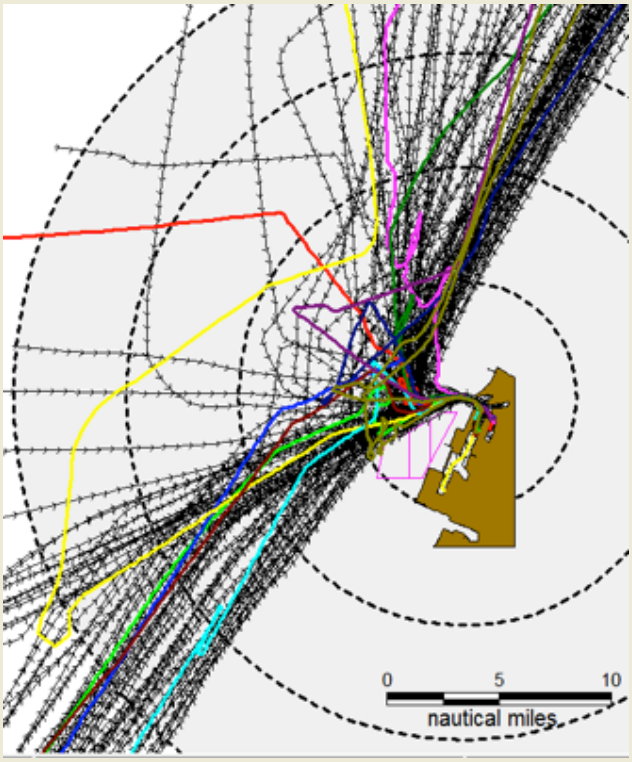
(3) Smart piloting with vessel dynamics information

Shipping and ports play a crucial role in the economy and development of the country. For their management and improvement, it is necessary to select appropriate, measurable indicators. As the vessel automatic identification system (AIS) of each country has accumulated a huge amount of data, how to apply AIS information to matters such as port safety, efficiency, and environmental indicators has become a research subject of increasing concern. This project integrates geographic information of vessel dynamics and electronic navigational charts to conduct a spatio-temporal analysis on AIS data, aiming to provide a specific quantitative indicator of port safety and efficiency as an important reference for navigation planning and operational efficiency by the Maritime and Port Bureau of the MOTC or Taiwan International Ports Corporation, Ltd. and for assisting the performance of vessel traffic services (VTS) of existing port branch companies.

The data adopted by this project are mainly from the AIS database that collects data from coastal AIS receiving devices by the Vessel Dynamic Information of Taiwan Maritime Area system developed by the IOT of the MOTC. In the process of developing analytical methods, a platform that can show vessel trajectory for observation must first be developed. As shown in Figure 76, it can be seen from the platform that some vessels have arrived but are hovering outside the port and waiting to enter.

基於船舶軌跡顯示平台，本計畫分析港區附近船舶的進港航跡，以臺中港為例，臺中港的船舶進港航跡分析如圖 77 所示，船舶進港航跡可特別標示出 5 條航跡距離超長的船舶進港情況，由圖 77 可見某些航跡確實有在港外徘徊或是繞遠路進港的增加油耗現象。

因不同港口的地理環境與進出港航道的設計不同，且從各個方向到港的正常航行時間與距離都有差異。以臺中港為例，分析從穿越 20 浬的距離圈進到臺中港的船舶軌跡，得出臺中港不同方向進港航跡的航行距離與時間分析如表 4 所示。其分析統計結果，從北方進港的航行路徑較長且較耗時。



▲ 圖 77　臺中港的船舶進港航跡分析
Figure 77 Analysis of ship tracks that enter Taichung Port

表 4 臺中港不同方向進港航跡的航行距離與時間分析
Table 4 Analysis of travel time and distance on ship tracks from different directions to

通過 20 浬到進港	全部	北來 (取 350 度 ~27 度)	其他來向
航跡數比例	100%	49.7%	50.3%
距離平均值 μ (浬)	23.35	24.60	22.12
距離標準差 σ (浬)	4.20	2.97	4.83
距離 μ + σ (浬)	27.55	27.57	26.95
時間平均值 μ (秒)	8839	9436	8250
時間標準差 σ (秒)	5446	6046	4706
時間 μ + σ (小時)	3.97	4.30	3.60

Via the vessel trajectory display platform, this project analyzes the port-entering ship tracks near the port area. Using Taichung Port as an example, the port-entering ship tracks are analyzed and shown in Figure 77. From them five extra-long distanced tracks can be specified, showing that some vessels have actually lingered outside the port or taken a long way to enter the port, a phenomenon that increases fuel consumption.

Due to the differences of geographical environment and inbound-outbound route design of different ports, the normal travel times and distances from various directions to the port are different. Using Taichung Port as an example, an analysis of ship tracks entering the port within the circle of 20 nautical miles comes up with travel times and distances of port-entering ship tracks from different directions to Taichung Port, as shown in Table 3. Statistical results show that travel paths from the north take a longer distance and time.

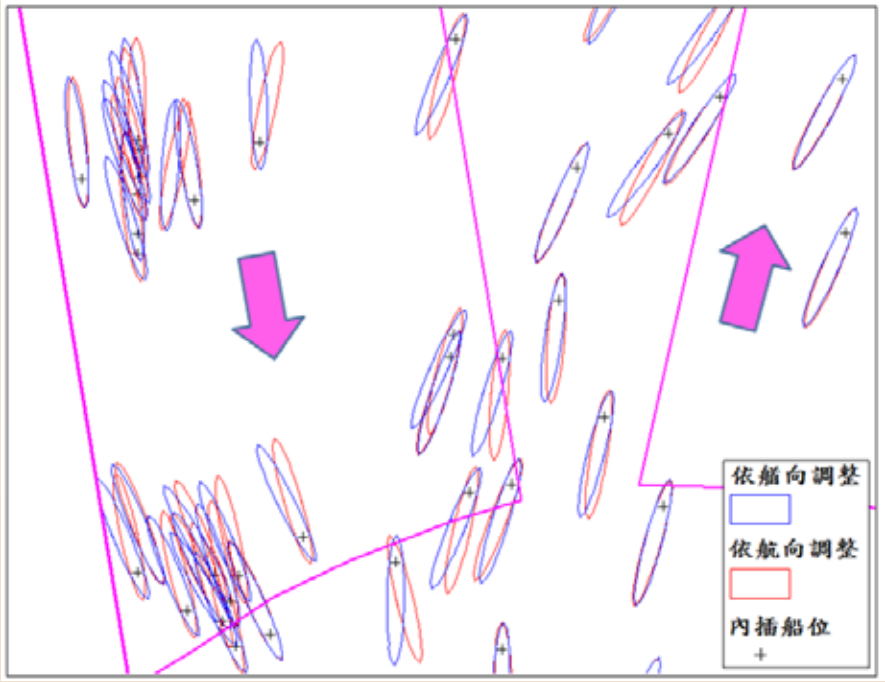


圖 78　兩相鄰船舶調整之距離推算

Figure 78　Projection of adjusted distance between two adjacent vessels

另外本研究利用 AIS 船舶軌跡偵測差點發生而未發生的事件（near-miss）來作為風險指標，藉以作為動態風險管理時參考運用。本研究利用 AIS 資料包括船舶的長度、寬度、船位經緯度、對地航速、對地航向、艏向等產生船舶輪廓與船舶領域圖徵，帶入以船舶長度為參數的橢圓長短軸領域邊界數值。再利用空間資訊分析計算兩相鄰船舶之間及船舶與危險障礙物或淺水區之間的距離，來偵測評估 near-miss 狀況。兩相鄰船舶調整之距離推算如圖 77 所示，從圖 78 可比較推算調整船舶中心點的距離。

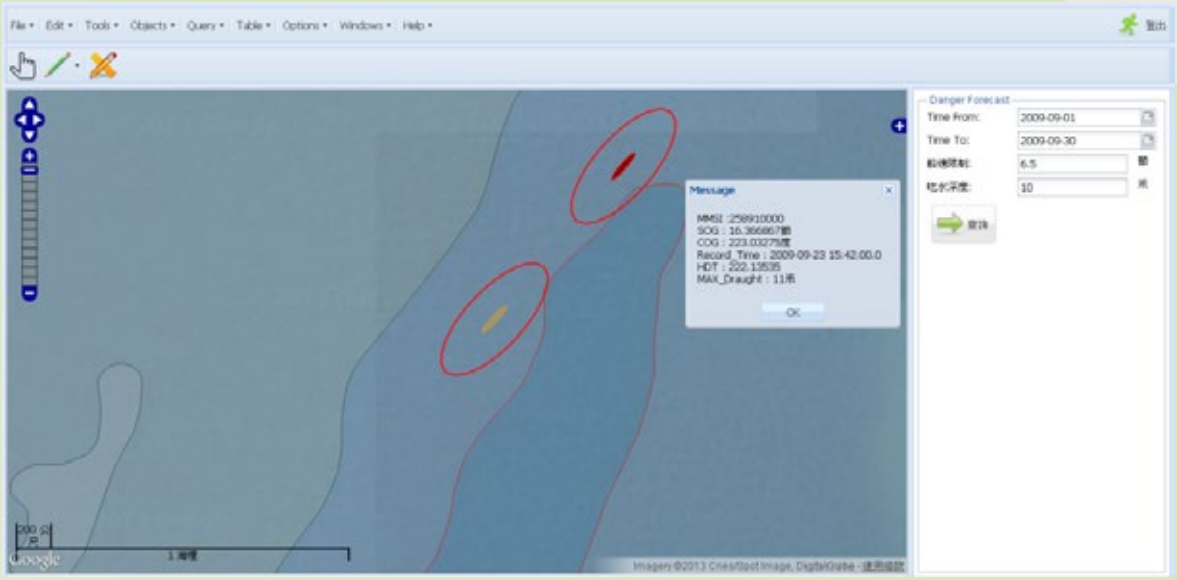
本計畫並結合船舶動靜態資料 (AIS) 與電子海圖 (ENC) 來進行船舶航行的 3D 空間幾何分析。船舶航行資料與電子海圖的等深線，配合各別船舶的最大吃水深度資料，本計畫可判定此航行船舶是否有擱淺的危機。整合 AIS 與 ENC 資料的擱淺危險分析如圖 79 所示。

本計畫建立整合船舶動態資料 (AIS) 與電子海圖 (ENC) 的分析技術與平臺，產出可應用於航港安全與效率評估指標的量化資訊。本計畫所建立的各項分析方法與工具，可產生船舶交通的安全與效率相關指標。有關研究分析兩相鄰船舶間的 Near-miss 事件可應用於航行安全指標，且研究分析所獲得之若干參數或數據結果，經由各港務分公司依據各港的實際數據加以調效與驗證，將可以獲得各港所需的最佳化航安效益指標。

In addition, this study adopts near-miss events detected from AIS vessel trajectory as risk indicators to apply to dynamic risk management. The AIS data used in this study include vessel length and width, latitude and longitude of vessel position, speed over ground (SOG), course over ground (COG), and heading, to generate vessel outline and domain icons. Adding in the elliptic-area boundary value that is based on vessel length parameter, and using spatial information analysis to calculate the distance between two adjacent vessels, and between the vessel and dangerous obstacles or shallow water, the near-miss situation can be detected and assessed. The projection of adjusted distance between two adjacent vessels is shown in Figure 78, from which the distance to vessel central point can be adjusted by comparison and projection.

This project also combines AIS with electronic navigational chart (ENC) to perform 3D geometry analysis on vessel navigation. With AIS data, ENC fathom line, and maximum draft of each vessel, this project can determine whether the sailing vessel is facing grounding crisis. The analysis on grounding risk with the integration of AIS and ENC data is shown in Figure 79.

This project creates an analytical technique and platform to integrate AIS and ENC data; its output can be applied in quantitative form for indicators of port safety and efficiency assessment. The analytical methods and tools created in this project can generate indicators related to safety and efficiency of vessel traffic. The research and analysis on near-miss incidents between two adjacent vessels can be applied to navigation safety indicators; a number of parameters or data analysis results from the research, after calibrated and verified with actual figures of various ports by the port branch companies, make it possible to obtain the best safe navigation indicator for each port.



▲ 圖 79　整合 AIS 與 ENC 資料的擱淺危險分析
Figure 79 Analysis on grounding risk with AIS and ENC data integration

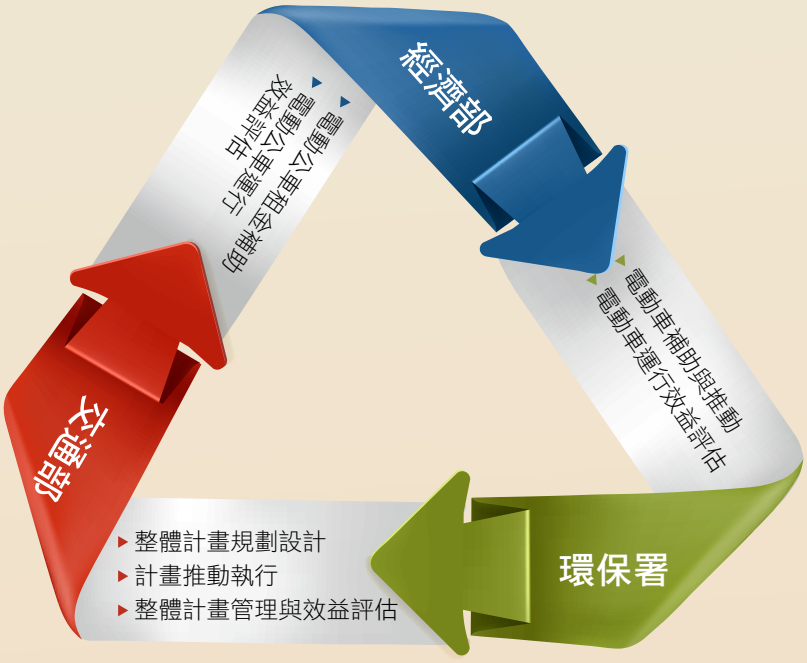
七、交通運輸服務

(一) i3 travel 愛上旅遊 – 低碳觀光、智慧旅遊示範計畫

政府目前正積極推動各項觀光發展與各項旅遊活動，行政院更將觀光視為六大新興產業之一，並大力推動「觀光拔尖領航」計畫。由近年來的觀光統計資料可發現，在交通部觀光局的積極執行下，國內各旅遊景點人數確實已有顯著成長趨勢。然而上述狀況對於部分腹地較小之觀光遊憩區卻因交通壅塞問題而大大降低旅遊品質，且嚴重影響遊憩區內空氣品質。因此，為能因應日趨增加的國內外觀光旅客以及自助型的旅遊型態，如何解決觀光遊憩區交通問題並提供友善的旅遊資訊查詢服務，已是政府推廣觀光旅遊時必須面臨的重要問題。

本計畫提出創新（innovative）的思維與理念，提供智慧化（intelligent）的資訊與服務，以及提升旅遊與生活樂趣（interesting）的「i3 Travel 愛上旅遊」構想，以國內目前最熱門的日月潭國家風景區為對象，透過「資訊整合」與「主動服務」概念，經由整體規劃與協調機制，整合民眾在觀光旅遊時所需之服務與資訊 (包括交通、觀光、食宿與購物等)，並導入低碳複合運輸服務，建置智慧運輸服務基礎設施，提供即時的適地性（LBS）交通旅遊資訊、優質的無縫公共運輸服務，以降低民眾在日月潭核心區域使用私人運具之比例。

本計畫藉由整合交通部、經濟部與環保署的政府資源，以及和泰汽車、和運租車、華碩電腦、台達電與中華電信等國內企業技術與資金，在日月潭國家風景區提供即時性交通資訊、當地旅遊資訊、無縫且高品質的公共運輸系統，並導入車輛共乘服務，鼓勵遊客採「Park & Travel」方式遊玩日月潭。



7. Transportation Services

(1) i3 Travel, Falling in Love With Travel—Low-Carbon and Intelligent Tourism Demonstration Project

The government is currently actively promoting a number of activities for tourism development. The Executive Yuan views tourism as one of the six key emerging industries and has energetically promoted Project Vanguard for Excellence in Tourism. Tourism statistics from the past several years indicate that under the efforts of the Tourism Bureau, the number of people visiting domestic tourist attractions has grown significantly. However, this has resulted in substantial declines in tourist quality in a number of smaller tourism and recreation areas because of traffic congestion problems. These problems have also severely affected air quality within recreation areas. Therefore, to respond to the growing numbers of domestic and foreign tourists and to independent travel patterns, resolving the traffic problems in tourism and recreation areas and providing friendly tourist information inquiry services have become major problems faced by the government in promoting tourism.

This project proposes innovative thinking and ideas to provide intelligent information and service, and to improve tourism and life to make them more interesting, elements that constitute the concept of i3 Travel—Falling in Love with Travel. Aimed at Sun Moon Lake, which is currently the most popular National Scenic Area in Taiwan, the concepts of information integration and active service are used to integrate the services and information required for tourism (including transportation, tourist, accommodation, and shopping resources) through overall planning and coordination mechanisms. Low-carbon intermodal transportation services and the basic infrastructure for intelligent transportation services are introduced to provide high-quality seamless public transportation services with real-time location-based service (LBS) for transportation and tourism information. This would reduce the percentage of people using private vehicles in the area of Sun Moon Lake.

This project integrates government resources from the MOTC, the Ministry of Economic Affairs, and the Environmental Protection Administration with technologies and funding from a number of domestic corporations, including Hotai Motor, Hotai Leasing Corporation, Asus, Delta Electronics, and Chunghwa Telecom, to create a seamless, high-quality public transportation system for the National Scenic Area of Sun Moon Lake that provides real-time transportation information and local tourist information. Carpool services are also introduced to encourage tourists to tour Sun Moon Lake through the method of Park and Travel.

在本計畫之整合協調下，日月潭之「低碳觀光、智慧旅遊」服務正逐漸成形，其中電動車共享 (EV-Sharing) 服務已於 102 年 4 月 25 日正式啟用，在短短 3 個月期間已累積超過 5 千使用人次，不僅為日月潭國家風景區的節能減碳有具體貢獻，對增加日月潭當地的觀光旅遊特色也有所助益。

在日月潭所運行的每輛電動車上均配置由本計畫所協助開發 ANS(Advanced Navi Service) 系統，ANS 除了可結合 LBS（Location Base Services）技術，提供旅客在旅遊時隨時可獲得當地景點的資訊外，更利用 O2O（Online to Offline）之服務概念，為當地店家提供全新商業模式服務，創造地方商機。

此外本計畫也完成跨部門（高公局、公路總局、日管處、南投縣政府、運研所）資訊整合作業，協助日月潭風景區管理處執行大型活動（101 年花火嘉年華）之交通管制與疏散作業，有效改善當地大型活動時之交通壅塞狀況，縮短旅客疏散時間。

Under the integration and coordination of this project, low-carbon tourism and intelligent travel services are gradually forming for Sun Moon Lake. EV-Sharing services officially began on April 25, 2013. Within 3 short weeks, these services had already been used more than 5000 times. Not only has this made a concrete contribution to energy saving and carbon reduction at the Sun Moon Lake National Scenic Area, but it has also helped enhance the local tourism characteristics of Sun Moon Lake.

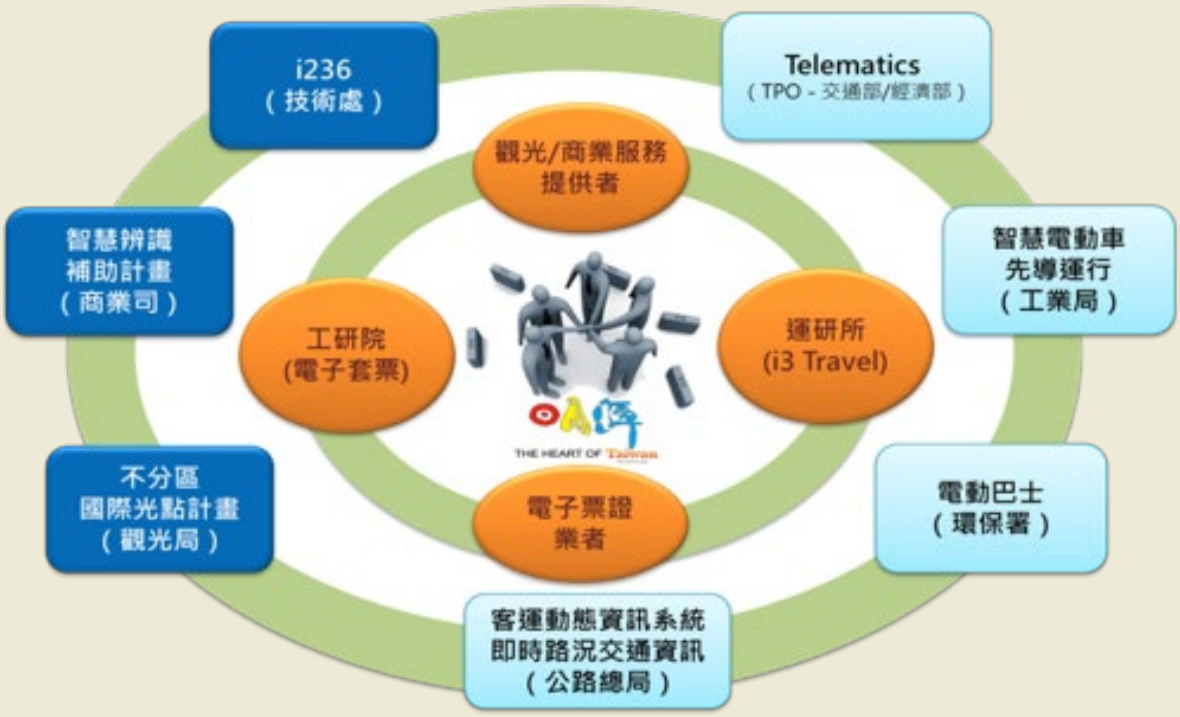
Every electric car operating at Sun Moon Lake is equipped with the Advanced Navi Service (ANS) system, which this project assisted in developing. The ANS integrates LBS technology to provide tourists with information on local attractions at any time while touring. In addition, it also uses the service concept of online to offline (O2O) to provide service under an all-new commercial model for local shops, creating local opportunities.

This projected has also completed intersectoral (National Freeway Bureau, Directorate General of Highways, Sun Moon Lake National Area Administration, Nantou County Government, Institute of Transportation) information integration to assist the Sun Moon Lake National Area Administration with traffic control and evacuation operations for large-scale activities (2012 Fireworks Festival), efficiently improving traffic congestion during large-scale local activities and shortening traveler evacuation times.

本計畫於今年度除了將持續協助日月潭國家風景區管理處導入電動公車外，為能提供旅客體驗完整的智慧運輸與低碳觀光遊程，已規劃將現有的 i3 資訊平台與工研院開發之電子旅遊套票創新服務進行整合，推動「低碳觀光電子旅遊套票示範計畫」，與相關服務生態體系合作（包括：電子票證業者、旅行社、交通業者、在地商家…等），共同發展交通、環保與商業之 PPP (Public-Private Partnership) 整合模式。

「低碳觀光電子旅遊套票示範計畫」整合雲端核銷的商業體系與離線讀寫卡片的交通體系，推動完整的智慧運輸與低碳觀光服務平台，包括：水 (交通船)、陸 (台灣好行 / 環湖公車)、空 (纜車) 三種重點大眾運輸，自行車、電動車等遊客租用交通工具，以及食、宿、遊、購等商業活動。設計獨具特色之電子旅遊套票產品，讓旅客能夠自在悠遊日月潭，並搭配日月潭國際花火節音樂暨自行車嘉年華活動擴大民眾體驗，屆時不僅可有效改善日月潭的交通壅塞與空氣汙染問題，更可將日月潭打造成為國內低碳觀光、智慧旅遊的示範區域。

日月潭智慧運輸與低碳觀光示範區
發展交通、環保與商業之 PPP 整合模式（車流、人流、金流與商流之整合）



食、宿、旅、購、行五位一體

This year, in addition to continuing to assist the Sun Moon Lake National Area Administration in introducing electric buses, this project has planned the integration of the existing i3 information platform and the innovative services of the electronic travel packages developed by the Industrial Technology Research Institute to allow travelers to experience complete intelligent transportation and low-carbon tourism. The Low-Carbon Tourism Electronic Travel Package Demonstration Program is being promoted. Related service ecosystems (including electronic ticket businesses, travel agencies, transportation businesses, and local merchants) will cooperate to develop an integrated public-private partnership (PPP) model of transportation, environmental protection, and business.

The Low-Carbon Tourism Electronic Travel Package Demonstration Program integrates a commercial cloud verification system with an offline card-reading transportation system to promote a complete intelligent transportation and low-carbon tourism service platform. This platform includes the three key forms of public transportation, which are water (ferries), land (Taiwan Tourist Bus / Round-the-Lake Bus), and air (aerial trams), bicycles, electric cars, and other vehicles that tourists can rent, and a variety of business activities, including dining, accommodations, traveling, and shopping. The design of unique electronic travel package products allows travelers to move at ease around Sun Moon Lake. The Sun Moon Lake International Fireworks, Music, and Come! Bikeday Festival expands the experience of the people. Not only can this project effectively improve the traffic congestion and air pollution problems of Sun Moon Lake, but it can also make Sun Moon Lake a demonstration area for domestic low-carbon tourism and intelligent travel.

(二) 港灣環境資訊服務系統 - 海上的媽祖

目前交通部運輸研究所港灣技術研究中心（以下簡稱本中心）對於國內各主要港口已使用精密的觀測儀器，建立長期觀測站，並同步即時傳輸觀測資料至本中心，以建立海氣象即時觀測系統。本計畫整合現場海氣象即時觀測與海象數值計算即時預報兩個動態系統之作業流程。此外結合本中心其他四大子系統：港區地震、模擬海嘯、藍色公路及港區大氣腐蝕等之港灣資訊系統，以期獲得全面性、整體性、即時性之港灣動靜態環境完整資訊，透過港灣環境資訊服務系統 (網址 http://isohe.ihmt.gov.tw) 整合及建置 ，如圖 80 所示 ，提供港埠管理單位、全國災害防救中心及中央主管機關查詢，並且透過資訊網路即時提供給港灣管理單位、國內外船舶業者及相關單位人員與民眾瀏覽查詢，可有效提升海上航行安全之保障。

港灣環境資訊網功能項目包括有「海象觀測及模擬資訊」、「藍色公路」、「港區地震資訊」、「海嘯模擬資訊」、「港區大氣腐蝕」，如圖 81 所示。以下針對這幾項應用功能做進一步的簡單介紹。

▲ 圖 80　港灣環境資訊網
Figure 80 Harbor environment information website

(2) Harbor Environment Information Service System—Mazu on the Sea

The Harbor and Marine Technology Center (referred to as the center below) of the Institute of Transportation, MOTC, is currently using sophisticated observation instruments to establish long-term observation stations at the primary ports of Taiwan. These stations instantly transmit observation data to the center to establish a real-time marine meteorological observation system. This project integrates on-site, real-time marine meteorological observations and marine meteorological numerical calculations to provide instant forests of the processes of two dynamic systems. In addition, four of the center's other major subsystems are integrated: the port earthquake, simulated tsunami, blue highway, and port atmospheric corrosion harbor information systems. These subsystems are integrated to obtain complete, real-time information on the static and dynamic environments of harbors. The integration and establishment of the Harbor Environment Information Service System (http://isohe.ihmt.gov.tw), as shown in Fig. 80, permits queries from port management units, disaster response centers throughout the country, and the central competent authorities. The information website can also be browsed and queried in real time by harbor management units, domestic and foreign shipping businesses, the staff of related units, and the people to improve the safety of maritime navigation effectively.

The functions of the harbor environment information website include marine meteorological observation and simulation information, blue highway, port earthquake information, tsunami simulation information, and port atmospheric corrosion, as shown in Fig. 81. These applications are further briefly introduced below.

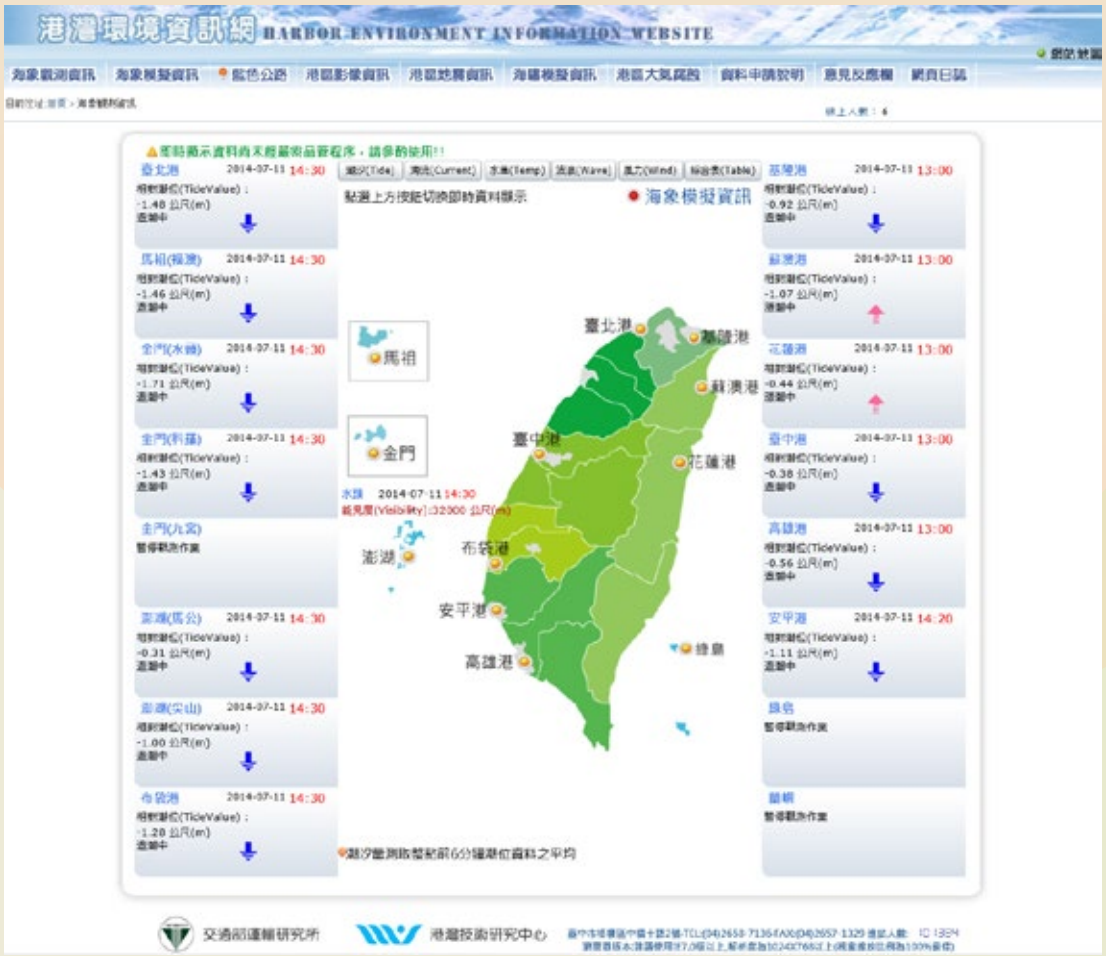
▲ 圖 81　港灣環境資訊網功能項目
Figure 81 Functions of the harbor environment information website

1. 海象觀測資訊及港區即時影像

呈現基隆港、蘇澳港、花蓮港、高雄港、布袋港、安平港、臺中港、臺北港以及離島 (包含金門、馬祖) 之即時風力、潮汐、波浪、海流資訊，並透過歷線圖瞭解某段期間內海氣象的變化特性。另搭配港區即時影像子系統，隨時監視港區海氣象狀態，同時讓相關單位掌握船舶管理各項訊息，並有效管理航港營運，如圖 82 所示。

2. 海象模擬資訊

本系統提供各港區之風場、波浪、水位及流場的海氣象數值模擬資訊，並與海象即時觀測相輔相成，可提供非觀測位置之海象資訊。展示部分以套疊觀測及模擬資料之歷線圖表作呈現及整合其相關海氣象圖形動畫，並依模擬尺度範圍 (遠域、近域及近岸港區) 規劃區分做展示，可供港務單位及相關人員參考使用，確保港口船舶交通航運安全，如圖 83 所示。



▲ 圖 82　港灣環境資訊網 - 海象觀測資訊
Figure 82 Harbor environment information website—marine meteorological observation information

▲ 圖 83　港灣環境資訊網 - 海象觀測資訊

Figure 83 Harbor environment information website—marine meteorological observation information

A. Maritime Meteorological Observation Information and Real-Time Port Video

Real-time wind, tide, wave, and current information from the Port of Keelung, Suao Port, the Port of Hualien, the Port of Kaohsiung, Budai Port, Anping Port, the Port of Taichung, the Port of Taipei, and the outlying islands (including Kinmen and Matsu) is provided. Hydrographs are used to understand the changing characteristics of ocean weather during a certain period. The real-time port video subsystem allows monitoring of the ocean meteorology at ports. Relevant units can also grasp a variety of information related to ship management and effectively manage shipping and port operations.

B. Marine Meteorological Simulation Information

This system provides marine meteorological numerical simulation information on the wind, waves, water levels, and flow fields of ports. It can complement real-time marine meteorological observations to provide marine meteorological information from non-observation positions. This information is presented as hydrographs with overlays of observation and simulation data. Graphic animations related to marine meteorology are integrated and divided based on simulated scale (far-field, near-field, and nearshore harbor) for display. These data can be referenced by port units and relevant personnel to ensure port vessel traffic and shipping safety, as shown in Fig. 83.

▲ 圖 84　港灣環境資訊網 - 海象觀測資訊
Figure 84 Harbor environment information website—marine meteorological observation information

3. 藍色公路

採用本所發展之風浪預報模式，提供環島海上藍色公路航行之風浪資訊需求。目前已建置基隆 - 馬祖 (北竿) 、臺中 - 平潭、布袋 - 馬公、高雄 - 馬公、基隆 - 花蓮等 14 條藍色公路航段，提供風速、風向、波高以及波向資訊。同時整合船舶自動辨識系統 (AIS)，納入固定船班之船舶即時座標位置、航速、航向等資訊，配合海上航路海氣象預報資訊之提供，可供業者、船長及遊客即時掌握海氣象及船舶航行等資訊，如圖 84 所示。

4. 海嘯模擬資訊

透過網路擷取國內外所發佈地震參數，配合已建置之港區地形水深資料快速解算太平洋區域內因地震引發海嘯，抵達臺灣各主要港口之時間及水位變化。

C. Blue Highway

The storm prediction model developed by this institute is adopted to provide the storm information needed for voyages through the offshore blue highway around the island. Currently, 14 blue highway segments have been established, including Keelung-Matsu (Beigan), Taichung-Pingtan, Budai-Magong, Kaohsiung-Magong, and Keelung-Hualien. Wind speed, wind direction, wave height, and wave direction information is provided. The automatic identification system (AIS) is also integrated, with real-time information on the coordinate positions, speeds, and headings of vessels in fixed ship classes included. Weather forecast information for maritime routes is also provided to allow businesses, ship captains, and passengers grasp real-time marine weather and ship navigation information, as shown in Fig. 84.

D. Tsunami Simulation Information

The Internet is used to retrieve seismic parameters published domestically and internationally. Combined with established port bathymetry data, these parameters are used to calculate tsunamis caused by earthquakes in the Asia-Pacific Region, the times they will reach the major ports of Taiwan, and changes in water levels.

5. 港區地震資訊

提供臺灣港區之近期及歷史地震資訊查詢，呈現地震發生時間、震度、地表加速度、x,y 水平向和 z 垂直向地表地震波形，以判斷地震發生時，對於港區結構物及土壤液化所產生的影響。

6. 港區大氣腐蝕

提供離港區 0m、100m 以及 300m 試驗點之腐蝕監測資訊，包括氣象資料相對溼度、氯鹽 (Cl-) 與二氧化硫 (SO2) 沉積量調查及現地暴露試驗，針對碳、鋼、鋅、和鋁、銅四種金屬試驗資料。

隨著智慧型手機與平板電腦等行動裝置的普及化，讓使用者可以透過快速下載、安裝並執行於智慧型行動裝置上，進而得到資訊便利性，生活智慧化的服務。透過加值應用建置港灣環境資訊 App，支援 iOS 與 Android 無線手持裝置，如圖 85 所示，期使能更即時提供港埠管理單位、全國災害防救中心、中央主管機關與一般民眾查詢。藉此，可迅速準確獲得各港區海域及藍色公路之海氣象即時與預報資訊，以擬定高效率之港埠營運計畫、適當之防災因應對策及方便性之海上旅程規劃。

▲ 圖 85　港灣環境資訊 APP
Figure 85　Harbor environment information app

E. Port Earthquake Information

Recent and historical earthquake information queries for Taiwanese ports are provided. The time of occurrence, seismic intensity, ground acceleration, x and y horizontal and z vertical surface seismic waveforms are presented to help judge the effects of earthquakes on port structures and soil liquefaction when they occur.

F. Port Atmospheric Corrosion

Corrosion monitoring information from test points 0 m, 100 m, and 300 m from ports is provided. This information includes meteorological data, relative humidity, Cl- and SO2 deposition surveys, and on-site exposure tests. Test data cover carbon and four metals: steel, zinc, aluminum, and copper.

The popularization of smartphones, tablet computers, and other mobile devices has allowed users to obtain convenient information and smart life services by rapidly downloading, installing, and executing applications on their smart mobile devices. Value applications have been used to establish the harbor environment information app, which supports iOS and Android wireless handheld devices, as shown in Fig. 84. The app permits real-time queries from port management units, national disaster response centers, the central competent authorities, and the general public. Real-time marine meteorology and forecast information for port waters and the blue highway can be obtained quickly and accurately to help formulate highly efficient port business plans, appropriate disaster prevention and response strategies, and convenient marine journal plans.

04 Achievements in Application Implementation
INSTITUTE OF TRANSPORTATION, MOTC

肆 落實應用實績

為達成交通部「建置智慧型運輸系統，推動永續綠運輸，符合節能減碳」之施政目標，本所致力於落實科技計畫研究成果於交通部政策推動，並配合我國交通環境，研發相關交通科技軟、硬體系統後，移轉至各交通管理機關或地方政府實施應用，以提升各交通管理機關與地方政府之交通管理效能。以下即簡要介紹相關實績：

研訂「運輸政策白皮書 (2)」

繼 101 年完成「101 年運輸政策白皮書 (1)」，包括：總論、綠運輸、公路公共運輸、智慧型運輸等 4 分冊後，另運輸安全、海運及空運等 3 分冊，亦於 102 年 7 月完成並印製出版「運輸政策白皮書 (2)」，已分送立法院交通委員會委員、行政院經建會、交通部暨部屬機關及地方政府相關部門參考，另已將電子檔登載於交通部與本所網站，提供各界下載使用，本年出版三分冊之重點內容摘述如下：

（一） 運輸安全分冊：基於提昇運輸安全、保障人民福祉已為國際社會之共同價值，本白皮書係交通部第 1 次就運輸安全之領域單獨頒布，期以「重視生命價值、提昇安全文化」之政策願景作為未來施政之藍本。針對道路、鐵路、海運與空運四大運輸系統，依照「風險評估機制」、「人因安全管理」、「組織制度監督」、「整體安全文化」、「國際規範接軌」及「基礎安全研究」等核心方向擬定 9 項政策，與其下 19 項策略及 49 項行動綱領，以做為我國運輸安全政策擬訂與推動之重要依據。期透過政府與民間的共同努力，達成 10 年內道路安全績效指標改善 20%、鐵路、海運及空運安全績效指標改善 30% 之長期目標。

To achieve the policy objectives of the MOTC to "establish intelligent transportation systems, promote sustainable green transportation, and realize energy saving and carbon reduction," this institute has striven to implement research results from science and technology projects in the policy promotion of the MOTC. In accordance with the national transportation environment, the institute has researched and developed software and hardware systems related to transportation technology and transferred them to traffic management authorities and local governments for implementation and application to improve their traffic management efficiency. Related achievements are briefly introduced below:

Developing the White Paper on Transport Policy (2)

This paper is a continuation of the 2012 White Paper on Transport Policy (1), completed in 2012. The 2012 paper comprised seven sections: Subject, Green Transportation, Highway Public Transportation, Intelligent Transportation, Transportation Safety, Maritime Transportation, and Air Transportation. In July 2013, the White Paper on Transport Policy (2) was completed and published. It has been sent to the Transportation Committee of the Legislative Yuan, the Council for Economic Planning and Development, the MOTC and its subordinate agencies, and the relevant departments of local governments for reference. The electronic file has also been posted to the websites of the MOTC and this institute to allow people from all sectors to download and use it. The highlights of the three sections published this year are described as follows:

(1) Transportation Safety: Improving transportation safety and protecting people's well-being have become common values in international society. This white paper is the first independent effort by the MOTC in the field of transportation safety. The MOTC hopes to use the policy vision of "emphasizing the value of life and improving the safety culture" as a blueprint for future policy. Nine policies aimed at the four main transportation networks (road, rail, sea, and air) and based on the core directions of "risk assessment mechanisms," "human factor safety management," "organizational system monitoring," "overall safety culture," "meeting international norms," and "basic safety research" have been formulated. These policies comprise 19 strategies and 49 programs of action, which serve as important bases for the formulation and promotion of transportation safety policy in Taiwan. Through the joint efforts of the government and the people, the MOTC has set long-term goals that road safety performance indicators be improved by 20% and rail, sea transport, and air transport performance indicators be improved by 30% within 10 years.

（二） 海運分冊：從航運發展、港口營運、兩岸直航、海事安全等角度，整合產官學界意見，界定當前課題，擬訂海運發展政策。 以「成為國際海運樞紐，帶動航運產業發展」為發展願景，提出四大海運政策、18 項策略及 76 項短中長期行動方案。四大海運政策為：1. 整合國際港群資源，型塑亞太海運樞紐；2. 多元拓展港埠業務，提升自由港區效能；3. 營造優質經營環境，促進海運產業發展；4. 強化安全管理體制，邁向世界一流水準。

（三） 空運分冊：從國際航空市場、國內航空市場、服務效能、機場發展、友善永續及飛航安全等面向，整合產官學界意見，界定當前課題，擬訂空運發展政策。以「成為國際空運樞紐」為發展願景，提出四大空運政策、26 項策略及 94 項短中長期行動方案。四大空運政策為：1. 型塑東亞空運樞紐，落實航空城計畫；2. 鼓勵營運多元發展，營造永續經營環境；3. 加強資源有效運用，提昇民航服務效能；4. 強化安全管理機制，邁向世界一流水準。

辦理「交通部門中長程各次類別計畫」年度預算之審議及個案計畫審查

辦理「運輸部門中長程公共建設發展作業評估」相關研究，並配合交通部辦理 103 年度公共建設運輸部門先期作業審查；協助編擬中長程發展計畫報院核定。 102 年除協助交通部審議與評估相關建設計畫案件，出席縣市政府及各機關交通建設與改善計畫審查會與諮商會議外，並協助交通部就行政院經建會 102 年「國家建設總合評估規劃」補助經費案研提審查意見，且協助交通部審核各機關提報 101 年度屆期重大公共建設計畫執行成效檢討評估。

(2) Sea Transport: From the perspectives of transport development, port operations, direct cross-strait transport, and maritime security, the views of industry, government, and academia are integrated, current issues are defined, and maritime transport development policies are formulated. With "becoming an international maritime transport hub and driving the development of the shipping industry" as a vision for development, 4 major maritime transport policies, 18 strategies, and 76 short-, medium-, and long-term action programs are presented. The four major maritime transport policies are as follows: 1. Integrating international port group resources to mold an Asia-Pacific maritime transport hub. 2. Multivariate expansion of port business to improve the effectiveness of free ports. 3. Creating quality business environments to promote the development of the maritime transport industry. 4. Strengthening safety management systems and moving toward world-class standards.

(3) Air Transport: From the dimensions of the international aviation market, the domestic aviation market, service performance, airport development, friendliness and sustainability, and flight safety, the views of industry, government, and academia are integrated, current issues are defined, and air transport development policies are formulated. With "becoming an international air transport hub" as a vision for development, 4 major air transport policies, 26 strategies, and 94 short-, medium-, and long-term action programs are presented. The four major air transport policies are as follows: 1. Shaping an air transportation hub for East Asia and implementing aerotropolis projects. 2. Encouraging diversified development in operations and creating sustainable operating environments. 3. Strengthening the effective use of resources and improving the service performance of civil aviation. 4. Strengthening safety management mechanisms and moving toward world-class standards.

Conducting Annual Budget Deliberations and Case Project Reviews for the Medium- and Long-Term Subcategory Projects of the Transportation Sector

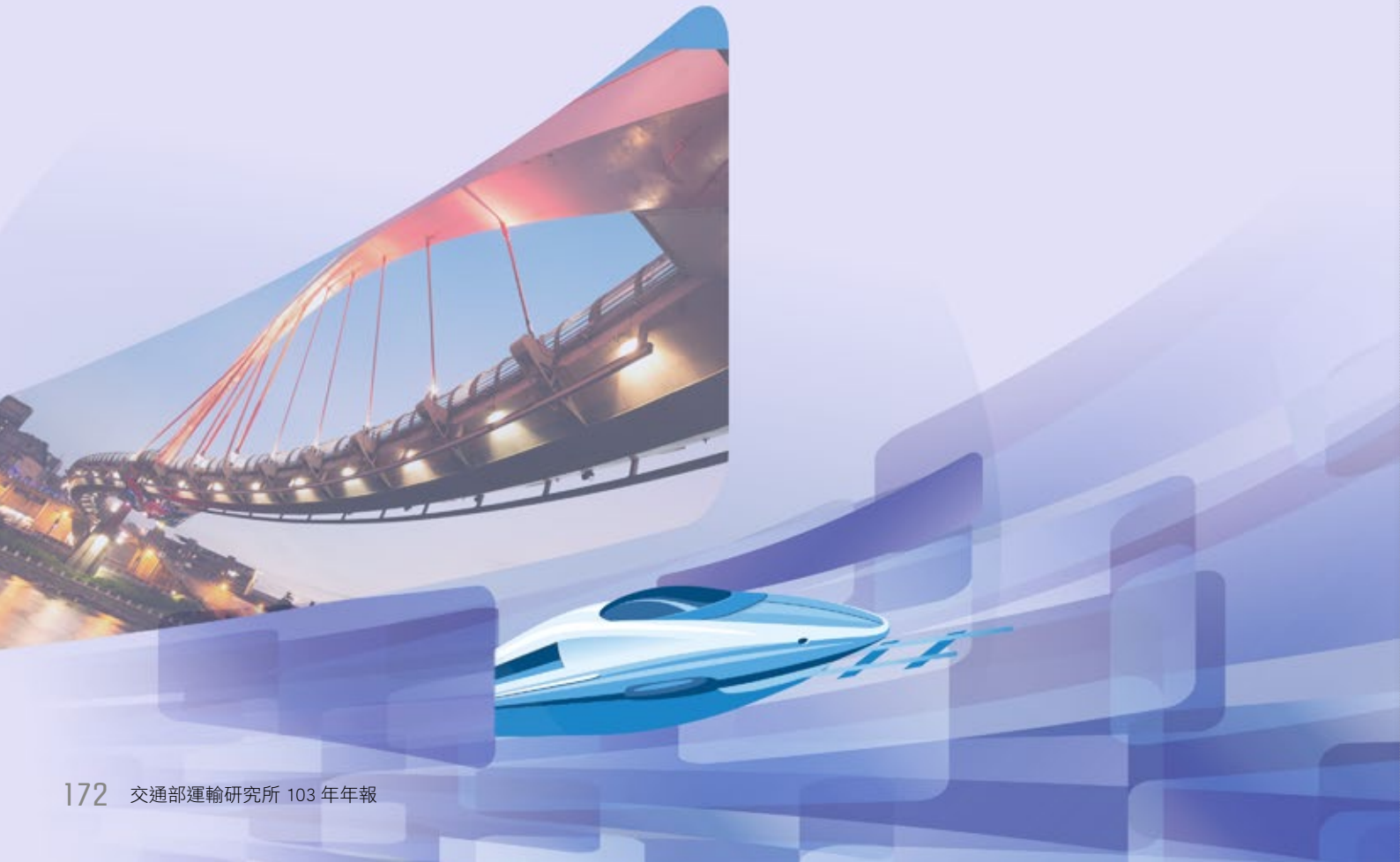
The institute conducted research related to the Development Work Assessment for Medium- and Long-Term Public Works in the Transportation Sector and cooperated with the MOTC to conduct the 2014 preliminary work reviews of public works in the transportation sector, assisting in preparing medium- and long-term development plans for the approval of the Executive Yuan. In 2013, in addition to helping the MOTC consider and assess relevant construction projects and attending review and consultation meetings on transportation construction and improvement projects with county and city governments and various agencies, the institute also assisted the MOTC in formulating review comments for the grant funding case of the 2013 Aggregate Assessment Plan for National Construction from the Council for Economic Planning and Development, Executive Yuan. The institute also assisted the MOTC in auditing the execution of effectiveness reviews and assessments for major public construction projects for the 2012 session from various agencies.

辦理「南部區域整體交通系統改善方案」

配合行政院「國土空間發展策略計畫」要求「強化區域政策工具，各部門中長程施政計畫應納入區域治理機制，尤其是公共建設資源分配應有區域考量」及「推動三大城市區域建設計畫（如大高雄地區整體綱要計畫、臺中都會區域或臺北都會區域整體綱要計畫）」，辦理「南部區域整體交通系統改善方案」，以做為中央及地方政府執行區域整體交通系統改善之參考。103 年亦將完成「北部區域整體交通系統改善方案」與「中部區域整體交通系統改善方案」。

辦理橋梁維護管理作業評鑑

為落實橋梁安全管理與維護，以提升臺灣橋梁使用安全與改善交通環境安全，本所於 102 年 5 月完成 101 年度縣市政府評鑑作業，公布評鑑結果；另於 102 年 7 ～ 8 月辦理北、中、南 3 場「臺灣地區橋梁管理資訊系統」教育訓練，計訓練 893 人次，已達成縣市首長重視橋梁安全之目的。另外，102 年度增加外部稽核作業，透過三級品管制度，確保各縣市政府落實執行橋梁檢測與維護作業；同時，進行二代橋梁管理資訊系統之開發作業，期以構件化與模組化的方式，強化橋梁管理資訊系統的功能。另為提升行人安全，於 102 年 9 月新增「人行天橋模組」，供各縣市政府進行人行天橋之檢測與養護使用。



Conducting the Overall Transportation System Improvement Plan for Southern Region

In accordance with the Executive Yuan's Homeland Spatial Development Strategy Plan's demand for "strengthening regional policy tools and the inclusion of regional governance mechanisms in the medium- and long-range policy planning of all departments. In particular, resource distributions for public works should take into account "regional considerations" and "promoting construction projects in the three major urban areas (such as the overall outline plan for the greater Kaohsiung region, the Taichung metropolitan area, and the overall outline plan for the Taipei metropolitan area)." The institute conducted the Improvement Plan for the Overall Southern Transportation System to serve as a reference for central and local governments in improving overall regional transportation systems. In 2014, the Improvement Plan for the Overall Northern Transportation System and the Improvement Plan for the Overall Central Transportation System will also be completed.

Conducting Evaluations of Bridge Maintenance and Management Operations

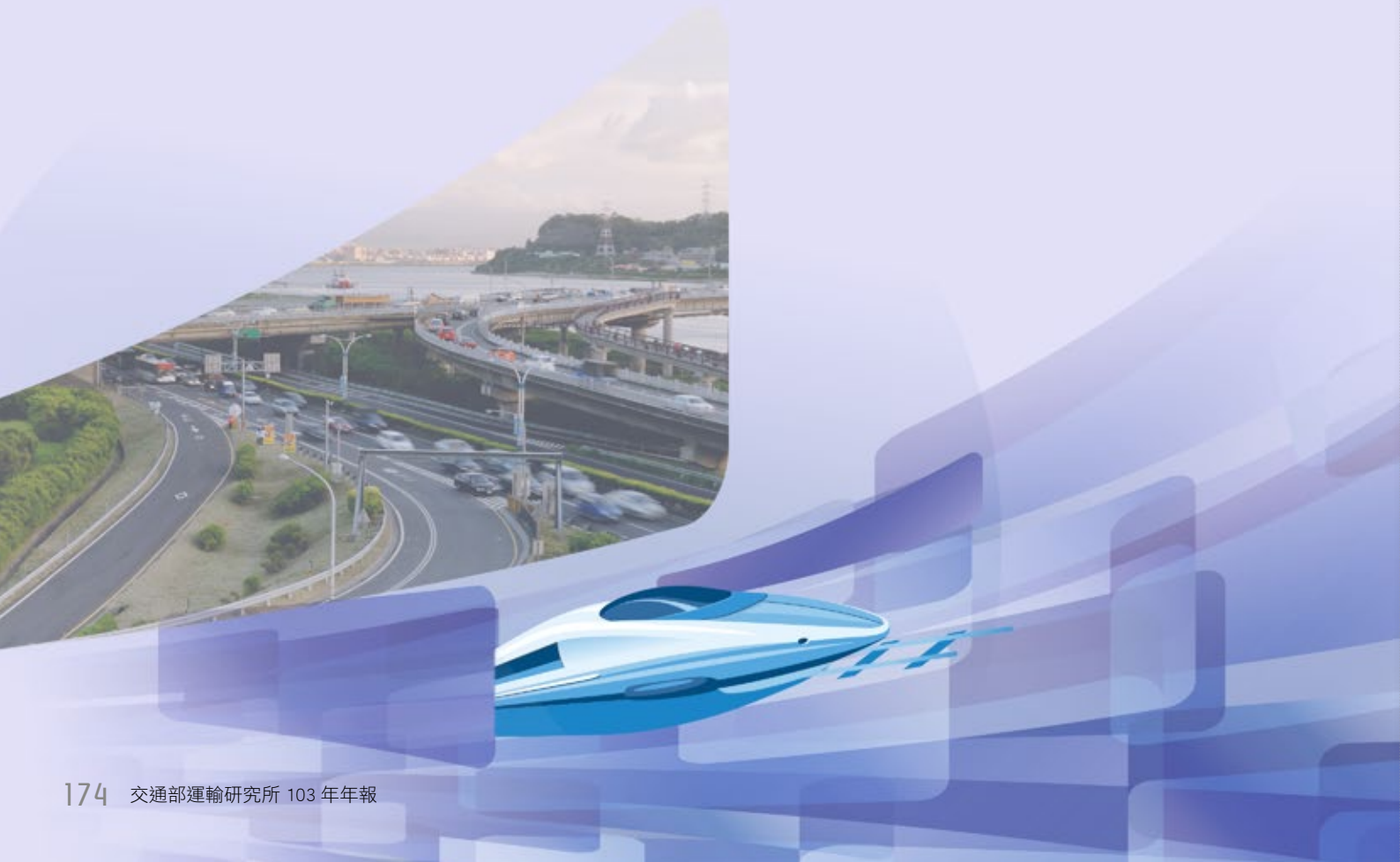
To implement bridge safety management and maintenance and to improve bridge usage safety and transportation environment safety in Taiwan, this institute completed an evaluation of the work of county and city governments for the year 2012 and announced the evaluation results in May 2012. In addition, three education and training sessions on information systems for bridge management in Taiwan were held in July 2013 and August 2013 in northern, central, and southern Taiwan. A total of 893 people were trained, achieving the goal of making city and county heads emphasize bridge safety. In 2013, external audit work was also increased. A three-grade quality control system was used to ensure that all county and city governments implement bridge inspections and maintenance. Second-generation information systems for bridge management were also developed. Componentized and modular approaches are used to strengthen the functions of information systems for bridge management. Additionally, to improve pedestrian safety, a "pedestrian bridge module" was newly added in September 2013 for county and city governments to use while testing and maintaining pedestrian bridges.

協助交通部推動「公路公共運輸提昇計畫 (102-105 年)」

交通部自 99 年起推動「公路公共運輸發展計畫 (99-101 年)」，執行以來，公共運輸市占率自 98 年的 13.4％ 、99 年的 13.9％ 、100 年的 14.3％ ，至 101 年已逐年提升為 15.0％ 。本計畫於 102 年榮獲世界公共運輸國際協會（UITP）頒發「亞太政治承諾獎項」最佳殊榮。為延續前述計畫之推動成果，交通部「公路公共運輸提昇計畫 (102 － 105 年)」已奉行政院核定，為期 4 年。本計畫依據市場區隔、民眾偏好、經濟效益與各種公共運輸之服務優勢等考量因素，透過服務整合與無縫接駁的理念，以市場行銷之概念，透過服務、成本、無縫、便利與安全等競爭因素，發揮整體公共運輸在日常通勤通學活動中對民眾之最大吸引力，逐漸引導民眾改變對於私人運具的倚賴習慣。本計畫 102 年預算數為 31 億 7,946 萬 7,000 元，交通部已核定各縣市政府申請之補助計畫，後續本所將配合交通部賡續督導及協助各縣市推動本計畫，以強化全國各地區公共運輸服務品質與能量。

辦理「環境影響評估 - 交通影響評估案」審議與追蹤

本所持續配合交通部辦理部屬機關環境影響評估審議事宜，102 年度截至 12 月底參與行政院環保署環評案件審查 282 件、內政部區域計畫委員會審查 118 件、內政部都市計畫委員會審查 310 案。



Assisting the MOTC in Promoting the Highway Public Transportation Improvement Plan (2013 to 2016)

The MOTC promoted the Highway Public Transportation Improvement Plan (2010 to 2012) beginning in 2010. Since then, the market share of public transportation grew from 13.4% in 2009 to 13.9% in 2010, 14.3% in 2011, and 15.0% in 2012. This project won top honors at the Asia-Pacific Political Commitment Awards held by the International Association of Public Transport (UITP) in 2013. Intended to extend the achievements of this project, the MOTC's Highway Public Transportation Improvement Plan (2013 to 2016) has already been approved by the Executive Yuan and will last four years. In accordance with market segmentation, public preferences, economic benefits, the service advantages of various forms of public transportation, and other considerations, this project used the ideas of service integration and seamless connection, the concepts of marketing, and the competitive factors of service, cost, seamlessness, convenience, and safety to give the overall public transportation system maximum appeal for people commuting the work and school activities in their daily lives. The people are gradually guided to alter their dependence on private vehicles. The budget for this project in 2013 was NT$3,179,467,000. The MOTC has approved applications from county and city governments for subsidy plans. In the future, the institute will cooperate with the MOTC to continue to supervise and assist county and city governments in promoting this project to strengthen the service quality and capability of public transportation in regions throughout Taiwan.

Conducting Deliberation and Tracking on Environmental Impact Assessment—Traffic Impact Assessment Cases

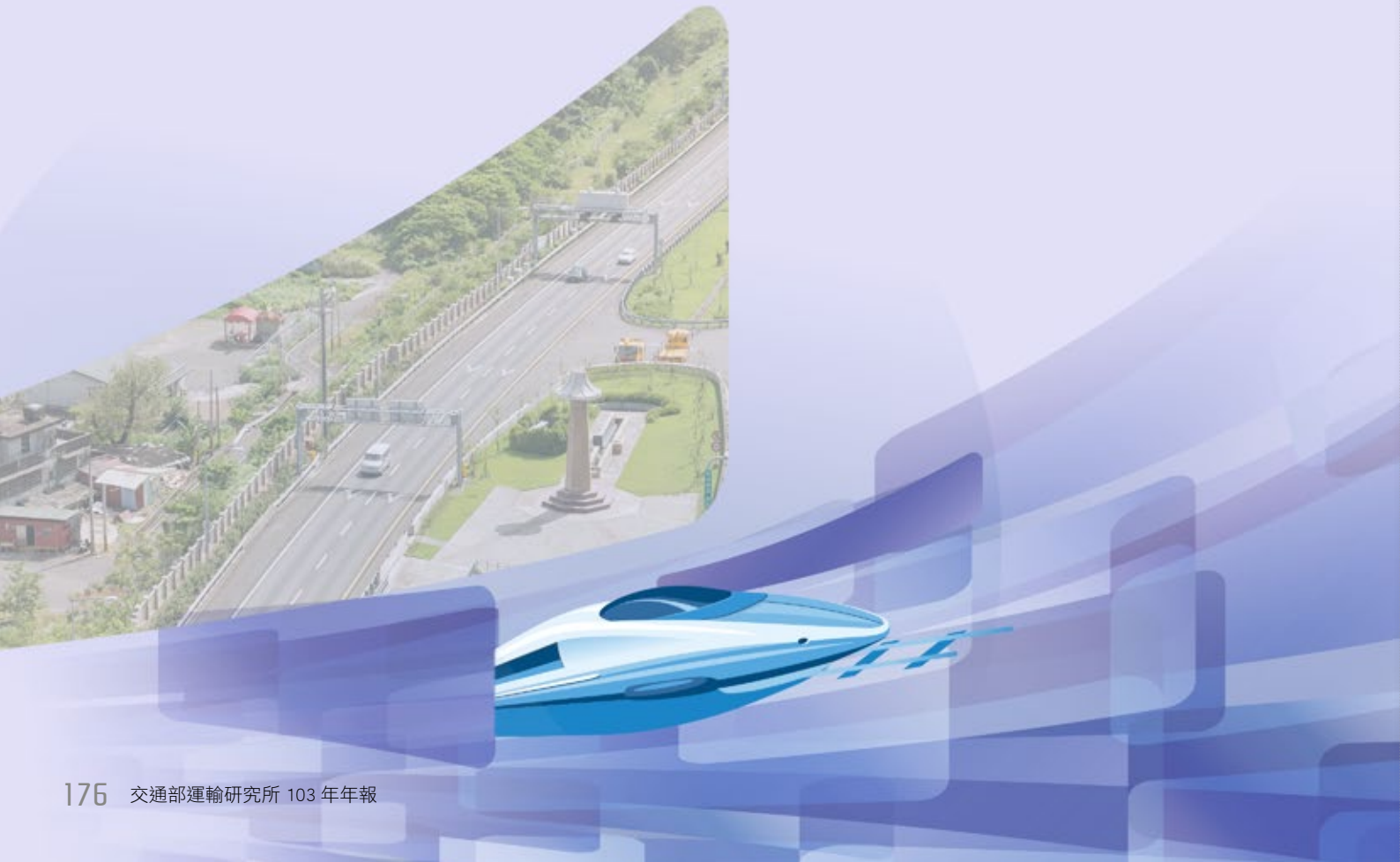
This institute has continued to cooperate with the MOTC in conducting deliberations on the environmental impact assessment of subordinate agencies. As of the end of December 2013, the institute participated in 282 case reviews of environmental impact assessments with the Environmental Protection Administration of the Executive Yuan, 118 reviews with the Regional Planning Committee of the Ministry of the Interior, and 310 reviews with the Urban Planning Committee of the Ministry of the Interior.

辦理院頒「道路交通秩序與交通安全改進方案」

有關行政院「道路交通秩序與交通安全改進方案」已進行至第 11 期 (民國 102-104 年)，每期方案實施 3 年。依據院頒方案之重點項目與實施要領，本案由交通部道安委員會主辦，針對各縣市、高公局、公路總局等機關前一年度之相關計畫執行情形辦理督導與考評，執行院頒方案年終視導工作。本所主要支援「道路交通工程與設施」項之考評，並於 103 年 5 月完成各機關 102 年院頒方案推動工作之考評。

辦理「臺灣地區易肇事路段改善計畫」

配合行政院「道路交通秩序與交通安全改進方案」執行臺灣地區易肇事路段改善工作，提供各縣市道安聯席（督導）會報於研提易肇事地點改善計畫之相關技術分析協助，以提昇道路交通安全。102 年底已完成第 31 期「臺灣地區易肇事路段改善計畫」，本（103）年正規劃第 32 期之計畫。以 99 年（第 28 期）計畫改善地點 158 處之執行成效為例，改善前（98 年）與改善後（101 年）肇事件數減少 31％ 、死亡人數減少 75％ 、受傷人數減少 25%，成效良好。



Conducting the Program of Road Traffic Order and Safety Improvement Promulgated by the Executive Yuan

The Program of Road Traffic Order and Safety Improvement from the Executive Yuan has entered its 11th stage (2013 to 2015). Each stage of the act is implemented for three years. Based on the key projects and implementation essentials of the program, the Road Traffic Safety Committee is sponsoring the project and supervising and evaluating the execution of related projects by city and county governments, the Taiwan Area National Freeway Bureau, the Directorate General of Highways, and other agencies over the previous year. The committee implements supervisory work for the state of the act at the end of the year. The institute primarily supports the evaluation of road traffic engineering and facilities. Evaluation of the promotional work for the 2013 act by each agency was completed in May 2014.

Conducting the Project for Improving Accident-Prone Locations in Taiwan

In coordination with the Executive Yuan's Program of Traffic Order and Safety Improvement, improvements to accident-prone locations in Taiwan have been conducted. The joint committees (steering councils) for road safety in each county and city are provided with technical analysis and assistance for researching improvement projects for accident-prone locations to improve road traffic safety. By the end of 2013, the 31st Project for Improving Accident-Prone Locations in Taiwan was completed. The 32nd project is being planned for this year (2014). Taking the effectiveness of the implementation of the 2010 (28th) project, which improved 158 locations, as an example, the number of accidents that occurred in the year after the improvements (2012) was 31% less, the number of fatalities was 75% less, and the number of injuries was 25% less than in the year prior to the improvements (2009). The improvements had good results.

辦理「運輸部門節能減碳政策與推動策略」之擬定暨有關政策評估決策支援系統研究

配合行政院成立「節能減碳推動會」及依據交通部指示，由本所擔任「綠色運輸推廣」工作組之幕僚作業，已完成「國家節能減碳總行動方案」交通部負責部分之綜整，並配合行政院國發會與交通部管考業務，辦理各行動計畫各季與年度辦理情形的彙整提報。此外，除持續進行運輸部門節能減碳政策的滾動檢討，及適時修訂運輸部門節能減碳策略與行動方案外，並建置「運輸一能源一經濟」整合模型與決策支援系統，對於運輸部門後續推動各項節能減碳政策之經濟效益可提供初步評估分析結果，以作為交通部暨地方政府交通主管機關節能減碳政策施政之參據。另配合交通部「e 化交通 - 智慧交控系統」計畫協助各縣市政府進行交通控制中心的升級與路口號誌時制之改善與重整，本所完成都市號誌系統改善計畫之節能減碳效益評估工具，已提供地方政府使用。

辦理「臺灣綠色港埠建置之研究」

為因應全球港埠環境之發展趨向，我國港埠發展需一併考量環境永續性和社會公義性，藉由港市介面有效的整合，以環境友善的港埠空間來帶動都市繁榮，達到港埠永續發展之目標。本研究除針對港埠實質之空間進行整體檢視及整合性之規劃外，並建構環境友善及節能之評估架構，目前完成綠色港埠之有效水資源指標、港埠之永續敷地指標、能源指標、材料及資源指標、港埠室內環境指標、創新制度指標等系統之建立，落實港埠節能行動及港埠建物之綠建築規劃。另本所配合政策推動我國綠色港埠的發展，以迎合全球港埠發展之新趨向，目前正進行歐盟「生態港」(Eco Ports) 第二階段港埠環境檢視系統之認證申辦。綠色港埠之實施除了可提升我國港埠之國際形象外，並可達到我國港埠與國際「綠色港埠」標準接軌之目標。

Conducting the Formulation of Energy-Saving and Carbon-Reduction Policies and Promotion Strategies for the Transportation Sector and Research Related to the Policy Evaluation and Decision Support System

In accordance with the Committee for the Promotion of Energy Conservation and Carbon Reduction established by the Executive Yuan and instructions from the MOTC, this institute acts as an advisor for the working group for the promotion of green transportation. A summary of the part of the Energy Conservation and Carbon Reduction Action Plan for which the MOTC is responsible has been completed. In accordance with the evaluation work of the National Development Council and the MOTC, reports have been conducted on the quarterly and annual progress of various action plans. In addition to conducting rolling reviews on energy conservation and carbon reduction policies in the transportation sector and making timely revisions to the energy conservation and carbon reduction strategies and action plans of the transportation sector, the institute has also established an integrated "transportation-energy-economy" model and a decision-making support system. This system provides preliminary assessment and analysis results for the transportation sector for the economic benefits of the future promotion of energy conservation and carbon reduction policies. These results serve as a basis for the MOTC and the transportation authorities of local governments to implement related energy conservation and carbon reduction policies. In addition, in accordance with the Digitalized Transportation—Smart Traffic Control Systems project from the MOTC, city and county governments are assisted in upgrading their traffic control centers and improving and reforming their traffic signal timings. The institute has completed an energy conservation and carbon reduction benefit assessment tool for improvement plans for urban traffic signal systems. This tool can be used by local governments.

Conducting A Study on Building Green Ports in Taiwan

To respond to development trends in the global port environment, environmental sustainability and social justice must also be considered in the development of Taiwanese ports. Through the effective integration of the port city interface, environmentally friendly port spaces are used to drive urban prosperity and achieve the objective of sustainable port development. This study conducted an overall review and integrated planning of essential port spaces and constructed an assessment framework for environmental friendliness and energy conservation. As of now, the establishment of effective water resource indicators for green ports, sustainable land indicators for ports, energy indicators, material and resource indicators, indoor environmental indicators for ports, and innovation indicators has been completed, implementing energy-saving actions for ports and green construction planning for port buildings. In addition, the institute has cooperated with policies promoting the development of green ports in Taiwan to cater to new trends in global port development. Bidding for the E.U. Eco Ports second-stage port environment view systems is currently being conducted. In addition to improving the international image of Taiwanese ports, the implementation of green ports can also achieve the goal of bringing Taiwan's ports in line with international "green port" standards.

辦理「山地原住民鄉（區）交通改善計畫」

102 年度針對 30 個山地原住民鄉 (區)，蒐集人口、產業與道路交通等相關資料，檢討分析其通學、通勤、觀光與地方產業等運輸需要，據以研擬包括道路交通安全改善、道路行駛車輛種類管制，與非典型公共運輸之發展等各項改善措施。預定於 103 年底完成後彙編「山地原住民鄉 (區) 交通改善規劃報告」，送交相關單位作為後續各年執行原住民鄉 (區) 交通改善之參考依據。

辦理「機車交通安全管理行動方案」之規劃

道路交通事故累積之全年事故成本占我國 GDP 約 3％ ，損失十分巨大，其中機車當事人死亡及受傷人數分占總死亡及受傷人數超過 60％ 及 80％ ，尤應優先改善。依據行政院頒布「第 11 期道路交通秩序與交通安全改進方案」，「騎乘機車事故防制」列為重點項目之首，配合交通部政策，從建立遠景、目標，以及技術之行動方案層面，作為支援交通部頒布「運輸安全白皮書」，在機車安全施政之推動方案。本研究部分成果，已納入交通部「全國道安扎根強化行動」計畫中落實推動。

協助交通部推動「聰明公車」計畫

協助交通部補助臺北市、新北市、桃園縣、新竹市、臺中市 (含改制前之臺中縣)、嘉義縣、嘉義市、臺南市 (含改制前之臺南縣)、高雄市 (含改制前之高雄縣)、屏東縣、基隆市、宜蘭縣、花蓮縣及金門縣等 14 個縣市建置公車動態資訊系統；另交通部公路總局辦理「公路汽車客運動態資訊管理系統建置案」，協助公路汽車客運業者建置約 6,500 輛聰明公車，目前臺灣本島及金門地區民眾均可掌握公車預估到站時間，減少候車焦慮及等待時間，並可有效加強政府對業者之監督稽核，健全公共運輸服務品質。

Conducting the Transportation Improvement Plan for Aboriginal Townships (Districts)

In 2013, demographic, industry, and road traffic data from 30 aboriginal townships (districts) were collected. The transportation needs of these areas for commuting to school, commuting to work, tourism and local industry were reviewed and analyzed to formulate road traffic safety improvements, road vehicle type controls, and various improvement measures for the development of atypical public transport. The plan is expected to be completed by the end of 2014. After this, the Report on the Transportation Improvement Plan for Aboriginal Townships (Districts) will be compiled. This report will serve as a reference for relevant units conducting subsequent annual traffic improvements for aboriginal townships (districts).

Conducting the Planning of the Motorcycle Traffic Safety and Management Action Plan

The cumulative annual cost of road traffic accidents is approximately 3% of Taiwan's GDP. This is an enormous loss. Scooters involved more than 60% and 80% of fatalities and injuries, respectively. Scooter safety should be given particular priority for improvement. The 11th Act of Traffic Order and Safety Improvement promulgated by the Executive Yuan listed "scooter accident prevention" as the most important key project. In accordance with MOTC policy, visions, goals, and technological action plans are established to serve as action plans for scooter safety policy to support the White Paper on Transport Safety published by the MOTC. A portion of this study's results has been implemented and promoted in the MOTC's "National Road Safety Enhancement Action" program.

Assisting the MOTC in Promoting the Smart Bus Plan

The institute assisted the MOTC in providing grants for the establishment of dynamic bus information systems in 14 cities and countries: Taipei City, New Taipei City, Taoyuan County, Hsinchu City, Taichung City (including Taichung County before restructuring), Chiayi County, Chiayi City, Tainan City (including Tainan County before restructuring), Kaohsiung City (including Kaohsiung County before restructuring), Pingtung County, Keelung City, Yilan County, Hualien County, and Kinmen County. In addition, the Directorate General of Highways conducted the Highway Bus Information and Management System Project to assist highway bus operators in establishing approximately 6,500 smart buses. The people of the island of Taiwan and the Kinmen region can now learn the estimated arrival times of buses, reducing anxiety and the time spent waiting for buses. These systems also effectively strengthen government oversight and auditing of businesses, improving the quality of service of public transportation.

協助交通部擬定交通建設氣候變遷調適策略與行動方案

配合行政院國發會「規劃推動氣候變遷調適政策綱領及行動計畫」專案，協助交通部擔任「維生基礎設施」調適領域主辦機關之行政幕僚作業，彙整及檢視各部屬機關所提氣候變遷調適行動計畫之內容並提供具體建議，同時針對重大鐵公路建設之氣候變遷調適策略、脆弱度評估指標及調適資訊平台等辦理相關研究。此外，依據交通部指示協助國發會審查該會「建置氣候變遷調適網站資訊平台及宣傳推廣」計畫及各地方政府氣候變遷調適計畫。目前本所已依據行政院 101 年 6 月 25 日核定之「國家氣候變遷調適政策綱領」及國發會 102 年 5 月 27 日召開之「規劃推動氣候變遷調適政策綱領及行動計畫」專案小組第 19 次會議結論，彙整「維生基礎設施」調適領域所屬各部會署 / 機關修正後之調適行動計畫，於 102 年 7 月 10 日將資料送國發會彙辦。另持續配合國發會函陳行政院之「國家氣候變遷調適行動計畫 (102-106 年)」草案提供意見。

辦理「運輸部門永續發展政策與推動策略」之擬定

本所依據行政院「國家永續發展委員會」與交通部指示，已完成「中華民國永續發展政策綱領—交通發展」撰擬及行動計畫之研擬。102 年度並配合永續會指示，依據「聯合國永續發展大會 (Rio+20)」產出文件—「我們想要的未來」，檢討完成交通與生活分組行動計畫之修訂，刻正由部屬相關機關據以推動中。另依據環保署召開之「我國參與『聯合國永續發展大會自願性承諾』研商會議」，已於 102 年 8 月 30 日完成交通部自願性承諾項目登錄作業。

Assisting the MOTC in Formulating Climate Change Adaptation Strategies and Action Plans for Transportation Construction

In accordance with the National Development Council's project Planning and Promoting Climate Change Adaptation Policy Frameworks and Action Plans, the institute has assisted the MOTC in conducting administrative and consulting work for authorities in the field of adapting "subsistence infrastructure." The contents of the climate change adaptation action plans proposed by subordinate agencies have been compiled and reviewed and concrete recommendations provided. Related research has also been conducted on climate change adaptation strategies for major rail and road construction, vulnerability assessment indicators, and adaptation information platforms. In addition, in accordance with MOTC instructions, the institute has assisted the National Development Council in reviewing the council's plans to "establish an online information platform and promotion for climate change adaptation" and the climate change adaptation plans of local governments. In accordance with the Adaptation Strategy to Climate Change in Taiwan approved by the Executive Yuan on June 25, 2012, and the conclusions of the 19th meeting of the ad-hoc group on Planning and Promoting Climate Change Adaptation Policy Frameworks and Action Plans convened by the National Development Council on May 27, 2013, the institute compiled the revised adaptation action plans from ministries, commissions, and agencies in the field of adapting "subsistence infrastructure" and delivered these data to the National Development Council on July 10, 2013. In addition, the institute continues to provide opinions regarding the draft from the National Development Council for the Executive Yuan's National Climate Change Adaptation Action Plan (2013 to 2017).

Formulating the Sustainable Development Policies and Promotion Strategies for the Transportation Sector

In accordance with instructions from the National Council for Sustainable Development, Executive Yuan, and the MOTC, the institute has formulated the Sustainable Development Policy Agenda for the Republic of China—Transportation Development and action plans. In 2013, in accordance with instructions from the National Council for Sustainable Development, based on the document "The Future We Want" produced by the United Nations Conference on Sustainable Development (Rio+20), the institute completed a review of the amendments to the action plans of the traffic and life group. Subordinate agencies are currently engaging in promotion based on this. In addition, in accordance with the Study Meeting for Taiwan's Participation in the Voluntary Commitments of the United Nations Conference on Sustainable Development, logging of the voluntary commitments of the MOTC was completed on August 30, 2013.

辦理「臺灣主要港口海域長期性海氣象觀測及資料特性應用」研究

配合交通部推動科學技術發展目標－「強化各項基礎資料之蒐集與資訊系統建立之機制」，本研究以建置維護臺灣各國際港與國內港附近海域之長期性海氣象觀測網站為首要工作。各港口之觀測資料除提供即時性資訊作為船隻航行安全維護，並進行推算模式建置與應用，以及受氣候變遷影響之分析探討，共同建立港池安全動態資訊管理系統。本研究除出版各港口每年之海象觀測資料年報與專刊外，並應國內產官學研各界需求每年提供研究成果將近 40 件作為在港灣、海岸工程規劃設計與環境評估的重要參據。

進行「整體運輸規劃」與運輸策略系列研究

整體運輸規劃是政府用以擬訂未來各項交通運輸建設或政策之主要依據及藍圖，本所自民國 65 年以來，以 10 年為一期，陸續完成 4 期的整體運輸規劃，考量近期全球經濟環境變化極為快速，國內高鐵通車與高快速公路網陸續完成後，民眾機動性與可及性大幅提升，相關的社經發展趨勢與運輸需求之改變，將影響運輸需求模式中各項參數、各模組間之關係及模式整體解釋能力，爰於 102 年賡續進行城際運輸需求模式檢討及參數更新，城際客運及貨運需求模式驗證、研析高鐵營運對西部城際陸路公共運輸消長之觀察 (96-101 年)、配合行政院辦理國土規劃，協助交通部研提部門計畫；維護運輸規劃資料庫、進行需求模式開發與推廣應用。

Conducting a Study on Long-Term Marine Meteorological Observations and Data Feature Applications for the Waters of Taiwan's Major Ports

In accordance with the MOTC's promotion of science and technology development goals—Mechanisms for Strengthening the Collection of Basic Data and the Establishment of Information Systems—this study aimed to establish and maintain a long-term marine meteorological observation website for the waters near Taiwan's international and domestic ports. The observation data for each port provide real-time information for the maintenance of safe navigation. Project models were also established and applied and the analysis and discussion of the effects of climate change were conducted to establish a secure dynamic information management system for harbor basins. In addition to publishing annual observation data reports and monographs on marine meteorological observations for each harbor, this study also provided nearly 40 annual research reports in response to the needs of domestic industry, government, and academia to serve as major references for the project planning, design, and environmental assessment of harbors and coasts.

Conducting a Series of Studies on Overall Transportation Planning and Transportation Strategy

Overall transportation planning is the primary basis and blueprint for the government to formulate future transportation construction or policies. Since 1976, the institute has completed four stages of overall transportation plans, with each stage lasting ten years. The global economic environment has changed rapidly in recent years. The completion of the high-speed rail and the highway network substantially increased the mobility and accessibility of the people. Related socioeconomic development trends and changes in transportation demand will influence the parameters of the transportation demand model, the relationships among the modules, and the overall explanatory power of models. Thus, in 2013, the intercity transportation demand model was reviewed and its parameters updated. The intercity passenger and freight demand model was verified. Observations (2007 to 2012) of the dynamics of intercity public transportation in western Taiwan in response to high-speed rail operations were researched and analyzed. Territorial planning was conducted in accordance with the Executive Yuan. The MOTC was assisted in formulating sector plans. The transportation planning database was maintained. Demand models were developed and their application was promoted.

研訂我國「運輸系統容量分析」手冊及分析軟體並推廣其應用

本所於 102 年提出我國第一版軌道容量手冊「2013 年臺灣鐵道容量手冊」暨操作軟體，並持續修訂「2011 年臺灣公路容量手冊」及分析軟體，辦理坡度路段公路容量模擬模式之研究，期使運輸系統容量分析過程標準化並提高評估效率；辦理中央及地方政府交通運輸人員培訓，並擴及顧問公司專業人員與大學交通系所學生，以提升運輸專業從業人員之運輸系統分析評估能力。

協助推動東部地區自行車道示範計畫並編定自行車道系統規劃參考手冊

為持續配合行政院推動節能減碳政策，於 102 年檢討 98-100 年經典路線計畫，完成東部地區自行車道示範計畫總結報告及旅遊書「鐵馬、鐵路、ㄐㄧㄠ遊趣」；協助交通部研議「自行車友善環境路網延伸計畫」，期將自行車東部示範計畫之經驗轉移至西部地區。本所於 102 年 8 月正式出版之「自行車道系統規劃參考手冊」，已成為內政部營建署、教育部體育署補助各縣市自行車道系統規劃與建置之規範手冊。

Developing a Handbook and Analysis Software for Transportation System Capacity Analysis in Taiwan and Promoting Its Application

In 2013, the institute presented Taiwan's first track capacity manual, the 2013 Taiwan Railway Capacity Manual, and operating software. The institute has also continued to revise the 2011 Taiwan Highway Capacity Manual and analysis software. Research on capacity simulation models for slope sections of highways has been conducted to standardize the process of capacity analysis for the transportation system and to improve assessment efficiency. Training has been conducted for the transportation personnel of central and local governments. This has been extended to the professional staff of consulting companies and students in university transportation departments to increase the transportation system analysis and evaluation capabilities of professional practitioners in the field of transportation.

Assisting in the Promotion of the Bike Lane Demonstration Project for Eastern Taiwan and Compiling a Planning Reference Manual for Bike Lane Systems

To continue to cooperate with the energy conservation and carbon reduction policies promoted by the Executive Yuan, the 2009 to 2011 classic route plan was reviewed in 2013. A summary report on the bike lane demonstration project for eastern Taiwan and the travel book "Bicycles, Railways, Outing Fun" were completed. The MOTC was assisted in deliberating on the Extension Plan for Bike and Environmentally Friendly Networks. This plan aims to transfer the experiences of the eastern bike demonstration project to western Taiwan. The Reference Manual for Bike Lane System Planning officially published by the institute in August 2013 has become the specifications manual for the Construction and Planning Agency of the Ministry of the Interior and the Sports Administration of the Ministry of Education to subsidize the planning and establishment of bike lane systems in counties and cities.

辦理「我國及亞洲主要港口之主航線及運能資料建置」

亞太地區貨櫃運量在海運市場之比重逐年增加，近年大陸地區之港埠設施亦蓬勃發展。海運市場之整體經營環境產生相當變化，如船舶大型化、運能過剩、天天馬士基服務、聯盟聯營擴大、節能減碳、運價偏低、產業型態改變、大型航商投入碼頭營運等因素，使世界各大航商調整其主要航線布局以回應經營環境變化。本計畫蒐集 2013 年之亞歐及亞美主航線資料，進行彙整及驗證後，建立亞太地區主航線之資料庫，並依據蒐集所得之資料以高雄港及廈門港為例，探討兩者間之競合，並據以提出相關策略供港埠政策參考。

辦理「亞洲鄰近國家海空運政策研析」

環顧臺灣所處的亞太地區，近年來為因應經濟全球化及區域整合的趨勢，與全球海空運市場的持續成長，亞洲各主要海空運國家皆積極擬定海空運政策，除港埠設施與機場的建設之外，亦積極提昇海空運產業發展，並提出各項獎勵誘因吸引國際航商與航空公司停靠，以達到厚植國家海空運競爭力的目標。我國在航港局、港務公司及桃園機場公司成立後，在經營管理體制上已有大幅變革，為進一步強化競爭優勢，爰蒐集亞洲主要國家的海空運政策，並藉由專家訪問及調查了解各項發展策略方案之重要性，再利用量化統計分析方式，得到各項推動方案之優先順序，以提供交通部及海空營運單位未來施政及策略規劃之參考。

Conducting the Establishment of Data on Main Routes and Transport Capacity for the Major Ports of Taiwan and Asia

The proportion of Asia-Pacific container traffic in the marine shipping market has increased annually. In recent years, the port facilities of mainland China have also flourished. The overall business environment of the marine shipping market has changed considerably. For example, vessels have grown in size, transport capacity exceeds demand, Maersk service operates every day, alliances and joint ventures have expanded, energy conservation and carbon reduction have become goals, freight rates tend to be low, industrial patterns have changed, and large shipping companies have invested in terminal operators. These factors have forced large shipping companies throughout the world to adjust their main route layouts to respond to changes in the operating environment. This project collected 2013 data on Asia-Europe and Asia-America main routes. After compiling and verifying these data, a database of main routes in the Asia-Pacific region was established. Using the collected data, coopetition between the Port of Kaohsiung and the Port of Xiamen was examined to propose relevant strategies for reference in port policy.

Conducting Research and Analysis on the Sea and Air Transport Policies of Neighboring Asian Countries

Examining the Asia-Pacific region in which Taiwan is located, in recent years the major sea and air transport countries in Asia have actively formulated sea and air transport policies to respond to trends of economic globalization and regional integration and the continuing growth of the global sea and air transport market. In addition to establishing port facilities and airports, these countries have also actively upgraded the development of their sea and air transport industries and proposed numerous incentives to attract international shipping companies and airlines and thereby reinforce the competitiveness of their sea and air shipping. Since the establishment of the Maritime and Port Bureau, the Taiwan International Ports Corporation, and the Taoyuan Airport Corporation in Taiwan, substantial reforms have occurred in management systems. To strengthen competitiveness further, the sea and air shipping policies of major Asia-Pacific countries were collected. Expert interviews and questionnaires were used to understand the importance of various development strategies and plans. Quantitative statistical analysis methods were then used to prioritize promotion programs for the reference of the MOTC and sea and air operations units in future policies and strategic planning.

協助臺鐵局建立列車排點之資訊化及系統化

列車班表支配各類軌道資源 (人、車輛、軌道)，為車輛運用、乘務人員運用、運轉整理及列車調度計畫的基礎，亦為營運規劃作業最核心的工作之一。本所 102 年度已藉由自力發展之演算法及配合電腦平行運算能力大幅進步，發展符合臺鐵排點作業實務應用之鐵路列車自動排點系統雛型，結合多項核心技術以及鐵路決策輔助支援平臺 (Railway Decision Support Platform, RDSP)，提供鐵路列車自動排點所需功能。系統功能包括：1. 服務計畫模組：讀取運輸需求以及車次樣板以產生服務計畫；2. 班表求解模組：臨時列車模組，在給定之背景班表中自動插入臨時列車；3. 運行圖顯示模組：由給定班表產生運行圖；4. 衝突檢查模組：在給定班表中檢查衝突；5. 衝突排除模組：自動排除班表中衝突；6. 班表管理模組。此系統除能作為臺鐵局排點作業的自動輔助系統外，並能用以對鐵路公共投資方案作於營運面之深度評估。

推動「觀光遊憩區導入智慧型運輸系統計畫－ i3 Travel 愛上旅遊」

本計畫以「低碳觀光」與「智慧運輸」概念，結合創新（innovative）的思維，提供智慧化（intelligent）的資訊服務，以服務整合（integrating）的 i3Travel 理念，積極推動日月潭國家風景區成為國內「低碳觀光、智慧旅遊」的示範景點。102 年度整合經濟部工業局、環保署以及交通部之行政資源，以及和泰汽車、華碩電腦、台達電與中華電信等國內企業資金與技術，共計吸引投資金額高達 2 億元新臺幣。本計畫在 103 年將整合環湖區域的低碳運輸系統 (電動公車、電動小汽車、自行車、纜車與遊艇) 以及當地優質商家，透過悠遊卡提供整合式電子旅遊套票服務，預計本計畫將可為國內觀光產業提供全新的旅遊服務模式。

Assisting the Taiwan Railways Administration in Systemizing and Applying Information Technology to Train Scheduling

Train timetables allocate various track resources (people, vehicles, tracks). They are the foundations of vehicle usage, crew usage, operation organization, and train dispatching plans. They are also the most important of the core tasks of operations planning. In 2013, this institute used the algorithm of development in coordination with substantial advances in the computing capabilities of computers to develop a prototype for an automatic train scheduling system for application to the scheduling operations of the Taiwan Railways Administration. A number of core technologies and the railway decision support platform (RDSP) are integrated to provide the functions needed for automatic train scheduling. System functions include the following: 1. Service Planning Module: Transportation needs and trip models are read to produce service plans. 2. Timetable Solving Module: The extemporaneous train module inserts extemporaneous trains automatically into given background timetables. 3. Diagram Display Module: Given timetables produce diagrams. 4. Conflict Checking Module: This module checks for conflicts in given timetables. 5. Conflict Removal Module: This module automatically removes conflicts from timetables. 6. Timetable Management Module. In addition to acting as an automatic support system for the scheduling of the Taiwan Railways Administration, this system can also be used for in-depth assessment of the operations of public railway investment programs.

Promoting the Plan for the Introduction of Intelligent Transportation Systems Into Tourism and Leisure Areas—i3 Travel, Falling in Love With Travel

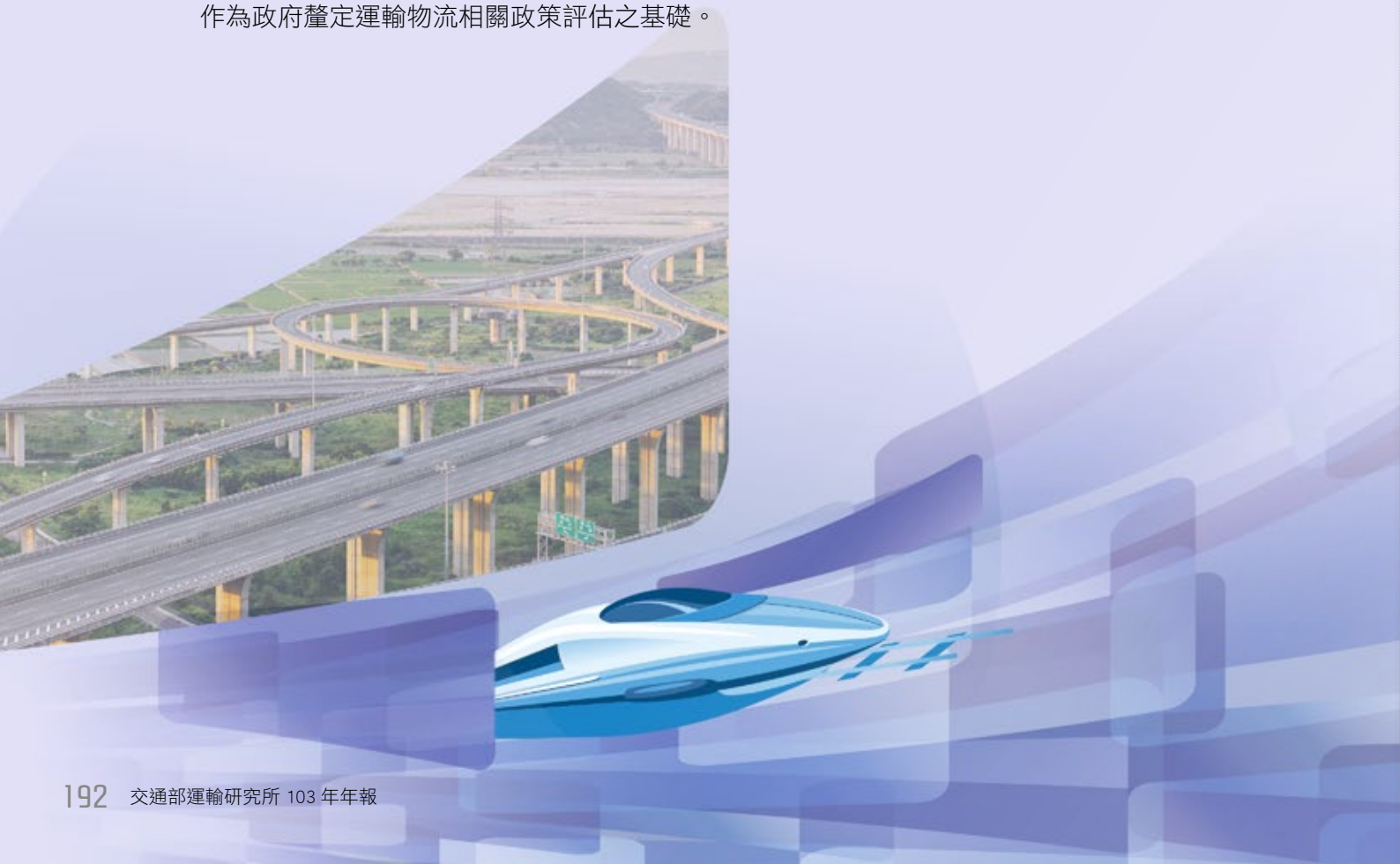
This project combines the concepts of low-carbon tourism and intelligent transportation with innovative thinking to provide intelligent information services. The service integration ideas of i3 Travel are used to promote actively the transformation of Sun Moon Lake National Scenic Area into a demonstration attraction for domestic low-carbon tourism and intelligent tourism. In 2013, the administrative resources of the Industrial Development Bureau of the Ministry of Economic Affairs, the Environmental Protection Administration, and the MOTC were integrated with the capital and technology of domestic corporations, including Hotai Motor, Asus, Delta Electronics, and Chunghwa Telecom, attracting a total investment of NT$200 million. In 2014, this project will integrate low-carbon transportation systems around the lake area (electric buses, electric cars, bicycles, aerial trams, and yachts) with local high-quality businesses. EasyCards will be used to provide integrated electronic travel package services. This project is expected to provide all-new tourism service models for the domestic tourism industry.

「交通服務 e 網通」整合網站系統維運與擴充服務

本案整合國省縣道及市區路況資訊及陸海空公共運輸資訊，持續維運及更新「交通服務 e 網通」相關資訊，並強化路況資訊自動化蒐集（如車輛偵測器）、觀光活動及自行車路網等資訊之蒐集及發佈，以擴充「交通服務 e 網通」之服務及加值應用。本年度計畫工作重點有二：一是強化即時路況事件資訊蒐集與發布，本所目前已與高公局合作進行高速公路路況資訊服務品質提升作業、二是強化公共運輸資訊服務，本所現已與交通部管理資訊中心合作，進行我國公共運輸資訊服務品質提升策略規劃。

辦理「運輸物流管理系統整體研究發展」

以運輸物流為主要研究對象，針對交通部之運輸物流發展政策重新檢視，以因應我國物流產業發展政策之動態性調整及國際全球運籌發展趨勢。102 年度配合行政院「國際物流服務業發展行動計畫」之推動，辦理「我國國家運輸物流競爭力指標系統之建立」及「發展低溫運輸系統之課題與因應策略」研究，分析國際間對於物流競爭力評比指標之運用機制及發展經驗，建立我國國家運輸物流競爭力指標系統，以強化既有運輸物流服務之競爭力，協助國內運輸物流產業結構轉型及與國際標準接軌，並預先規劃交通部門因應國際冷鏈及低溫運輸物流發展及交通建設投資方向，拓展兩岸低溫運輸物流商機，創造就業機會，並作為政府釐定運輸物流相關政策評估之基礎。



The Traffic & Trans Service Center Integrates Site System Maintenance and Operation With Expanded Service

This project integrates information on the conditions of national, provincial, county, and city roads with public land, sea, and air transportation to maintain, operate, and update the information on the Traffic & Trans Service Center. The automatic collection of traffic information (such as vehicle detectors) and the collection and release of information on tourism activities bike bath networks are structured to expand the services and value applications of the Traffic & Trans Service Center. This year's project has two priorities. The first is strengthening the real-time collection and release of information on traffic incidents. The institute is collaborating with the National Freeway Bureau to improve the service quality of information on freeway conditions. The second is strengthening public transportation information services. The institute is now cooperating with the Information Management Center of the MOTC to conduct strategic planning for improving the quality of public transportation information services in Taiwan.

Conducting Overall Research and Development on the Transportation Logistics Management System

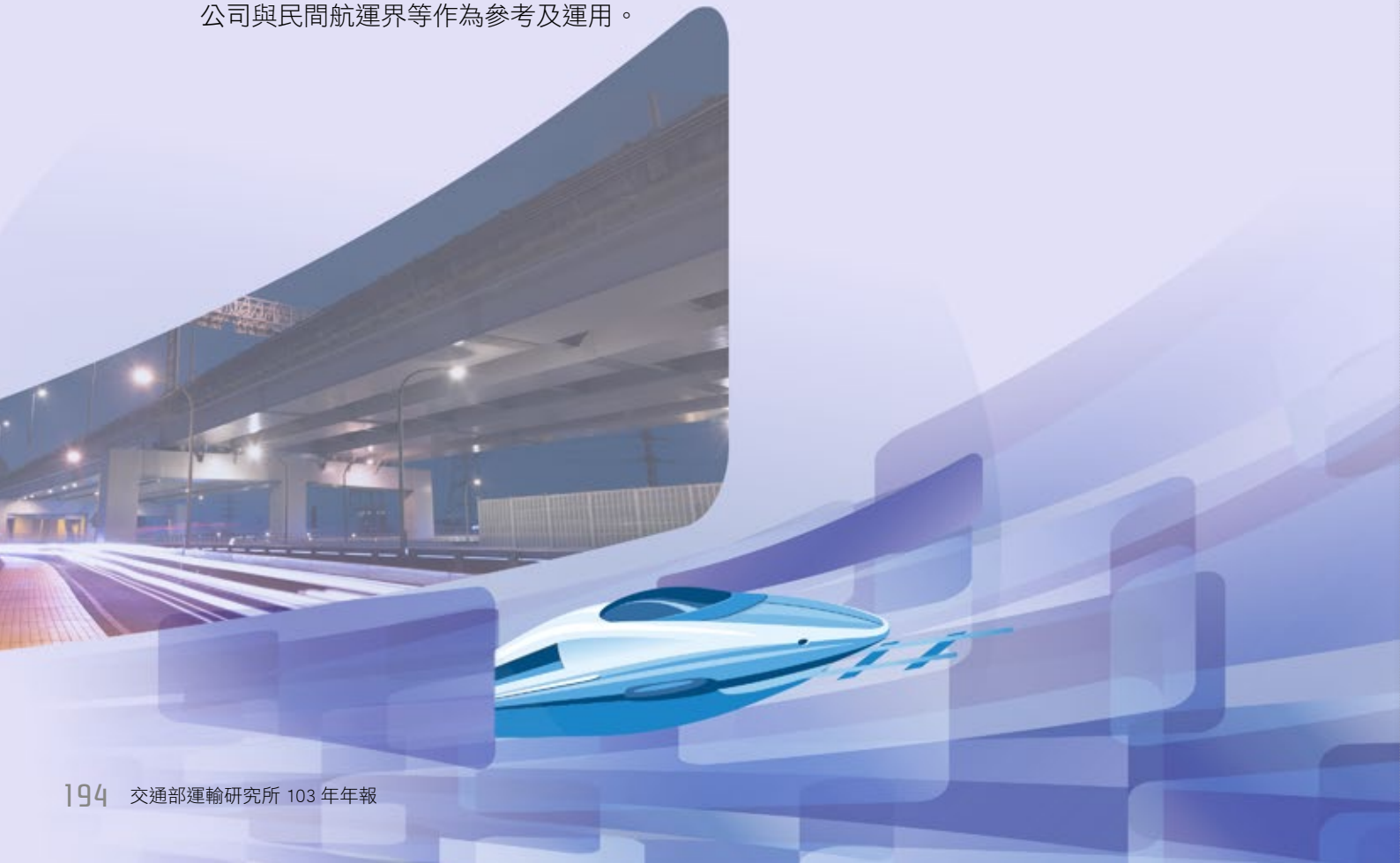
Transportation logistics was the main subject of this study. The development strategies for transportation logistics of the MOTC were reexamined to respond to the dynamic adjustment of development policies for the Taiwanese logistics industry and development trends in global operations. In 2013, in accordance with the promotion of the Executive Yuan's Development Action Plan for the International Logistics Industry, the studies The Establishment of a National Transportation Logistics Competitiveness Indicator System for Taiwan and Topics and Coping Strategies in the Development of Cold Chain System were conducted. The mechanisms used and the development experiences of international assessment indicators for logistics competitiveness were analyzed to establish a national competitiveness indicator system for transportation logistics in Taiwan. This system strengthens the current competitiveness of transportation logistics services and assists the domestic transportation logistics industry in restructuring and meeting international standards. In addition, advance planning of the transportation sector's responses to the international development of cold chain transportation logistics and investment directions for transportation construction has been performed. Opportunities for cross-strait cold chain transportation logistics are expanded to create employment opportunities and serve as foundations for the government to determine assessments of policies related to transportation logistics.

辦理「交通部門配合推動 LED 路燈照明成本效益之研究」

行政院於 100 年 12 月核定「擴大設置 LED 路燈節能專案計畫」，預計於 102 年度起汰換 25 萬盞水銀路燈。為配合暨因應經濟部未來 LED 路燈汰換計畫，交通部門必須在兼顧交通安全、節能減碳及照明設備維運管養成本等目標下，預為研擬配合推動作法與配套措施。基此，本所 102 年度辦理相關研究，分析國、省道建置 LED 路燈之可行性，以及初步推估節能減碳效益與成本效益、辦理「交通部門 LED 路燈發展策略研討會」，並規劃省道 LED 路燈測試計畫，研究成果可作為我國推動國、省道建置 LED 路燈之參據。

推動及執行「智慧型航行與監測系統」

為持續提升臺灣海運相關產業的競爭力，並因應國際 e- 化航行之趨勢，貫徹政府「加強海洋科技研發、永續發展海洋產業」的施政目標，本研究結合了臺灣海運的現有實力與電子資通訊技術，針對臺灣海運開發出一套智慧化與本土化的航行監測系統。本研究的主要目的就是整合前期研究所建立的電子航行圖 (ENC) 資料庫系統為基礎，再加上目前國際標準化的船舶自動識別系統 (AIS) 資料庫系統，依據國際航行有關的標準架構下，實現臺灣海域 e- 化航行的最終目標。本研究目前已經完成電子航行圖 (ENC) 資料庫及船舶自動識別系統 (AIS) 資料庫的建置與其運作的基本模式，將可提供給交通部、航港局、海巡署、各港務分公司與民間航運界等作為參考及運用。



Conducting A Study on the Cost-Effectiveness of the Transportation Sector's Cooperation in Promoting LED Streetlights

In December 2011, the Executive Yuan approved the Energy-Saving Project Plan for Expanding the Installation of LED Streetlights. Beginning in 2013, 250,000 mercury streetlights were expected to be replaced. In accordance with and in response to the Ministry of Economic Affairs' future LED streetlight replacement plan, the transportation sector must consider the objectives of traffic safety, energy conservation and carbon reduction, and the maintenance, operation, and management costs of lighting while formulating cooperation and promotion practices and supporting measures. In view of this, the institute conducted related studies in 2013 to analyze the feasibility of establishing LED streetlights on freeways and provincial highways and to perform a preliminary estimate of the energy conservation, carbon reduction, and cost benefits. The Seminar on Development Strategies for LED Lighting in the Transportation Sector was conducted and a test project for LED lighting on provincial highways was planned. The results of these studies can be referenced in the promotion of establishing LED streetlights on freeways and provincial highways in Taiwan.

Promoting and Implementing Intelligent Navigation and Surveillance Systems

To continue to increase the competitiveness of Taiwan's marine transportation industry and to respond to the trend toward digitalization in international navigation, the government is implementing its policy objective of "strengthening marine science and technology research and development and the sustainable development of marine industries." This study integrates the existing capabilities of marine transport in Taiwan with electronic information and communication technology to develop an intelligent, local navigation monitoring system for marine transport in Taiwan. The primary purpose of this study was to use the electronic navigation chart (ENC) database system established in previous research as a foundation for integration with the international standardized AIS database system. Based on standard architectures relevant to international navigation, the ultimate goal of digitalized navigation for the waters of Taiwan was realized. This study has completed the establishment of the ENC database and the AIS database along with their basic models of operation. These results can be referenced and used by the MOTC, the Maritime and Port Bureau, the Coast Guard Administration, branches of the Taiwan International Ports Corporation, and the private shipping industry.

推動「港灣海象環境資訊服務系統」

整合國內各主要港區現場海氣象即時觀測系統、數值模擬預報系統、海上藍色公路、港區地震地資訊、海嘯模擬資訊、港區大氣腐蝕系統及即時影像傳輸系統，建立完整海情資料庫，並將臺灣各港區之海氣地象與港灣相關環境資訊，以動態網頁與手持裝置 App 相互搭配顯示方式，透過「港灣環境資訊網」即時提供給一般民眾、港灣管理機關、國內外船舶業者及有關人員查詢，以提昇船舶航行安全、增進港埠營運效能及救災緊急措施之擬定。本系統建置成果於每年 3 月辦理使用者年度會議時進行推廣運用並彙整使用者意見作為年度系統修正參考。近年來並與交通部中央氣象局、基隆、臺中、高雄、花蓮等港務分公司、成功大學近海水文中心、成功大學水工試驗所及宜蘭縣政府環境保護局簽訂合作備忘錄。

辦理「港灣與濱海地區構造物現況調查與維護之研究」

本研究除對港灣碼頭、防坡堤、濱海建物之現況及大氣腐蝕影響因子，進行現地調查外，更就金屬材料腐蝕防治之需求，建立臺灣地區大氣腐蝕環境分類資訊系統，並驗證港灣設施維護管理系統之適用性，作為港灣設施檢測程序、劣損診斷、維護管理與構造物防蝕規範制定，及未來公共工程建設或建廠時所需設計與維護之參考依據，期使工程設施使用壽齡延長。102 年度已完成花蓮港區東、西防波堤、航道岸壁、4 號至 9 號鋼板樁碼頭及多座重力式碼頭之現況調查與評估，建置大氣腐蝕劣化因子資訊平台，並發行大氣腐蝕劣化因子資料年報。

Promoting the Harbor Marine Meteorology and Environment Information Service System

Real-time on-site marine meteorological observation systems for the major ports of Taiwan, numerical simulation forecasting systems, offshore blue highway, port earthquake information, tsunami simulation information, port atmospheric corrosion systems, and real-time video transmission systems are integrated to established a complete database on ocean conditions. Dynamic websites and apps for handheld devices complement each other to display marine meteorological and harbor environment information from the ports of Taiwan. The Harbor Environment Information Website permits real-time queries from the general public, harbor management authorities, domestic and foreign shipping businesses, and relevant personnel to enhance navigation safety, to improve harbor operating effectiveness, and to formulate emergency relief measures. The achievements of the establishment of this system are promoted and applied during annual user meetings in March of each year. The opinions of users are compiled to serve as a reference for annual system revision. In recent years, memoranda of cooperation have been signed with the Central Weather Bureau, the branches of Taiwan International Ports Corporation – Port of Keelung, Port of Taichung, Port of Kaohsiung, and Port of Hualien, the Coastal Ocean Monitoring Center of National Cheng Kung University, the Tainan Hydraulics Laboratory of National Cheng Kung University, and the Environmental Protection Bureau of Yilan County.

Conducting A Study on the Status and Maintenance of Structures in Harbor and Coastal Regions

This study performed field investigations on the conditions and atmospheric corrosion factors of harbor quays, breakwaters, and coastal buildings. In addition, an environmental classification information system for atmospheric corrosion in Taiwan based on requirements for preventing metal corrosion was established. The applicability of maintenance management systems for harbor facilities was verified to serve as a basis for testing procedures for harbor facilities, deterioration and loss diagnosis, maintenance management, norm-setting for structure corrosion, and the designs and maintenance required for the future construction of public works or factories. These results are expected to extend the lifespans of projects and facilities. In 2013, condition surveys and assessments were completed for Hualien Port East and West Breakwaters, Channel Quay, Steel Sheet Pile Wharfs Nos. 4 to 9, and a number of gravity wharfs. A degradation factor information platform of atmospheric corrosion was established and an annual data report on the degradation factors of atmospheric corrosion was issued.

辦理「混合車流情境之機車交通安全工程設計方法研究」

為改善機車乘員涉入交通事故之嚴重傷亡課題，配合交通部 102 年發布「運輸政策白皮書－運輸安全」之安全改善策略，亟需從交通工程設計層面檢討現行汽、機車混合車流所造成之安全衝突與風險，本計畫結合機車涉入事故與道路類型等資料，研析高風險之道路環境與事故碰撞類型，據以發展可行之工程設計改善方案，本案所提出之機車交通工程改善方案，已於 103 年度在新北市部分路口進行試辦，並供後續計畫評估使用效益。

辦理「與 IMO 海運安全公約及國際海事案件處理規範調和之研究」

海運具有高度國際化之特性，我國雖非國際海事組織 (IMO) 會員國，但無法自外於國際公約之規範，為與國際接軌，與 IMO 海運安全相關公約、規範調和，以增進我國海運安全及海事案件處理分析能力，爰對海運安全主要相關國際公約、規範加以蒐集彙整分析應用，並研析我國海運安全及海事案件調查相關法規制度亟待改善之處。本研究已提出更新版「海上交通安全法建議草案」，另建議我國海事調查制度之改善應同時兼顧兩個面向，其一為推動建立具獨立性之海事安全調查制度；其二則為建立海事行政 / 監理調查與評議之法源，本研究成果可供交通部及航港局參採。

Conducting A Study on Design Methods for Scooter Traffic Safety Engineering in Mixed-Traffic Situations

To improve the serious injuries and deaths that occur when scooter riders are involved in traffic accidents, in accordance with the safety improvement measures of the White Paper on Transport Policy—Transportation Safety published by the MOTC in 2013, the safety conflicts and risks caused by mixed traffic flow comprising existing cars and scooters must urgently be reviewed on the level of traffic engineering design. This project integrates data on scooter involvement in accidents and road types to research and analyze high-risk road environments and accident collision types. The results are used as a basis to develop feasible engineering design improvement plans. The scooter traffic engineering improvements proposed in this project were given a pilot test at some intersections in New Taipei City in 2014. The results of these tests will facilitate assessment of the usage benefits of subsequent programs.

Conducting A Study on Harmonizing With IMO Marine Transport Safety Conventions and International Maritime Case Handling Specifications

Marine transport is highly international. Although Taiwan is not a member of the IMO, it cannot remain outside of the norms of international conventions. To meet international standards and harmonize with IMO conventions and norms related to marine transport safety and thereby increase marine transport safety in Taiwan and Taiwan's ability to handle and analyze maritime cases, the main international conventions and norms related to marine transport safety have been collected, compiled, and analyzed. Areas where Taiwanese rules and regulations regarding marine transport safety and maritime case investigations urgently need to be improved were also researched and analyzed. This study has presented an updated version of the Draft Recommendations for the Maritime Traffic Safety Law. In addition, the study recommends that improvements to Taiwan's marine investigation system also consider two other dimensions. The first is promoting the establishment of an independent marine safety investigation system. The second is establishing legal sources for marine administrative/supervisory investigations and reviews. The results of this study can be referenced by the MOTC and the Maritime and Port Bureau.

01 Calendar of Events
INSTITUTE OF TRANSPORTATION, MOTC

壹 大事紀要

以下簡述本所 102 年度辦理完成之各項大事紀要：

月份	日期	辦理事項
1 月	2	辦理「Complete Street 的觀念介紹」專題演講
	11	「港埠建設永續發展之探討」講習會
	18	辦理「交通部性別平等業務推動經驗分享暨研討會」
2 月	13-21	執行 102 年春節疏運計畫
	21-05.06	參與 102 年度行政院院頒「道路交通秩序與交通安全改進方案」年終視導
	26	「危機管理及處變處理能力」教育訓練
3 月	7	協辦「2013 亞洲通用設計研討會－暢行未來 Amenity & Seamless」
	21-04.09	辦理「高速公路經常巡查模組」教育訓練
	22-23	與澳洲科廷大學和蒙納許大學合設之交通事故研究中心 (CMARC) 學者合辦「102 年道路交通安全研討會」
	29-04.17	辦理 102 年交通部金路獎『用路人資訊類』複評作業
	29	「臺灣高頻雷達海面海流監測網之發展」教育訓練
4 月	10	中國大陸物流園區概況與台灣物流業發展契機
	16	董事長與工友：物流從業人員的危機與轉機
	24	以「假說導引」配合「事實根據」的策略規劃法 -- 以海空運為例
	25	電動車共享 (EV-Sharing) 服務正式啟用

The following is the calendar of events conducted and completed by the institute in 2013.

Month	Date	Matters
January	2	Conducted a keynote speech on "The Introduction of the Concept of Complete Street"
	11	Seminar on "An Exploration of Sustainable Development in Port Construction"
	18	Conducted "Sharing of Experiences and Seminar on Promoting Gender Equality in the MOTC"
April	13-21	Implemented the 2013 Chinese New Year Distribution Plan
	21-05.06	Participated in the 2013 year-end supervision of the Program of Road Traffic Order and Safety Improvement Promulgated by the Executive Yuan
	26	Education and training on crisis management and processing capacity at times of change
March	7	Assisted in conducting the 2013 Asian Universal Design Workshop—Navigating the Future Amenity & Seamless
	21-04.09	Conducted education and training on the frequent inspections module for highways
	22-23	Collaborated with scholars from the Curtin Monash Accident Research Centre (CMARC) to conduct the 2013 road traffic safety seminar
	29-04.17	Conducted re-evaluation work for the 2013 MOTC Golden Road Awards in the category of Passersby Information
	29	Education and Training on The Development of a High-Frequency Radar Ocean Current Monitoring Network in Taiwan
April	10	Status of Mainland China's Logistics Park and Development Opportunities for the Taiwanese Logistics Industry
	16	Chairman and Workers: Crises and Turning Points of Logistics Practitioners
	24	Methods of Strategic Planning Matching "Hypothetical Guidance" With "Facts"—Examining Sea and Air Transport
	25	Official Launch of EV-Sharing Service

月份	日期	辦理事項
5 月	6	國際綠色港埠之發展
	10	辦理「老師，您會不會回來」讀書會
	15	辦理「公路設計、運作及交通安全」專題演講
	16	航空公司收益管理
	20	辦理「現代圓環的設計與服務水準的介紹」專題演講
	27	辦理「道路交通安全管理國際新趨勢 - ISO 39001 標準介紹」研究會
	29	商務機發展及策略
		桃園機場尊榮通關服務介紹
	30	辦理日本自動車安全運轉中心小林理事長等訪問交流會議
6 月	5	北部空域容量飽和問題與解決方案
		辦理「中長程計畫審議決策支援系統實務應用簡介與實機操作」研究會
7 月	2	辦理「低溫運輸物流發展趨勢」教育訓練
		「非線性波浪與結構物交互作用之研究」專題講演
	2-4	辦理「102 年度國道經常巡查模組維護擴充作業」教育訓練
	10	航空貨物集散站經營管理實務
	11	辦理「公路車輛行駛時間調查 (101-102 年)」教育訓練
		日本派任 IMO 代表 Yoshida Koichi 吉田公一來所參訪，辦理「IMO 公約及海事調查國際接軌相關事宜」座談會

Month	Date	Matters
May	6	Development of International Green Ports
	10	Conducted a group reading of "Teacher, Won't You Come Back?"
	15	Conducted a keynote speech on "Highway Design, Operation, and Traffic Safety"
	16	Airline Revenue Management
	20	Conducted a keynote speech on "An Introduction to Design and Service Standards of Modern Roundabouts"
	27	Conducted a research conference on "New International Trends in Road Traffic Safety Management—Introduction to ISO 39001 Standard"
	29	Commercial Aircraft Development and Strategy
		Introduction to the Elite Clearing Services at Taoyuan Airport
	30	Conducted a visit and exchange meeting for Chairman Kobayashi of the Japan Safe Driving Center
June	5	Northern Airspace Capacity Saturation Problems and Solutions
		Conducted a research conference on "An Introduction to and Actual Operations of the Practical Application of the Decision Support System for Mid- and Long-Range Project Deliberations"
July	2	Conducted research and training on "Development Trends in Cold Chain Transportation Logistics"
		Presentation on A Study on the Interactions Between Nonlinear Waves and Structures
	2-4	Conducted education and training on "2013 Maintenance Expansion Operations for the Freeway Frequent Inspections Module"
	10	Air Cargo Terminal Operations and Management Practice
	11	Conducted education and training on the "Road Vehicle Travel Time Survey (2012-2013)"
		Japanese representative to the IMO Yoshida Koichi visited the institute to conduct a forum on "Matters Related to Meeting IMO Conventions and International Standards for Marine Investigations"

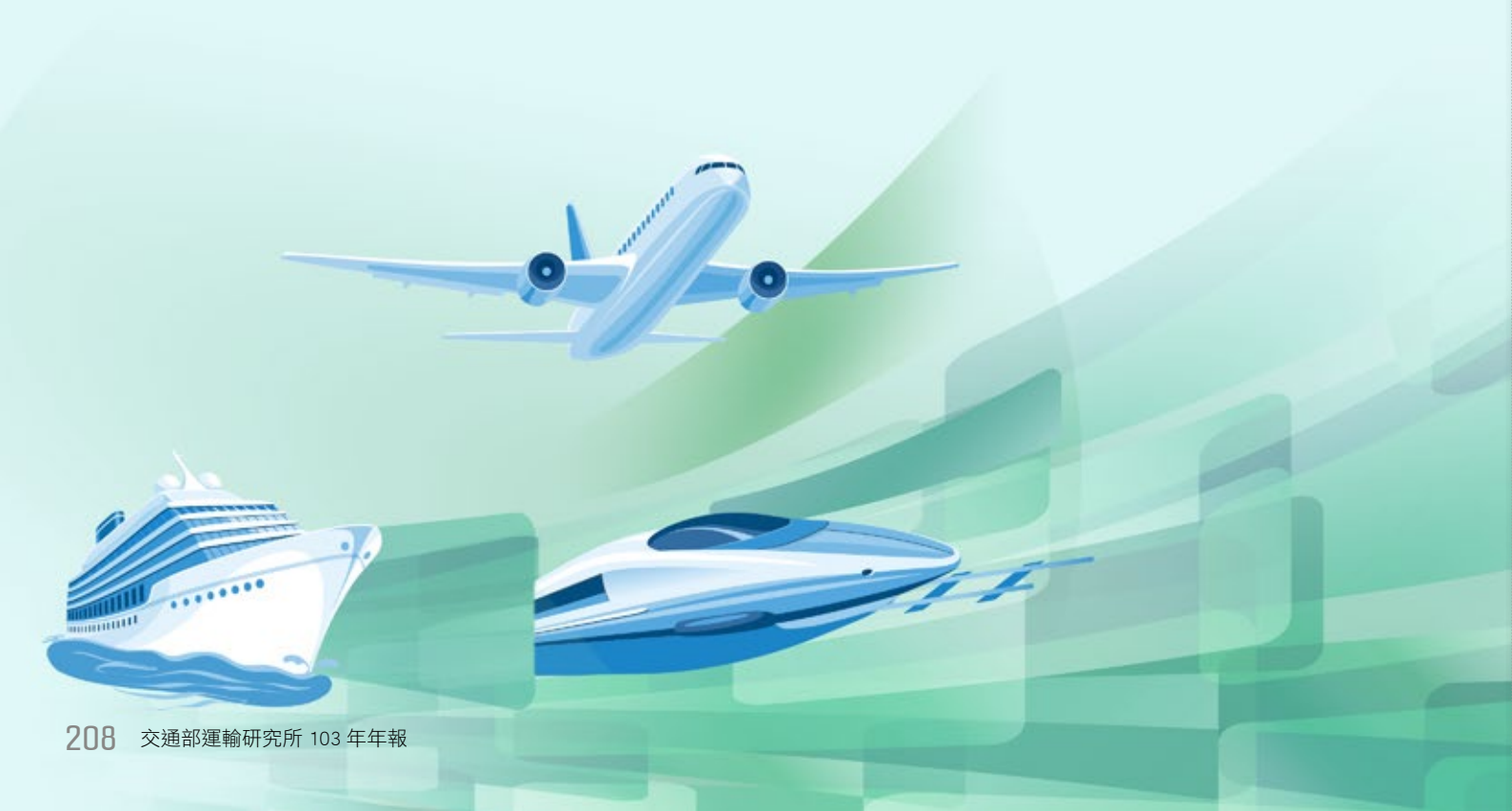
月份	日期	辦理事項
7	17-08.16	辦理「102 年度橋梁維護管理訓練講習」
	18	辦理「公路車輛行駛時間調查 (101-102 年)」教育訓練
	23	辦理「淺談羅吉特模式之應用與限制兼論活動基礎模式」專題演講
	30	海運貨物承攬業問題探討 (海空運承攬及供應鏈整合實例介紹)
	31	國際物流管理與操作實務探討
8 月	6	台日韓三國貨櫃碼頭營運政策之比較分析
	7	國際物流與商務整合應用
	13	國際貨櫃航商在巴拿馬運河拓寬後的主航線配置情勢分析暨加入綠色航運策略 (Clean-liner) 的執行成效探討
	14	我國開拓國際維修航機市場前景
	20	多國　櫃業務之發展
9 月	3	「港灣環境資訊服務系統合作備忘錄」簽訂儀式及中心成果簡介
	4	飛航標準介紹
	16	辦理「臺灣地區橋梁管理資訊系統人行陸橋模組」教育訓練
	27	辦理「機車交通工程安全改善方案座談會」

Month	Date	Matters
July	17-08.16	Conducted the 2013 Bridge Maintenance and Management Training Seminar
	18	Conducted education and training on the "Road Vehicle Travel Time Survey (2012-2013)"
	23	Conducted a keynote speech on "The Application and Restrictions of the Logit Model and Discussion on the Activity-Based Model"
	30	Discussion of Seaborne Cargo Forwarder Issues (Example Introduction of Sea and Air Freight Forwarders and Supply Chain Integration)
	31	Discussion on International Logistics Management and Operating Practices
August	6	Comparative Analysis of Container Terminal Operating Policies in Taiwan, Japan, and South Korea
	7	International Logistics and Business Integration Applications
	13	Mainline Configuration Situation Analysis of International Container Carriers After the Widening of the Panama Canal and Exploring the Effectiveness of the Implementation of Clean-Liners
	14	Exploring Taiwan's Prospects in the International Aircraft Maintenance Market
	20	The Development of Multinational Mergers in the Container Business
September	3	Signing Ceremony for the Cooperation Memorandum on Cooperation in Harbor Environment Information Service Systems and Introduction to Center Achievements
	4	Introduction to Flight Standards
	16	Conducted Education and Training on "The Pedestrian Bridge Module of the Bridge Management Information System in Taiwan"
	27	Conducted the Forum on Scooter Traffic Engineering Safety Improvement Plans

月份	日期	辦理事項
10 月	1	「無網格數值方法於水波模擬之應用研究」專題演講
	2	Low Cost Carrier Study
	4	與 IMO 海運安全公約及國際海事案件處理規範調和座談會
	4-11.08	辦理「第 31 期臺灣地區易肇事路段改善計畫」會勘會議
	14	辦理「臺灣公路容量軟體教育訓練」- 高雄場
	15	「臺灣港埠船舶減速查核機制系統之建置」教育訓練
	21	辦理「機車安全管理行動方案」座談會
	21	辦理「臺灣公路容量軟體教育訓練」- 臺北場
	23	航空聯盟及聯盟治理介紹
	25	辦理「TTDSS 運輸部門決策支援系統」推廣應用研究會
	28	辦理大陸交通運輸部職業資格中心劉處長等訪問交流會議
	29-11.24	辦理「先進公共運輸系統整合資料庫加值應用系統」教育訓練與技術移轉
	29	辦理「混合車流情境之機車交通安全工程設計方法座談會」
		辦理「研訂交通部法規檢討修正之機制或程序座談會」
		「臺灣港埠新紀元—2013 綠色港埠發展」研討會和「生態港 PERS」認證講習

Month	Date	Matters
October	1	Keynote Speech on "A Study on Applying Meshless Numerical Methods to Wave Simulation
	2	Low Cost Carrier Study
	4	Forum on Harmonizing With IMO Marine Transport Safety Conventions and International Specifications for the Handling of Marine Incidents
	4-11.08	Conducted a joint meeting on the 31st Project for Improving Accident-Prone Roads in Taiwan
	14	Conducted Taiwan Highway Capacity Software Education and Training—Kaohsiung Session
	15	Education and training on "The Establishment of a Ship Deceleration Checking Mechanism and System for Taiwanese Ports"
	21	Conducted the forum on Scooter Safety Management Action Plan
	21	Conducted Taiwan Highway Capacity Software Education and Training—Taipei Session
	23	Introduction to Airline Alliance and Coalition Governance
	25	Conducted a research conference on promoting the application of the Taiwan Transportation Decision Support System (TTDSS)
	28	Conducted a visit and exchange meeting with Director Liu from the Center of Occupational Accreditation of the mainland Ministry of Transport
	29-11.24	Conducted education, training, and technology transfer on the "Integration of Advanced Public Transportation Systems With Database Value-Added Application Systems"
	29	Conducted the Forum on Scooter Traffic Safety Engineering Design Methods for Mixed-Traffic Situations
		Conducted the Forum on Formulating Mechanisms or Procedures for Regulatory Review and Revision in the MOTC
		Seminar on "A New Era for Taiwanese Ports—Green Port Development in 2013" and the Eco Port PERS certification workshop

月份	日期	辦理事項
11 月	19	辦理「低溫運輸物流發展趨勢與策略」教育訓練
	24	辦理「先進公共運輸系統整合資料庫加值應用系統」教育訓練與技術移轉
12 月	6	辦理「102 年駕駛模擬儀軟硬體系統簡介及場景建構程式設計教育訓練課程」
	12	辦理「全球經濟整合與我國運輸業市場開放」專題演講
	19	「臺北港觀測樁海氣項觀測系統維護與操作」教育訓練
	24	辦理「智慧型運輸系統節能減碳與成本效益評估工具暨資料庫之應用」教育訓練
	27	辦理「LED 路燈適用性及未來發展研討會」論壇



Month	Date	Matters
November	19	Conducted education and training on "Development Trends and Strategies for Cold Chain Transportation Logistics"
	24	Conducted education, training, and technology transfer on the "Integration of Advanced Public Transportation Systems With Database Value-Added Application Systems"
December	6	Conducted An Introduction to the 2013 Driving Simulation Software and Hardware System and Education and Training Courses on Scenario Construction and Programming
	12	Conducted a keynote speech on "Global Economic Integration and the Development of the Taiwanese Transportation Market
	19	Education and training on the "Maintenance and Operation of the Marine Meteorological Observation System for the Port of Taipei"
	24	Conducted education and training on "Energy Conservation, Carbon Reduction, and Cost-Benefit Assessment Tools for Intelligent Transportation Systems and the Application of Databases"
	27	Conducted the "Seminar on the Applicability and Future Development of LED Streetlights"

2014 ANNUAL REPORT

2014 ANNUAL REPORT OF THE INSTITUTE OF TRANSPORTATION, MOTC

交通部運輸研究所103年年報

刊期頻率：年刊

出版機關：交通部運輸研究所

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出版年月：中華民國 103 年 12 月

創刊年月：中華民國 76 年 12 月

設計製作：四點設計有限公司

定　　價：200 元

展 售 處：交通部運輸研究所運輸資訊組 電話：(02)23496887

國家書店松江門市：10485 臺北市中山區松江路 209 號 電話：(02)26579211

五南文化廣場：40042 臺中市中山路 6 號 電話：(04)22260330

GPN：2007600006 ISSN：1018-8886


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