國立台灣大學工學院土木工程學系

碩士論文

Department of Civil Engineering

College of Engineering

National Taiwan University

Master Thesis

台灣高速鐵路民間參與投資之經驗對美國高速鐵路發展之參考性

Lessons Learned from the Private Participation in the Taiwan High Speed Rail Project as the Reference for Future Development of U.S. High Speed Rail

余亭慧

Ting-Hui (Vanesa) Yu

指導教授：高聰忠 博士

曾惠斌 博士

Advisor: Tsung-Chung Kao, Ph.D.

Hui-Ping Tserng, Ph.D.

中華民國 100 年 6 月

June, 2011

國立臺灣大學碩士學位論文
口試委員會審定書

台灣高速鐵路民間參與投資之經驗對美國發展高速鐵路發展之參考

Lessons Learned from the Private Participation in the Taiwan High Speed Rail Project as the Reference for Future Development of US High Speed Rail

本論文係余亭慧君（R98521701）在國立臺灣大學土木工程學系碩士班完成之碩士學位論文，於民國 100 年 06 月 23 日承下列考試委員審查通過及口試及格，特此證明

口試委員：

曾惠斌 （指導教授）

高聰忠 （指導教授）

賴勇成

吳松竹

系主任 呂良正

ACKNOWLEDGEMENT

It is a pleasure to thank those who made this thesis possible. First of all, I am heartily thankful to my supervisors, Tsung-Chung Kao and Hui-Ping Tserng, whose encouragement, guidance and support from the initial to the final level enabled me to develop an understanding of the subject. Thank you for the good care you have given to me during this past two years.

I am also thankful to the professors of the CEM division that taught me the art of being a student of the CEM division, for being extremely nice when I faced problem and the encouragement and approval for the works I have done. This thesis wouldn't have been possible unless the professors that had played major roles during my four years of bachelor. If it weren't you I would never had the courage and the motive to pursue for the Master degree.

Thanks professor Lai and professor Wu for your advices in the oral defense to make my thesis more perfect. I am especially grateful to professor Wu who spent the whole day trying to correct the mess of my thesis. Thanks Chieh Lin, you have made available your support in a number of ways that helped me go through many critical moments. Thank you for the great advices you have given to me when I was so lost.

I am indebted to my many of my colleagues to support me during these two years. I am very happy and honored to co-work with you, it have been a wonderful experience and I would never forget the trip we took to Ryukyu Island and I-Lan that have deepen our relationship. Thanks Long for helping me with the THSR data collection, and thanks to everyone who helped me during my six years in Taiwan. If it wasn't for your kindness and support, I would never reach this far and achieve this master degree. Gracias de corazón, los quiero!

Regards,

Vanesa Yu (August, 2011)

摘要

高速鐵路建設之多數成敗關鍵在於資金，當 1980 年代時台灣因經濟的急速發展無法繼續滿足國內南北交通壅塞之困境時，為了解決此問題，台灣政府決定學習日本及歐洲各國選擇建造一條連接台灣南北的高速鐵路，事後又因為資金到位之問題而引入私人企業參與此一重大之交通建設。雖然台灣高速鐵路BOT案為國際上史無前例且國內第一個BOT專案的經驗，對於政府來說，卻是一個只許成功不許失敗之工程。所以儘管建造過程中有許多的波折以及爭論，最終還是圓滿完成且在 2007 年正式營運。

美國為世界經濟與政治大國，過去二十年美國聯邦政府將其都市發展資金投資於公路建造與航空業發展，長期忽略鐵路。在完全沒有高速鐵路的情形下，因環境變遷、世界天災多變、能源危機等問題，使得大量仰賴石油的美國重新思考鐵路之重要性。美國發展高速鐵路之好處，除了可減輕公路與航空負擔，同時也可大幅降低碳排量與能源消耗，更可拉近各州都市間距離。這些因素促使美國重新考量興建高速鐵路之可能性，若未來美國決定興建，這將會是國際競相爭取的營建市場，但也迫使美國面臨興建高鐵所衍生的資金成本，營造方式及環境問題等嚴苛挑戰，這也使本研究欲以台灣促參之經驗針對財務方面提供經驗參考。

期望建造高速鐵路的國家不勝枚舉，但國家能否籌備足夠資金支持高速鐵路計劃是一個共通的問題。本研究希望藉由台灣高速鐵路之經驗，提供美國以及其它國家做參考，提出高速鐵路計劃引進私部門企業參與之優缺點；從政府的觀點來看可減輕政府財務負擔、引進私部門工程執行效率、政府風險轉移降低興建及營運失敗風險、須花費較長時間籌備相關法條及合約協商。本研究藉由專家訪談以及其問卷調查，歸納出美國高速鐵路以促參方式辦理須注意之關鍵因素；如專案融資實施、基礎條例、程序及特許團隊、合約內容與招選標程序、運量等，期望提供美國或欲採用促參建造高速鐵路之國家一個重要經驗參考及降低其風險及成本損失。

Abstract

To undertake the investment of a HSR project, the most challenging issue is the financing. During the development of the Taiwan High Speed Rail (HSR) project, in the 80s, it was decided to learn from Japan and European countries to build a dedicated HSR line. The government hoped to benefit from the advantages of the HSR and solve the problem faced in the domestic transportation sector. Due to financing difficulties the government made an important decision to build the HSR with private participation (Build-Operate-Transfer). Without previous experiences, the THSR is the first one of the HSR BOT project in the world at the time. The determination to have a successful HSR providing service to the Taiwanese people was the main goal of the government, and despites all the controversies and debates during the project life cycle, it was finally completed and started to provide service in 2007.

After the Cold War, America became the world most powerful country economically and politically. In the last two decades the U.S. Federal Government had put its attention in the development of nationwide highway networks and airport systems, neglecting the development of the conventional railway system. Without any HSR line, many serious nature-caused catastrophes and energy crisis had lead to the oil-dependent America reconsider the long-neglected railway system. The development of HSR in America can reduce highway and airway burden, also can cut down country's carbon dioxide emission and energy consumption. Most importantly, it can reduce

the distance and barriers of different States and cities. These issues induced America to reconsider the possibility of HSR, if America decides to build HSR, will eventually turn itself to the biggest HSR market that the world wishes to participate. However the decision toward a HSR line also brings up financial, construction method and environmental issues. Therefore this thesis analyses Taiwan's private participation experience (BOT) and proposes financial suggestions as reference.

Countries interested to develop HSR are numerous, but countries that have enough resources and funding are rare. From Taiwan High Speed Rail experience, this study analyzes the advantages and disadvantages of a HSR project using BOT model. From the point of view of the government, advantages are to reduce financial burden, introduce private sector efficiency, and minimize the risk of construction and operation. However, disadvantages are time spending in the contract negotiation and the design of related laws. By expert interviews and survey analysis, this study points out key issues when implementing alternative financing in HSR: Implementation of project financing, basic acts to promote HSR, procedures and involvement, contract terms and bidding control procedures, ridership expectation, etc. This study aims to reduce risk and cost for countries seeking for alternative financing to execute their high-speed rail project.

Keywords: High Speed Rail, BOT, Private Participation, Construction Management, Taiwan.

Table of Content

Figures

Tables

Chapter 1 Introduction

1.1 Background and Motivation

As a new-era transportation system the High Speed Rail (HSR) has been proven as a sustainable, highly competitive and environmentally friendly transportation tool. During the last 40 years it has been rapidly expanding trough Europe and Asia. Described as the "Transportation of the Future," it is characterized to offer customers and the society: safety, capacity (within velocity), and sustainability, particularly for the environment.

It is a green transportation tool that became the transportation trend of the century and there are many successful projects around the world. Increasing number of countries is considering their own High Speed Rail project and desire to join the HSR boom. Particularly the United States, who had put its attention in nationwide highway and air transportation during past half century, does not posses any HSR line. The necessity to link their cities by HSR eventually turned the U.S. to become the world biggest HSR market.

As High Speed Rail is developing to provide us faster and greener trains, interoperability and intermodal transportation, there are still many challenges to the construction of a HSR line. Taiwan has the experience of private participation (Build-Operate-Transfer) in HSR. It is undeniable that the funding is one of the many important issues that lead to the success of a HSR project. Therefore, Taiwan's BOT experience is extremely valuable for future HSR cases.

1.2 Research Objectives

Building, maintaining and operating HSR lines is expensive. It has many challenges and involves significant amount of previous investment costs that may significantly compromise the development of the country's transport sector for decades. This is the reason of the debates concerning development of HSR. The involvement of HSR deserves closer look. The main objective of this paper is to discuss the feasibility of HSR from an economic viewpoint, same time determine in more detail HSR private participation. This understanding is especially useful for future projects since funding has always been one of the major concerns in a HSR project.

Taiwan High Speed Rail is the world's first and only HSR project that employed private partnership (BOT). By literature review of world HSR cases and U.S. challenges, and detailed study of Taiwan's HSR BOT case, this research tries to analyze the experiences and lessons learned from Taiwan's private participation experience. With the analysis of THSR BOT project's pros and cons and abundant literature review from world and U.S.' HSR articles, this thesis aims to propose BOT key issues as reference for the U.S. or other countries with intention to build their HSR projects with private partnership.

1.3 Methodology

The methodology and procedure of this research begins with research background, follows with research motives, and ends with the summary of research objective. Through the review of the

fundamental theory in literature review, the research framework and research hypotheses are established. This study is supported with strong literature review and it is then followed by the design of a questionnaire, pre-test of the questionnaire, data analysis of pre-test and the formal distribution of the questionnaire. Through information gathering and results of questionnaire's analysis, the conclusions, suggestions, and further research are finally presented. The research process of this study is shown below in Fig. 1.3.1.

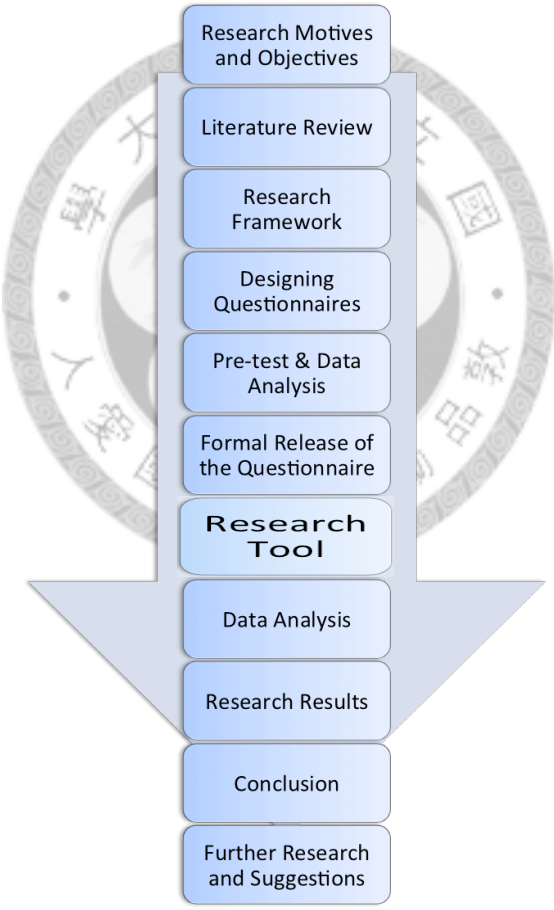

Fig. 1.3.1 Research Process

Source: Organized by this study

1.4 Limitations

The research is based on the Taiwan High Speed Rail's experience, due to the fact that Taiwan High Speed Rail is the first world HSR constructed by BOT, therefore experts opinions are very precious.

The questionnaire is sent to those experts with HSR and BOT experiences. It is also required that the experts have to have experience in HSR or BOT, therefore these requirements limited the number of replied and valid questionnaire.

Experts are mainly from government institutions, non-government institutions and the academic field. These experts were mostly involved in the Taiwan High Speed Rail's case. In order to obtain neutral answers of the questionnaire, it is executed anonymously to reduce the probability of deviation in the statistics result.

Chapter 2 Developments of HSR around the World

2.1 Literature Review

Since the beginning of the railroad development, the world's transportation mode has been progressing to reach higher records. The transportation, in this century, has turned to be an indispensable element of human's life.

The pursuit for the speed can be dated back from 1825, when the first railroad in England appeared with the speed of 24km/h. It didn't take the scientists long to beat their records and by the beginning of the 20th century, the speed jumped from 24km/h to 144 km/h (France). Today, the world record is still held by France with a speed of 574.8km/h. (LeFigaro.fr)

Japan is the first country with the *bullet train* concept. Since 1964 Japan had been providing HSR services and had performed over 100 million passenger-trips. Japan is the pioneer of the bullet trains, however there is also long HSR history in Europe. Nowadays, there are HSR services in more than 15 European countries, and the network is still growing at a very fast pace. (Campos, 2007). Since October 1, 1964, the Tokyo Shinkansen High Speed Rail started to operate to serve the opening in the same year of the Olympics in Tokyo, providing services above 270km/h. (MTI, 2005)

It wasn't until 1967 that the SNCF (France's National State-Owned Railway Company) realized that the growing automobile and air transportation soon will be collapsed by the expansion

of the cities and it was in need to provide seriously better speeds to compete against it. They commenced studies and research into the concept of High Speed Rail where first results emerged in 1970 with the scheme to build a new line to connect Paris and Lyon on the condition of the following principles: (UIC, 2010)

- Dedicated line: a line exclusively to passenger traffic that will reduce cost of infrastructure investment and also maximum use of capacity available.
- Compatibility: trains may continue their journeys over older lines and infiltrate deeply into cities.
- Efficiency: greater frequency and shorter travel times.

It finally came to the opening in 1981 where the train was named Train à Grande Vitesse (TGV) linking Paris and Lyon at a speed of 260km/h. From the first electric TGV generation scientists has been working to surpass its own records in velocity, technique and commodity.

Soon after France released its TGV series, Germany joined the service with its Germany Intercity Express (ICE) at the speed of 300kph. The project started in the 1980s and it was the first intercity experimental which hold the world record for a train of 400km/h for a short period.

Similar to France, the ICE system runs on its own dedicated high-speed lines, but most of the ICE services run on existing conventional railway lines. This places the ICE in an unfavorable position that slower down the train's speed, depending on how curved the line is, it can mostly cruse at a maximum of 200km/h.

In the 21st century, with more than 40 years of efforts developing the high-speed rail, conventional trains and airplanes can no more afford most country's transportation need, specially in Europe and Asia. Desperate in searching for other transportation mode the high-speed rail turn out to be the one that can provides us high-speed, high capacity and low pollution; thus, turning our lives better, more efficient and greener.

Although HSR shares the same basic engineering principle with conventional railways, according to UIC (2010), the High Speed Rail is a very complex system consisting of many subsystems:

- Infrastructure (including civil engineering works, track, catenary)
- Stations (location, functional design, equipment)
- E&M core system (Rolling stock , Signaling systems, power, communication)
- Track system
- Operations (design and planning, control, rules)
- Maintenance policy and systems
- Financing
- Marketing
- Management
- Legal

Not only technical differences, the conventional railway also uses different electrification

system. These are the preconditions to the success of the high-speed rail, each and every one of the components in combination is the key to save even one minute, be competitive and safe.

One may think that the high-speed rail is just an upgrade of the conventional rail, however they are different everywhere. The high-speed rail system depends on how all the elements are deliberated and adapted. It possesses some characteristics: (UIC, 2010)

- Self propelled, fixed composition and bi-directional.
- High level of technology
- Limited axle load (11 to 17 tons for 300km/h)
- High traction power (approx.. 11 to 24W per ton)
- Power electronic equipment.
- Control circuits. Computer network. Automatic diagnostic system.
- Optimized aerodynamic system.
- Improved commercial performance.
- In-cab signaling system/s.
- Several braking systems.
- Improved commercial performance.
- High level of RAMS (Reliability, Availability, Maintainability and Safety)
- Airtight structure
- Technical and safety requirements

- Compatibility with infrastructure (track gauge, loading gauge, platforms, catenary, etc.)

The final system can also vary in different projects. In terms of cost and performances it could be very different from one country to another. (Fig. 2.1.1)

Fig. 2.1.1 High Speed Rail Systems in the World (2010)
Source: UIC, 2010.

2.2 HSR in Operation

Today, there are 13 countries operating their high-speed trains, which are Japan, France, Germany, Italy, Belgium, Spain, Russia, Taiwan, UK, China, Netherland, Sweden and South Korea. Many countries such as Turkey, Iran, Poland, Morocco, Brazil, Vietnam, United States, etc. are either under construction or in planning stage. According to the International Union of Railways (UIC), the expected evolution of the world HSR network will reach more than 35600km (See Fig. 2.2.1).

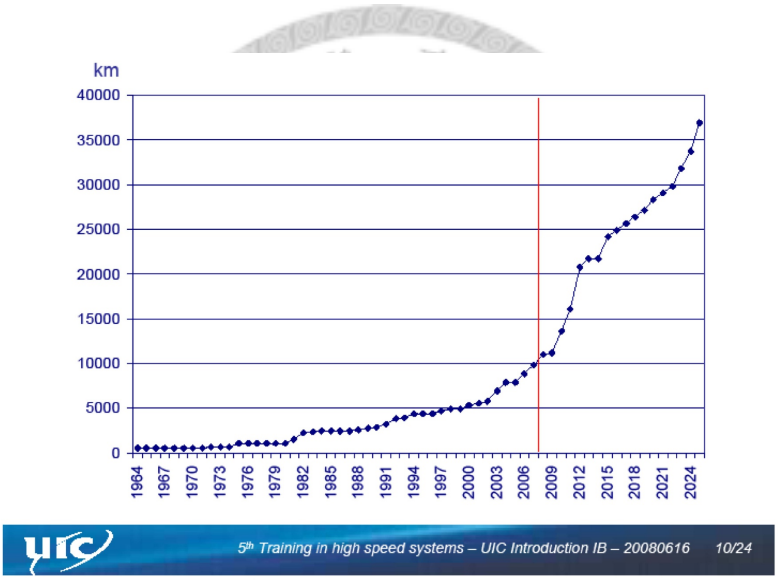

Fig. 2.2.1 Expected evolution of the world HSR network
Source: UIC

The evolution of the ridership demand in Asia and Europe is also significant. HSR services in Japan started providing services since 1965 and enjoyed a sustained ridership growth for the following 20 years. European HSR projects are young in comparison to the Japan HSR; therefore it is expectable to have high growth rates. As shown in Fig. 2.2.2.

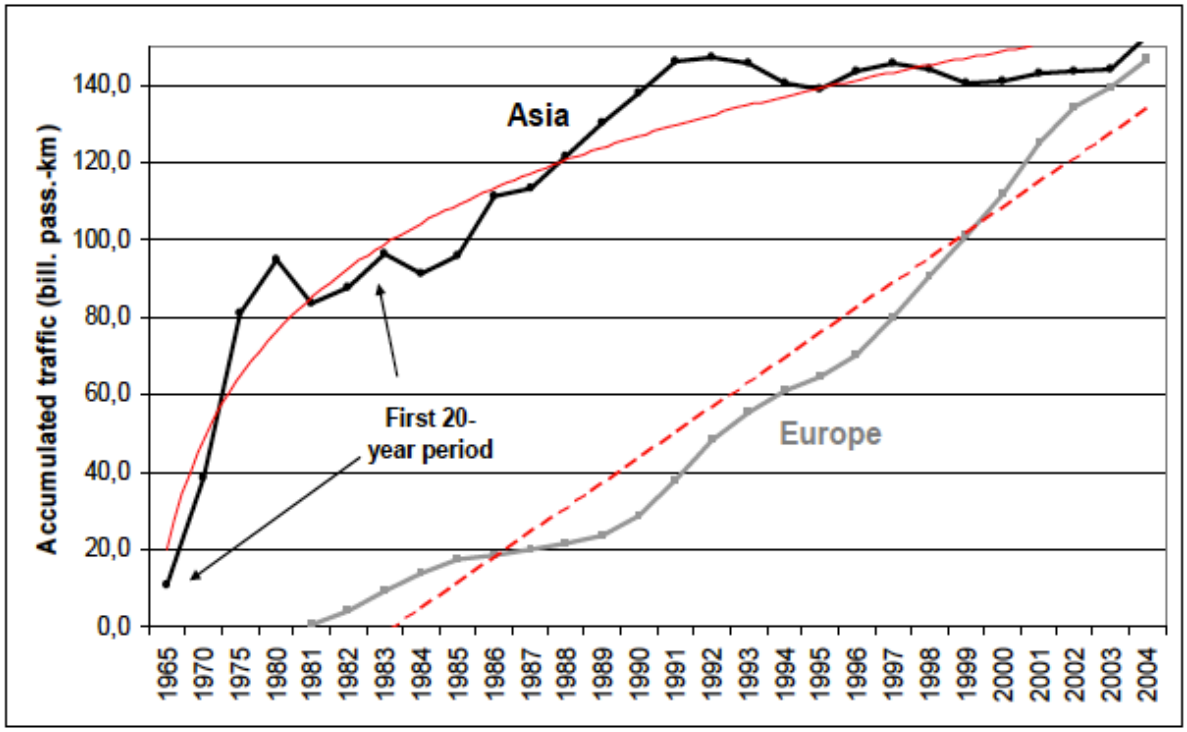

Fig. 2.2.2 Evolution of accumulated ridership: Asia vs. Europe
Source: UIC and MPRA, 2007.

- High Speed System in Europe Area (2010 and 2025). See Fig. 2.2.3 and Fig. 2.2.4.
- Potential High Speed System in Americas (United States and Brazil). See Fig. 2.2.5 and Fig. 2.2.6.

- Potential High Speed System in Asia (Taiwan, South Korea, China, Japan, India, Middle East) Fig. 2.2.7, Fig. 2.2.8, Fig. 2.2.9, Fig. 2.2.10.

Fig. 2.2.3 High Speed Rail System in Europe Area by 2010
Source: UIC, HSR – Fast Track to Sustainable Mobility

Fig. 2.2.4 High Speed Rail System in Europe Area by 2025
Source: UIC, HSR – Fast Track to Sustainable Mobility

Fig. 2.2.5 High Speed System in America

Source: UIC, HSR – Fast Track to Sustainable Mobility

Fig. 2.2.6 High Speed System in Brazil

Source: UIC, HSR – Fast Track to Sustainable Mobility

Fig. 2.2.7 High Speed System in Asia

Source: UIC, HSR – Fast Track to Sustainable Mobility

Fig. 2.2.8 High Speed System in Japan

Source: UIC, HSR – Fast Track to Sustainable Mobility

Fig. 2.2.9 High Speed System in India
Source: UIC, HSR – Fast Track to Sustainable Mobility

Fig. 2.2.10 High Speed System in Middle East
Source: UIC, HSR – Fast Track to Sustainable Mobility

2.3 Advantages of High Speed Rail

2.3.1 Better Sustainability = Environment + Economy + Social

Nowadays, High Speed Rail has become a transportation trend that provides high speed, high capacity and low pollution services. The energy efficiency of High Speed Train in comparison to airplane is 1 to 4 in favor to the High Speed Train and 1 to 9 in comparison to private cars, if we compare the CO2 emission, High Speed train is about 1/4 of airplane and 1/6 of private car (See Fig. 2.3.1)

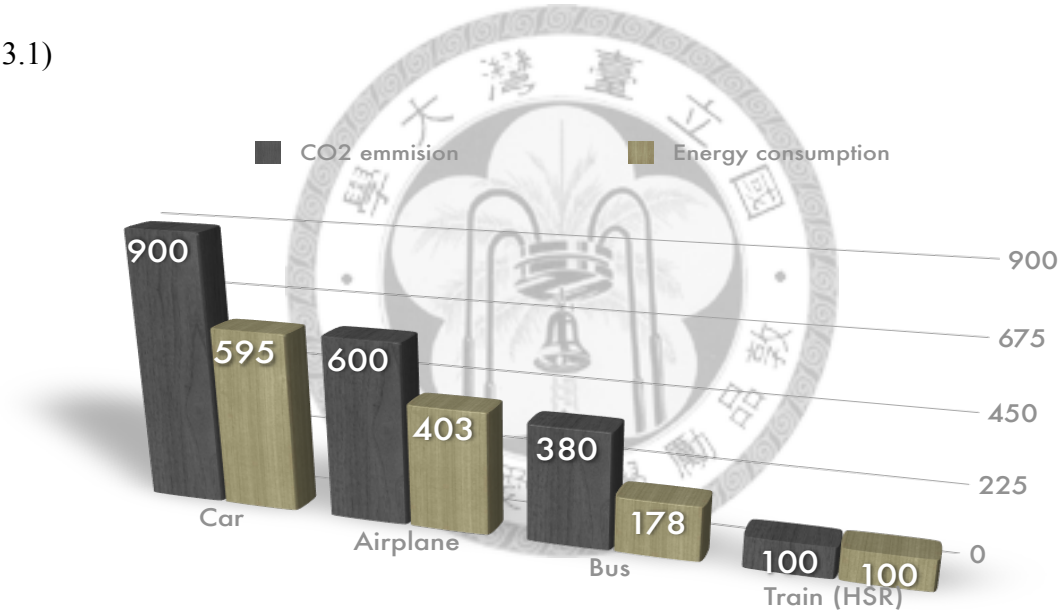

Fig. 2.3.1 Energy efficiency and CO2 emission comparison of various transportation modes
Source: Organized by this study.

2.3.2 Less Land Use

The high-speed rail is a highly efficient transportation, in comparison with the traditional motorway, the land needed for the high-speed rail lines are much reduced. As an example, based on

same capacity, an average motorway uses 9.3ha/km while the high-speed rail line uses 3.2ha/km. (See Fig. 2.3.2)

2.3.3 Higher Safety

Across the high-speed rail planning and construction stage, the numbers are calculated with high safety factors to ensure the safe ride of the train in different extreme weather or natural hazards conditions, as to earthquakes, cross wind and extreme climate conditions such as snow, cold weather, typhoons, etc. Notwithstanding the external conditions the high-speed rail has maintained an excellent safety record. No fatal accident on high-speed lines since the first introduction on the high-speed rail (UIC, 2010). This safety record is on account of the prudence of the operations. The main scope of the technicians is to perform safe train management, avoid any collisions and/or accidents.

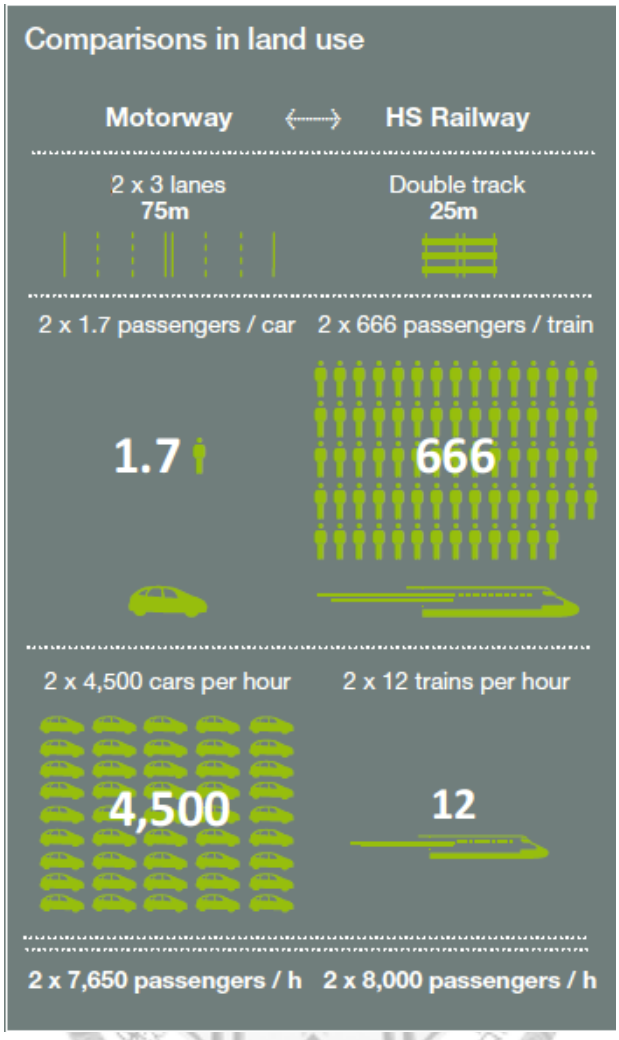

Fig. 2.3.2 Comparison in Land Use

Source: UIC, HSR – Fast Track to Sustainable Mobility

Comparison: HSR vs. Airplane

According to the International Union of Railways, High Speed Rail is considered as an infrastructure for new lines designed for speeds above 250 km/h, and upgraded lines for speeds up to 200 or even 220 km/h. Although today it runs at a maximum speed of 350km/h for conventional High Speed Rail and 431km/h for Maglev trains, the world record for conventional High Speed Rail is held by France's V150 with a speed of 574.8 km/h on a test run, competing in speed and

travel time with airplanes.

Speed

Airplanes can travel at great speed, no one would doubt about that, and we know that we are only limited by the speed of sound (around1250km/h), therefore we can conclude that there will be a top limit of roughly 1000km/h for aircrafts. However, commercial airplanes usually travel at a speed of 500km/h to 800km/h, depending of how much fuel it consumes. Trains, however, travel at a maximum speed of 400km/h. The number is considerably less than the airplane, so how can we be sure that high-speed trains can compete?

Accessibility

Think that you are going to travel from your city to anywhere else by plane, you have to arrange a car or ask for shuttle bus to take you to the airport because the airport are not usually in city centers, then, for international flights you have to get there two hours before departure to check in, pass through the security check and wait in your gate for your plane to settle down. Luckily if there is no heavy rains, fog or typhoons, you may be in the air more or less on time, depending on how much delay it took the crews to check the airplane. Later, when you get to your destination, repeat same procedures, get your luggage and take a taxi to the city center.

Surely you are familiar with all the checking and inconveniences. Aircrafts have crucial disadvantages, although once in the air it can travel with very high speed, it takes long time to

arrange everything.

First, Airports are usually out of town. This is because the need several square miles. Travelers, to get to the airport faces a journey too, usually 30 min of transportation to get them to the airport. But for historical reasons, trains stations are usually in the center of cities, even if there is not enough space for a train station, underground stations can be built, hence journey time to and from stations is much less than to airports.

Second, airports have a lot of standard procedures requirements such as check-in, leaving your baggage, provide thickets all the time, and people are usually asked to arrive are the airport early. But this will never happen with trains, one can just book the ticket at home and walk onto the train right after he finds the correct platform. Luggage will be with you during the journey and the immigration and passport control can be cone on board too.

Capacity

As trains are designed for high capacity, it has four doors per car to facilitate passengers in and out. While it takes the airplane15 min to load 400 passengers, it only takes 2-3mins for trains. Also, planes cannot leave immediately, while trains can. When airplanes are ready to go, it still has to spend a lot of time taxiing. And at busy airports such as Los Angeles LAX, the airplane has to wait for clearance to take off, the same happen when you land, airplanes usually spend time circling around the airport and worse cases have to wait until gate becomes free. In addition, high-speed rail

in comparison to airplanes and other transportation modes are more susceptible to heavy rain, fog and other weather factors.

Energy Saving

High-speed trains are energy saving. They have air resistance, but airplane relies on air resistance to stay in the air, which in comparison have more air resistance than trains. In other hand, airplanes uses fuel to run its huge engines, where noise, heat, wind come out of the engines as wasted energy and only 10% of the energy makes the plane go, but for trains, 40% to 60% of the energy goes into making it go.

Environmentally friendly

As mentioned before, electrically powered trains don't produce carbon emissions, and conventional trains still have lower emissions comparing to airplanes in the base of distance and passengers. Although we still need the electricity to be generated, the energy efficiency is really high. It produces noises just as aircrafts do, however more importantly, 98% of the noise produced by high-speed rail can be cutout by placing sound barriers.

One thing we are sure of is that the transportation mode that uses oil, such as cars, will always pollute our environment. Although scientists are trying very hard to improve the efficiency of our daily transportation, trains are evolving at the same time at even higher speeds.

2.4 HSR exploitation models

With all the differences of the types of power, we can suggest that one of the relevant roles in the economic definition of high-speed service is the relationship of HSR with the existing conventional services. We can summarize them into four different exploitation models, as shown in Fig. 2.4.1.

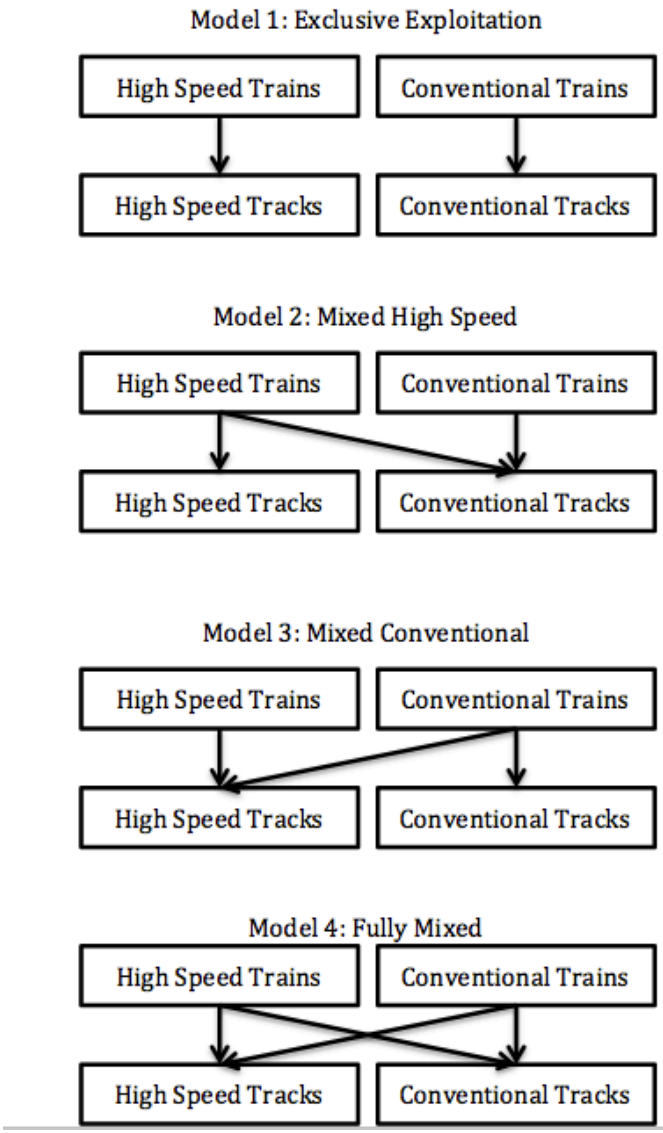

Fig. 2.4.1 HSR models according to relationship with conventional services

Source: MPRA, 2007

The *exclusive exploitation model* is characterized by a complete separation between high-speed services and conventional services. Each one has its own infrastructure and system. This is the model adopted by the Japanese Shinkansen. The major advantage of this model is that the market organization of both HSR and conventional services are fully independent. (Campos. 2007)

France adopted the *mixed high-speed model*. In this model the high-speed trains can run either on specifically built new lines or on upgraded segments of conventional lines. The main advantage of this model is that it can reduce significantly building costs. (Campos, 2007)

The mixed conventional model has been adopted by Spain's AVE (Alta Velocidad Española). This is the case where some conventional trains run on high-speed lines. To facilitate the interoperability of international services, a specific adaptive technology for rolling stock was developed in 1942 (i.e. the TALGO trains). The advantage of this model is the saving of rolling stock acquisition and maintenance costs and the flexibility for providing intermediate high-speed services on certain routes. (Campos, 2007)

The fully mixed model allows for the maximum flexibility, this is the case where both high-speed service and conventional service can run at their corresponding speeds on each type of infrastructure. Adopted by the German intercity trains (ICE) and the Rome-Florence line in Italy. The advantage of this model is the wider use of infrastructure, but at the same time high maintenance costs. (Campos, 2007)

The decision for the exploitation model will affect the cost of building a new infrastructure versus the cost of upgrading the conventional network. The definition of HSR immediately becomes not only a technical question but also an economic one. Therefore additional factors such as decision of technical characteristics, public support, demand, etc. should also be considered.

2.5 Costs of HSR

The costs involved in a HSR project can be mainly divided into infrastructure costs, operating services costs and external costs.

Building new HSR infrastructure requires specific design. It requires precise technical support in order to provide services above 250-300 km/h. These technical restrictions basically include roadway level crossing, frequent stops or sharp curves unfitted for higher speeds, signaling mechanisms and powerful electrification systems, etc.

According to a report from UIC, building new HSR infrastructure involves three major types of costs: planning and land costs, infrastructure building costs and superstructure costs. Once the infrastructure has been built, the operation of HSR services involves two types of costs: exploitation and maintenance of the infrastructure itself and those related to the provision of transport services using that infrastructure. The external costs of HSR includes environmental costs, it cannot be neglected due to the land take, barrier effects, visual intrusion, noise, air pollution and contribution to global warming. However in comparison to other modes, the deviation of traffic

from air and road to rail increases efficiency if HSR has lower external effects. (Campos, 2007)

2.6 Future of HSR

The HSR is currently considered as one of the most significant technological breakthroughs in the 20th and 21st century. Due to its lower travel time and high quality transportation, the worldwide rail network is devoted to possess and provide high-speed rail services. (MPRA, 2007) Many countries had used the HSR for years, and many are either constructing or planning their first high speed line. Therefore future high-speed rail and train development is dedicated in new technical breakthroughs, such as: (Kao, 2010)

- Faster trains – Newer and faster trains are experimented and being built, these trains are able to test run at speed close to 600km/h and provide service at close to 400km/h.
- Greener trains – Scientists are trying newer generations of trains that works totally with sustainable energy such as wind and solar.
- Interoperability – The unification of specifications for high-speed rail operating in Asian and European countries.
- Intermodal transportation – Better integration of new vehicles with all existing system and form a more efficient transportation system.

For the ERTMS (European Rail Traffic Management System), the main goals are: Interoperability, Safety, Capacity, Availability, Cost-effectiveness, less on-board equipment and

Open market.

The future of the transportation system will be more efficient if we can combine all the air, high-speed rail, metro and cars. The success and failure of the high-speed rail project depends on many factors, which means building a fast train is easy, but building tracks good enough to allow the train to run safely and smoothly at high speed is a challenge. The high-speed rail is a high-tech system, besides trains reaching standard speed requirement, the train car, the track line and the signaling system must be closely interconnected and tested.

2.7 Summary

During the past 40 years, the HSR was considered as the most potential transportation tool for the future. It was first developed by Japan, followed by many European countries. The success of these countries and the advantages the HSR caused the HSR boom in Europe and Asia. Nowadays there are 13 countries with HSR in operation.

The evolution and demand for faster and safer transportation has been raising in the world, and therefore, many countries such as America, India, Brazil, and the Middle East have already proposed their vision for HSR in their countries. This evolution of the HSR leads us closer to the vision of Global Village, where frontiers are blurred by the HSR lines and via the HSR network we hope to create a harmonic relation between human and the Earth.

Advantages of HSR are numerous, especially when the today global warming issue, the HSR

seems to be the solution to human's dependence of cars and airplanes. However, different HSR exploitation modes vary the investment cost of the HSR projects. These modes have its own advantages and disadvantages, and defer in costs and construction. The cost of building new HSR infrastructure involves planning and land costs, infrastructure building costs and superstructure costs. After the completion of the HSR line there are operating and external costs involved.

The funding is an essential issue in HSR projects. From experiences of HSR development around the world, we can identify many challenges during the HSR project life cycle, but money is what we should be more concerned about. Therefore, in the following chapter alternative financing will be introduced.

Chapter 3 Introduction to Alternative Financing

3.1 Literature Review

PPP is the acronym of "Public Private Partnership," also called "Private Participation in Infrastructure." The most commonly known and used PPP type is the "Built-Operate-Transfer" (BOT). In this kind of government-private participation projects, private companies usually can receive a concession from the public or private sector to finance, design, construct, operate and profit from a facility in the concession contract. Because it is called "Build-Operate-Transfer," when the contract expires, the operating company will transfer at no cost to those who grant the concession, who usually is the government.

Factors for the search of alternative finance:

- Continued population and economic growth that leads to the need for more infrastructures.
- Country's debt crisis.
- International contracting firms with downturns in business looks for alternative ways to promote projects.
- Competition for global market.

Traditionally, a state's new infrastructures in industrialized countries or less developed countries are funded by their state's fiscal sources, sovereign borrowings or using bond instruments.

But for developing countries, that often get financial support from international financial organizations such as World Bank, IMF, etc., might not be able to support large projects such as high-speed rail, tend to adopt the PPP or BOT method.

PPP is commonly used for infrastructure facilities, such as: (Fight, 2005)

1. Roads, bridges, tunnels and relevant utilities and facilities;
2. Railways and tramways;
3. Airports, seaports, river-ports, and ferry-landings;
4. Water plants, drainage systems and waste or sewage treatment systems;
5. Power plants; power transmission lines;
6. Other infrastructure facilities as decided by the Prime Minister.

According to the World Bank, there are many PPP types that can be classified as: Management and Lease Contracts, Concessions (including ROT, RLT and BROT), Greenfield Projects[1] (including BLT, BOT and BOO) and Full/Partial Diversities. (MTI, 2006)

Depending on specific PPP projects, the principal parties may vary. For example, a BOT project typically has following parties (Fig. 3.1.1). And it evolves through different stages (Sapte, 1997) (Fig. 3.1.2)

[1] Greenfield is a project that lacks any constraints imposed by prior work. The image is that of construction on greenfield land, where there is no need to remodel or demolish an existing structure.

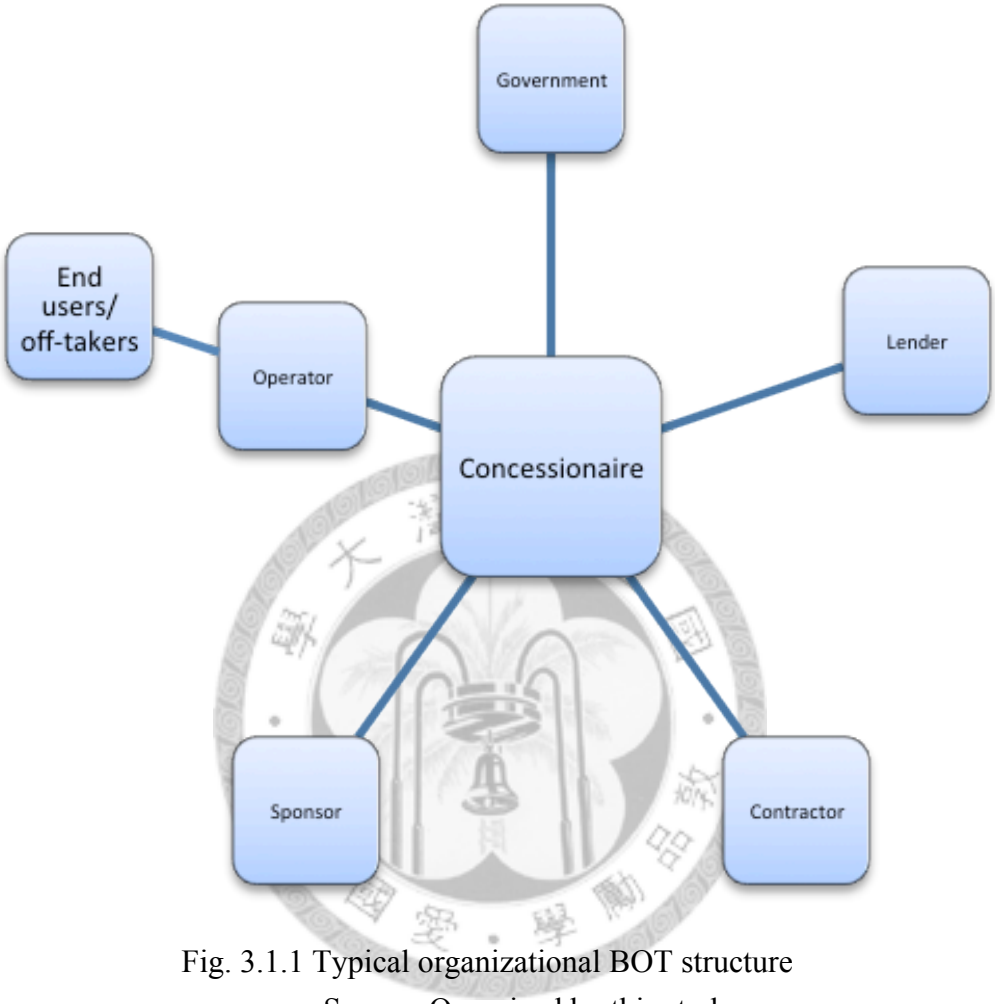

Fig. 3.1.1 Typical organizational BOT structure

Source: Organized by this study

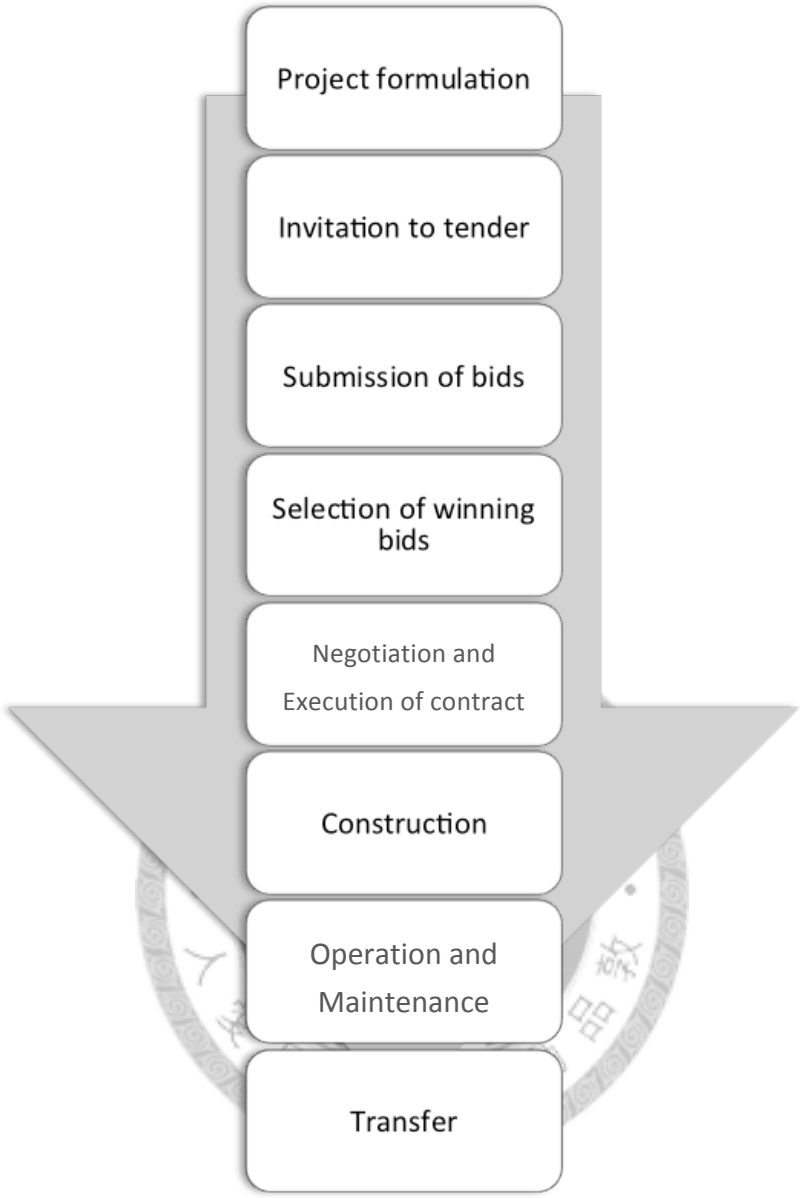

Fig. 3.1.2 Typical stages of PPP project
Source: Organized by this study

The following table shows the main advantages and disadvantages for the government, the citizen, the PPP consortium and the host country when involved in a PPP or BOT type projects. (See Table 3.1.1)

Table 3.1.1 Advantages and disadvantages of PPP

	Advantages	Disadvantages
For the host government	1. Can obtain an important public facility at little or no cost to taxpayers. (Levy 1996) 2. Low or absent risk for finance, construction and maintenance. 3. Faster construction process. 4. High facility quality.	1. Takes time to evolve and careful analysis in all part because of the complication of the project. 2. Complex and extensive documentation that normally requires lengthy negotiation. 3. May have to provide financial incentives to encourage participation. 4. Equity contributions, loss of control of Special Purpose Vehicle (SPV), Forecasting, Risks, etc.
For citizen and the host country	1. Don't have to pay taxes for new infrastructure projects.	
For the PPP consortium	1. Mega infrastructure projects not usually obtained. 2. During the construction stage, the consortium members can get profits from the project. (Levy 1996) 3. By purchasing land next to the project, the consortium members can increase land value and benefit from it.	

To implement a successful PPP it requires: (Fight, 2005)

- Political support: The political support with respective and complete policy is important for the private sector.
- Enabling legislation: PPP projects need to be supported with firmly embedded legislation in the legal structure of the host country.

- Expertise: required for both public and private sectors.
- Project prioritization: the government should identify the prioritized sectors and undertake a detailed review of the viability of the project.
- Heavy deal flow and standardization: to recognize possible risks.

3.2 Build Operate and Transfer

The Built-Operate and Transfer (BOT) is called for public-private joint venture or a private entity builds and operates a new facility for the period specified in the project contract. By the end of the concession period, the facility will return to the public sector.

These kinds of projects are called in general "Greenfield Projects," where can be classified under the following categories:

- BLT (Build, Lease and Transfer): The private sector builds a new facility at its own risk, after the completion of the project, the private sector transfers the ownership to the government, leases the facility from the government and operates it at its own risk until the expiry of the lease, and transfer back to the government.
- BOT (Build, Operate and Transfer): The private sector builds and operates the facility at its own risk, and then transfer back the facility to the government at the end of the concession period. The private sector may or may not have the ownership of the assets during the contract period depending on the case.

•BOO (Build, Own and Operate): The private sector builds, owns and operates the facility at its own risk.

Following table shows the classification of different types of privatization models. (Table 3.2.1)

Table 3.2.1 Classification of different types of privatization models

Model	Option	Capital Investment	Operation and Maintenance	Asset Ownership
Privatization	Divestiture and BOO	Private	Private	Private or Public and Private
Concession	BOOT/BOT/DBFO	Private	Private	Private or Public and Private
	Concession	Private	Private	Public
	Lease	Private	Private	Public
Operation and Maintenance	Management Contract	Public	Private	Public
	Service Contract	Public	Public and Private	Public

(Source: Jones, 2001)

Taiwan, with the need of a HSR line to release its traffic congestion problem but with financial difficulties, is the first country to implement BOT to a High Speed Rail project, which it is until now one of the largest BOT transportation project in the world.

3.3 Summary

The alternative financing is a way for the private sector to play a dynamic role in accelerating a country's growth and development. Decades before, countries already encouraged private sector involvement and attracted new money into new projects. The private sector is considered capable to

implement projects and in a shorter project period, more efficiently.

The concept of alternative financing had been used diversely in construction projects, such as transportation, energy power stations, water-treatment plants or health care centers, etc. It is commonly called the Private-Public Partnership (PPP), which is categorized in different models with differences in the involved parties and contract duties.

The Taiwan high Speed Rail's project adopted alternative financing to reduce the government financial burden and to solve the domestic traffic problem. This combination of alternative financing and high-speed rail is the first and only in the world, therefore without previous examples, the THSR project's experience and lessons learned can be considered as high value experience and as a basis for other future high-speed rail projects.

Chapter 4 Taiwan High Speed Rail

4.1 Literature Review

Taiwan High Speed Rail is in operation for more than 4 years, since the beginning of the project, there had been many controversies, good and bad voices. However, despite of the negativities, we still cannot deny that it brought to the Taiwanese people comfort and efficiency.

The Executive Yuan of Taiwan approved the High Speed Rail line in 1992 and included it to the twelve major national constructions in 1994 to reduce the increasingly heavy government public spending. Same year, the "Statute for Encouragement of Private Participation in Transportation Infrastructure" Act was approved, so the Ministry of Transportation and Communications officially announced the contents of the plan to invite private sectors to participate in the validation. In May 1998, the Taiwan High Speed Rail Consortium (THSRC) signed a 35 years plan build-operate contract and 50 year of station area development concession contract. (Liu and Hsu, 2009)

The total fund including draw interest, according to the Bureau of High Speed Rail, was a total of 513.3 billion New Taiwanese Dollars (NTD); which 105.7 billion NTD was budget of the government to acquire land and development matters. The private sector raised 407.6 billion NTD, which contains 127.6 billion NTD of equity and 280 billion NTD of financing. The government also budgeted 39.6 billion NTD to build and develop planned High Speed Rail Areas.

The Taiwan High Speed Rail BOT project; during its planning, execution and operation stages; was the center of the attention of the world, therefore disputes were inevitable. Disputes were mainly center on whether the government should invest in this project provide guarantee, the financial team did not actively participate the validation process, contractual issues, risk-sharing issues and others.

In the case of Taiwan governments, the origin objective of implementing the THSR project as BOT scheme was successful, but some of the key factors in the project process triggered issues and disputes, they also brought up the impact of the implementation of a BOT case, such as bidding problem in BOT projects, contracts should be more precise and detailed, interest depreciation and amortization of financing should be reasonably calculated, and so on. BOT is indeed for governments to address public work's budget approach, and the experience of the above can be used as the implementation for Taiwan's similar cases or for other countries trying to use BOT for their High Speed Rail plans. (Liu and Hsu, 2009)

4.2 Introduction of THSR's BOT

4.2.1 Background

Under the growing shortage of government revenue, the Taiwan government still needs to build all kinds of public construction and social welfare facilities, but at the time the state had

increasingly heavy financial burden, causing bottlenecks and losses in the government's construction and operation of public facilities. The government therefore hopes to introduce private sector capital, technology and operational efficiency, the promotion of BOT was what the government vigorously wanted to adopt.

Therefore, the Taiwan High Speed Rail (THSR) project, under the principle of "No increase of government burden," adopted the traditional model of public works undertaken by the government's construction policy and allowing private participation in the investment in the construction of THSR by the BOT model. (Ho, 2008)

The government's original 345 km railway planned an amount of project funding of 426.6 billion New Taiwan Dollars (NTD), of which financial resources from the government non-self-liquidating takes part of 54.9% (234.2 billion NTD), and 54.1% (192.4 billion NTD) for the compensation part, which is enforced with the private participation method.

However, in 1993, the government construction budget was rejected in the Taiwan Legislative Yuan, therefore the change of the policy to seek for private participation in investment and construction. At the same time, with such a policy change and the need to promote for follow-up BOT projects, the government gradually introduced legislations and established "Statute for Encouragement of Private Participation in Transportation Infrastructure Projects" (The Encouragement Statute) in order to promote and facilitate the progress of future private participation in infrastructure projects. THSR project is the first case in the history of the country

with BOT in transportation infrastructure, and one of the largest transportation constructions in the world at the same time. (Liao, 2008)

According to Bureau of High Speed Rail the Taiwan High Speed Rail Authority and the Taiwan High Speed Rail Company (THSRC), at the time of the THSR project was officially decided, the total expenses, including funds and draw interest was a total of 513.3 billion NTD, of which 105.7 billion NTD is allocated by the government for land acquisition and development matters. What is left (407.6 billion NTD) was responsibility of the private concessionaire company for equity financing and station adjacent area development and road connection planning. (Feng, 1995)

4.2.2 Why did the government choose to implement BOT?

1. Reduce government's fiscal burden:

In the past, the government budget usually comes from releasing bonds or budgeting to construct public infrastructure, producing heavy financial burden to the government. As the THSR project is decided to carry on with the BOT model, the government then can use private funds to implement this huge project, allowing the government switch its limited budget to other low-income or private sector' less interested project.

2. Share the investment risk with the private sector:

To construct a high-speed line requires large amount of investment, and its construction involves long period and slow cost recovery, therefore it implies that in the construction and operation stage of an high-speed rail project it is more risky, such as increase of cost because of delay and initial operating losses and so on. If the government is responsible for the construction, then the risk will go to the government; but also after the introduction of BOT, not only the government reduced its financial burden, but also part of the investment risk was transferred and shared to the private sector.

3. Governmental departments are less efficient:

The efficiency of governmental department to build and operate the public works usually has negative impressions for the people, and its operating losses and poor management often resulted in criticism. The THSR project construction time is very long, if we adopt the BOT model, through private participation and introducing free competition and efficient construction concepts, the government then can acquire private sectors flexible operation modes and management efficiency, enhancing public works quality, efficiency and speed up the project progress.

4. Use private sector's funding for national development:

During the construction of HSR, it is expected an expansion of domestic demand and it can

also promote economic prosperity, such as driven the raw material's market, providing large number of labor force development opportunities, etc. During the operation stage, it is expected to drive regional development, increase total tax revenue, also to increase land values.

Combined above analysis, the government changed the construction approach of THSR case to BOT, to build the HSR with the capital and the technology of the private sector. In the hope to achieve three win-win situations; the government can reduce the burden and accelerate the construction to facilitate and advantage the citizens, and the private institution can get revenue and experience.

4.2.3 How did the government plan the BOT?

The case of THSR has experienced rather long planning stage. Since 1993 to the official opening in 2007, it has been over 14 years. From the decision to build the project in the hand of the private sector to finally get into the stage of operation.

Before the decision of BOT, the government already carried out some studies such as reconnaissance surveys, comprehensive planning, the ridership forecasting, environmental impact estimations, and subsequent decision to remove the previous budget and to promote the BOT, develop the Encouragement Statute, review and approve the re-budgeting, detailed design, land acquisition, soliciting private investment - invitation to tender and other consideration and

screening procedures. Finally in July 23rd, 1998. The "Construction and Operation Agreement" for a concession period of 35 years, and the "Station Area Development Agreement" for a concession of 50 years was signed.

The total funding for the HSR project was expected to be 431.6 billion NTD, of which 105.7 billion was government's fund for land acquisition and for the construction, supervision and management of the Taipei underground construction; in the other hand, the Taiwan High Speed Rail Company (THSRC) has to invest 325.9 billion NTD (excluding interest), responsible for road construction, railway stations, core mechanical and electrical systems, rail, base maintenance, engineering design and construction, procurement, installation, system integration, testing, operation and maintenance work. (Wu, 2006)

The THSR project was the first domestic engineering project of private participation in major public construction to invest in BOT; it was also the international attention of transportation projects. The Bureau of Taiwan High Speed Rail is responsible for the administration of this project. During the project's implementation, there were many innovative practices and relevant supporting initiatives. The summary of how the government promoted the process of THSR in BOT will be explained as follows.

1. The government formulated regulations as the Encouragement Statute to meet the necessity of the THSR BOT case:

To ascertain that such a huge BOT project will eventually be successful, the Ministry of Transportation developed the Encouragement Statute and sent for review to the Legislative Yuan. The Encouragement Statute was promulgates in December 1994, and it was the basis for the Taiwan High Speed Rail investment and construction of private participation. By January 30th, 1995 the legislature vote on the HSR plan and admitted with a condition that the private sector's investment has to be at least or above 40%. (HSR Authority)

2. Former preparation works of the government in the HSR BOT case:

When the government announced to invite private investment, they have already completed the high-speed line setting, bridges, land and infrastructure, tunnels, landscape, drainage, soil and water conservation, environmental protection, construction coordination in the preliminary engineering design, land abandon and raw material investigation work. The design was used by the Taiwan Ministry of Transportation to calculate the fund for the project and also to provide the information as great help to the qualified applicants. (Wu, 2006)

3. Investor selection plan and the evaluation process of the case of THSR (Cheng, 2000):

Following the adoption of HSR budget agreement, the government began to handle pre-construction works such as zoning changes and land acquisition. The involvement from part of the private sector was to participate the explanation, help by investment instructions held by the

government, about the project investment, and to determine the private sector willingness to invest.

After the private sector showed interest for the project, the government then proceeded with the selection process for the concessionaire companies. The concessionaire companies selection process was divided into two stages: the first stage, review the companies capital or revenue to confirm the companies' operating capacity; the second stage was to inspect the viability of the proposed business plan proposed by the concessionaire companies.

Before going on to the second stage, the government must execute the "parallel consultation" process, which means that the government will gather together firms evaluated in the first stage and consult with them about the concession contract's common terms, specially, the scope of the companies investments, concession period and to make sure the evaluation for the final bid winner was based on the same basis.

As for the second stage's review, it can be divided into formal review, technical review, and integrated review. The formal review is to identify and make sure the consortium companies meet the proposed investment projects procedural requirements; the technical review is teamed by experts from experts to execute the confirmation of concessionaire's project plan, financial planning and risk management feasibility; the integrated review is represented by the committee formed by the government representatives and business representatives to evaluate from the political aspect the feasibility of the investment plan. In the second phase of the review, the winner of the bid have priority for negotiate for the negotiation right, who did not win the bid comes

second. If the winning tenderer cannot sign the concession contract within a certain period, then a parallel negotiation will be executed, that is, the government can negotiate with two companies about the contract, to decide the most favorable contractual terms for the government.

In February 1997. Both China High Speed Rail company and Taiwan High speed Rail company won the first stage review, afterward in the second stage of the parallel negotiation process, both companies agreed the 35 years concessionaire period and plan the project with the biggest scope and investment plan possible. As for the government, stuck to the principle of "Minimum government expenditure" and "Government most beneficial" as the selection criteria, and meanwhile also considered about the obligation from part of the government take responsibilities about the pipeline relocation, disposal areas set up to exclude environmental protests and the obligation to ensure the ridership guarantee, whether the government should pay for the premium, introduction of foreign labor debate and the matter of sharing risk factors.

The original plan was, in the end of August after the companies presented their investment proposal, the government will have three months to review the proposal The winner of the bid was supposed to reveal by the end of November. However, after beginning the review process, the government in order to avoid pressure of the selected committee, revealed the winner of the bid by September 25th, which implies that the review process was held for less than a month.

The final bid winner was the Taiwan High Speed Rail Company (THSRC) with a total investment of 336.6 billion NTD, and -105.7 billion NTD for part of the government's investment.

It not only implied that the calculated investment by the government (105.7 billion TND) could now be cut down to 0 (zero), also it claimed that the government could get back the expenditure that the government spent before. China High Speed Rail Company, at knowing the government expenditure was proposed to be negative, also suggested that its proposal could be changed and the number could also be cut to zero, but this claim was not accepted by the government.

Subsequently, CHSRC raised question about the well execution of the selection process, and that the selection between two parties was under inconsistence basis, that is, both for the ridership estimation, station development effectiveness, changes in exchange rates and interest and other matters were predicted according to different risk estimation: the THSRC took optimistic stance while CHSRC took conservative stance, therefore the CHSRC proposed more than 100 billion NTD of project construction reserves, and the THSRC did not propose any construction reserve. The estimation of the HSR station development benefit from part of the CHSRC was about 19.7 billion NTD and from THSRC was 63.3 billion NTD.

If CHSRC's proposal was expected to take the optimistic risk consideration, and do not include any project construction reserve, then the CHSRC can also propose a number as low as the THSRC's. In addition, at the time of the parallel consultation process, the government had mentioned that the companies need not to pay a premium for the government, but the THSRC, at the tender stage still calculated a 10% of the operating income as the premium for the government each year. Within the same time, there were different voices in the Bureau of Taiwan High Speed

Rail, about whether the government can offer a negative number? What's the legal nature of the amount 105.7 billion NTD? Nevertheless, the Taiwan Ministry of Transportation still considered THSRC as its best applicant for the concessionaire company.

4. The negotiation operation about the contract and government responsibilities between the Taiwan Ministry of Transportation and the THSRC; (Lin, 2000)

In the contract negotiation, the THSRC presented 149.5 billion NTD of project reserve, and excluded the case of rapid exchange rate movements from the contract, though if this happens, the THSRC will have an extension in the concession period or tax reduction and other means to obtain compensation. Besides, in the investment announcement, the electrical and mechanical system must be selected as the reference system, the concessionaire companies still have to take account of commercial considerations and select the most suitable mechanical and electrical system. Finally, the Taiwan Ministry of Transportation within its term of reference of the government responsibilities agreed to sign a contract of "Government Commitment for Responsible Assistance". The Ministry of Transportation has obligation within these responsibilities, and if violate will have to take responsibility; besides of the government responsibilities, they signed a "Government Commitment to Help" contract, where the Ministry has obligations of coordinating the authority, but if negotiation fails, it is excepted by the contract and does not need to be responsible of non-performing.

5. As to the case of THSR, the Ministry of Transportation, THSRC and the financing banks executed the financing operations: (Lin, 2000 and Zheng, 2000)

According to the original financial planning of the Taiwan High Speed Rail Union, nearly a total of 400 billion NTD, 280 billion NTD of funding was expected to obtain from bank loans, of which 210 billion NTD intended from domestic commercial bank loans, while more than 7 billion NTD from foreign loan input. Soon after occurred the Southeast Asian financial crisis that caused exchange ate instability. Due to the crisis, the Union had to assume greater exchange rate risk, so they amend the financial plan hoping to raise at least 280 billion NTD from domestic financial institutions.

At first the three leading syndicated loan banks (Bank of Communications, The International Commercial Bank of China and Bank of Taiwan) were frightened by this large financing amount, and other banks showed no interest in participating in loans.

With the financial difficulty, the THSRC asked the government to come forward and assist them in obtaining financing. However the Ministry of Transportation proposed that the financing was not responsibility and duty of the Government, therefore the government will not assist THSRC to obtain financing loans. The government in order to avoid the THSRC to get excuses and exercise the right of termination, agreed at last. The government agreed that the THSR Union could obtain funds through the Council's "Long-term Approach Funds Act". For exchange, the THSRC

abandoned its right of Contract Termination.

Since the chapter 16 of the high-speed rail operation contract has an optional force buying mechanism (later became an obligation clause). When the construction operation is terminated, THSRC should submit files to the Bureau of High Speed Rail and later to the Ministry of Transportation for buying worthy and usable operating and under construction assets. As the mechanism puts the government in a risky position, the Ministry of Transportation together with the Bureau of Taiwan High Speed Rail and the financial banks preceded a three-party consultation consortium. The Ministry of Transportation declared that the amount of the commitment is higher than the THSRC's credit balance. Troubles in defining an acceptable solution caused the financing banks to have troubles in fully lock its credit risk.

The situation wasn't solved until August 1999. The government was in charge to formulate the necessary expenses, damages and interest deduction limits, so that after the deduction the force buying mechanism amount will not be less than the credit limit.

With the government approval and formulations, the government showed its determination and promises to the public. Banks that was not interested in financing supports now shows high interests; therefore by February 2000 THSRC together with 25 alliance loan bank executed a joint credit contract and confirmed 323.3 billion NTD of alternative finance project. This financing plan is the biggest in amount in the history of Taiwan's financing projects.

Set down the financing source, the THSRC then began the selection of electromechanical

system. Although the European system was initially selected, nevertheless, THSRC executed again the electromechanical system tender process to select the Japanese system as the core system supplier.

6. The construction of THSR BOT case: (Control Yuan, 2009)

In July 1998, the government signed the "Construction of Operation Contract" with the THSRC. The government investment was 105.7 billion NTD for the 345km lad acquisition project from Taipei to Kaohsiung and the Taipei underground construction supervision and management. The THSRC was in charge of the design of the HSR line and invested about 407.6 billion NTD.

The construction of the Taiwan High Speed Rail project includes:

- Full range of civil engineering planning, design and construction;
- Track line, electrical and mechanical systems, maintenance base, station design and construction planning;
- Taipei city (NanGang – BanCiao) underground railway line civil engineering changes;
- Necessary changes of the Taipei Main Station.

According to the statistics results of the THSRC in June 2009, the total funding for the construction was about 449.7 billion NTD. In the future, the THSRC will continue it's investment according to the contract, execute construction in MiaoLi, ChangHua, YunLin, the electromechanical systems from Zongsan to HsiChih, HsiChih base project, etc. more than 23

hectares of commercial land development. Gradually reach the full feature of the Taiwan high-speed rail western corridor.

The THSRC since august 2007, after the completion of land delivery, has accelerated the design and investment operations. However due to the population growth and urban development was not as expected, consequently affected the will of vendors participation and investments.

7. The operation works of the THSR BOT project: (Control Yuan, 2009 and Central News Agency, 2010)

The THSRC and the Ministry of Transportation signed the "HSR construction and operation contract" in 1998, and obtained franchise rights for 35 years (including construction period), which has to be returned to the government without compensation by year 2033. In other words, discounting 9 years of construction time, the THSRC must recover 480 billion NTD investment during the 26 years left and also make profit.

From 2007, January 5th the opening of the THSR line, 38 two-way trains travel trips a day, with 26000 passengers daily, the THSR had rapid ridership growth. In 2009, the highest daily frequency was 134 two-way trains per day, and the average daily transport was about 80 thousand to 90 thousand people per day. According to the THSRC 2009 annual report, it shows revenue of 233.2 billion NTD, with slight growth of 1.2% comparing to year 2008.

The depreciation method recently changed from linear method to ridership percentage method.

This helped THSRC to get gross profit of 65.5 billion NTD and net profit of 55.6 billion NTD in year 2009. This is the first profit since the first operation in 2007. In fact, high-speed rail ridership has been significantly improved. In February 2010, for the first time of the history of THSR, the monthly ridership exceeded 300 million a day on weekdays and up to 12 million passengers on holidays, showing a stable growth trend. If the ridership growth trend remains stable, we can estimate the average daily ridership will reach 18 million people in 3 years.

8. High Speed Rail BOT project migration: (Control Yuan, 2009)

The migration of the THSR project can be divided into two types according to the deadline of the concessionaire contract:

(1) Transfer after the expiry of the concession period;

According to the Encouragement Statute, the Ministry of Transportation should take actions 3 years before the expiry of the concession period. Actions include inform the follow operation to the THSRC. 5 years before the expiry of the concession contract, both parties should start the negotiations about assets transfer issues.

- Transfer subjects includes: All operating assets and others that maintains the normal operation of HSR, land routes, maintenance bas and all the buildings within the station sites, transportation facilities and ancillary facilities, all construction service contracts operating assets, related computer programming and software, etc.

- The migration process: preparation of assets inventory, total seizure of assets before transfer.
- The migration conditions: divided into paid transfer and without compensation transfer.
- Pricing

(2) Transfer before the expiry of the concession period;

4.3 Lessons Learned from the Privatization of THSR

According to literature review and studies pointed out in previous sections, the lesson learned from the THSR project process can be summarized as following:

4.3.1 Strategy Implementation

- The decision for a high-speed line via BOT was made by the Ministry of Transportation and Communication of Taiwan (MOTC) in 1996, but at that time, besides of the government's BOT related codes, regulations and related requirements to execute this kind of projects were not properly established, the MOTC had no BOT experiences.
- It didn't take long for the government to realize not every construction project is suitable to be built via PPP. As pointed out the HM Treasury of UK, by establishing an evaluation system like the "Value for Money" will significantly reduce the risk of a failed PPP project.
- The Executive Yuan should establish a detailed financial and economic evaluation system (both

qualitative and quantitative) for future Taiwan PPP projects.

- The Public Construction Commission (PCC) should strengthen the professional training on the BOT know-how to the government officials according to the Law for promotion of private participation in infrastructure projects (Taiwan PPP Law).

4.3.2 Selection of the best applicant (the preferred bidder):

The evaluation criteria were issued to the qualified bidders only 15 days prior to the latest submittal date for the investment proposal of THSR. It violated the common practice for the International Competitive Bidding of PPP. Usually the selection method and the evaluation criteria for the best applicant should be clearly set forth in the Public Notice for any PPP. According to the Article 44 of the Law for the promotion of private participation in infrastructure projects, it is clearly stated that the evaluation criteria shall be announced simultaneously upon the announcement of the public notice inviting private participation.

4.3.3 Where should the government invest its funding? (Lin, 2000)

The Taiwan high-speed rail project is the biggest BOT project in the world; however, it was the first time the government deals with BOT. Therefore, government officers, concessionaire, and financing organizations were all short in experience. Inevitably, they needed to learn and cumulate experience from mistakes.

Since THSR BOT was executed, external criticism about BOT affairs had never been stopped.

In the following section, this study organizes opinions from others in a synthetically and generally way; moreover, it summarizes some experience and improvement from the beginning of THSR BOT until now.

1. Legislation for THSR BOT:

In fact, the act of THSR BOT is flawed. It was based on "The Encouragement Statute" which was drafted ten years before and some of them were not suitable for BOT. The objects, methodology, and involved ranges of BOT are extensive, also legislation for general case does not fit for BOT. Based on foreign cases, most of them legislates for specific case. Although it obstructs legislative economy, it solves more special problem derived from different transportation infrastructure whose properties are quite different.

By legislation for special case, it is easier to solve problem caused by different properties such as: land acquisition, tax relief, funding sources, and financing etc. In foreign cases, they all deals with special code. Therefore, it is beneficial for large cases to succeed by spending more time to analyze what problem caused by execution processes, gain legislative basis to solve those problem.

2. THSR BOT Bidding Procedure:

(1) Reliability of THSR BOT:

Before the bidding deadline of THSR BOT project, the selection committee took only one

month to examine all applicants and choose for the best one. It is quite questionable that it took so little time to decide a budget of 500 billion NTD.

Besides, the Bureau of High Speed Rail announced “Regulation for Evaluation of the Most Advantageous Tender” and “Investment Required from Government” 15 days before the deadline. By international BOT convention, standard should be announced along with tender selection, and the authority should give bidders more time for preparation.

(2) THSR BOT project adopted the “minimum bidding amount” as the selection criteria:

THSRC decided to allocate at least ten percentage of the surplus before the operation income tax to repay the government for land acquisition charges, and CHSRC not only required the government to approve expenditure but also charged the government for 149.5 billion NTD. The difference between two proposals is up to 255.2 billion NTD. As the government had taken the traditional minimum bidding criteria “government investment limit” as principle, THSRC won the bid. However, the financial problem of THSRC made it hard to comply with winning bidding price, and it leads to people question about this BOT. Nowadays, foreign BOT no longer adopts the minimum bidding criteria, so THSR BOT project should revise traditional bidding award method to rational bidding evaluation based engineering value.

(3) Financing team did not participate in the selection process:

Taiwan's financing banks value the mortgage and require real objects as warranty for long-term loan. In the Taiwan High Speed Rail project there was lack of experience from foreign banks, and there was lack of participation from financing teams, so it was difficult for the government and THSRC to make detailed evaluation the project's loan plan. In the end, the government was forced to guarantee the finance of the THSR BOT project, which highly increased the government's financial risk.

(4) Review process lack of parallel negotiation:

It was believed that the government should complete the parallel negotiation process, and treat qualified applicants equally. Moreover, the government should conduct the negotiation and fully understand each party's situation. By this negotiation, the government could understand both applicants' concerns (e.g. the government's responsibility, applicants' rights and interests). On the other hand, applicants can also have more consideration about what the government concerns (e.g. the possibility for finance and alternative financing, government's funding, and rewarding bonus, etc.) and propel investment plan to support public interest; furthermore, disputes after signed contracts can be avoided.

3. Government made a concession during contract negotiation and settlement:

The reason why BOT contract is much more important than others comes from the execution

of BOT. It is different from the traditional engineering contract. Both government and non-government organizations need to afford the risk and duty of their own, individually, so it is reasonable to enumerate explicitly the responsibilities and risks of each party. The only reliable basis for both parties is the signed contract.

There were numerous questions during the THSR BOT contracting process. Since the government embraced the attitude of assured success, it couldn't nullify the bidding rashly due to political reasons. The above reasons put the government at weaker position during contracting.

(1) Contractual issues with THSRC:

For the reason of "government responsibility was not done within one year" and "fail to get financing", THSRC did not complete the contract before deadline. Surprisingly, the government signed "the memo of government's responsibility" and "the memo of tripartite deed" instead of confiscating the bail. And the government agreed if they cannot fulfill its responsibility and coordinate banks to give finance loans to THSRC, THSRC could terminate this contract based on those two memos.

(2) Investment plan was not part of the contract:

Investment plan in the bidding application stated eight core companies of THSRC that gathered 52.9 billion NTD which consist of 51% of the total capital and promised these eight

companies will fill the deficiency; however, the “high speed rail construction and operation contract” regulates the holding of party as 25%. It is quite different from the investment plan. The actual investment, up to June 2009, from the original sponsor was merely 29.5 billion NTD, which was 27.9% of the total capital of THSRC. The actual investment was much less than the commitment made in investment plan.

4. Division of works:

(1) The construction of core system should deliver to the Bureau of HSR for revaluation:

The bidding book of THSRC stated “electro-mechanic reference system” as the European system composed by Germany and France. However, after the synthetic comparison and rating, THSRC announced the selection would be “The Taiwan Shinkansen” with Japanese system. Then THSRC informed the government the replacement of electro-mechanic system and applied for acceptance. The European Railway Union claimed THSRC infringe its interests and applied arbitration for compensation. In the end, THSRC and the European Railway Union made an agreement for repaying settlement fee and 65.75 million USD of interest. THSRC paid immediately when the settlement agreement was made.

The above arbitration perfectly makes sense, because selection of core system is just a commercial activity and THSRC had violated their agreement.

(2) The THSR project involves more parties, not merely THSRC

THSR BOT contains part of work constructed by the government, such as the system of access road network and Taipei metropolitan area's underground section; the government manages the system of access road network, and the underground section was rented to THSRC. Included in the THSR project plan was also the co-coordination of three stations in the Taipei Main Station, although it was constructed by the THSRC, it is in fact maintained and operated by the government. This act is an example of the use of THSRC's funds and efficiency to enforce public facilities' welfare, same as the MRT and the TRA stations projects.

5. Financial Risk of the THSR BOT project:

(1) Financing risks mainly undertaken by the government

Due to the inability of domestic bank groups to accede project-financing loans, and because of the concern about the creditor's assurance, the government was forced to assume more financial risks. As mentioned in previous section, the memo of tripartite deed, was clearly identified the government will take responsibility of the THSRC's contract financing debt's capital, interest, liquidated damages and the sum of other expenses. The government made its promise to the THSRC and financing banks to ensure and guarantee full responsibility.

In the THSR operation contract there were also an "Optional Force Buying" mechanism, that is when THSRC cannot complete the project, even if they breach the contract, the government will

still buy and take over the THSR according to the fair price. According to international practice, when non-governmental organizations breaches the contact, the government has the right to claim and is free to take over, even it is not necessary to give assurances and take full responsibility.

Nevertheless, the THSR plan is a governmental established policy. Even if the private sector is not interested, the government will still execute the project. In order to allow the THSRC put together in as short time as possible and have a successful financing and banking completion, the government made its financial risk guarantee.

(2) Domestic financial institutions in charge of the THSR's financing may affect the domestic financial system

When the signing of the THSR BOT contract was completed, it was still unable to obtain foreign financing support, it was only possible to get syndicated loan from domestic financial institutions and government's finance support. Because of the financial crisis, the government wanted to avoid exchange rate risk, so the THSRC opted domestic financial support as their first choice, but the high speed rail requires vast amount of fund, once the concessionaire company breaches the contract, will certainly result the government and the domestic financial institutions' problem and further affect the national economy and competitiveness. Therefore, foreign financing institutions should be introduces and take as experience for future development of BOT cases.

(3) The high-speed rail contract did not specify enough private sector investment, thus causing public sector continuous injection of money

In the Taiwan high-speed rail project bidding book, 103.8 billion of equity financing source was expected. But in the THSRC construction contract was not specified the high-speed rail promoter's contribution rate. Until June 2009, the promoter's shareholding ration was only about 27.97% of the total promised, 51% below the original settled number. Furthermore, the Ministry of Transportation did not include regulations concerning the commitments and penalties in the contract, as consequence the government was forced to invest.

From above, the government indeed violated the spirit of BOT, and the government also faced challenged from the public as consequence; but thinking deeper, the government investment was not fully mistaken, if we exclude the financial part and consider the high effectiveness that the high-speed rail can create (save 100 minutes per person in every trip from Taipei to Kaoshiung), the result in time saving is a substantial economic benefit. Therefore referring to above condition, the government investment to maintain the high-speed rail operation did not resulted in financial benefits but still is reasonable.

(4) The problem of financing interest and depreciation method

The main source of the high-speed rail funding is from alternative financing, but the financing has to be charged a big amount of interest costs, coupled with the depreciation charge for

high-speed rail operations, even if THSR has revenues, it is still insufficient to meet the heavy interest and depreciation burden. Therefore certainly will generate losses.

It resulted THSRC to face severe financial difficulties and in order to solve the problems, the THSRC proposed a debt restructuring plan to the financial team. The hosting bank required five original THSRC's shareholders to give guarantee to accept the plan. However major shareholders questioned that they only shares 23% and had to act as guarantor, so eventually both sides could not reach to a consensus.

Due to the high cost of depreciation, the THSRC implemented the fixed assets depreciation method to make it more rational and systematic. Since January 2009 the THSRC received approval from the Executive Yuan changed the depreciation method to be directly responsible of land and ridership improvements, housing and construction, part of the machinery and equipment, transportation equipment.

4.4 Summary

The execution of engineering projects with BOT is the first experience of large scale BOT transportation project for the Taiwan government and the concessionaire company (THSRC). As for Taiwan's private entities, they were diverged in the methodology and opinion about this BOT project that eventually learned and understood from the experience and execution.

The origin and the idea of Taiwan High Speed Rail BOT project are correct, but some of the

major factors made the implementation process full of problems and controversy. The government set up a legislation foundation that did not match and fully help the execution of the BOT project; the personnel involved in the project were also unfamiliar with the BOT ideology, in consequence the lack of experience turn out to be problems that emerged from the beginning of the project.

The problems were mainly the government's rigid legislations; questions about the validation process and its standards; contracts were not fully considered and were incomplete, etc. Moreover, Taiwan faced political pressure and was in need for infrastructure developments, so that the implementation of the Taiwan high-speed rail BOT project was not executed as same as traditional BOT measures, causing serious debates from all sectors.

On the other hand, Taiwan High Speed Corporation same as other Taiwan's private sector have the ideology that public construction is always the government's responsibility. They think the government should take more risks and assist the continuousness of the project plan, or even the government should give ridership revenue guarantees. These misunderstandings were common during the process and negotiation of the project contract and the execution of the engineering work.

Both the THSRC and the government might be clear about their responsibilities but did not perform the role they should play in the project. In consequence, the Taiwan's BOT case has many differences from abroad BOT cases. Both sides wanted to defend their rights and solve their problem, that's why in the end they reached on some unreasonable agreements. The government

committed to the project's major financial risk, at the same time gave guarantees to the THSRC and loan banks. The appearance of these problems also brought out shocks on the implementation of the case, such as "What kind of problems should the government pay attention in the BOT bidding process", "What kind of details should be set in the project contract", "The reasonable calculation of financing depreciation and amortization", "The government's investment as investment funds?" etc.

However the BOT method indeed solved the government budget constrains in public works, and we can conclude that the Taiwan HSR experience is valuable for future similar BOT implementation or as reference for other countries trying to implement high-speed rail project with BOT approach.

Chapter 5 Development of HSR in America

5.1 Literature Review

America has a long rail history, with very successful freight railroads, but the development of its passenger railroad has been long neglected. However, what we have to clarify is that does America need HSR?

America is the world economically and politically most powerful country, while the world had been developing the high-speed technology, America was focused on the development of its highway network and air transportation. Until today there is no HSR services in America, however the demand for faster and greener transportation is raising. America needs to develop high-speed rail in short period to solve the domestic demand, this eventually makes America to be the biggest HSR market in the world that experts and companies from all over the world wants to share.

An America's transportation research shows that the U.S. now spends up to $700 billion a year to import foreign oil, 70 percent of which is consumed by cars, trucks, and airplanes; 28% of the U.S. year CO2 emission is produced by the transportation sector (Fig. 5.1.1), therefore we can't deny, with the energy crisis, rising price of oil and the environment problem such as Green house effect, HSR is the only potential way to break through the bottleneck.

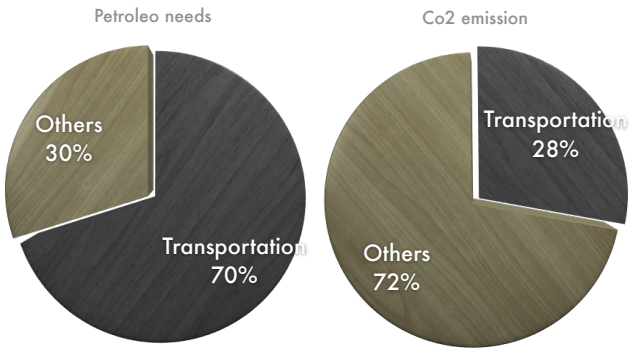

Fig. 5.1.1 America's transportation oil consumption and its green house gas source
Source: Organized by this study

Since 1965, nearly same time Japan introduced its first high speed rail line, the U.S. Congress showed interest in high speed transportation with the passage of High Speed Ground Transportation Act (HSGTA), (DOT, 1997). The office of High Speed Ground Transportation of the Federal Railroad Administration introduced modern high-speed ground transportation to America by 1969. The HSGT program included multimodal transportation projects, The Rail Passenger Service Act of 1970 led to the creation of the National Railroad Passenger Corporation (Amtrak) to ensure the operation of an intercity passenger network in the United States. (DOT, 1997)

In 1971, America's Amtrak started to provide service, yet according to the International Union of Railways, Amtrak does not meet the High Speed Rail's speed standard, top speed are mainly limited by track conditions, 79 mph off the Northeast Corridor and up to 150 mph on the rest of the corridor (GAO, 2010).

By the mid 20th century, Congress had put their attentions on the networks of public roads for

motor vehicles and the aviation system, in consequence creating difficulties for the rail carriers. (Fig. 5.1.2) Amtrak preserved a small portion of the nationwide intercity passenger rail system, however, it has continuously lose money and required Congress financial support. (CRS, 2009) After federal involvement in funding, intercity passenger rail has mainly consisted of capital and operating subsidies to Amtrak annually appropriated from general funds. However, recent legislation has vastly increased the federal role (GAO, 2010).

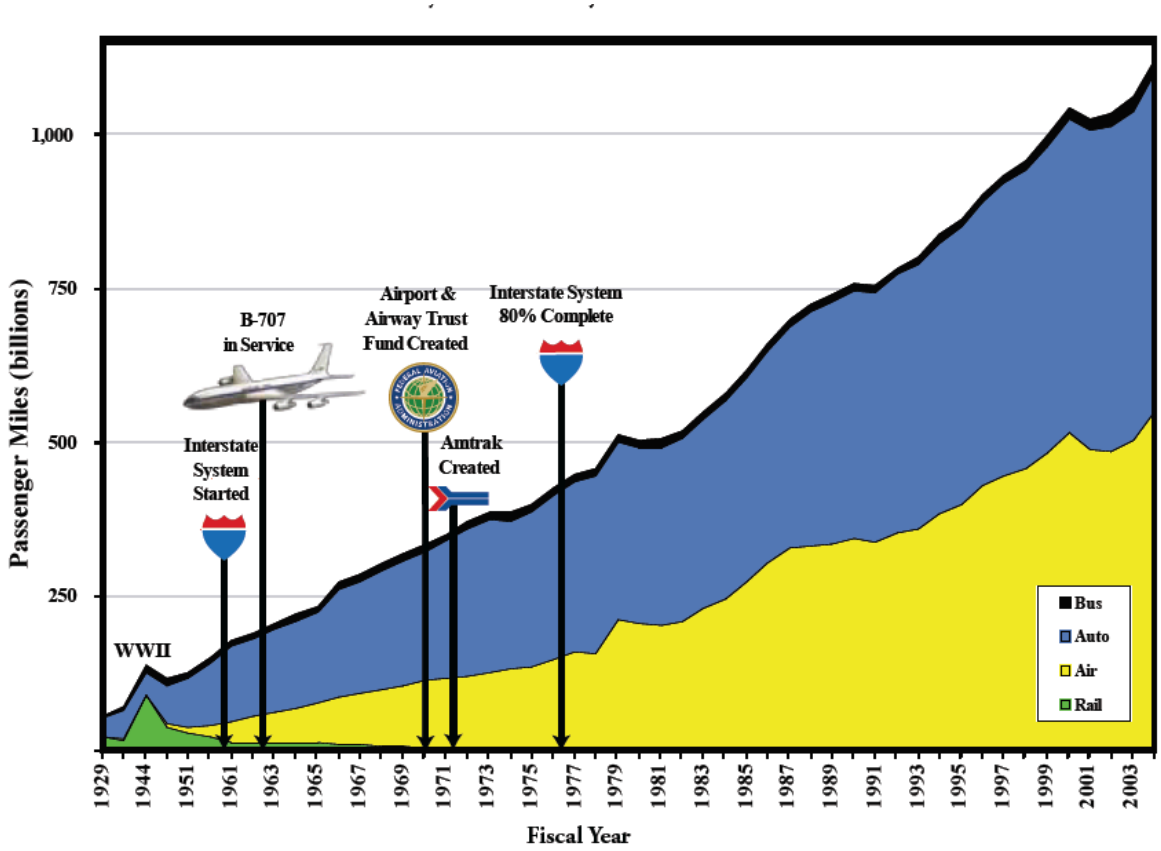

Fig. 5.1.2 U.S. Intercity Travel Trends by Modal Share, 1929-2004
Source: DOT, 2009

For six decades, the federal transportation strategy was focused most intercity transportation investments in the highways and the aviation systems, while the passenger rail (including high-speed rail) has represented less than 3% of the federal investment in intercity transportation.

(Fig. 5.1.3) (DOT, 2009)

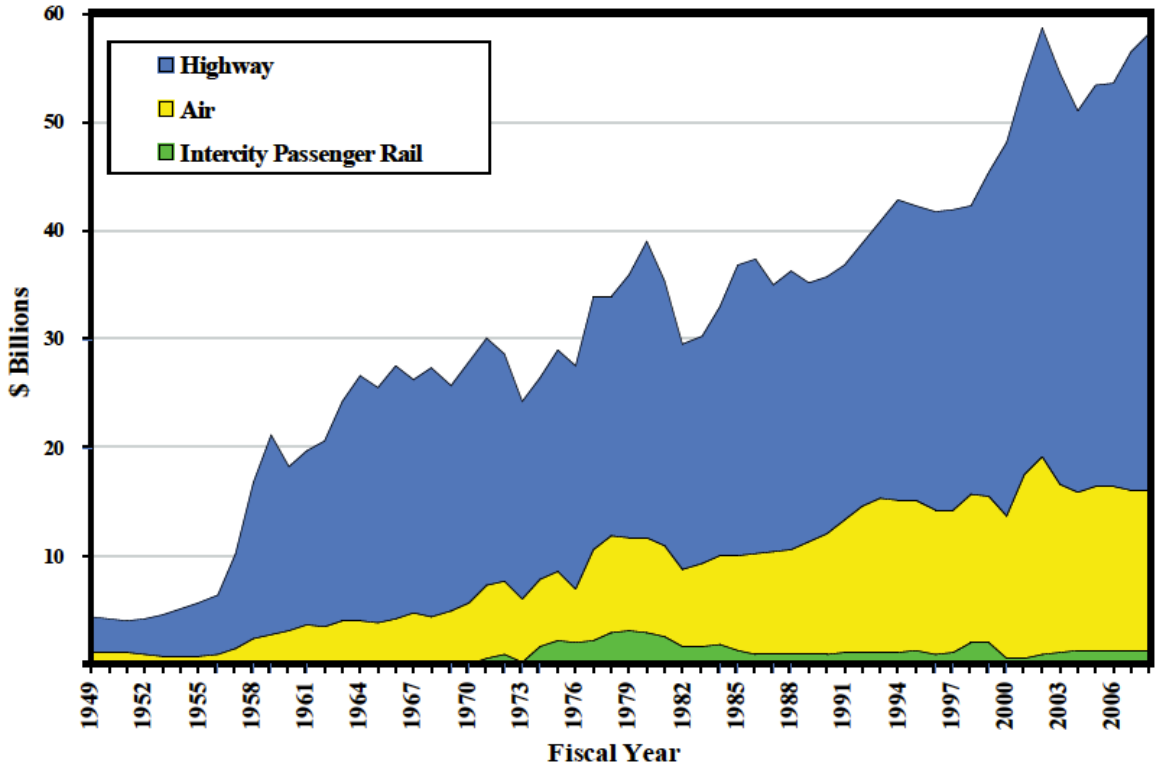

Fig. 5.1.3 Federal Investment in Intercity Transportation, 1949-2008
(2009 Constant dollars. Time Axis Not to Scale.)
Source: DOT, 2009

The transportation takes part of our daily life and each of them play critical role on the intercity passenger transportation, but the comparative advantage of each of them varies by the market factor, as shown in (Table 5.1.1)

Table 5.1.1 Potential Modal comparative Advantage by Market
Source: DOT, 2009

Intercity Distance Mile			
Population Density	0-100	100-600	600-3,000
Light	1) Auto	1) Auto 2) Conventional Rail	1) Auto 2) Air
Moderate	1) Auto 2) Commuter Rail	1) High Speed Rail 2) Auto	1) Auto 2) Air
High	1) Commuter Rail 2) Auto	1) High Speed Rail 2) Air	1) Air

HSR is an extensive, long-term project that requires coordination among and between a number of key actors and stakeholders. The inability to travel quickly by rail will appear to be a deficiency in the nearly future for the United State's citizens. The benefits that the development of HSR line will bring to the United States are mostly: (CRS, 2009) (DOT, 2009)

- Alleviate highway and airport congestion;
- Reduction of pollution and energy used in the transportation sector: reinforce efforts to foster energy independence and renewable energy together with the reduction of pollutants and greenhouse gas emissions;
- Promotion of economic development and build a foundation for economic competitiveness;
- Ensure safe and efficient transportation choices;
- Provide more options for travelers;
- Support interconnected, livable communities;

5.2 U.S. Attempts on HSR

The Congress has always been interested in the potential benefits of high-speed rail. In 1965 the Congress passed an act to help the establishment of the rail service. In 1970 the Pennsylvania Central Railroad, owner of the Northeast Corridor, suffered bankrupt and was transferred to Amtrak. Same time, the Congress promoted the Northeast Corridor Improvement Program and

provided billions of dollars for the improvement of the corridors and trains.

The Congress attempts on high-speed rail did not end with the Amtrak support. It also supported on the research of maglev and other high-speed related technologies. In addition to providing findings for researches, the Congress promoted programs for the development of maglev lines or dedicated high-speed rail lines.

The Federal Railway Administration (FRA), under the High Speed Ground Transportation Act, introduced the Metro liner and Turbot train in the Northeast Corridor Service. When the HSGT Act appropriations ended in 1975, the Congressional focus shifted to upgrade the existing Northeast Corridor infrastructure to enhance reliability and shorten trip times, especially from New York City to Washington D. C.

Since then, the closest high-speed rail attempt was the Acela HSR program initiated by Amtrak in 1992, with the purpose to provide high-speed service with trains that could run at speed of 240km/h. Acela began operation in December 2000, and its service trains now runs at speed around 110 and 150 mph on part of the corridor. Afterward, there have been 19 efforts from part of the government to develop and deploy some kind of high-speed transportation, but for many reasons, none of these attempts has lead to construction (DOT, 1997). Table 5.2.1 lists those projects identified.

In the U.S., the adoption of the incremental HSR approach was to “reduce the resistance” and the “low cost,” also requires far more financial and political commitment from both the Federal and

State governments (MTI, 2006). Learning from the foreign and past experiences, the PRIIA requires the federal government to incorporate the U.S. HSR projects into the national rail plan and therefore the national transportation plan (FRA, 2009).

Table 5.2.1 U.S. High Speed Ground Transportation Projects as of May 2004
Source: MTI, 2005

Project/Corridor	Federally Designated	Date of Initial Designation	HSGT Type Being Pursued
Atlanta-Chattanooga	No	--	Maglev
Baltimore, MD- Washington, D.C.	Maglev Deployment Program	1/18/01	Maglev
California Corridor	Yes	10/19/92	New HSR
Chicago Hub Network Midwest Regional Rail Initiative	Yes No, but includes above	10/15/92 --	Incremental HSR
Empire Corridor	Yes	10/10/98	Incremental HSR
Florida Corridor	Yes	10/16/92	New HSR
Gulf Coast Corridor	Yes	11/18/98	Incremental HSR
Keystone Corridor	Yes	10/10/98	Incremental HSR
Nevada-Southern California	No	--	Maglev
Northeast Corridor	No	--	Incremental HSR
Northern New England Corridor	Yes	10/11/00	Incremental HSR
Ohio & Lake Erie Regional Rail Network	No, parts in Chicago Hub	--	Incremental HSR
Pacific Northwest Corridor	Yes	10/20/92	Incremental HSR
Pittsburgh	Maglev Deployment Program	1/18/01	Maglev
South Central Corridor	Yes	10/11/00	Incremental HSR
Southeast Corridor Southeastern High-Speed Rail	Yes No, but includes above	10/20/92 --	Incremental HSR
Texas Triangle	No, part in South Central Corridor	--	New HSR

In October 2008, Congress enacted the Passenger Rail Investment and Improvement Act in 2008 (PRIIA), which established program to develop High Speed corridors. This act authorized more than U$ 3.7 billion for three different high-speed rail federal programs, intercity passenger rail congestion, and capital grants. (GAO, 2010)

Several factors have constrained the development of high-speed rail. Federal vision for HSR is needed along with a national network strategy for rail that combines passenger, freight, non-HSR intercity and HSR, and how each of them also links to non-rail modes of transportation (MTI, 2006).

Weather to develop a new HSR or an incremental higher speed rail system depends on what one hopes to accomplish. The Congress' near-term investment strategy seeks to advance new express high-speed corridor services with speeds above 150mph on primarily dedicated tracks, develop emerging and regional high-speed corridor services and upgrade reliability and service on conventional intercity rail services. (See Table 5.2.2)

Consequently, despites of decades of efforts for a high-speed rail, as of 2009 there are still no exclusive high-speed rail line in the United States, only one rail line that can attain speeds of over 110mph (the Northeast Corridor). (CRS, 2009)

Table 5.2.2 Recent Congressional Initiatives Related to High Speed Rail

Source: CRS, 2009.

Programs created and/or amended in the 109th - 110th Congresses

Initiative	Source	Funding	Status
Maglev Deployment Program	Authorized in SAFETEA (§1307, P.L. 109-59); funding provided in SAFETEA Technical Corrections Act (P.L. 110-244)	$90 million provided over FY2008-FY2009. $45 million is for a line from Primm, NV, to Las Vegas; $45 million is for one or more of three eligible projects: the Pittsburgh area, from Baltimore to DC, and from Atlanta to Chattanooga.	Deadline for applications was February 13, 2009. All three eligible projects east of the Mississippi applied for funding. FRA selected the Pittsburgh and Georgia projects to receive funding, in addition to the Nevada project.
Amtrak Capital Grants	Passenger Rail Investment and Improvement Act of 2008 (PRIIA) (Division B of P.L. 110-432), §101(c)	$5.315 billion authorized over FY2009-FY2013.	$655 million provided in FY2009 DOT appropriations bill (Title XII, P.L. 111-8); $1.3 billion provided in ARRA.
NEC High Speed Service Study	PRIIA §212(d)	Not specified.	Amtrak to submit report to Congress by October 16, 2009, on what would be required to reduce trip times on NEC to certain thresholds.
Intercity Passenger Rail Service Corridor Capital Assistance Program	PRIIA §301 (49 USC §24402)	$1.9 billion authorized over FY2009-FY2013.	These three programs were provided a total of $8 billion in ARRA. The allocation of that funding among the programs is to be determined by DOT. DOT provided a strategic plan for implementing these programs to Congress on April 16, 2009,[a] and issued interim guidance to prospective applicants for these grants on June 17, 2009.[b] The application deadlines varied by program; the final deadline was October 2, 2009.
High Speed Rail Corridor Development Program	PRIIA §501 (49 USC §26106)	$1.5 billion authorized over FY2009-FY2013.	
Congestion Grant Program (to alleviate congestion on passenger rail corridors)	PRIIA §302 (49 USC §24105)	$325 million authorized over FY2010-FY2013.	
Solicitation for new high speed intercity passenger rail system	PRIIA §502	$5 million authorized for planning and preliminary engineering activities for projects selected by DOT.	FRA issued a request for expressions of interest on December 16, 2008. Deadline for response was September 14, 2009.
Requirement for implementation of Positive Train Control on main lines where passenger rail service is regularly provided by December 2015	Rail Safety Improvement Act of 2008 (Division A of P.L. 110-432), §104 (49 USC §20157)	$250 million authorized for grants over FY2009-FY2013.	Affected rail operators must submit a plan for meeting this requirement to FRA by April 2010.

Source: CRS.

In April 17, 2009 President Obama announced his plan of the "Vision of High Speed Rail in America," appropriating the award of 8 billion initiative fund for 13 new HSR corridors across the nation. (Fig. 5.2.1)

Fig. 5.2.1 Federally Design High Speed Rail Corridors
Source: CRS, 2009.

5.3 Lessons Learned from previous attempts

Learning from the past, according to MTI, 2005, the essential key for a successful implementation of high-speed rail is to have strong leadership and authority to implement changes. Most of the criticism of HSR is based on the concern about the cost-effectiveness of the HSR, particularly the HSR relies more on general tax revenues than other transportation modes. The cost of HSR can be divided into two main categories: (CRS, 2009) Infrastructure costs and operating costs. But most importantly, vision and funding are main obstacles for the development of high-speed rail lines.

The Federal vision for HSR must complement with a national rail network strategy that combines passenger, freight, non-HSR and HSR services. (MTI, 2006)

In the history, attempts for HSR adopted the incremental HSR approach to reduce the resistance and investment cost, together reduce financial and political commitments. (MTI, 2006) This was the strategy Amtrak adopted for its system, and today, it is the nation's only intercity passenger rail operator, which nowadays carries less than 1% of the country's total intercity passenger miles. (GAO, 2010)

The U.S National Journal Transportation Experts discussed about the topic of "Will HSR Drive Business?" The report focused on major potential HSR cities such as Albany, N.Y.; Chicago; Los Angeles; and Orlando. These cities are different, but what's interesting is that the high-speed rail networks had similar effects in all of them, including the effectiveness that the high-speed rail can help business, expanding markets, etc.

The President of the American Public Transportation Association William Millar pointed out in the report that the investment on high-speed rail is the most significant step towards transforming United State's transportation network since the interstate highway system begun. It will create billions of jobs, revitalize State's economy and reduce the dependence on oil. However it is crucial that the high-speed rail achieves its economic potential, it is necessary to:

- Develop existing and emerging regional high-speed corridors;
- Upgrade reliability and service con conventional intercity and commuter rail services.

- Stations located in high density and transit-oriented places.
- Ensure interconnectivity with regional rail and bus networks, airports and other modes.

It is important to achieve mentioned above to own the benefits that high-speed rail brings. The P.E., Executive Director of the American Society of Civil Engineers Patrick J. Natale pointed out that all of those great HSR benefits hinge on increased investment in transit and freight mobility. Apart from getting people to the rail station, it is also important to appropriate zoning near the station. A successful transit oriented neighborhood not only has to be an attractive place to and but also to work.

HSR projects are extensive and long-term projects; implementing a HSR project therefore needs shared authorities and requires coordination among and between a number of key actors and stakeholders.

One may wonder why HSGT has taken so long to take hold in America, according to Harrison (1995) in the ASCE Journal "High Speed Ground Transportation is Coming to America – Slowly" the introduction of the automobile in the early part of this century quickly undermined the market for interurban rail service. America had put too much reliance on automobile and auto-oriented public policies, according to the U.S. Congressional Budget Office, various level of government in this century have spent its fund on highways expansions as a consequence the disappearance of the nation's trolley system.

The geographic, topographic, urban and economic development, political and cultural factors

are also different from Japan, France or other HSR successful countries. Except the densely populated Northeast Corridor, urban development and land use in the US. have not favored fixed guideway modes of intercity passenger travel. By contrast, the geography, topography and urban development of Europe and Japan are very suitable for the development of rail service. They have little land to build super highways, more densely populated urban areas are all factors in favor for the development of railroads in these regions.

5.4 Challenges to the vision of HSR

Challenges to promote a successful HSR require the federal government to incorporate the America HSR projects into the national rail plan and also the national transportation plan. Meanwhile, the FRA has to change from being conservative to be one that can make multi-billion dollar investment choices and simultaneously carry out safety mission. (GAO, 2010)

Overall, the challenges to promote HSR in America are: (DOT, 2009)

- *Federal support and leadership*;
- *Lack of expertise and resources*: the Federal support in passenger rail was minimal in recent decades, resulted in a shrinking pool of experts in the field, including engineers skilled in signal, track works, rolling stock design and experiences rail planners and managers. The high-speed rail investment program will surely bring more expertise back into the industry, but that process will be slow lagging behind the need to implement and

manage a major new program;

- *State fiscal constrains*: many States are in a precarious fiscal condition because of the economic downturn. Some States have continued searching budget in passenger rail even without the Federal support with the vision for the expansion of passenger rail and development of HSR;
- *Partnerships with private railroads*: Amtrak has the right of access to private road facilities. That access was provided by the Federal law and has been constrained by the capacity of rail lines and freight traffic. Now with the public funding supporting States for high-speed lines investments, partnerships will be needed between States and the private railroads that own the infrastructure;
- *Multi-State Partnerships*: most of the design high-speed rail corridors cross State boundaries, which means that it will require a multi-State partnership in many cases. The States involved will need to coordinate through interstate compact or multi-State agreements. But most importantly, multi-State partnership will require the backing of several political and administrative entities within each States;
- *Need for High-Speed Rail Safety Standards*: the high-speed rail has good safety record in other countries in the world, usually on dedicated lines. The U.S. railroad safety standards are designed to keep passengers and crew safe in an environment with conventional freight equipment, therefore, to propose a high-speed rail safety standard will be a challenge for

the Federal Railroad Administration (FRA);

- *Legislative Foundations*: the Congress established new framework in 2008 for the development of the intercity passenger rail. Four key pieces of legislations are: (DOT, 2009)
  - The FY 2008 Appropriation Act that established a new IPR State Grant Program;
  - The Rail Safety Improvement Act of 2008 (RSIA);
  - The Passenger Rail Investment and Improvement Act of 2008 (PRIIA);
  - The American Recovery and Reinvestment Act of 2009 (ARRA).

Funding for intercity passenger rail has been provided through the annual appropriation process, usually without considering in longer-term planning parameters. It has focused on basic operating and capital maintenance requirements. Historically, any development of corridors around the country has relied on State funding, which was not active. (See Fig. 5.4.1) Now, with the Congress support and legislations, the Federal government is committing for the first time to promote in high-speed intercity passenger rail. See where shows Federal funding over last four decades for Amtrak and States.

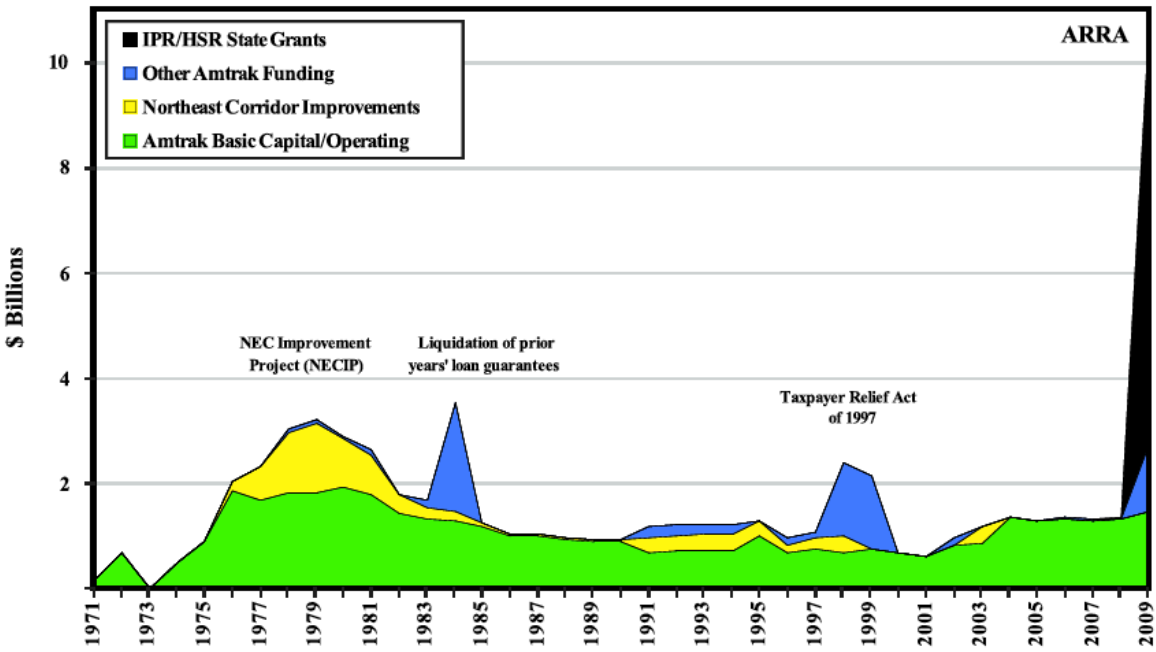

Fig. 5.4.1 Federal Funding for Intercity Passenger Rail, 1971-2009

Source: DOT, 2009

5.5 Obama's Effort 2009

In April 17th, 2009. President Obama announced his plan of the "Vision of High Speed Rail in America." Appropriating the award of 8 billion dollars of initiative fund for the 13 new HSR corridors across the nation. Besides, the recovery Act provided up to 100% federal funding available for expenditure until 2017 and exempted projects from having to be included in a state rail plan (GAO).

With the president support, the door towards the HSR was opened. In January 2010. The FRA announced that 62 HSR project in 23 states and the District of Columbia would receive nearly U$8 billion in Recovery Act funds (GAO). And now, the Federal funds available for high-speed

intercity passenger rail raised from U$120 million in 2008 and 2009 combined to U$10.5 billion in fiscal year 2010.

The situation is optimistic, a stable federal funding would certainly encourage firms to enter and invest in the intercity passenger rail market place. However, concerns still remains between stakeholders, as mentioned before, a HSR project takes several years to complete, even with strong federal leadership and funding it could take several years to provide the necessary infrastructure, and it usually takes about 5 years for a HSR project to gain enough momentum to move on itself, where usually is when the construction at site starts and major contractors are in place.

5.6 BOT for HSR

Build-Operate0-Transfer (BOT) is a financing system that can be a solution to this problem. According to Algarni, 2007, in his study of BOT in infrastructure Projects in the United States indicate that very few American agencies use BOT. The main reason is the availability of proven alternatives and enough funds, the existence of political barriers and the resistance from both the government agencies and private sponsors.

The reason why BOT is not being used in the United States for their large projects are mainly because there are:

1. Availability of other methods, such as design-bid-build, design-build, construction management, etc. and these methods has been very popular and were subject of several

research studies. In contrast, BOT is a relatively new approach. (Algarni, 2007)

2. Political obstacles since BOT projects always need special legislation. This approach is of much concern to citizens as well as politicians. According to the finding of Algarni (2007) the social support is one of the critical success actors in public-private partnership (PPP) projects. Therefore positive political attitude towards the private sector involved in an infrastructure project such as HSR would support the growth of private partnership.
3. Enough funds available.
4. Lack of legislation.
5. Negative attitude of the private sector, etc.

5.7 Summary

America needs to develop high-speed rail in short period to solve its domestic demand. From researches and literature review we know that the intercity passenger rail had been put apart for decades, the Congressional interest and funds were focused on the development of highways and air. Apart from the benefits that the high-speed rail can bring to one country, most importantly the United States needs high-speed rail to reduce the dependency on oil and also to solve its transportation bottleneck problem.

Since the very beginning of the development of high-speed rail in Japan and Europe, the

United States had shown interest in the development of this technology by introducing HSGT Act to promote intercity passenger rails, but the attempt faced many problems and obstacles.

America is the world economically and politically most powerful country, but there is no HSR service running in the country. The economic situation and Federal focus was against the development of high-speed rail. Although attempts for high-speed rail had never ceased, for many reasons none of them had lead to construction. According to literature review, these challenges are federal support and leadership, lack of expertise and resources, state fiscal constrains, partnership with private railroads, multi-state partnerships, need for HSR safety standards and legislative foundations. The challenges are many, however in this paper we only focus on the funding problem.

In April 17th, 2009. President Obama announced his plan of the "Vision of High Speed Rail in America." Appropriating the award of 8 billion dollars of initiative fund for the 13 new HSR corridors across the nation. Moreover, the Congress had established new legislation to support as basis for the ongoing plans of high-speed rail.

Therefore, the vision for high-speed rail in America is positive. A stable federal funding would certainly encourage firms to enter and invest in the intercity passenger rail market place. According to the study of Algarni (2007), 14% of the respondents think it is unnecessary to implement BOT because they have enough funding for its infrastructure projects. However a HSR project involves large amount of money, this is the case where the states have to search for Federal support or

alternative financing method to build public facilities. It is undeniable that private partnership is a potential solution to HSR projects, with the THSR experience and study of challenges in the U.S. that shows increased demand for HSR and the lack of funds to construct, maintain, operate the facilities, public agencies should rethink and reconsider their needs. The implementation of BOT could help the public and the private sector to understand that BOT is a feasible alternative for HSR projects. (Algarni, 2007)

Chapter 6 Survey and Analysis

6.1 Questionnaire Design

6.1.1 Questionnaire Purpose

The literature review of this paper is divided into several sections, covering world HSR experiences, alternative financing, Taiwan HSR experience and the challenges of HSR in U.S.

The purpose of this questionnaire is to understand thoroughly key issues of a HSR project executed with Build-Operate and Transfer (BOT). Discover the factors of success or failure during different stages of the HSR BOT model. According to the Taiwan high-speed rail experience, build up assumptions and make reasonable analysis of the recovered questionnaires, ultimately with the results obtained from the questionnaire explain and prove the theories and assumptions mentioned in previous chapters.

6.1.2 Selections of Respondents

The main targets of this questionnaire are those who participated in the different stages of the THSR's life cycle, mostly the public sector, the concessionaire company and other private units.

The designed questions are targeted in the most ambiguous part during the three stages of the project: Planning, Executing and future. In order to obtain neutral and true answers of each questions; the questionnaire is executed anonymously to reduce the probability of deviation in the

result.

Total of 188 questionnaires were send, 80 of them was recovered and are effective. The effective recovery rate is 42.6%. (Table 6.1.1)

This questionnaire has low recovery in comparison with others mostly because experts that meet the requirements of the specific experience are rare, in addition, there was many voices and criticism during the construction of the Taiwan high-speed rail, therefore, it is reasonable that some experts would like to avoid disputes.

Table 6.1.1 Questionnaire's recovery statistics

Total Released Copies	Total Recovered Copies	Effective Recovery Rate
188	80	42.6%

6.1.3 Content of the Questionnaire and Basic Information

The questionnaire is divided into 3 stages according to the life cycle of the THSR project, which are below with its main concerns:

- Planning Stage: The decision to implement BOT; Basic laws to support the private public partnership.
- Execution Stage: Fairness of the bidding procedure; government's responsibilities and duties; Project financing.
- Future Works: Over-estimation of ridership; Value of THSR.

Experts are asked to answer some questions about their basic information:

- Working Unit:
    - Government institutions
    - Non-government institutions
- Professional Field:
    - Public works
    - Non-public works
    - Non- civil engineering works
- Total Working Experience;
- Total Working Experience in PPP or BOT;
- Total Working Experience in HSR.

6.1.4 Selection of the Questionnaire's Scale

The questionnaire applies the social science' attitude measurement to obtain the respondent's degree of agreement about the evaluation items. Therefore adopt the general type of Likert-type Scale Equal Appearing Intervals attitude Measurement. According to the expression of personal feelings or ideas, the respondents can give with different intensity high and low scores, hence the magnitude to the extent of agreement represent the individual's degree of consent.

The questionnaire is divided into two sections: opened and closed. In the closed section, the

purpose is to understand the opinion of the respondents in each question, therefore in the questionnaire design, it is adopted the 5 point Likert-type Scale, as shown in Fig. 6.1.1, 1 for "Strongly Disagree," 2 for "Tend to Disagree," 3 for "Neither agree nor disagree," 4 for "Tend to Agree and 5 for "Strongly Agree." The other section is opened for experts' opinions fill up, to consult recommendations and opinions about the questions as basis for amendments, detailed questionnaire is shown in Appendix I.

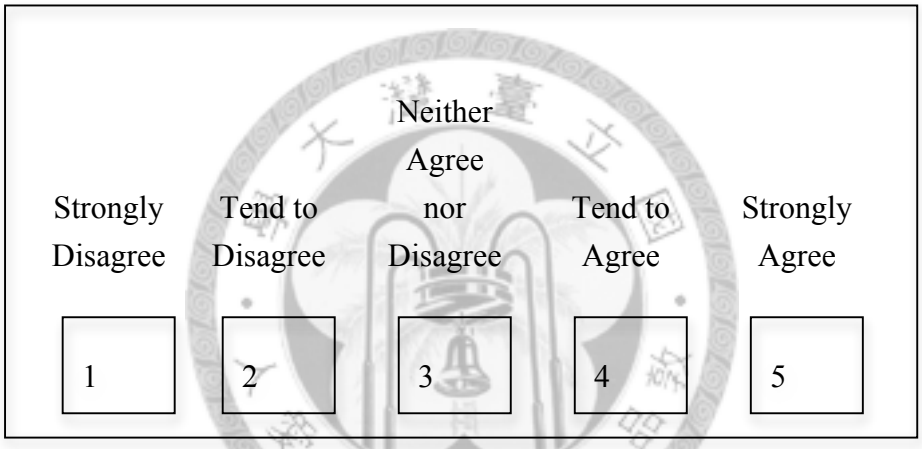

Fig. 6.1.1 Experts questionnaire opinion scale
Source: Organized by this study

6.1.5 Execution of the Questionnaire

First, enumerate data and archive. Questionnaires are organized in a systematic order according to the recovered date, using 1, 2, 3... as identifying numbers, input data and proofread to avoid human error.

Second, discard invalid questionnaires in order to maintain the rationality and reliability of the questionnaire. It is consider invalid if there is incomplete data and/or obvious random answers.

6.2 Pre-test and Analysis

Questions were carefully selected to reach key issues, so as to be prudent we also carry out a pre-test to determine the accuracy of the questionnaire.

As this study involves the life circle of a HSR project, from its planning stage to its execution and operation stage, it might increase the complexity and lower the practicality, so prior to the analysis, it is necessary to shrink the elements by conducting the factor analysis to extract the hidden potential factors. The principal component analysis extracted factors method was implemented in this study, with oblique target shaft to finally achieve the purpose of factor reduction.

6.2.1 Factor Extraction and the Decision of the Number

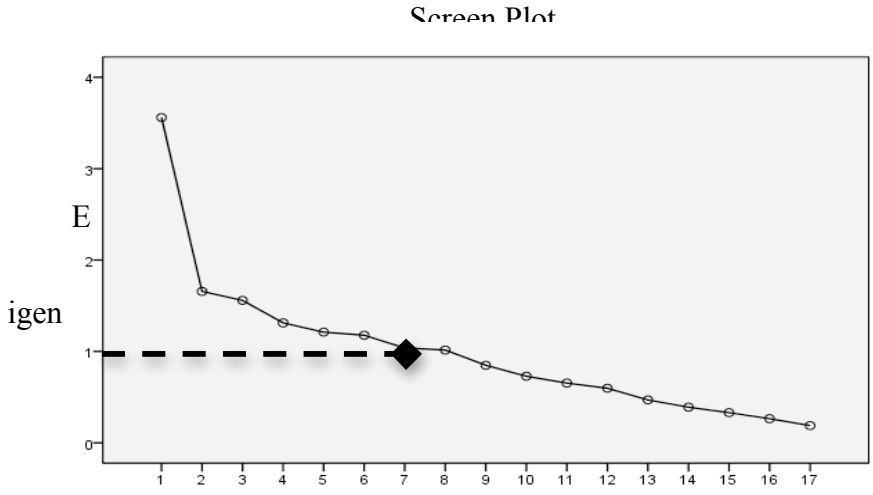

Fig. 6.2.1 Factor extraction (Screen Plot)

Source: Organized by this study

In practice, the most commonly used Kaiser method for determining the number of factors is the extraction method. Kaiser thinks that the hidden potential factors that contribute to the total commonality of one or more of the types must be greater than the total variables, same time referencing the screen plot's recess place, we can find out that after the analysis we can select 7 factors, the cumulative variance will be 67.018%, as shown in the Table 6.2.1.

Table 6.2.1 The Cumulative Variance

Cumulative Variance

Factor	Extraction sums of Squared Loadings		
	Total	Variance %	Cumulative%
1	2.001	11.768	11.768
2	1.845	10.853	22.621
3	1.639	9.640	32.261
4	1.612	9.483	41.744
5	1.476	8.681	50.425
6	1.466	8.625	59.049
7	1.355	7.969	67.018
8	1.137	6.686	73.704

Extraction Method: Principal Component Analysis

6.2.2 Decision of the Number

The requirement to name the elements is to have the factor structure of the matric as the basis, as shown in Table 6.2.2 below. As long as the hidden factors and the correlation coefficient between the original variables has the absolute value greater than 0.4, then it is considered as significant.

Table 6.2.2 Factor Structure Matrix

	Factor							
	1	2	3	4	5	6	7	8
C4	.925							
B5		.872						
C5		.506						
B8								
B4								
A3			.834					
C3								
A1					.839			
A2					.532			
B6						-.746		
B3						.623		
B7							.847	
B2							.636	
C2								.914

With the above analysis results, we can conclude and explain the meaning of each group of factors. We can extract 7 factors from the questionnaire and analyze as shown below:

- Factor 1: Value of the THSR experience; (Table 6.2.3)

Table 6.2.3 Value of the THSR experience

Number	Factor	Factor Loading
C4	Value of the THSR experience	0.925

- Factor 2: Project Financing Implementation; (Table 6.2.4)

Table 6.2.4 Project Financing Implementation

Number	Factor	Factor Loading
B5	Government financing assurance	0.872
C5	Project Financing Implementation	0.506

- Factor 3: Basic Acts to promote HSR; (Table 6.2.5)

Table 6.2.5 Basic Acts to promote HSR

Number	Factor	Factor Loading
A3	Basic Acts to promote HSR	0.834

- Factor 4: Not considered.

- Factor 5: The combination of BOT and HSR; (Table 6.2.6)

Table 6.2.6 The combination of BOT and HSR

Number	Factor	Factor Loading
A2	Advantage of BOT	0.532
A1	Advantage of HSR	0.839

- Factor 6: Procedures and involvement; (Table 6.2.7)

Table 6.2.7 Procedures and involvement

Number	Factor	Factor Loading
B3	Fairness of the bid	0.623
B6	The Finance role in HSR project	0.746

- Factor 7: Contract terms and Bidding control procedures; (Table 6.2.8)

Table 6.2.8 Contract Terms and bidding control procedures

Number	Factor	Factor Loading
B2	Control process	0.636
B7	Bidding procedures and contract terms	0.847

- Factor 8: Ridership forecast; (Table 6.2.9)

Table 6.2.9 Ridership forecast

Number	Factor	Factor Loading
C2	Ridership forecast	0.914

6.2.3 Credibility and Dependent Analysis

Apart from factor analysis, credibility and dependent analysis were carried too. In Table 6.2.10 we can see that the result of the credibility test was Cronbach's alpha = 0.622 (which is >0.6) and with dependency test -.328 as shown in Table 6.2.10. The result of dependency test indicates that the variables are dependent; this may be mainly caused by the selection of questions. After the pre-test (20 questionnaire to experts in the field) some of the questions were advice to be deleted but many of them, because of its critical issue and the level of controversy, are remained after consulted with experts. Detailed statistics are as shown in Table 6.2.10.

Table 6.2.10 Reliability Statistics and Dependence Test

Reliability Statistics

Cronbach's Alpha Value	Cronbach's Alpha Value based on Standardized Items	N of Items
.622	.687	17

Correlations

		xsum	ysum
xsum	Pearson Correlations	1	-.328**
	Sig. (2-tailed)		.003
	N	80	80
ysum	Pearson Correlations	-.328**	1
	Sig. (2-tailed)	.003	
	N	80	80

**. Correlation is significant at the 0.01 level (2-tailed).

6.3 Statistic Method and Outcomes

6.3.1 Statistic Method

The statistical testing can be divided into two types: estimation of population parameters and hypothesis testing. Hypothesis testing is one of the most important tools of application of statistics to real life problems. Most often, decisions are required to be made taking into account population

on the basis of sample information. There are five ingredients to any statistical test: (source: CEE University)

- Null Hypothesis
- Alternate Hypothesis
- Test Statistic
- Rejection/Critical Region
- Conclusion

The statistical hypothesis is based on the concept of "proof by contradiction." Whenever we have a decision to make about a population characteristic, we make a hypothesis. For example:

$M > 3$ or

$M \neq 5$

Suppose we want to test the hypothesis that $M \neq 5$. Then we can first assume our opponent suggests that $M = 5$. In this case we can call the opponent's hypothesis the *null hypothesis* and write:

$H0: M = 5$

And our hypothesis the *alternative hypothesis* and write:

$H1: M \neq 5$

(For the null hypothesis we always use equality, since we are comparing "M" with a previously determined mean).

When using probability, there is always chance of driving to the wrong conclusions. Even when choosing a probability level of 95%, there is always 5% of chance to reject the null hypothesis when it is actually correct. This is called the "Type I error," in the contrary, if one fails to reject the null hypothesis when it is incorrect, it is called the "Type II error." These two errors are shown as below: (Table 6.3.1)

Table 6.3.1 Types of error

Type of decision	H0 true	H0 false
Reject H0	Type I error (a)	Correct decision (1-b)
Accept H0	Correct decision (1-a)	Type II error (b)

In this study, the hypothesis testing were executed according to the following steps:

1. Identify the null hypothesis H0 and the alternate hypothesis H1.
2. Choose (a). In this case $\alpha = 5\%$.[2]
3. Select the test statistic and determine its value from the sample data.
4. By P-value method, using statistic analysis to obtain P's value.
5. If P-value < α, then reject H0.

[2] Popular levels of significance are 10% (0.1), 5% (0.05), 1% (0.01), 0.5% (0.005), and 0.1% (0.001). If a test of significance gives a p-value lower than the α-level, the null hypothesis is thus rejected. Such results are informally referred to as 'statistically significant'. In this thesis we adopt alpha value = 5%.

6.3.2 Statistic Outcome

Total of 188 questionnaires were send, 80 of them was recovered and are effective. The effective recovery rate is 42.6%. (Table 6.1.1).

The experts with more than 10 years of experiences account for 95% of the recovered questionnaire, hence rich experience and knowledge about the questions. See Table 6.3.2, Table 6.3.3, Table 6.3.4, Fig. 6.3.1.

Table 6.3.2 Expert's working unit statistics

Working Unit	Total	Percentage
Government Institutions	54	67.5%
Non-government Institutions	26	32.5%
Total	80	100%

Table 6.3.3 Expert's professional field statistics

Professional Field	Total	Percentage
Public Works	50	62.5%
Non-public Works	17	21.3%
Non-civil engineering Works	21	26.3%
Total	88[3]	100%

[3] Experts are allowed to choose more than one professional field, therefore the total number of answers exceed 80 (total of questionnaire number).

Table 6.3.4 Experts working experiences statistics

Working experiences	Total	Percentage
1. Above 25 years	33	41.3%
2. 21~25 years	15	18.8%
3. 16~20 years	15	18.8%
4. 11~15 years	13	16.3%
5. 6~10 years	2	2.5%
6. Under 5 years	2	2.5%
Total	80	100%

Table 6.3.5 Expert's working experience in PPP or BOT statistics

Working experiences in PPP or BOT	Total	Percentage
1. Above 10 years	40	50.0%
2. 8~9 years	7	8.8%
3. 6~7 years	9	11.3%
4. 4~5 years	7	8.8%
5. 2~3 years	7	8.8%
6. Under 2 years	10	12.5%
Total	80	100%

Table 6.3.6 Expert's working experience in HSR statistics

Working experiences in HSR	Total	Percentage
1. Above 10 years	27	33.8%
2. 8~9 years	7	8.8%
3. 6~7 years	3	3.8%
4. 4~5 years	7	8.8%
5. 2~3 years	12	15.0%
6. Under 2 years	24	30.0%
Total	80	100%

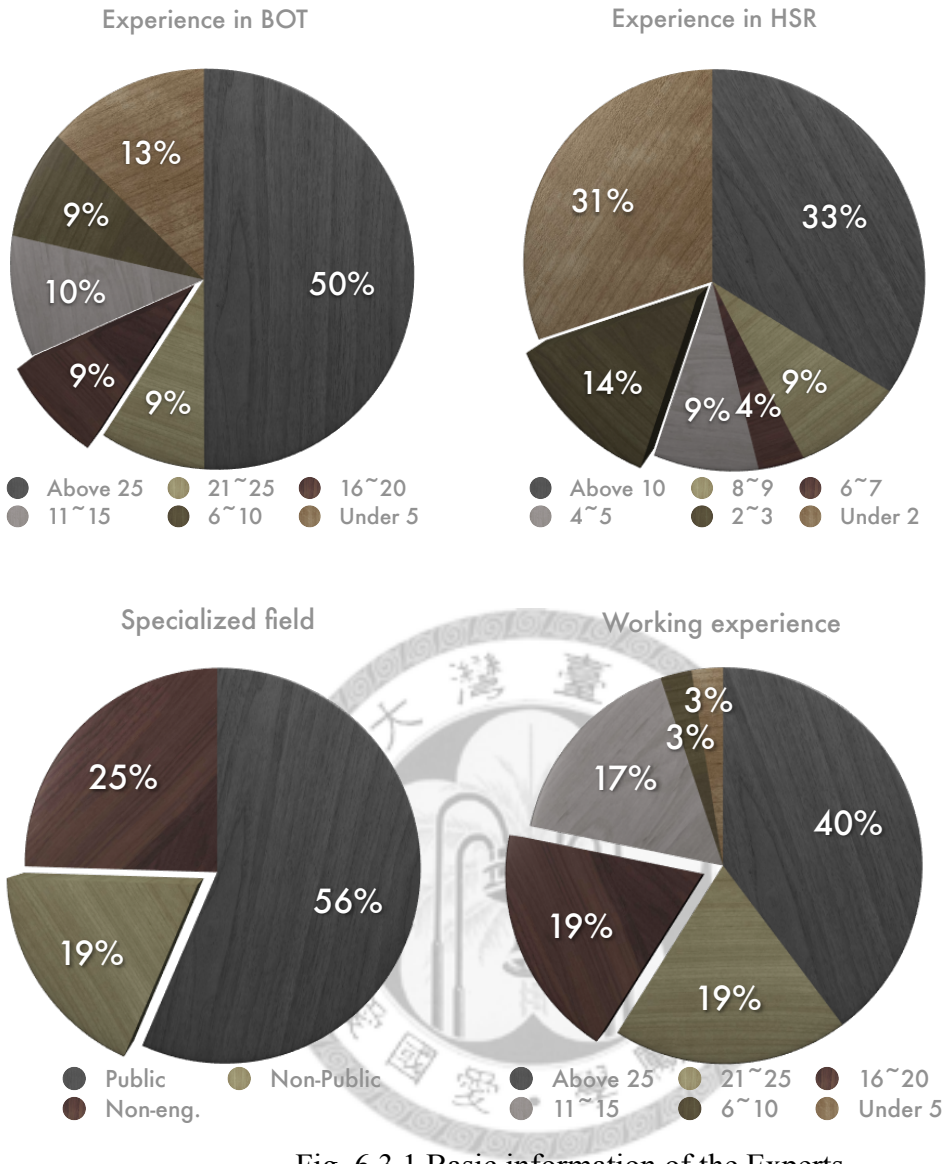

Fig. 6.3.1 Basic information of the Experts

Source: Organized by this study

6.4 Questionnaire Analysis

6.4.1 Independent sample T-test (P-value)

The statistics of the questions are as follow:

The questionnaire is divided into three main parts; planning stage, the execution stage and future work. In the planning stage, questions are mainly about the contract and responsibilities of

each parties; in the execution part the issues are the control, BOT regulation basis, alternative financing and bidding procedures; and in the last part we ask about the ridership after the service launched, and also the value of Taiwan's experience. Questions and its corresponding degree of agreement (votes) are as follow: (See Table 6.4.1 Statistics of the questionnaire)

Table 6.4.1 Statistics of the questionnaire

Part 1: Planning Stage	Strongly disagree	Tend to disagree	Neither agree nor disagree	Tend to agree	Strongly agree
1. Most studies have shown that the advantages of high-speed rail are: use of less land area, energy saving, low pollution, and high capacity. Do you think THSR has provided Taiwan's north-south such a transportation system?	0	2	1	9	68
2. Do you agree that BOT can alleviate government's financial burden, at the same time introduce private sector's efficiency?	2	3	5	18	52
3. As the first HSR to implement BOT, the government set out a Private Participation in Transportation Construction" Act. Do you think the act provides adequate basis for the private sector's participation and for the construction of THSR?	0	6	22	31	21

Table 6.4.2 Statistics of the questionnaire (continued)

Part 2: Execution Stage					
1. Taiwan High Speed Rail's tender and bidding review procedures are divided as follow: Seminars, Franchise companies bidding (to determine viability and feasibility), parallel negotiation, review, sign contracts. Do you think the THSR BOT indeed implemented the above standard bidding procedures?	2	6	13	29	30
2. According to above, Do you think for huge BOT projects (such as HSR) should further increase its control process? What kind of process do you think it is necessary?	8	5	9	18	40
3. Do you think that THSRC proposed a very favorable bid to the government so the government made its decision in a short time?	4	8	15	24	29
4. In the case of THSR BOT, the Ministry of Transportation, THSRC and the financing group gathered to discuss about the financing work. Do you think the government should **NOT** intervene in the financing negotiation?	22	24	5	9	20
5. Like the THSR BOT case, it allows private institutions to execute the whole project, while the government has to give financing assurance, do you think it is reasonable?	10	8	9	28	24
6. The financial team in the THSR BOT project played a crucial role. Do you think that the financial team should participate from the beginning (tender) to the end in this kind of projects?	4	4	3	18	51
7. In the THSR experience, Do you think the government should clarify the matters and reference terms before deciding the best applicant in order to help the project proceed more smoothly?	0	1	1	7	71
8. To ensure the smooth conduction of the THSR case, the Taiwan government made a lot of unreasonable commitment, do you agree?	6	10	8	27	29

Table 6.4.3 Statistics of the questionnaire (continued)

Part 3: Future work					
1. Taiwan High Speed Rail is facing financial deficit, do you think the main reason is because the THSRC was too optimistic?	2	7	8	30	33
2. The ridership of THSR is not that optimistic as expected, do you think it is due to the government's misleading?	11	22	13	22	12
3. If other countries want to build a HSR project with BOT as Taiwan did, do you believe it is feasible?	4	12	13	20	31
4. If other countries want to build a HSR line, and they want to take Taiwan's case as a reference, do you think Taiwan's case is valuable?	1	4	4	17	54
5. Although the controversies when implementing the THSR, do you think it still provided great contribution to Taiwan's transportation?	4	5	7	16	48

Part 1: Planning Stage

Q **A1**: Considers "The THSR has provided Taiwan's north-south a transportation that uses less land area, energy saving, low pollution and high capacity" as true.

The statistics are as follow:

Table 6.4.4 Statistics of question A1

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	4.73	0.667	P<0.05	0.312	Not significant
Government Institutions	54	4.81	0.552	P<0.05		
Total	80	4.79	0.589	P<0.05	0.035	Reject

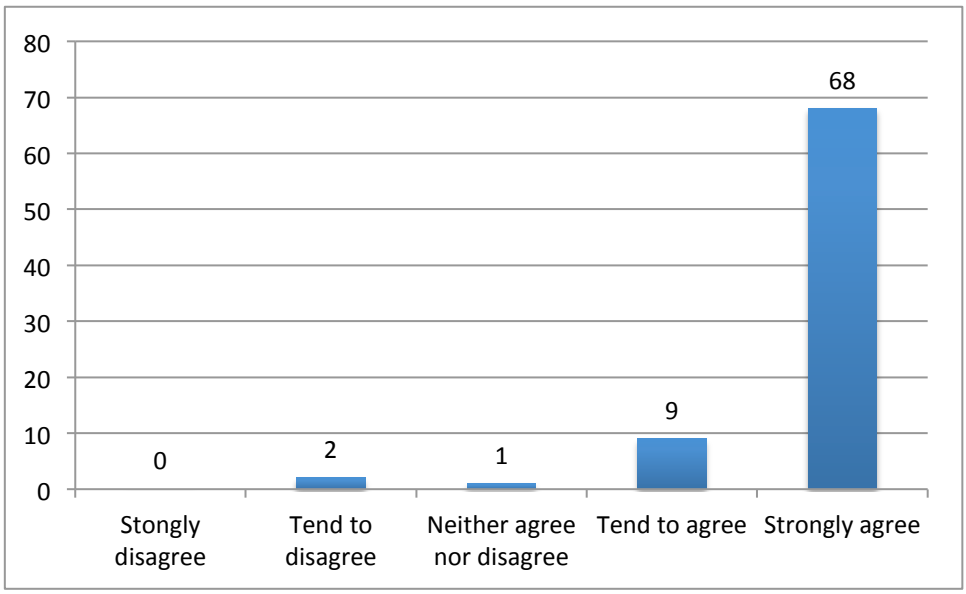

Fig. 6.4.1 Statistics of question A1

We the result shown above, we can conclude *that most of the experts have similar opinions, they think that the HSR provided Taiwan a transportation that uses less land area, low pollution and high capacity*. This result matches with our assumption that the HSR is the transportation needed for the future. In the Taiwan High Speed Rail experience, it certainly brought convenience and commodity to the Taiwanese people.

Q **A2**: Considers "The BOT model can alleviate government's financial burden and at the same time introduce private sector's efficiency" as true. The statistic results are as follow:

Table 6.4.5 Statistics of question A2

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	4.46	1.029	P<0.05	0.527	Not significant
Government Institutions	54	4.43	0.924	P<0.05		
Total	80	4.44	0.953	P<0.05	0.024	Reject

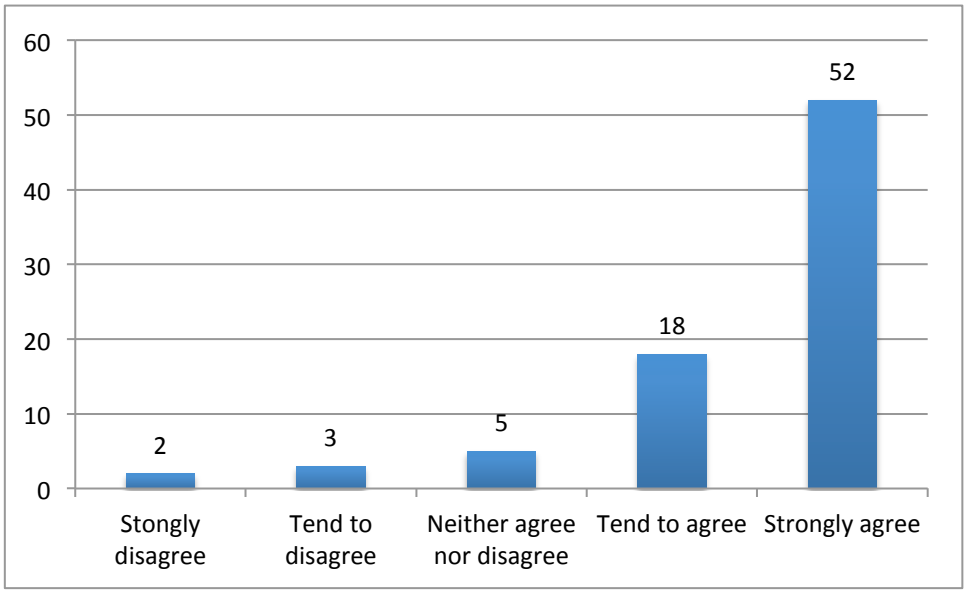

Fig. 6.4.2 Statistics of question A2

With the result shown above**,** *we can conclude that most of the expert thinks that by introducing the BOT model can alleviate government's financial burden and also introduce private sector's efficiency*. There is no doubt that the Taiwanese government did well on promoting the HSR project, even with BOT, despite all the controversies and voices.

Traditionally, big civil engineering projects such as the construction of a HSR line was considered to be feasible with the promotion and execution of the state government. However, we can see from Taiwan's experience that HSR projects do not necessarily need government's fund. With the participation of the private sector it is a win-win situation.

Q **A3**: Considers "The Encouragement Statute" is an adequate basis for the private sector's participation and for the construction of THSR" as true. The statistic results are as follow:

Table 6.4.6 Statistics of question A3

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	3.81	0.981	P<0.05	0.877	Not significant
Government Institutions	54	3.85	0.878	P<0.05		
Total	80	3.84	0.981	P<0.05	0.041	Reject

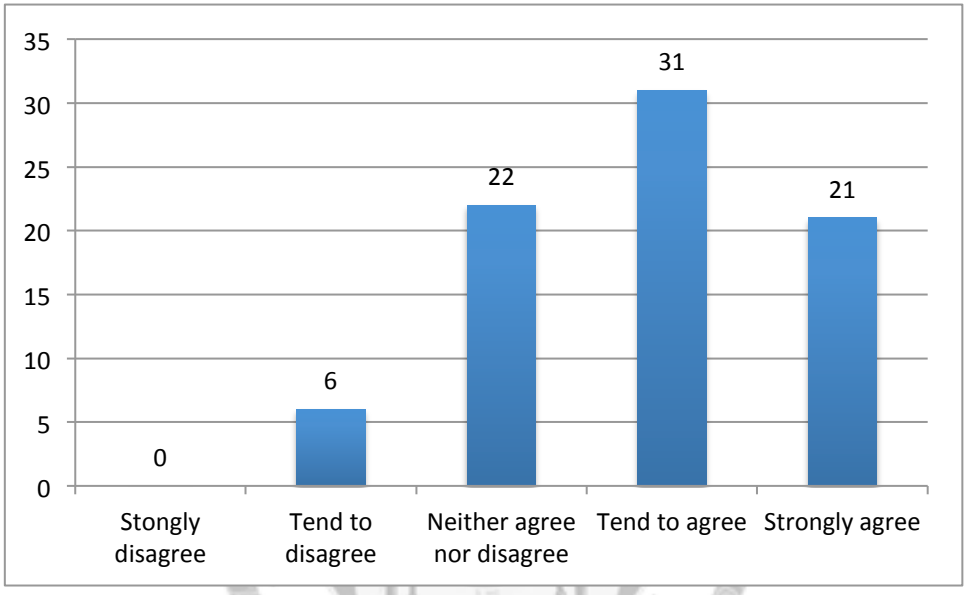

Fig. 6.4.3 Statistics of question A3

With the result shown above, we can see that experts' opinions are not varied. *The majority of the experts agree that the Encouragement Statute was quite useful as a basis for the construction of the HSR.*

Without previous experiences to promote national transportation projects with private participation, the Encouragement Statute was the minimum basis to start with; However, during the planning, negotiation and construction stage of the THSR project, the government and the concessionaire company suffered huge pressure from the Taiwanese media, mainly because the

THSR is the first HSR project executed with BOT.

However, by expert interviews, we now know *that the Encouragement Statute was helpful but not enough and complete*, expert suggests that the Encouragement Statute should also include the following to facilitate the project construction:

- Laws concerning the safety management outside the responsibility area of the high-speed rail line.
- More complete government regulations to support the management of public power.

Part 2: Execution Stage

Q **B1**: Considers "The Taiwan government indeed implemented the tender and bidding review procedures (Seminars, Franchise companies bidding (to determine viability and feasibility), parallel negotiation, review, sign contracts) in the THSR project" as alternative hypothesis (H1), in the contrary null hypothesis (H0). The statistic results are as follow:

Table 6.4.7 Statistic results of question B1

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	3.69	1.192	P<0.05	0.049	Significant
Government Institutions	54	4.13	0.933	P<0.05		
Total	80	3.99	1.037	P<0.05	0.077	Accept

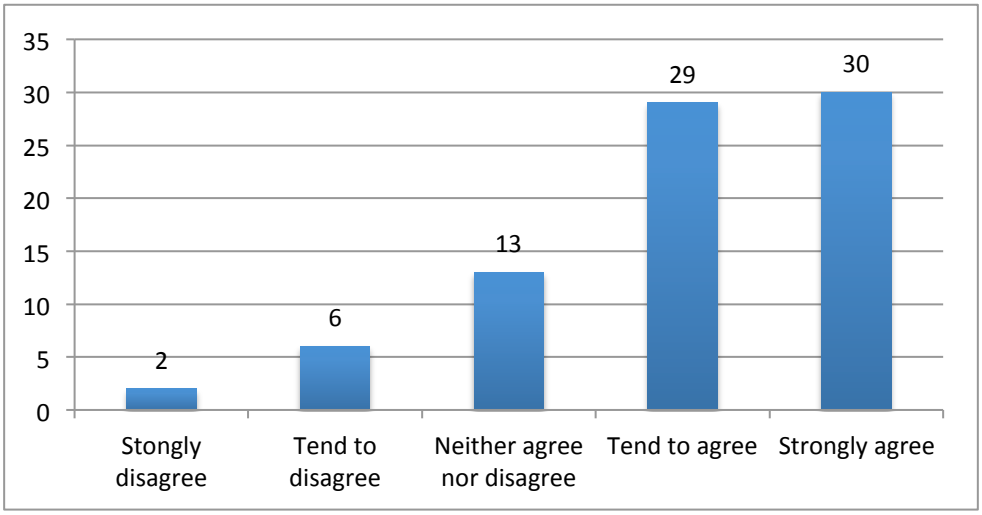

Fig. 6.4.4 Statistics of question B1

With the result shown above, *we fund out that government and non-government institutions' opinions are varied. We can conclude that most of the expert accepts the null hypothesis. It means that the Taiwan government DID NOT implement the tender and bidding review procedures as it should be.* The non-government institutions agree with this result, where in the contrary, *government institutions reject the null hypothesis.*

The bidding procedure and the review standard was mainly divided into bidding description meeting, licensed manufacturer tender election (to determine viability and feasibility), the parallel negotiation, review and sign contracts. However by expert interviews, we discover that in the reality, parallel negotiation was not executed as planned, where during the recovery of the questionnaire, opinions are mainly targeted to the importance of the parallel negotiation and it shouldn't be discarded during the process.

Q **B2**: Considers " Huge BOT projects such as HSR should increase its control process" as true. The statistic results are as follow:

Table 6.4.8 Statistics of question B2

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	4.19	1.059	P<0.05	0.030	Significant
Government Institutions	54	3.85	1.446	P<0.05		
Total	80	3.96	1.335	P<0.05	0.228	Accept

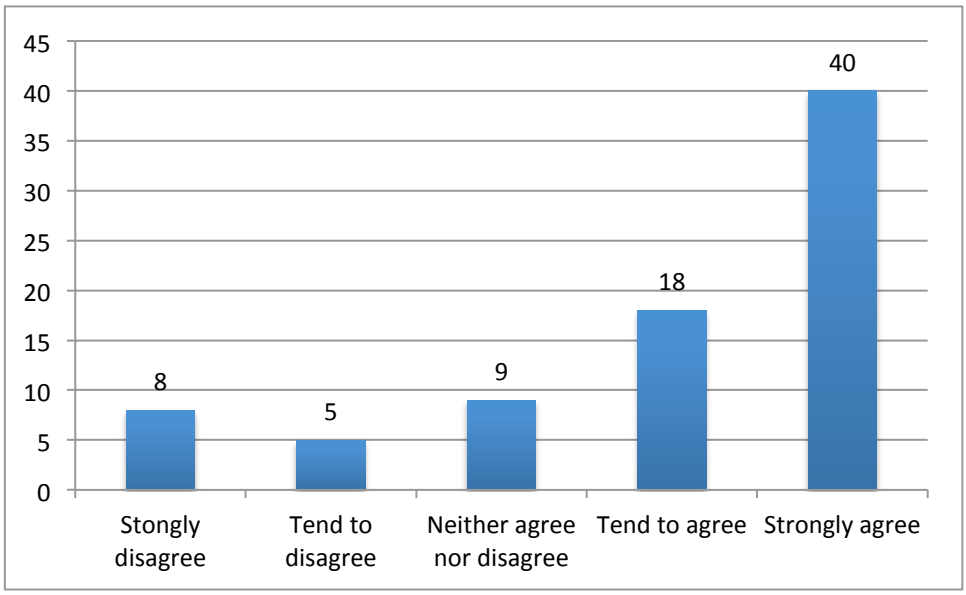

Fig. 6.4.5 Statistics of question B2

With the above result, we can conclude that *the opinions from the government institutions and the non-government institutions are different. Non-government institutions tend to think more control process is needed, while government institutions not*. However if we consider it generally, the control processes executed in the THSR case is acceptable. Experts suggest following control processes can be added:

- The supervision and quality management are important
- Financial banks and financing teams should participate from beginning to end.
- Financing evaluation will help the project go more smoothly.
- Government's responsibilities and supervision of its efficiency.
- Improvement in the administration of financing conditions, especially availability of funds.
- The Ministry of Finance should actively assist alternative finance matters.

Q **B3**: Considers "The THSRC proposed a very favorable bid to the government so the government made its decision in a short time" as true. The results are shown as follow:

Table 6.4.9 Statistics of question B3

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	3.96	1.148	P<0.05	0.307	Not Significant
Government Institutions	54	3.76	1.196	P<0.05		
Total	80	3.83	1.178	P<0.05	0.075	Accept

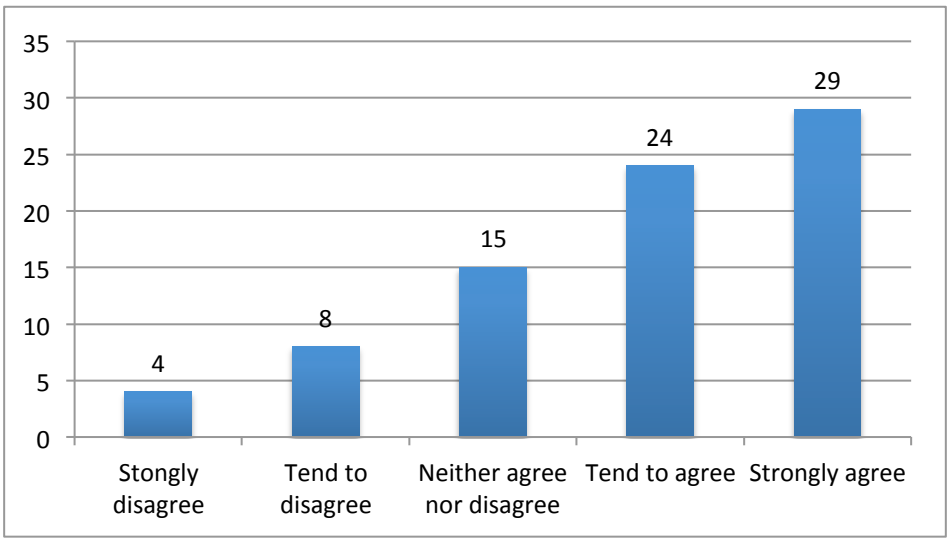

Fig. 6.4.6 Statistics of question B3

With the above result, we can see that both government and non-government opinions are not varied. That is *the government DID NOT made its decision shorter than it should be*. However, we can see in the bar chart that expert tend to agree on the hypothesis question and the mean value of the opinions is 3.83. Traditionally, the plan was after the concessionaire company propose their investment plan by August, the government will spend 3 months to decide for the best bidding, which they will announce the bid winner by November, However after the beginning of the review process, the government, to reduce the Selection Committee's pressure, announced the award by 25th September. The total bidding review process time was less tan one month. Therefore experts' opinions are the government should release the final decision in scheduled date.

Q **B4**: Considers "The government should **NOT** intervene in the financing negotiation" as alternative financing (H1), in the contrary null hypothesis (H0). The results are shown as follow:

Table 6.4.10 Statistics of question B4

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	3.12	1.558	P<0.05	0.795	Not Significant
Government Institutions	54	2.59	1.572	P<0.05		
Total	80	2.76	1.577	P<0.05	0.166	Accept

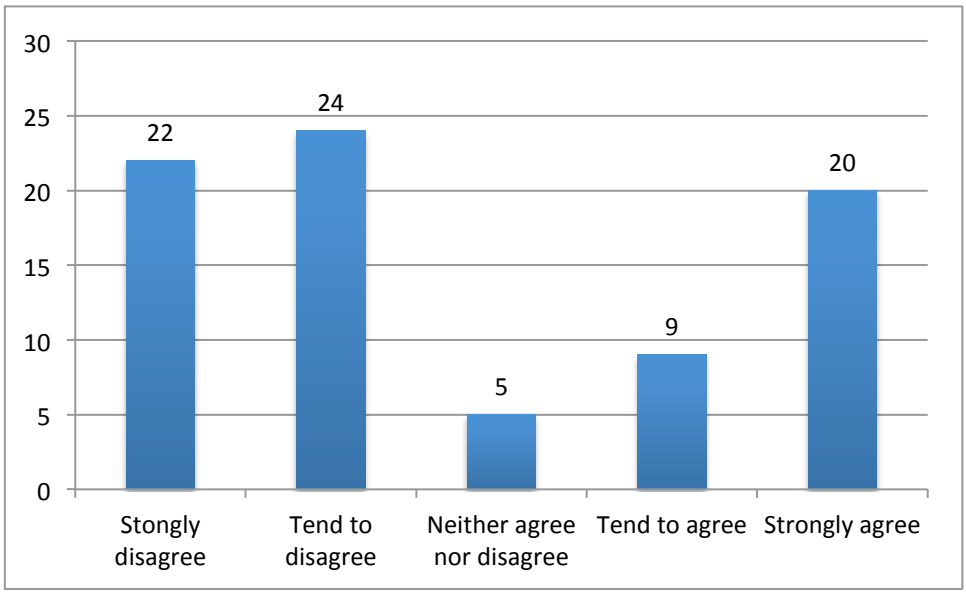

Fig. 6.4.7 Statistics of question B4

With the above result, we can conclude that *both government and non-government institutions accepts the null hypothesis (H0), which means that they consider that the government should intervene in the financing negotiation*.

This is mainly because of during the execution process, the THSRC faced critical obstacles in getting financing loans, therefore afraid of the suspension of the project, the government stood out

to promise and interfere in the loan negotiation between the concessionaire company and the financing firms.

The concerns of the financing firms were mainly the amount of financing loan and the enormous risk and uncertainty, therefore, if the government had not intervened, with the magnitude of the Taiwanese financing banks and the lack of experience in project financing, the THSR project will never complete.

However, experts suggest that the government could just give promises to the financing banks to let them know the government's determination on this case, and not necessarily get involved in the financing negotiation.

Q **B5**: Consider "The government has to give financing assurance and allow private institutions to execute the whole project" as alternative hypothesis (H1), in the contrary considered as null hypothesis (H0). The statistic result is as follow:

Table 6.4.11 Statistics of question B5

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	3.00	1.442	P<0.05	0.016	Significant
Government Institutions	54	3.83	1.314	P<0.05		
Total	80	3.56	1.404	P<0.05	0.012	Reject

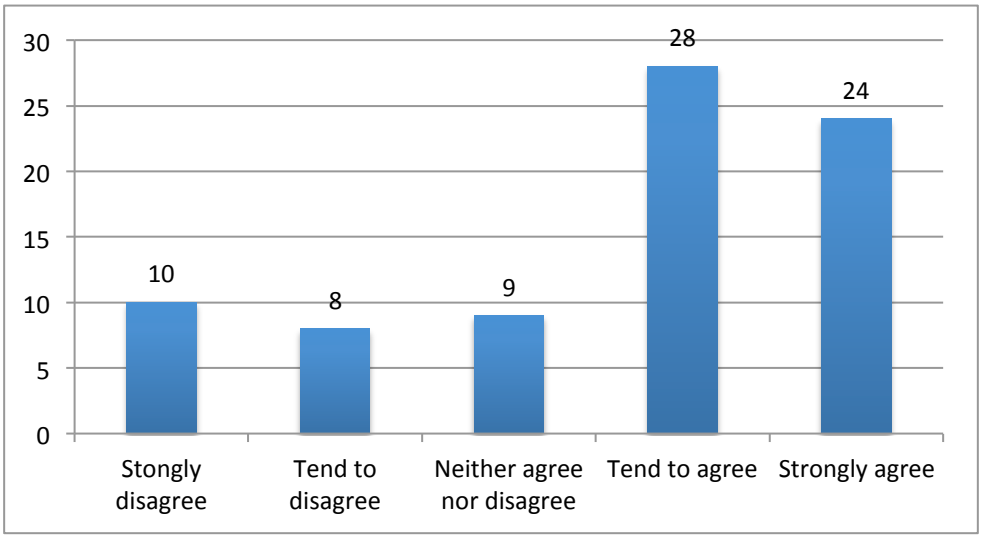

Fig. 6.4.8 Statistics of question B5

With the results shown above *we can conclude that government and non-government opinions are varied. Non-government institutions tend to disagree on the hypothesis question and government institutions tend to agree. When we analyze the hypothesis question from over all, the result is the government should give financing assurance and allow private institutions to execute the whole project.* The government gave funding promises (not included in the contract) to ensure and show that the government was determined to promote the project and it was a commitment to the Taiwanese people. Big BOT projects like THSR never promises that the private company's ability to withstand the initial losses of the operation and the financial pressure, though this might be the art of the construction bidding.

Q **B6**: Consider "The financial team should participate from the beginning (tender) to the end in a HSR BOT project" as true. The results are shown as follow:

Table 6.4.12 Statistics of question B6

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	4.19	1.297	P<0.05	0.146	Not Significant
Government Institutions	54	4.43	1.002	P<0.05		
Total	80	4.35	1.104	P<0.05	0.008	Reject

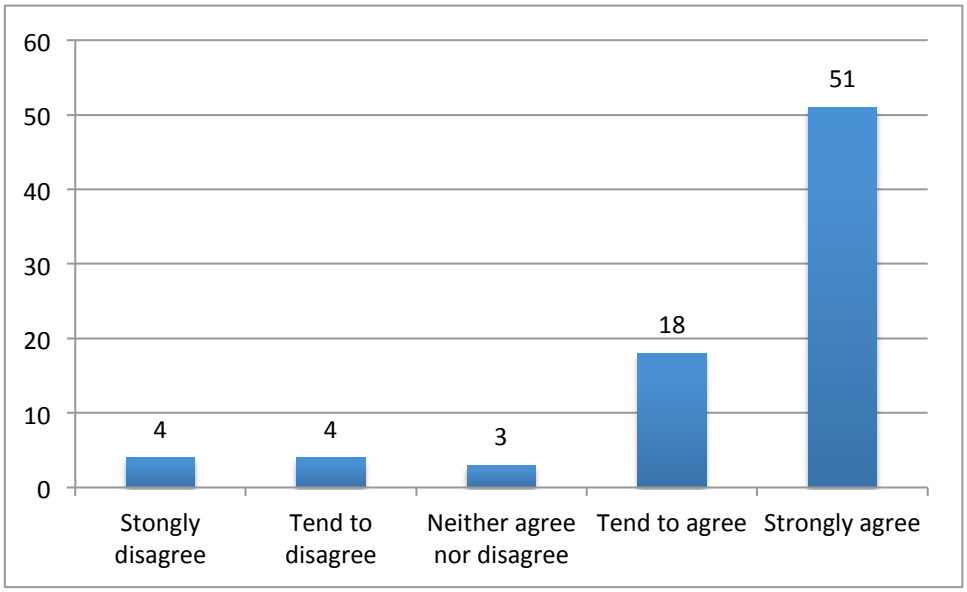

Fig. 6.4.9 Statistics of question B6

With the result showed above we can conclude that experts opinions are alike. Most experts suggest *that the financial team should participate from the beginning to the end in a HSR BOT project to ensure the steady progress of the project*. Moreover, the participation of the financial team and the assistance of the Ministry of Finance should be involved, only considering the confidence of the project; process such as construction bidding should be avoided.

Q **B7**: Consider "The government should clarify the matters and reference terms before deciding the best applicant in order to help the project proceed more smoothly" as true. The results are shown as follow:

Table 6.4.13 Statistics of question B7

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	4.92	0.272	P<0.05	0.056	Not Significant
Government Institutions	54	4.81	0.552	P<0.05		
Total	80	4.85	0.480	P<0.05	0.032	Reject

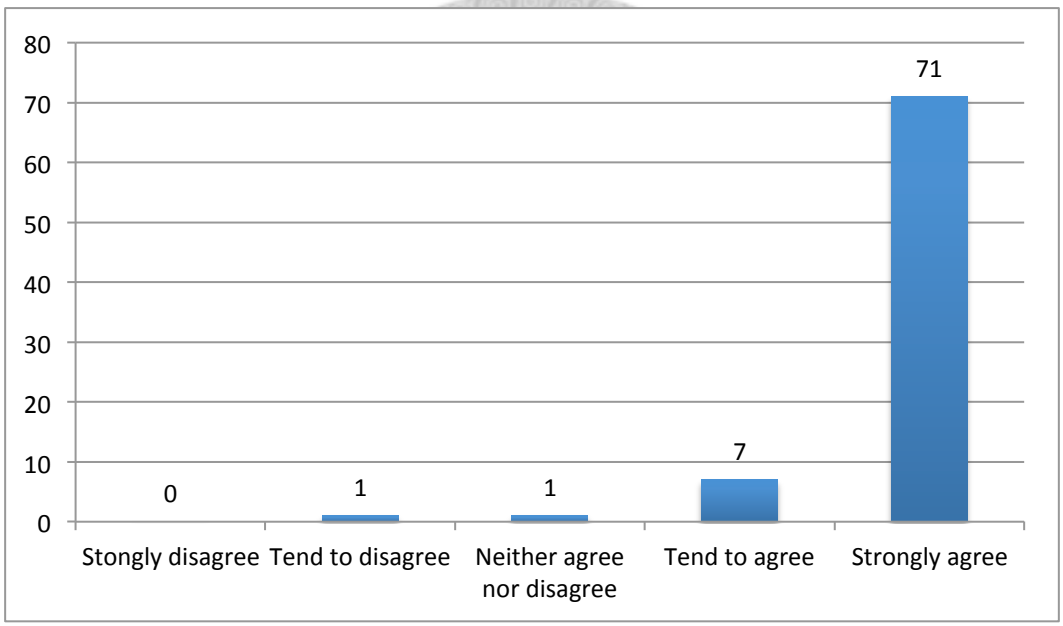

Fig. 6.4.10 Statistics of question B7

With the result shown above, experts think that *the government should clarify the matters and reference terms before deciding the best applicant in order to help the project proceed more smoothly*. It is very important to clarify the scope of issues and responsibilities, which is responsibility of the government, to support the project, however, in the THSR case, there is

opinions that the bidding winner was decided in too short time and this eventually cause the government to make lots of promises that shouldn't be.

Q **B8**: Consider "During the conduction of the THSR case, the Taiwan government made a lot of unreasonable commitment is a suitable act" as alternative hypothesis (H1), in the contrary null hypothesis (H0). The results are shown as follow:

Table 6.4.14 Statistics of question B8

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	3.31	1.408	P<0.05	0.135	Not Significant
Government Institutions	54	4.02	1.141	P<0.05		
Total	80	3.79	1.270	P<0.05	0.018	Reject

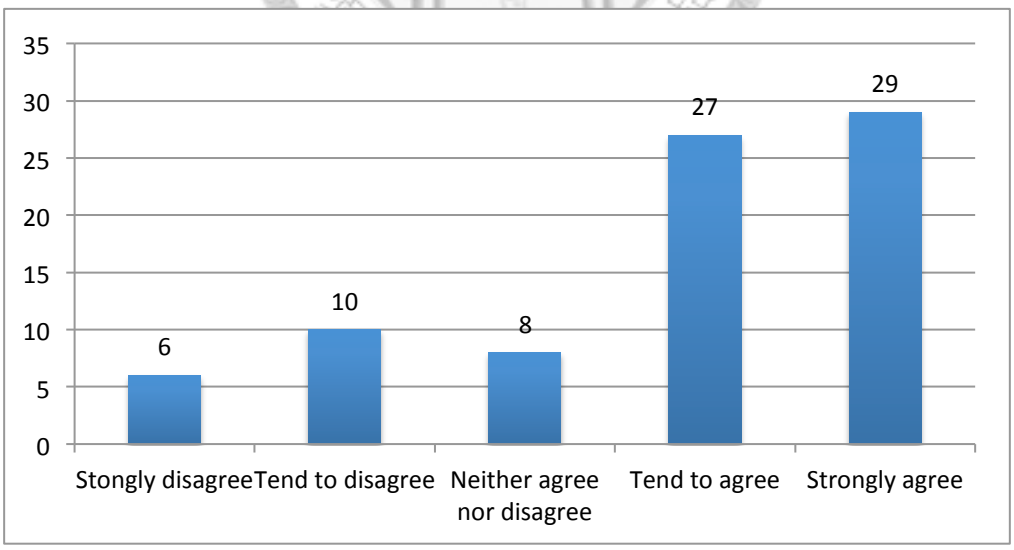

Fig. 6.4.11 Statistics of question B8

With the results shown above, experts' opinions are *the government's unreasonable*

commitments are suitable. The pressure from the media and the public consolidated the government's determination for the success of the THSR project. This is also one of the factors that put the government in a weaker position during the negotiation and the execution of the project.

Many unreasonable commitments are for example the THSRC did not enforced the contract; there was investment proposal in the contract that wasn't included in the bidding book; the government had to promise and take responsibility of the financial loans, etc.

The THSR case adopted the international standard system of bidding, therefore the government declared its commitment to promote for the reason of public welfare, the government had to make promises to show the representatives and the Taiwanese media its determination on the project and to ensure the on going of the project. Therefore, although we mentioned many unreasonable commitments above, from the point of view of the experts, these are suitable and necessary for the ongoing and success of the THSR project.

Part 3: Future Works

Q **C1**: Considers "The main reason for the financial deficit of the THSRC is because the they were too optimistic" as true, the results are as follow:

Table 6.4.15 Statistics of question C1

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	4.12	0.993	P<0.05	0.831	Not Significant
Government Institutions	54	4.04	1.081	P<0.05		
Total	80	4.06	1.048	P<0.05	0.097	Accept

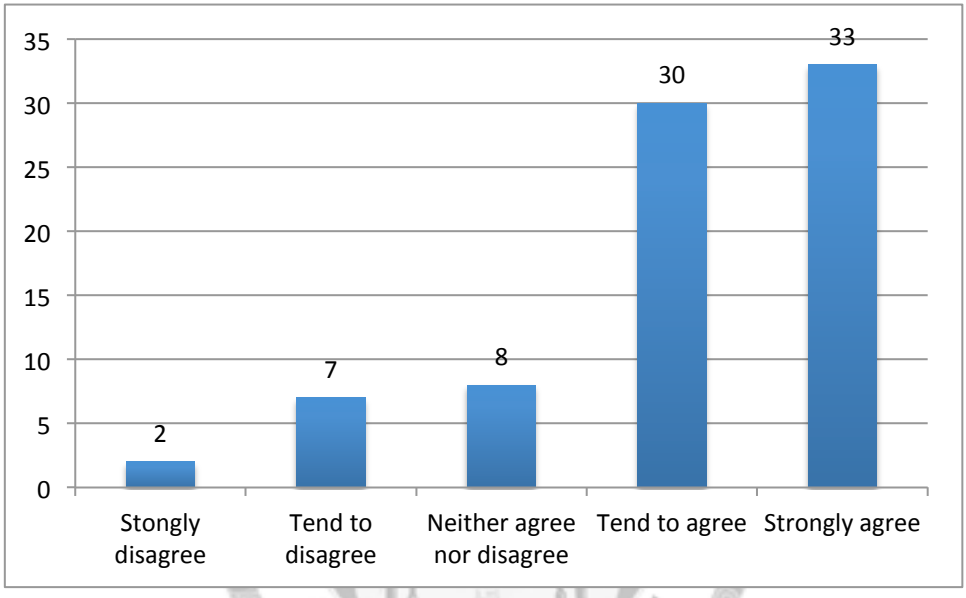

Fig. 6.4.12 Statistics of question C1

With the results shown above, expert's opinions are alike. Most of the experts think that *the THSRC were not too optimistic calculating the ridership.* More precisely, both the government and the concessionaire company were optimistic in the ridership forecast. Looking back from now, main reasons may be that the Taiwan's economic size is small and it is usually influenced by the international and domestic political environment and economic growth. Moreover, 20 millions of Taiwanese businessman had emigrated and installed in China duo to the domestic economic growth, therefore either of the parties was indeed mistaken.

Q **C2**: Consider "The ridership is not as optimistic as expected because of the government's misleading" as true, the results are shown as follow:

Table 6.4.16 Statistics of question C2

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	2.88	1.143	P<0.05	0.027	Significant
Government Institutions	54	3.09	1.391	P<0.05		
Total	80	3.03	1.312	P<0.05	0.438	Accept

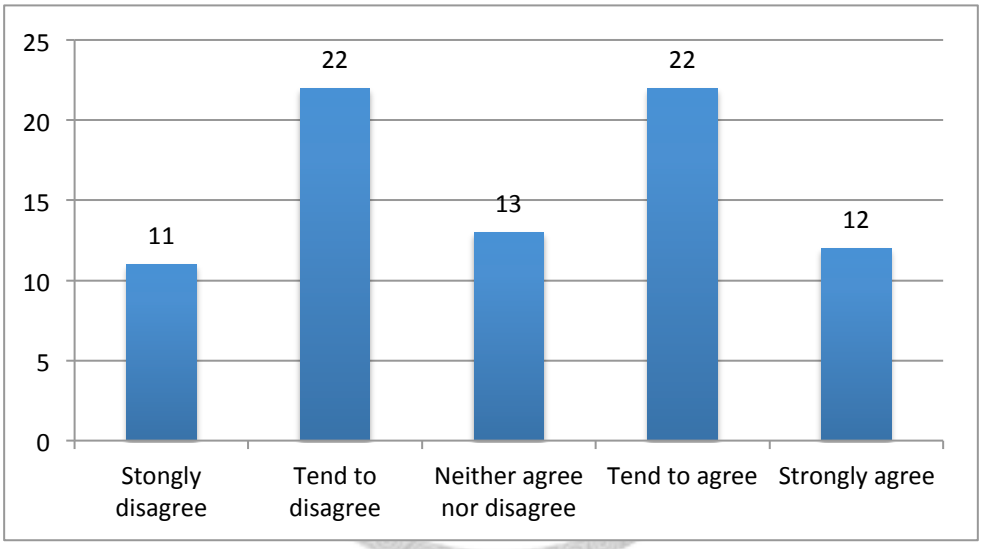

Fig. 6.4.13 Statistics of question C2

With the result shown above, we can see that experts' opinions are varied, Government institutions tend to disagree and non-government institutions tend to agree. However the government and non-government institutions thinks that the government did not mislead the ridership forecast. Therefore we can conclude *that both parties had to take responsibilities in the ridership.*

Q **C3**: Consider "It is feasible for other countries to build a HSR project with BOT as Taiwan did" as true, the results are shown as follow:

Table 6.4.17 Statistics of question C3

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	3.77	1.366	P<0.05	0.802	Not Significant
Government Institutions	54	3.78	1.208	P<0.05		
Total	80	3.78	1.253	P<0.05	0.001	Reject

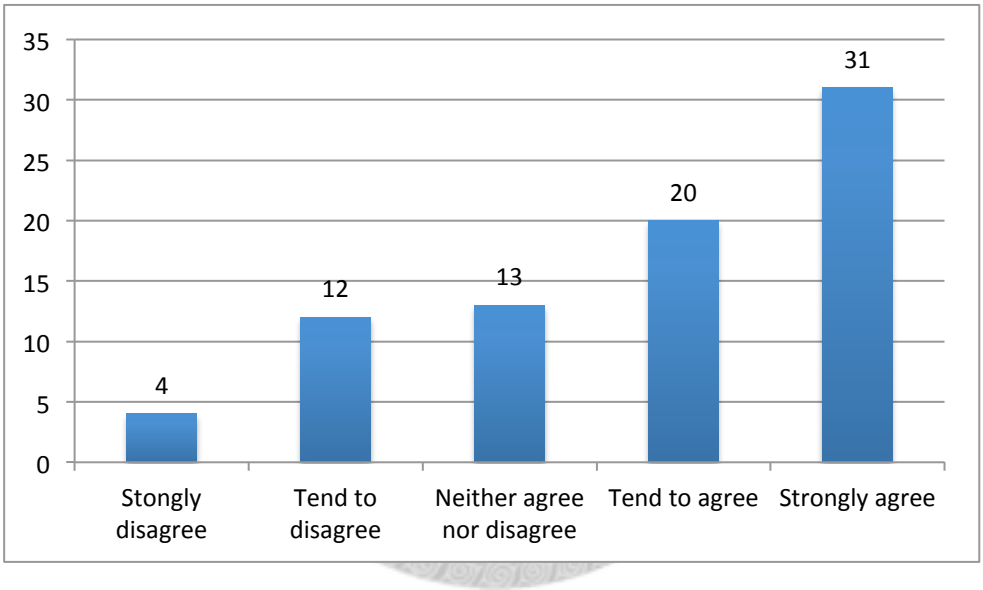

Fig. 6.4.14 Statistics of question C3

With the results shown above, we can suggest that it *is feasible for other countries to build a HSR project with BOT as Taiwan did.* Other countries that wish to implement HSR with BOT can refer to Taiwan's experience; taking accounts of our weakness and mistakes, surely HSR and BOT will be a match.

Q **C4**: Consider "The THSR experience is valuable for other countries who want to build a HSR line, and take Taiwan's case as a reference" as true, the results are shown as follow.

Table 6.4.18 Statistics of question C4

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	4.65	0.485	P<0.05	0.152	Not Significant
Government Institutions	54	4.41	1.037	P<0.05		
Total	80	4.49	0.900	P<0.05	0.006	Reject

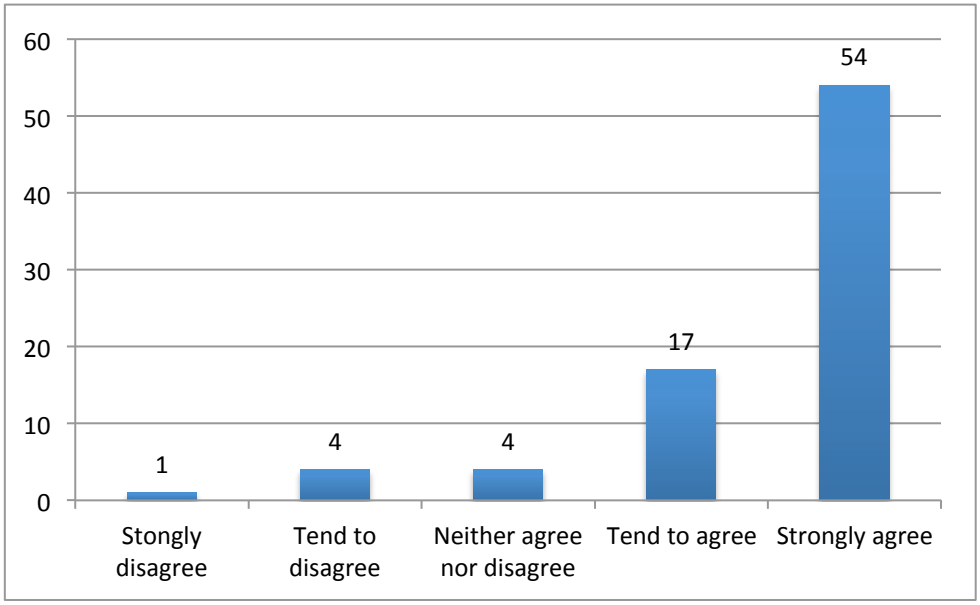

Fig. 6.4.15 Statistics of question C4

With the result shown above, we can see that the experts' opinions are that *the THSR experience is very valuable for other countries that want to build a HSR line.*

Q **C5**: Consider "The THSR provided great contribution to Taiwan's transportation in spite of all the controversies" as true, the results are shown as follow:

Table 6.4.19 Statistics of question C5

Unit	Valid Samples	Mean Value	Stand. Deviation	Reject Rule	P-value	Outcome
Non-Government Institutions	26	3.92	1.412	P<0.05	0.054	Not Significant
Government Institutions	54	4.39	0.998	P<0.05		
Total	80	4.42	1.161	P<0.05	0.030	Reject

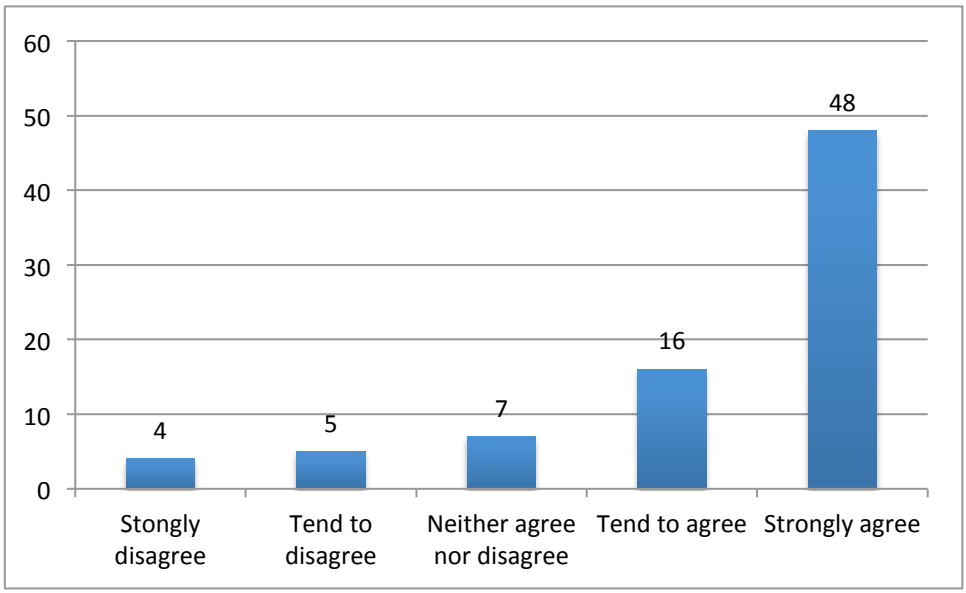

Fig. 6.4.16 Statistics of question C5

With the result shown above, we can say that *the THSR provided great contribution to the Taiwan's transportation.* Despites all the controversies, the THSR successfully overcame the challenges. THSR has been providing services to the Taiwanese people for 5 years, bringing comfort, and efficiency. We can always say that no project is perfect, what can be done is to learn from the past. If other countries face similar financial burden and need a high-speed rail line to

alleviate its domestic traffic problems or support the domestic economic growth, this research analyzes and gives suggestions on critical issues that will influence the success or failure of the project.

6.5 Summary

From the factor extraction and the decision of the number analysis, we can select 7 key factors; the cumulative variance is 67.018%. These factors are: Value of the THSR experience; Project Financing Implementation; Basic Acts to promote HSR; Combination of BOT and HSR; Procedure and Involvement; Contract Terms and bidding control procedures and ridership forecast. The credibility of the questionnaire is 0.622 (Cronbach's alpha value).

The released questionnaire was 188 copies; recovery rate is 42.6%. Experts, with more than 10 years of experience in the field, account for 95% of the total recovered copies. The results are:

- HSR provided Taiwan a transportation that uses less land are, low pollution and high capacity.
- Alternative financing (BOT) can alleviate government's financial burden and by implementing with HSR project, can also introduce private sector's efficiency.
- The Encouragement Statute is useful for the construction of HSR but it should be more complete. It should include safety management laws regarding areas outside the HSR line, government regulations to support management, etc.

- The government should implement the tender and bidding review procedures as it had planned.
- Control process of THSR BOT project is not enough. It can enhance supervision and quality management, financial terms and participation of financing teams, financing evaluation, government's responsibilities and supervision, improvements in the administration, and availability of funds.
- The government made its decision shorter than it should be, and it is not suitable.
- The government should intervene in the financing negotiation in this kind of projects.
- Government should clarify its determination to execute the HSR project and allow private institution to execute the whole project.
- Financial team plays crucial role in the project, therefore they should participate from beginning to end.
- Government should clarify matters and reference terms before deciding for the best applicant.
- Government's commitments are suitable, even they were unfair to the government.
- Ridership is a risk that should be taken by both parties; the government and the concessionaire company.
- HSR projects can work with alternative financing.
- No project is perfect; despites all the controversies, Taiwan HSR can play as reference

for other countries willing to build their HSR project.

Based on the survey, we have no doubt that the high-speed rail is the transportation of the new era that has many advantages such as energy efficient, low pollution, high capacity and use of little land. As for the Taiwan High Speed Rail's example, it certainly brought convenience and commodity to the Taiwanese people.

There is no doubt that the government did well on promoting the HSR project, even with BOT. By using the BOT method, the government not only alleviated its financial burden but also took advantages of the private sector's efficiency. During the planning, negotiation and construction stage of the THSR project, the government and the concessionaire company suffered huge pressure from the Taiwanese media for being the first HSR project executed with BOT, counties that has HSR or even in planning stage put their attention on every detail of the THSR project, therefore without the possibility to learn from other past experiences, the government set the "Encouragement Statute" to promote the involvement of the private sector and to give Taiwan high-speed rail a basis to grow on.

We now know that the Encouragement Statute was helpful but not enough and complete, laws about the safety management outside the high-speed line and government regulations were insufficient. The bidding procedure and the review process standard was not executed as planned and apart from the stated procedures, supervision and quality management were also important, if financial banks could participate in the entire process, will certainly help the project go more

smoothly.

The financing loans were main obstacles in the THSR project. Afraid of the suspension of the project, the government stood out to promise and interfered in the loan negotiation between the concessionaire company and the financing firms. The concerns of the financing firms are mainly the amount of financing loan, the enormous risk and uncertainty, but the intervention of the government caused complains from the public and the media, yet, if the government had not interfered, with the magnitude of the Taiwanese financing banks and the lack of experience in project financing, THSR will never complete.

In conclusion, dedicated laws for HSR as basis is indispensable for the success of HSR projects. If other countries face similar financial burden and seek a high-speed rail line to alleviate its domestic traffic problems or support the domestic economic growth, this research analyzes and gives suggestions on critical issues that will influence the success or failure of the project.

Chapter 7 Conclusions and Suggestions

7.1 Conclusions

From literature review we can see that the high-speed rail is a sustainable transportation that has many advantages; countries in the world seek to get benefits from this significant technological breakthrough of the 20th and 21st century. The evolution and demand for faster and safer transportation has been increasing, however, to carry on a HSR project is not easy, many challenges are involved in the process. In this thesis we only focus on the challenge of funding.

The private partnership and alternative financing is considered the most workable solution for this problem, this argument is further explained and enforced with a questionnaire survey. We can conclude that the introduction of BOT can alleviate government's financial burden and also introduce private sector's efficiency. In the Taiwan's high-speed rail experience, we executed public-private partnership BOT method. This unique experience is very valuable for countries that wish to build their HSR lines.

United States has many developed cities that are geographically and topographically diverged. Congress had been working continuously to develop high-speed rail, but none of the project has lead to construction. America needs HSR to solve its domestic traffic demand problem and possess the qualities for the development of high-speed rail to connect the intrastate cities. The advantages and qualities turn America to be the biggest HSR market in the world.

Since the inauguration of President Obama in April 17th, 2009, the president showed support in the development of high-speed rail and announced this plan of the "Vision of High Speed Rail in America". Together appropriating 8 billion dollars of initiative fund for the 13 new HSR corridors across the U.S. nation. The Congress also formulated several acts as legislative foundations to promote high-speed rail's development. It is undeniable that this is an upright start. However from foreign experience we recognize that the federal funding is not enough for the 13 HSR corridors, therefore from Taiwan's experience, this study defines private-public partnership to the State and local governments.

The partnership between government and private sector must reach key basic requirements in order to success in the HSR project:

- The private sector must be a self-sustainable entity and posses the ability to build and run the corridor;
- Detailed planning and project design;
- Strong financing team;
- Legislative foundation to protect both the government and the private party's rights and duties.

Potential factors for HSR BOT projects

From the analysis of the recovered questionnaire we can classify several potential hidden

factors that contribute to the success of HSR BOT. They are the legislation foundation, tender and bidding procedure, project control process and financing team, government's responsibility, and ridership:

Legislative foundation

To provide THSR a legislative foundation, the government should set up an ad hoc legislation (The Encouragement Statute) to facilitate the promotion of the THSR project. Although the Encouragement Statute was helpful but it was not enough and complete. For projects like HSR, laws concerning the safety management and government regulations should be added. The government should clarify its responsibilities in the contract and give complete regulation to grant public power management rights support and facilitate the private company. Areas outside the station and adjacent the high-speed rail line also requires safety management and development issues law settlement.

Tender and bidding procedure

The tender and bidding procedure should be fair and transparent. The government should clarify the matters and reference terms before deciding the best applicant. Most importantly the execution of parallel classification or negotiation should be included during the process. Bidding procedure should respect the announced deadlines and process. The Taiwan HSR case adopted the

minimum bidding amount criteria, which was largely criticized. Looking into foreign construction examples, they already abandoned the minimum bidding amount as a criteria to select its tender, therefore with the analysis and experts interviews we suggest that the minimum bidding amount is not suitable for the HSR project, considering reasonable value of the project and avoid the use of minimum bidding criteria.

Project control process and financing team

The government should focuses on the supervision and quality management processes during the execution stage. If the financing banks could participate from the beginning (planning and negotiation stage) to the end of the project, will help the project go more smoothly. The efficiency of the government's responsibilities and supervision should be achieved in order to facilitate the progress of the project and improvement in the administration of financing conditions especially the availability of funds.

Government's responsibility

Normally, in public private partnership the government does not need to provide funds or intervene in the process. However, in the THSR case the government intervened in the financing negotiation and surprisingly most experts in the survey agree on the intervention. The financing loans is the most important part of the HSR project, but domestic banks were afraid of the

suspension of the project and the potential risk, so did not want to accede loan to THSRC. The government stood out to promise and interfered in the loan negotiation to solve the problem.

If the government had not intervened, the THSR project will never complete. We assume that for this specific kind of projects, it is advisable that the government show strong support by giving promises to the financing banks and let them know the determination of the government. It is not necessary to involve itself in the financing negotiation and place itself in a weaker position. It is not suggested to have the government make unreasonable commitments to ensure the continuity of the project.

Ridership

After the completion of the THSR project, ridership was not that optimistic as expected. During the bidding and execution stages the concessionaire company was too optimistic in the ridership forecast. However either of these parties should take full responsibility, and either of the parties was indeed mistaken.

As from the questionnaire and analysis, we conclude that the Taiwan's experience is indeed valuable for future similar projects and despites of the controversies during the THSR project stages, it is recommendable for the United States to implement private public partnership for its development of HSR and reference from Taiwan's experience.

7.2 Future Works

This study analyzes comprehensively the execution of HSR with alternative financing; it determines main issues during different stages of a HSR BOT. From Taiwan HSR's experience, we share lessons learned and give advice for future applications.

Since this thesis examines with an overall perspective, details such as the selection of ridership forecast method or details of contract laws and risk management are generally explained and suggested.

For future works it is suggested to deeper study these issues and propose best method or basic standards.

References

1. Algarni, Ayed Muhammad (2007), "Build-Operate-Transfer in Infrastructure Projects in the United States", Journal of Construction and Management ASCE.
2. Campos, Javier, de Rus, Gines and Barron, Ignacio Fundacion BBVA (2007), "A review of HSR experiences around the world", Munich Personal RePEc Archive (MPRA), Paper No. 12397
3. Cerreno, Allison L. C. (October, 2005), "High-Speed Rail Projects in the United States: Identifying the Elements for Success". A publication of the Mineta Transportation Institute College of Business, MTI Report 05-01.
4. Chang, L. M. and Chen, P. H. (2001), "Bot financial Model: Taiwan High Speed Rail Case". Journal of Construction Engineering and Management (ASCE).
5. Chen, H. J. (2001), 陳宏榮，BOT 公共工程專案之投融資及風險評估程序。Master Thesis, National Chiao Tung University, Institute of Business and Management.
6. Cheng, P. Y. (2000), 鄭伯禹，BOT 實務與法制的檢討－以高鐵案的甄選程序為中心。"An Examination of Practices and Legal Institutions of BOT-Centering on the Procuring Procedure of the High Speed Railway", Master Thesis, National Taiwan University, college of Law.
7. Cheng, Y. H. (2009) "High-speed rail in Taiwan: New experience and issues for future development", Journal Elsevier, Transport Policy 17 (2010) 51-63
8. CRS (2009), "High Speed Rail (HSR) in the United States", Congressional Research Service 7-5700.
9. Dinh, Kien (2010) "Preliminary Study of BOT Transportation Projects in Vietnam". Master Thesis, National Taiwan University, Department of Civil Engineering.
10. DOT (April, 2009), "Vision for High-Speed Rail in America", High Speed Rail Strategic Plan, Department of Transportation, Federal Railroad Administration, United States.

11. DOT (September, 1997), “High Speed Ground Transportation for America”, U.S. Department of Transportation, Federal Railroad Administration, United States.
12. Fertey, Vincent (2007), “574,8 km/h!”, April 3, 2007, Online Resource: www.LeFigaro.fr, France.
13. Fight, Andrew (2006), “Introduction to Project Finance”, Editorial: Essential Capital Market (Repost), Butterworth-Heinemann, ISBN: 075065905X, United States.
14. FRA (March, 2009), “Overview, Highlights and Summary of the Passenger Rail Investment and Improvement Act of 2008 (PRIIA)”, Public Law No. 110-432, Division B, enacted Oct. 16, 2008, Amtrak/High-Speed Rail, Federal Railroad Administration, United States.
15. GAO (June, 2010), “High Speed Rail – Learning from service start-ups, prospects for increased industry investment, and federal oversight plans”, United States Government Accountability Office, Report to Congressional Committees, United States.
16. Hagler, Yoav (2008), “Back to Track: An Examination of Current Transportation Networks and Potential High-Speed Rail Systems in Three U.S. Mega regions”, United States.
17. Harrison, John A., Member, ASCE (1995), “High speed Ground Transportation is Coming to America – Slowly”, Journal of Transportation Engineering, Vol. 121, no.2.
18. Ho, M. K. (2007), 何明光,從商業倫理探討台灣 BOT 之制度—以台灣高鐵案為例。Master Thesis, National Central University, Graduate institute of Philosophy.
19. Ho, H. S. (2008), 何慶瑄，台灣高鐵專案獨立品質查核制度及界面管理機制之研究。“The Study of Quality and Interface Management System for Taiwan High Speed Rail Project”, Master Thesis, Feng Chia University, Civil and Hydraulic Engineering.
20. Hsiao, An-Chi (2000), 台灣ＢＯＴ制度之研究－以台灣高速鐵路為例。“A Study on the Design of Taiwan’s BOT System─ the Case of Taiwan High Speed Railway”. Master Thesis, National Taiwan University, Department of Finance.
21. Jeng, Y. (2004), 鄭義，交通運輸設施之全成本研究—以台灣高速鐵路為例。“Full Costing

Analysis in Transportation Sector─The Case of Taiwan High Speed Rail", Master Thesis, National Taipei University, Institute of Natural Resources Management.

22. Jones, B. (2001), "Public-Private Partnership for Ontario Hospital Capital Projects". A background report prepared by Bennett Jones LLP for the Ontario Hospital Association's Committee on Hospital Capital Development.
23. Kao, T. C. (2010), "A sustainable Transportation of The Century – High Speed Rail". The Twenty-Third KKCNN Symposium on Civil Engineering November 13–15, 2010.
24. Keating, Oliver (2011), "High Speed Trains Around the World", Online Resource: www.o-keating.com.
25. Levinson, David (1996), "The full cost of high-speed rail: an engineering approach", The Annals of Regional Science, 31:189-215.
26. Levinson, David (1998), "Air, high Speed Rail, or Highway: A Cost Comparison in the California Corridor", United States.
27. Liao, W. C. (2008), 廖偉智，政府大型 PPP 決策之承諾續擴現象研究：台灣高鐵個案研究。"The Escalation of Commitment in Public-Private-Partnership：The Case of Taiwan High speed Rail Project", Master Thesis, National Taiwan University, Department of Civil Engineering,.
28. Lin (May, 2000), 林能白，從高速鐵路及國際金融大樓兩案之經驗檢討我國 BOT 制度之設計。RDEC-RES-089-004, Research, Development and Evaluation Commission, Executive Yuan, R.O.C. Taiwan.
29. Liu, T. M. (2004), 劉梓梅，政策網絡之研究--以台灣南北高速鐵路計畫政策為例。Master Thesis, National Dong Hwa University, Graduate Institute of Public Administration.
30. Liu and Hsu (2009), 劉麗君、許宗盛，採用 BOT 興建台灣高鐵之政策考量與初期成效之評估報告。"The Financial Operation of BOT Special Project – Case Study with Taiwan High Speed Rail Project", Master Thesis, TamKang University, Executive Master's Program Of Business Administration (EMBA) In International Business.

31. MTI (2005), Mineta Transportation Institute, October 2005, “High Speed Rail Projects in the United States: Identifying the Elements for Success”, MTI Report 06-03, San Jose State University.
32. MTI (2006), Mineta Transportation Institute, March 2006, “High Speed Rail Projects in the United States: Identifying the Elements for Success, Part 2”. MTI Report 05-01, San Jose State University.
33. National Journal Expert Blogs, Transportation. Tuesday, July 6th, 2010, “Will High Speed Rail Drive Business?”, National Journal Group Inc.
34. THSR (2006), 南科高鐵減振工程探討，www.taasa-web.org/THSR/THSR.doc。
35. UIC (2010), International Union of Railways, July 2010. “Demand Forecast, Rail Simulation & Access Fees - New Perspectives in Financial Feasibility”. Transport Research Institute, France.
36. UIC (2010), International Union of Railways, November 2010, “High Speed Rail – Fast Track to Sustainable Mobility”, Transport Research Institute, France.
37. Virginia Tech, Department of Civil and Environmental Engineering (2010), Environmental sampling and monitoring primer, Hypothesis Testing by Georgina Wilson Gonzalez and Karpagam Sankaran. Online document: “http://www.cee.vt.edu/ewr/environmental/teach/smprimer/hypotest/ht.html”.
38. Wang (1999), 王其昌，高速鐵路工程，西南交通大學出版社，中國。
39. Wu (March, 2006), 吳福祥，台灣高速鐵路之新紀錄， R.O.C. Taiwan.
40. 監察院交通及採購委員會（2009），專案調查研究：“台灣高鐵 BOT 策略與執行成效之檢討”. Control Yuan, Communication and Procurement Affairs, R.O.C. Taiwan.

Appendix I

敬愛的專家、學者：

您好，末學是台灣大學土木工程所營建管理組碩士班研究生，這是一份有關於「台灣高速鐵路 BOT 成效之研討及其對未來美國發展高速鐵路參考性」之專家問卷調查。素仰 台端對民間參與公共建設學養淵博，懇請您能在百忙之中撥冗填寫問卷。

本研究期將臺灣高鐵經驗系統化整理後，提供美國興建高鐵時參考，故問卷將台灣高鐵 BOT 案分成策略規劃階段、工程執行階段與未來方向等三部份，共十八題，除勾選 1~5 的同意度指標選項外，若有您希望補充說明之部份也歡迎指教，盼您的豐富經驗與專業指導將有助於本研究之進行。您所提供資料只供學術研究使用，絕不做其它用途與對外公開。

由於本研究的時間限制，煩請您在本問卷勾選完後，在 3 月 31 日前以 e-mail 回覆至 r98521701@ntu.edu.tw，以利本研究後續之進行。若有題意不清或疑問的地方，懇請提出您的寶貴意見。感謝 您的熱忱協助，不便之處，尚請見諒！

敬祝

事業順利、吉祥如意

國立台灣大學土木工程所營建管理組

指導教授：高聰忠、曾惠斌

研 究 生：余亭慧 敬上

電話：0911-180108

e-mail: r98521701@ntu.edu.tw

基本資料

一、 您目前的單位：

□機關 □非機關

二、您的專業領域主要是：

□公共工程 □民間工程 □非工程類

二、 您的工作年資：

□25 年以上 □21~25 年 □16~20 年 □11~15 年

□6~10 年 □5 年以下

三、 您的促參相關年資：

□10 年以上 □8~9 年 □6~7 年 □4~5 年

□2~3 年 □2 年以下

四、 您的高速鐵路相關年資：

□10 年以上 □8~9 年 □6~7 年 □4~5 年

□2~3 年 □2 年以下

(請接下頁)

第一部份：高速鐵路ＢＯＴ案之策略規劃階段 (共四題)(「補充意見」部分非強制性)	請依您的同意度，在適當的“□”打勾。
	同　點　有　意
1. 多數文獻指出高速鐵路之優點為用地少、省能源、低污染、運量大。以台灣高鐵之建設為例，您是否認為台灣高速鐵路提供了台灣南北交通這樣的一個交通工具？ 補充意見(非強制性)：	□1 □2 □3 □4 □5
2. 您是否同意採用ＢＯＴ可幫助政府減輕財務負擔之外同時也引進了民間執行工程之效率？ 補充意見：	□1 □2 □3 □4 □5
3. 台灣高鐵為世界第一條以ＢＯＴ執行之高速鐵路工程案，對於其推行，政府所訂定了『獎勵民間參與交通建設條例』，你認為該法案充分的提供了推動民間機構參與建設台灣高速鐵路的基礎？ 補充意見：	□1 □2 □3 □4 □5

4. 國外若要建設高速鐵路，且要參考台灣高鐵之案例，您認為台灣高鐵案例是否據有參考價值？ 補充意見：	□1 □2 □3 □4 □5

第二部份：高速鐵路ＢＯＴ案之工程執行階段 (共九題)	**請依您的同意度，在適當的“□”打勾。**
	不同意 / 有點不同意 / 普通 / 有點同意 / 同意
1. 台灣高鐵招標、審標之程序大概分為：說明會、特許廠商招標（確定營運能力與可行性）、平行協商、審查、簽約，您認為台灣高鐵ＢＯＴ案是否確實執行以上招標審標程序？ 補充意見：	□1 □2 □3 □4 □5
2. 承上題，您認為對於大型金額之ＢＯＴ工程（如高速鐵路）是否應再增加控管作業流程？您認為何種程序是為必要？ 您建議之程序為：	□1 □2 □3 □4 □5

第二部份：高速鐵路ＢＯＴ案之工程執行階段 (共九題)	請依您的同意度，在適當的“□”打勾。
	不同意 有點不同意 普通 有點同意 同意
3. 你是否認為台灣高鐵公司提出相當優厚於政府的投標條件，使政府在短時間即決定決標？ 補充意見：	□1 □2 □3 □4 □5
4. 就台灣高鐵 BOT 案，交通部、台灣高鐵與融資銀行團進行之三方融資洽談作業，您認為政府是否不該出面介入台灣高鐵之融資洽談作業？ 補充意見：	□1 □2 □3 □4 □5
5. 像台灣高鐵之大型建設以ＢＯＴ方式讓民間機構執行整個工程，同時政府出面給與融資之保證，您認為是否合理？ 補充意見：	□1 □2 □3 □4 □5

第二部份：高速鐵路ＢＯＴ案之工程執行階段 (共九題)	請依您的同意度，在適當的“□”打勾。
	不同意 有點不同意 普通 有點同意 同意
6. 融資團隊在整個高鐵ＢＯＴ計劃案扮演著不可或缺的角色，您認為融資團隊應從頭(招標)到尾都參與是最為恰當？ 補充意見：	□1 □2 □3 □4 □5
7. 以台灣高鐵為例，在還未決定最優申請人之前，您是否認為政府應釐清其應辦事項與權責範圍，使往後台灣高鐵工程更順利進行？ 補充意見：	□1 □2 □3 □4 □5
8. 為確保台灣高鐵ＢＯＴ案順利的進行，台灣政府後來做了許多的承諾，您是否同意？ 補充意見：	□1 □2 □3 □4 □5

第三部份：高速鐵路ＢＯＴ案之未來方向(共四題)	請依您的同意度，在適當的“□”打勾。
	普通同意 有點同意
1. 目前台灣高鐵之財務面臨虧損之狀態，您是否認為主要原因是因為之前台灣高鐵公司太過樂觀？ 補充意見：	□1 □2 □3 □4 □5
2. 目前台灣高鐵之運量不如預期之樂觀，您是否認為為之前政府的誤導所致？ 補充意見：	□1 □2 □3 □4 □5
3. 國外若要建設高速鐵路且像台灣採用ＢＯＴ之方式，您認為是否可行？ 補充意見：	□1 □2 □3 □4 □5
4. 國外若要建設高速鐵路，且要參考台灣高鐵之案例，您認為台灣高鐵案例是否據有參考價值？ 補充意見：	□1 □2 □3 □4 □5

5. 台灣高鐵的執行雖然充滿爭議，但您是否覺得其結果對台灣的交通建設貢獻極大，所以過程的缺點是瑕不掩瑜? 補充意見：	□1 □2 □3 □4 □5