The Birth of the Taipei Metro and Technological Hybridity under American Hegemony: the History of the Rail Mass Transportation in Postwar Taiwan

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The Birth of the Taipei Metro and Technological Hybridity under American Hegemony: the History of the Rail Mass Transportation in Postwar Taiwan

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Table of Contents

Acknowledgments

This dissertation is the achievement of a decade-long exploration and thinking. When I was a two-year master student in the Institute of Sociology, National Tsing Hua University (NTHU) in 2009, I found that my term paper discussing how Taiwan Railways Administration's Tamsui Branch Line became the Red Line of Taipei Metro might have potential to be extended as a master's thesis. My advisor at that time, Professor Wu Chyuan-Yuan, agreed with my idea and encouraged me to write the thesis about the Taipei Metro so that I started my research on the history of the Taipei Metro. However, after I began to write the thesis, I found that I am swamped with the historical and theoretical complexity of this topic. Firstly, there was no comprehensive history writing about the metro system in Taiwan's capital, although the Taipei Metro already became a vital part of Taipei. Moreover, the metro system involved so many political and technological controversies that many historical materials became too sensitive to access. Notably, many of the controversies included not only local politics but also an international one. Finally, writing a historical and sociological thesis about a technological system in a catching-up country like Taiwan forced me to touch the intellectual issues which cost many scholars' talent and efforts for even more arguments. As a master student in the age of early twenties, I cannot handle this complicated topic with satisfaction. One of the committee members of my master's thesis told me, "I really admire your courage to choose this difficult topic as your thesis!" Then, he turned to Professor Wu, "I also admire the advisor who is willing to let his student do so!"

After I graduated from NTHU, many questions about the Taipei Metro's history occupied my mind. How has Taiwan's international status influenced Taiwan's metro systems? Where are the evidence which can prove the U.S. government did intervene in the project of Taipei Metro? Why are the cases of the Taipei Metro or other technological systems in Taiwan special? What is the uniqueness of the technology in Taiwan? Although I had worked for one year in Taichung City Government as a serviceman and for a technology corporation, these questions had accompanied me in these years. When I discussed my doctoral studies plan with Professor Wu, these questions were critical issues in our conversation. As a sociologist concentrating on the history of technology in Taiwan, Professor Wu also focused on similar issues. For me, to find answers to the questions and to write a better history for the Taipei Metro was the most crucial goal to study in the U.S., and the Georgia Tech became the best place for me to reach the goal. Five years passed, and I hand this dissertation as the answers to the questions

accompanying with me for over ten years. However, without many people's help, I cannot complete this job.

First, I need to thank my advisor, John Krige, sincerely for his assistance, profession, and endless passion for advising his graduate students. His works inspired me to combine diplomatic history and the history of technology for writing the history of Taiwan's rail mass transportation systems. He was one of the key reasons why I chose Georgia Tech. His teaching and advising have shown how a scholar and a teacher should be, and, during the process of working with him, I received solid training to be a scholar in the future. Because of him, I know an outstanding scholar can hold a rigorous attitude toward his research and teaching while providing helpful care to his student. I am proud of being his first Taiwanese doctoral student and the last one before his retirement.

Second, I want to thank the committee members of my dissertation for their contribution to this research. Professor Hanchao Lu did not only help me as the committee member but also gave me continuous advice and care for these years. His view of social history inspires me to write chapter 7 of this dissertation, making this research include users into it. Besides my doctoral study, he also broadened my knowledge and vision about China no matter for historical works or for the country itself. Profess Eric Schatzberg provided many useful opinions for my dissertation, especially his opinion about the idea of technological systems when the committee was reviewing my proposal. Professor Daniel Amsterdam brought his view of urban history, providing a helpful direction to me to refine this dissertation. I am delighted to receive the encouragement from these two scholars making me more confident with this dissertation. Dr. Michelle Fei-Yu Hsieh helped me to clarify my direction of organizing my materials with her sociologist perspective. Her comparative works also provided me a larger scale to locate my study of metro systems. Furthermore, I have to thank her for being a member of the committee as Professor Wu left us in sudden.

Many metro engineers and retired technical officials contributed very much to this dissertation, especially the ten interviewees. Their whole career life and profession built fantastic metro and railway systems for Taiwanese, and their passion and experience helped me to write the history of the Taipei Metro. I want to send my great thank to Dr. Hwang Ti-Chang. Dr. Hwang enabled me to reach many metro engineers and technical officials, making the interviews possible. Moreover, he also provided me plentiful materials and helpful suggestions for my study. I learned a lot about the technical knowledge of metro systems from him, so he was like another advisor in my field. The following institutes and their staffs also contributed to the materials collection of this dissertation.

The library of the Institute of Transportation assisted me in accessing many historical materials, especially the booklet in memory of Dr. Chiang Yu-sheng. National Archives in New Taipei City was another significant resource for my research. The staff spent much effort in helping me to use the national archives. The Department of Rapid Transit System, Taipei City Government, was definitely an essential place for me. I want to thank Ms. Chang in the library of the DORTS for her assistance with exploitation materials in the library.

I also need to thank the members of the School of History and Sociology, Georgia Tech, for their encouragement and friendship. Professor Kate Brown and Allen Hyde kept caring for my doctoral study and life in these years. I also learned a lot about how to teach sociology in an introductory level class by being Kate's TA. Professor Bill Winders was another outstanding teacher of sociology, whom I learned much. In these five years, Bill had helped me to live my studying aboard life smoothly. Thank Xinchen, Elise, Alejandra, Jonah, Alice, Mario, Chris, and Renee for their friendship and supports. I will really miss my time of being in the office with them. As a Taiwanese student in a city thousands of miles away from my hometown, I am lucky to have my Taiwanese friends in Atlanta to go through every tough time these years. Joe, MJ, Alan, Hoho, Enzo, Simon, Vincent, Jimmy, and many of them, I want to say they also contributed parts of my doctoral study.

Without my families' supports, I cannot complete my Ph.D. life. My parents, Jean Lin and Howard Huang, gave me my life and have spent all their lives providing me an ideal environment to pursue my dream. Due to the business that they built from zero, I have had a great environment to realize what technology looks like in the real world and how to be down to the earth when I try to be intellectual. They are what many historians and sociologists of technology have dreamed of. My sister, Emily, is not only my best friend in my whole life but also a role model in every step of my life. I also want to thank Szu-Chieh for her company and waiting on the other side of the earth in the final stage of my doctoral life. She gives me much energy to overcome the tough time of writing the dissertation.

Finally, this dissertation is in honor of Professor Wu Chyuan-Yuan, a man who dedicates his life to the history of technology in Taiwan. He introduced me to the world of STS and the history of technology changing my whole life. By working with him in NTHU, I got precious opportunities to witness the technological development in Taiwan and received solid training for my future academic career. His passion for the land and historical works built a role model of being a sociologist and historian of technology. Even

in the last weeks of his life, he still dedicated his profession and efforts to making this dissertation better as a member of the committee reviewing my proposal. I am lucky enough to have him as my teacher, but not fortunate enough to have him longer. Without him, I cannot complete this dissertation.

List of Figures

List of Tables

Acronyms and Names

This dissertation mentions many names and acronyms of institutes, technology, companies, and technical terms, and many of them are Chinese or Japanese. Hence, this appendix provides explanations and references for the names and acronyms in this dissertation. For readers' convenience, the references are in the form of charts listing the acronyms, full names, and their Chinese or Japanese. I also classify the charts into institutes, companies, and technology. The companies, institutes, and technology from America and Europe had their Chinese names in Taiwan's archives and my interviews, so I also list their Chinese names in the charts.

Governments and Institutes:		
Acronym	**Full Name**	**Chiese**
R.O.C.	Republic of China	中華民國
PRC	People Republic of China	中華人民共和國
AIT	American Institute in Taiwan	美國在台協會
FATPA	France Aisa Trade Promotion Association	法亞貿易促進會
KMT	Kuomintang/Chinese Nationalist Party	中國國民黨
CCP	Chiese Communist Party	中國共產黨
PLA	People's Liberation Army	中國人民解放軍
DPP	Democratic Progressive Party	民主進步黨
Executive Yuan	Executive Yuan	中華民國行政院
CUSA	Council for United States Aid	行政院美援運用委員會
CIECD	Council for International Economic Cooperation and Development	行政院國際經濟合作發展委員會
EPC	Economic Planning Council	行政院經濟設計委員會
CEPD	Council for Economic Planning and Development	行政院經濟建設委員會
NDC	National Development Council	行政院國家發展委員會
SAFED	Sino-American Fund for Economic and Social Development	行政院中美經濟社會發展基金
JCRR	Sino-American Joint Commission on Rural Reconstruction	中國農村復興聯合委員會
MND	Ministry of National Defense	中華民國國防部
MOTC	Ministry of Transportation and Communications	中華民國交通部
TRA	Taiwan Railways Administration	交通部台灣鐵路管理局

Governments and Institutes:		
Acronym	**Full Name**	**Chiese**
UHDC	Urban and Housing Development Committee	都市建設與住宅計畫小組
TPB	Transportation Planning Board	交通部運輸計畫委員會
IOT	Institute of Transportation	交通部運輸研究所
NTCU	National Chiao Tung University	國立交通大學
NCKU	National Cheng Kung University	國立成功大學
TMRT	Taipei Mass Rapid Transit Group, TPB	運輸計畫委員會捷運小組
TMCTS	Taipei Medium Capacity Transit System Group	臺北市政府中運量小組
TRUPO	Office of Taipei Railway Underground Project	交通部台北市區地下鐵路工程處
RRB	Railway Reconstruction Bureau	交通部鐵路改建工程局
DORTS	Department of Rapid Transit System, Taipei City Government	臺北市政府捷運工程局
TRTC	Taipei Rapid Transit Corporation	臺北大眾捷運股份有限公司
USTTG	United States-Taiwan Transit Group	美台捷運小組
THSR	Taiwan High Speed Rail	台灣高鐵

Companies		
Acronym	**Full Name**	**Chiese or Japanese**
DEC	Deutsche Eisenbahn Consulting	德國鐵路顧問司
PCI	Pacific Consultants International	パシフィックコンサルタンツ株式会社
SOFRETU	Société française d'études et de réalisations de transports urbains	法國SOFRETU集團
RATP	Régie Autonome des Transports Parisiens	法國RATP集團
P&B	Parsons & Brinckerhoff	派森斯公司
DMJM	Daniel, Mann, Johnson & Mendenhall	鼎捷工程顧問公司
BMTC	British Mass Transit Consultants	英國大眾捷運顧問司
TTC	Taipei Transit Consultants	台北捷運顧問司
ATC	American Transit Consultants	美國捷運顧問司
CECI	China Engineering Consultants Incorporated /CECI Engineering Consultants	中華工程顧問司/台灣世曦工程顧問股份有限公司
CTCI	CTCI Group	中鼎工程股份有限公司
BES	BES Group	中華工程股份有限公司
MAA	MAA Group	亞新工程顧問股份有限公司
KHI	Kawasaki Heavy Industries	川崎重工業株式会社
URC	Union Rail Car Partnership	美國聯合鐵路機車集團
GEC	General Electric Company	英國通用電器公司

Companies		
Acronym	**Full Name**	**Chiese or Japanese**
GRS	General Railway Signal Company	美國GRS公司
UTDC	Urban Transportation Development Corporation	加拿大UTDC公司
KMG	Kaku Morin Group	郭茂林グループ
TRSC	Taiwan Rolling Stocks Corporation	台灣車輛股份有限公司

Metro and Technology		
Acronym	**Full Name**	**Chiese or Japanese**
MRT	Mass Rapid Transit	大眾捷運系統
AGT	Automated Guideway Transit	自動導軌捷運系統
RRT	Railway Rapid Transit	鐵路捷運系統
MCTS	Medium Capacity Transit System	中運量捷運系統
LRT	Light Rail Transit	輕軌捷運系統
BRT	Bus Rapid Transit	公車捷運系統
CBTC	Communication-Based Train Control	通訊式列車控制
ATO	Automatic Train Operation	自動列車作業系統
ATC	Automatic Train Control	自動列車控制系統
UPS	Uninterruptible Power System	不斷電系統
TLA	Transmission Line Assembly	傳輸線路組
VAL	Véhicule Automatique Léger	Null
APM	Automated People Mover	Null
NTS	Newtran System/New Transport System	新交通システム
KRTS	Kaohsiung Rapid Transit System	高雄捷運系統
BART	Bay Area Rapid Transit	舊金山灣區捷運系統
WMATA	Washington Metropolitan Area Transit Authority	華盛頓捷運系統
MARTA	Metropolitan Atlanta Rapid Transit Authority	亞特蘭大捷運系統
RIT	Rede Integrada de Transporte	Null
JTA	Jacksonville Transportation Authority	Null

Summary

This dissertation discusses how a complex rail mass transportation emerged in postwar Taiwan, with particular emphasis on the role of U.S.-Taiwan relations in shaping Taiwan's profession of transportation studies and planning, and the subterranean railway project in Taipei, as well as the Taipei Metro. Two main interrelated theoretical innovations characterize this project. Firstly, I situate the evolution of the system in a global context. This is dominated in the 1950s and 1960s by American hegemony that "imposes" an 'American model" on Taiwan in the transportation study and planning phase in a Cold War context beginning with the Korean War. US President Nixon's tilt to mainland China in the 1970s opened a space for Taiwanese stakeholders to shop around for consultants and technology in different countries and led to the acquisition of very different types of hardware, to the consideration of different ways of laying out the tracks to facilitate passenger comfort, and even to different concepts for the huge central station to respect local customs. Facing a huge trade deficit with the U.S. in the 1980s, Washington then tried to impose a ‘Buy America’ policy on Taiwan, only to find that the local officials were now confident enough to push back against proposals made by U.S. consultants.

Secondly, I introduce and analyze the concept of technological hybridity to capture the rich complexity of this "large technological system.” Thinking about the Taipei Metro as a multi-dimensional hybrid system that is also engaged in the project of nation-building obliges me to ask: in what sense can it be regarded as a national project? I suggest that the national achievement lies in the capacity to integrate these multiple hybridities into a smoothly functioning technical system that is the pride of local authorities, the government, and the people of Taiwan.

Technological hybridity means the coexistence of knowledge, artifacts, and ideology coming from different nation-states in a technological system. However, we need to limit the use of the idea to particular conditions to give it any analytical weight. First, when hybridity redefines or changes the functions and meanings of the technology. Second, when hybridity mixes different political and technological ideologies even if they differ sharply from each other. Third, when hybridity reverses or at least changes the power relations between the stronger and the weaker partners. This dissertation aims to explain why and how hybridity occurred by analyzing the temporal-spatial environment, actors' interests and strategies, and the interactions among different actors and technology.

Finally, this dissertation also discusses how people maintain and manage the systems and how users have used them. Taiwanese technical officials and Taiwanese people have built a "Formosa technological sublime," a concept derived from David Nye's American technological sublime, to exhibit Taiwan's collective morality and nationality by building and displaying a spectacular technological system. The Taiwanese do not have a techno-nationalist attitude towards the rail mass transportation system, which emphasizes the nation's originality in technological innovation. Rather, they treat the metro and even the high speed rail system as emblems of a modern nation, as materials from which to construct a newly emerging Taiwanese national identity.

Chapter 1: Introduction

American Hegemony, Technological Hybridity, National Pride, and the History of Taiwan's Rail Transportation Systems after WWII

"Metro system is the crystal of modern technology, and even those advanced countries continue to develop and study it. However, this construction is still pioneering although we already reach top level worldwide in many engineering fields and technologies; but, on metro system's planning, designing, construction, operation, and management, especially on electromechanical engineering, we rely on the latest knowledge and experience of advanced countries. Hence, introducing the best technology of metro system in the world will be our first job. (捷運系統是現代科技的綜合結晶，而先進國家猶在不斷的研究發展之中。但此項建設在我國尚屬創舉，雖然我們在很多工程建設上，技術已具有國際第一流水準，但對捷運系統的規劃、設計、施工、營運、管理等方面，尤其在系統機電工程上，仍必須借助先進國家的最新知能和工作經驗。因此，引進當前國際上興建捷運統的最佳技術，變列為本局的首要工作。)"[1] Chi Pao-Cheng (齊寶錚), 1987.

"Knowledge that is so closely tied up with national economic and military competitiveness can only flow across borders if the states concerned see good reasons for it to do so. International collaboration transcends national boundaries, but it doesn't dissolve national interests. On the contrary, it is one strategy among others for pursuing national interests, at least in domains, such as space and the nuclear, that constituted the core state power after World War II.[2]" John Krige, 2014.

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[1] Chi, Pao-cheng 齊寶錚, *The Plan and Construction of the Taipei Metro*《台北都會區捷運系統的籌劃與建設》, (Taipei: KMT, 1987), Pp. 7.

[2] Krige, John, "Embedding the National in the Global: US-French Relationships in Space Science and Rocketry in the 1960s" in *Science and Technology in the Global Cold War* edited by Naomi Oreskes and John Krige (Cambridge, MA: MIT Press, 2014), Pp. 229.

A National Metro

Taipei, the capital city of Taiwan, is today a bustling city of 2.6 million inhabitants spread over 272 square kilometers. If we include the population living in New Taipei City[3] (新北市) we have Taiwan's largest metropolitan area with over 6 million people. They are served by a number of subterranean railways and a metro system that carries 789 million passengers per year[4]. This system comprises a complex network of six lines that criss-cross the city from north to south and east to west, many of which intersect in the huge Taipei Main Station. Since Taipei is the capital city and the largest metropolitan area of Taiwan, the metro system has becomes a symbol of this new emerging nation-state so that the system is not only a system for the city but also for the whole country. It has been gradually put together over three decades after a long phase of planning that began in the late 1960s early 1970s. Hence the fundamental question of this dissertation: how have the rail mass transportation systems in Taipei become what they are today? This thesis analyzes that historical development with particular attention to the political and bureaucratic processes that shaped the technological choices that produced the system that we have. While inspired by Thomas Hughes's analysis of large technical systems, it differs importantly by historicizing the evolution of the 'hardware' that is constitutive of its core, and that only acquires its 'momentum' in the 1990s.

Two main interrelated theoretical innovations characterize this project. Firstly, I situate the evolution of the system in a global context. This is dominated in the 1950s and 1960s by American hegemony that "imposes" an 'American model" agenda on Taiwan in the transportation study and planning phase based on the Cold War configuration set by the Korean War. US President Nixon's tilt to mainland China in the 1970s opened a space for Taiwanese stakeholders to shop around for consultants and technology in different countries (Canada, France, Germany, Japan, the UK) and led to the acquisition of very different types of hardware, to the consideration of different ways of laying out the tracks to facilitate passenger comfort, and even to different concepts for the huge central station to respect local customs.

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[3] New Taipei City is the largest city in Taiwan with about 4 million people surrounding Taipei City. It was reformed as New Taipei City from Taipei County in 2010 due to the administration reformation of local governments.

[4] In 2019.

Secondly, I introduce and analyze the concept of technological hybridity to capture the rich complexity (at many different levels) of this "large technological system." These types of hybridity are the hybridity of knowledge, the hybridity of functions and styles, and the hybridity of systems. Thinking about the Taipei Metro as a hybrid system that is also engaged in the project of nation building obliges me to ask: in what sense can it be regarded as a national project? I suggest that the national achievement lies in the capacity to integrate these multiple hybridities into a smoothly functioning technical system that is the pride of local authorities, the government, and the people of Taiwan.

In the remainder of this introduction, I fill out this theoretical framework in more detail, describe my methodology, and then summarize the content of each chapter. A brief epilog suggests further questions for research.

Metro, a Global System

Metro, or urban rail transportation system, is undoubtedly that kind of technological system described by historian of technology Thomas Hughes. Hughes states: "Technological systems contain messy, complex, problem-solving components." In addition, "they are both socially constructed and society shaping.[5]" Metro, as a kind of technological system, has physical components, such as rails, concrete structures, trains, stations, central train control centers, and power supply systems. It also includes organizations, such as manufacturing firms, utility companies, sometimes investment banks, and governments, and they incorporate components usually labeled scientific, such as books, articles, and university teaching and research programs. Legislative artifacts, such as regulatory laws, can also be part of technological systems like metro[6]. A metro system integrates these different technical, institutional, and ideological contents into a complex social transport facility pursuing particular goals and functions. For example, moving passengers inside or outside of a city, developing a new urban plan, incubating related industries, and forming a political, cultural, or social order—that is to say, building a new form of life.

In this sense, a history of building a metro system is like Hughes' "system building" studies. In Hughes' studies of power systems in American and European cities, he uses the metaphor of "reverse salient" to describe how system builders solved the problem of

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[5] Hughes, P. Thomas, "The Evolution of Large Technological Systems" in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* edited by Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch, Anniversary Edition (Cambridge, MA: MIT Press, 2012), Pp.45.

[6] Hughes, "Evolution," Pp. 45.

making systems work. The metaphor is appropriate because an advancing military exhibits many of the irregularities and unpredictable qualities of an evolving technological system. In the case of a technological system, inventors, engineers, and other professionals dedicate their creative and constructive powers to correcting reverse salients so that the system can function optimally and fulfill system goals[7]. Building a metro system involves unpredictability and its development is evolutionary so that Hughes' concept can also apply to the actual process of building a metro system. Taiwanese scholar, Chang Kuo-Hui (張國暉), takes Hughes' approach to analyze how Taiwanese introduced the VAL (Véhicule Automatique Léger) system from France to Taiwan. Chang finds that VAL's technological momentum triggered a series of deeper problems that were embedded within the context of Taiwan's developmental and authoritative state. He goes on to argue that Taiwanese engineers played a critical role in the mutual reshaping of the imported large technology system and local infrastructural construction network. The building or transplanting of a metro system involves solving reverse salients[8]. Just as Chang emphasizes the importance of local context for shaping or reshaping a technological system, Hughes' works also focusses on how local contexts of politics, economy, society, and cultures made a difference between power systems in different cities, regions, and countries.

However, Hughes does treat technological systems as global and involving transnational actors and transnational circulation of technology. His case studies of power networks are comparative, and restricted within the national frame. As a result Hughes overlooks three factors that are important for us here. First, he focuses on how the local political context shaped and reshaped technological systems, but relations between nation-states are mostly out of his scope or at least merely in the background. In the case of power networks in western countries or of the central artery project in Boston[9], his view may not be problematic because these cases in western countries did not involve the interrelations among different states, especially among western and non-western

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[7] Hughes, P. Thomas, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore, MD: Johns Hopkins University Press, 1993), Pp. 14.

[8] Chang, Kuo-Hui 張國暉 "Constructing the Taipei Metro Muzha Line: The Coproduction of Imported Large Technological System and Local Infrastructural Construction Network 捷運木柵線：移入的大型科技系統與在地交通建設網路的共造" in Taiwanese Journal for Studies of Science, Technology and Medicine, No.22 (2016): Pp. 159-224.

[9] Hughes, P. Thomas, "Coping with Complexity: Central Artery/Tunnel" in *Rescuing Prometheus: Four Monumental Projects that Change the Modern World* (New York: Vintage, 1998), Pp. 197-254.

countries. In the case of the metro system in a country like Taiwan, we cannot underestimate the importance of nation-states and the relations among states. Especially, as I pointed out at the very beginning, the Taipei Metro and the subterranean railways in Taipei are national technological systems developed in a global context marked by major asymmetries of power between states. Hughes does not consider the impact of power relations between technologically advanced countries and catching-up countries, like Taiwan. The solving of a reverse salient does not only mean the perfection of a system but also the formation of power relations.

Further, conflicts and cooperation can also be the sources of innovation implemented by hybrid strategies. Although technological momentum could more or less explain why technological systems from western countries tend to shape non-western countries' society rather than being shaped by it, it cannot thoroughly explain the power relations among different actors in the process of building a technological system. Moreover, power relations impact the evolution of a technological system before it gains momentum or even earlier.

Second, for Hughes, as for Latour in his "model of translation,[10]" the formation of technological systems in different countries seems to involve independent processes that are only weakly connected with each other. Hughes and Latour's concepts can indeed help us not to be trapped into the western-centric viewpoint or a diffusion model that overlooks the roles played by local context and actors. The formation of a metro system involves many years of knowledge acquisition, the circulation of transnational human 'manpower', and the coproduction and competition of global actors and local contexts. All metro systems are born to be both global and local. However, overlooking the linkages between them is to miss the transnational circulation of knowledge and technology in the process of building technological systems in different places while it dissolves the boundary between "local" and "global." If we don't look for interconnections, every system seems purely locally built and the importance of transnational actors, knowledge, and artifacts is not visible, even though they enrich our understanding of the history of technological systems. Chang's study of the Brown Line fixes this problem by taking the VAL's French context into consideration, showing that the making of the Brown Line was the coproduction of transplanting a large system[11]. Nonetheless, Chang's study only focuses on the case of the VAL system on the Brown Line, so it cannot provide a total

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[10] Latour, Bruno, *Science in Action* (Cambridge, MA: Harvard University Press1987), Pp. 132-144.

[11] Chang, "Constructing the Taipei Metro Muzha Line," Pp. 176-180.

picture of the transnational history of the Taipei Metro and the development of rail mass transportation technology in Taiwan.

Third, Hughes' case studies only concentrate on the construction of technological systems without going into the long preparatory period of design and planning that precedes building a system. Beginning in the 20th century, we can find that transportation studies and planning have played a critical role in building a rail mass transportation system since building and running a rail mass transportation system became more and more technically complex and expensive. Thus, two essential facts need to be noted. Firstly, before building a metro system, people need to acquire knowledge about the city. Without the knowledge of the city, system builders would not know where, how, and what to build for the city. Furthermore, to use Latour's words, they cannot translate the interests of building a metro system to persuade political leaders and citizens to support their plan. Secondly, in a catching-up country like Taiwan, people had to build institutions and transnational professional relationships to acquire knowledge and knowhow, so that they could later generate knowledge about their own cities. In the case of metro systems, people needed to build their profession of transportation studies and planning. Of course some countries simply hired international companies to do the knowledge-making job or even to build the whole system. But, even so, hiring international engineers and scientists to generate local knowledge about a city is a meaningful subject for historians of technology, notably in a country like Taiwan, whose social and political history is marked by a determination to affirm its autonomy and build its own identity faced by a powerful, hostile neighbor in mainland China.

Thus this dissertation treats metro systems as global systems that are the products of interaction, cooperation, negotiation, and struggles with transnational technology and actors. Describing a metro system as global does not mean that we are talking about a history of the diffusion of metro systems; instead, we need to emphasize not only local context but also transnational flows of technology. Building a metro system involves local and international scholars, political leaders of different nation-states, technical officials, international system providers, technical officials, and passengers riding on the system. These actors shared a decades-long procedure of knowledge-making and system building engaging people, knowledge, and artifacts across borders of nation-states. Taiwan's metro system is transnationally constructed, and this dissertation describes just how the Taipei Metro and Taiwan's other rail mass transportation systems have been transnationally produced.

Questions in Making of the Metro

Once we define building the Taipei Metro as the transnational production of a technological system, the questions that this dissertation tries to answer emerge. First, as the first section reveals, we may observe that Taiwan's rail mass transportation systems have many features derived from different types of technological or ideological thinking, and some of them even contradict each other. For example, two kinds of systems, RRT (Rail Rapid Transit) and AGT (Automated Guided Transit), were built into one metro system at the same time. Besides, the vast Taipei Main Station aims to be the grand central station serving passengers all around the metropolitan while the Taipei Metro has a network that distributes passengers to different interchange stations. Furthermore, the Brown Line, which is the outcome of the integration of the French system, the VAL256, and the Canadian system, CITYFLO650, is also a puzzle needing historians to solve. With the view of the transnational history of technology, we can figure out that the features might come from different countries rather than merely root in the local context. These phenomena show, I argue, the technological hybridity of a technological system, and one of the missions of the dissertation is to trace the sources of this hybridity.

Second, I would like to answer how technology transfer happened in Taiwan, especially the systematic technology of rail mass transportation systems. In the case of rail mass transportation technology in Taiwan, the Taiwanese government did not merely want to build a transportation system in Taiwan. It was also eager to build the profession of transportation studies and planning, the industries of rail transportation, and the abilities to design and build a metro system for Taiwan or even for other countries. Hence, we can regard the history of Taiwan rail mass transportation technology as the history of technology transfer. We can further find that a transnational view would be suitable for writing the history of technology transfer because, on the national level, technology transfer naturally involves transnational flows of technology. Technology transfer involves a complicated process, multiple actors, and chronological development. My dissertation shows how it has happened over decades providing a comprehensive picture of the technology transfer of rail mass transportation systems, and revealing the institution of technology transfer for rail mass transportation technology in Taiwan.

Third, this dissertation shows how a catching-up country like Taiwan dealt with the technologically advanced countries like the U.S. for its technological development. This question is the extension of the previous one, but I focus more on what limitations and opportunities Taiwanese had, what strategies they took, and how the power relations

worked when they dealt with the technologically advanced countries. Moreover, when a country tries to build a global technological system, it has to face the critical relations with the international consultants and system providers, especially as regards technology transfer. In this kind of relation, technologically advanced countries can use knowledge and technology to leverage their political and economic power; on the other hand, technologically advanced countries may lose superiority to the countries that receive knowledge and technology in the process of technology transfer. Therefore, the relations between technologically advanced countries and catching-up countries is problematic. In this dissertation, we will discuss the roots of these problematic relations, and the strategies of the actors, such as engineers, technical officials, political leaders, and international consultants.

By asking the questions above, we find that building the metro system in Taiwan has involved mobilizing transnational knowledge and technology. The process involves building the profession of transportation studies and planning so that Taiwanese technical officials could generate knowledge about their capital city, Taipei, to plan and design its mass transportation systems. It also involves the transnational flows of knowledge, technology, and people for transferring technology into the rising nation-state under decades-long military threats. Finally, the process has been achieved with tricks, strategies, policies, and institutions taken by different actors aiming at keeping or changing power relations between Taiwan and the technologically advanced countries led by the U.S. Therefore, I further discuss what factors shaped the decades-long process of the making of the system, what actions Taiwanese took in the process, and what the outcomes were of the process of transnational making of metro systems in Taiwan.

American Technological Hegemony in Taiwan

The first argument that this dissertation makes is that foreign policies have been one of the factors shaping the process of building the metro system, and it is the one which historians of technology focusing on the postwar period should not overlook. Since the Chinese Civil War from 1945 and 1949 and the following Korean War, the U.S. has been the hegemonic power over the postwar Taiwan with its military protection and international political impacts while the KMT[12] government in Taiwan and Taiwan itself has been faced by communist China's military threats for decades. Nonetheless, the KMT government has continued to develop Taiwan's economic and technological power to confront China's ideological and political competition and to secure the survival of its

[12] Kuomintang (中國國民黨) means Chinese Nationalist Party.

sovereignty, the U.S. being one of its primary resources. For the U.S., it tried to enforce its alliances through its superiority of economic and scientific power confronting the communist campaign in the Cold War. Moreover, the U.S. also exploited this predomination of resources and knowledge to attract neutral countries like India to join the "Free World" or at least not to join the communist bloc. The goal of the use of scientific and technological power was to shape a global environment with the political order which did not threaten its dominant status. We call this kind of effort and power the American hegemony of science and technology as John Krige does[13], and the U.S. used the hegemonic power globally in the Cold War for decades. By sharing knowledge, Americans tried to shape the world[14].

We may find a similar development in Asia at the same time. American experts played an essential role in the "Green Revolution" in Asia and Latin America, aiming at solving the problems of famine and poverty, especially in South Asia. In doing so they were mainly competing with the Soviet Union's economic and technological assistance in the neutral countries[15]. Moreover, we can also find how the Ford Foundation was dedicated to agriculture in India during the 1950s and the 1960s so as not to upset India's non-aligned policy[16]. In the cases in both West Europe and South Asia, we can find that consensus played a vital role in the hegemony. A consensus had to be won, and sometimes it was brokered against a backdrop of deep local and national divisions. In other words, consensual hegemony implies only that an influential fraction of a local elite, supplemented by U.S. overt and covert support, and operating in a particular local constellation of the balance of forces, was able to impose its vision of what kind of society should be built in these countries[17].

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[13] Krige, John, *American Hegemony and the Postwar Reconstruction of Science in Europe*. (Cambridge, MA: MIT Press, 2006)

[14] Krige, John, *Sharing Knowledge, Shaping Europe: US Technological Collaboration and Nonproliferation*. (Cambridge, MA: MIT Press, 2016).

[15] Cullather, Nick, *The Hungry World. America's Cold War Battle Against Poverty in Asia*. (Cambridge, MA: Harvard University Press, 2010). Latham, Michael E., *The Right Kind of Revolution. Modernization, Development, and U.S. Foreign Policy from the Cold War to the Present.* (Ithaca, NY: Cornell University Press, 2011).

[16] Sackley, Nicole, "Foundation in the Field. The Ford Foundation's New Delhi Office and the Construction of Development Knowledge," in John Krige and Helke Rausch, eds. *American Foundations of World Order in the Twentieth Century*. (Göttingen: Vandenhoeck and Ruprecht, 2012), Pp. 232-260.

[17] Krige, *Sharing Knowledge,* Pp. 9.

The KMT's political agenda met the U.S.' global Cold War strategy forming the Taiwanese version of American hegemony of science and technology. The KMT government and the U.S. government initiated a series of technological assistance projects in the framework of "U.S. Aid" to help Taiwan to build its infrastructure, incubate professional human resources, set up professional institutes, and develop industries. As it did in Western Europe, the U.S. government did not only provide economic assistance to Taiwan but also sent experts helping Taiwanese to develop their science and technology comprehensively. In these projects, knowledge, and technology crossed borders, flowing from the U.S. to Taiwan in written documents, human resources, education, training, and artifacts. The KMT government and Taiwanese technical officials cooperated with American experts and officials to build the institutions of technological assistance, causing the coproduction of American hegemony. America was not merely a place where knowledge and technology were coming from but also a symbol of progress and richness.

Although U.S. Aid ended in 1965, American technological assistance projects continued with the same institutions and Taiwan's profession of transportation studies and planning was founded during this time. The Taiwanese government hired American consultants through the U.S. government and the U.N. to diagnose Taiwan's transportation systems. It then introduced the science of transportation studies and planning, which was the rising discipline in the U.S. in the 1960s trying to build the profession of transportation studies and planning using the American model. The Transportation Planning Board, the Ministry of Transportation and Communication (TPB) was the institute that developed the profession. With it, the Taiwanese started to learn how to make knowledge about their cites for future transportation systems. Therefore, this profession was a product of the American hegemony of transportation science and technology.

However, the coproduction of hegemony does not imply 100% cooperation of Taiwanese, and when the U.S.-Taiwanese relations changed, the nature of technological hegemony changed too. In 1971, President Nixon announced that he would visit Beijing in the next year, and then, in the same year, the UN passed Resolution 2758, leading to the KMT government losing its seat in the UN. When Nixon visited China in 1972, the U.S. and China signed the first of the Three Joint Communiqués, but this was just the beginning of the KMT's government's diplomatic downfall in the 1970s. Although American companies shared noticeable business in the project of railway electrification in

the early 1970s[18], Deutsche Eisenbahn Consulting (DEC) from West Germany started to provide consulting services for the Taiwan Railways Administration (TRA) and then to consult the project of the mass transportation system in Taipei Metropolitan in 1977. Furthermore, in 1980 when the U.S. had just terminated its formal diplomatic relationship with the KMT government, the TPB hired British Mass Transit Consultants (BMTC), which had just finished its job of planning Hong Kong's metro system, to plan and design the Taipei Metro.

The decline of the U.S.-Taiwan relations would create space for Taiwanese technical officials to introduce alternative resources of knowledge and technology. During the 1960s, Taiwan had close relations with the U.S. confronting communist China so that the U.S. was the only source of knowledge and technology for Taiwan. Moreover, even in the field of transportation studies and planning, the U.S. still had immense superiority over Taiwan. Hence, participating in the coproduction of the American hegemony of science and technology seemed to be an ideal option. However, in the institution of technological hegemony, Taiwan still sought a measure of autonomy, and the limited autonomy granted to receivers was also a feature of the American hegemony of science and technology. When U.S.-Taiwan relations turned sour, the Taiwanese would seek alternative sources for their development. For the U.S., it did not necessarily need Taiwan to be wholly Americanized in every technological field because there was no intention of competing with communist China to show the superiority of the capitalist model.

As a result, the TPB introduced German, British, and Japanese companies and experts to co-work with Taiwanese technical officials and engineers hired by state-owned consultants joining the planning and designing of Taiwan mass transportation systems. First of all, the German consultants, DEC, consulted the Taipei Railway Underground Project in 1979 after it helped the TPB design the future mass transportation systems for the Taipei metropolitan, determining that the Taiwanese government would build a metro system and rebuild the West Coast Line as a subterranean railway. During the DEC's consulting, the transportation planning knowledge, ideas, and experience generated in Germany were introduced to Taipei with different forms. Furthermore, German ideas and designs about railways were realized in Taipei's subterranean railway. For example, Taipei Main Station was the product of the idea of a grand central station for a railway network.

On the other hand, the TPB formed the Taipei Mass Rapid Transit Group (TMRT) to initiate the project of the Taipei Metro, hiring the BMTC to consult the project. Like the

[18] Chang, "Constructing the Taipei Metro Muzha Line," Pp. 191.

DEC, BMTC also introduced British knowledge, experience, and designs of metro systems into Taiwan. Last but not least, Taiwanese technical officials also invited Japanese companies and experts to review German and British designs and plans. In some cases, they even directly hired the Japanese to design the affiliated facilities of the systems. Therefore, the TPB, as the technological institute within the Taiwanese government, exploited its autonomy to decide which country could import their knowledge into Taiwan when the KMT government's relationship with the U.S. declined in the early 1980s. It was the beginning of the end of the American hegemony of mass transportation technology.

However, a change in U.S.-Taiwan relations again changed the situation in the mid-1980s. Firstly, the Regan Administration raised the hope that formal diplomatic relations with the KMT government would improve dramatically, though this did not actually materialize. Following on the Soviet invasion of Afghanistan in December 1980, in 1982 the U.S. signed the August 17th Communiqué to enforce the U.S.-Sino relations by promising more ties between the two countries and gradually decreased the sale of weapons to Taiwan. At the same time, China presented the idea of "one country, two systems" and the "three links" creating political pressure on the KMT government. Secondly, Taiwan's strong economic growth powered by its manufacturing industries created a widening trade deficit between the U.S. and Taiwan, to which the U.S. government initiated its "buy American" policy seeking compensate for the trade imbalance in trade.

In 1984, the U.S. government introduced American metro-related companies to intervene in the project of the Taipei Metro. When the TPB and Taipei City Government seriously disagreed on whether to build an automated metro system in Taipei, the U.S. government "suggested" that the Taiwanese government hire American consultants to solve the conflict by integrating two metro systems into one. Then, in 1986, the U.S. government pressured the Taiwanese government to reopen the bid for general consultants of the project of the Taipei Metro. Although the BMTC could join the bid, the American Transit Consultants (ATC), which was formed by three American metro-related companies won the bid becoming the general consultants of the metro project. During the design and construction period, the ATC also introduce American ideas and experience to Taiwanese technical officials and engineers. Many American designs and ideas were also realized in the Taipei Metro.

That said, the Taiwanese did not completely eliminate other countries' ideas and designs, becoming wholly "Americanized" again. First, when Americans returned and

intervened in the project of the Taipei Metro, the Taipei's subterranean railway was under construction, and Taiwanese technical officials and British consultants had already made significant progress in design and planning. Hence, American consultants and Taiwanese technical officials kept many British designs in the Taipei Metro. Second, in the process of American interruption in the project of the Taipei Metro, Taiwanese technical officials retained their autonomy as the client of the consultants so that the decision-making power of the project was still in Taiwanese hands. Furthermore, facing the pressure of buying American, the Taiwanese often adopted flexible strategies to purchase the artifacts which they believed to be suitable for Taipei. Thus, although America returned as the main player in the construction of the Taipei Metro, the Taipei Metro did not become totally Americanized.

The ideas and history above show how the U.S.-Taiwan relations have affected the development of rail mass transportation technology in Taiwan after WWII and how the American hegemony of science and technology has worked as an institution shaping Taiwan's profession of transportation studies and planning. When U.S.-Taiwan relations were close, and Taiwan lacked resources and knowledge during the 1950s and 1960s, the Taiwanese willingly cooperated with the U.S. government and its experts creating the American technological hegemony together building an indigenous profession. When the relations declined, the Taiwanese exploited their autonomy turning to alternative sources of knowledge, seeking more suitable options for mass transportation systems in the capital city. Once political-economic interests emerged, the U.S. would again use its military and political power to leverage the situation bringing American technology back to Taiwan, and Taiwanese would take a series of strategies to fulfill American's needs on the one hand and maintain their autonomy on the other. The aftermath of the decades-long process, as the history above indicates, was the mixture and coexistence of knowledge, ideas, designs, and artifacts from different countries, and I call this kind of mixture technological hybridity.

The coproduction mechanisms under American hegemony created a suitable environment for the birth of hybrid knowledge and technology, and the development of the American hegemony of technology drove Taiwanese to adopt hybrid strategies to build their transportation system. First, the knowledge sharing and cooperation of local elites drove technology across the national border. Then, American experts and local elites would cooperatively produce knowledge and technology aiming at solving local problems, such as food supply, nuclear power, or urban planning, generating local's feedback to Americans. Thus, the circulation of knowledge and technology between the

two partners emerged. Moreover, if local elites introduced alternative knowledge and technology from other sources like the Soviet Union, or turned to “go their own way” to fulfill their requirements or political economy agendas, we may witness the birth of hybrid knowledge and technology. In our cases of the Taipei Metro and the railways in Taipei City, we found the artifacts also become hybrid due to the actions and strategies dealing with the American factor. So, hybridity is both a strategy and an outcome.

Technological Hybridity

Technological hybridity means the coexistence of knowledge, artifacts, and ideology coming from different nation-states in a technological system. This perspective can help us to catch the peculiar phenomena and the developmental track of technological systems in postcolonial countries like Taiwan, because, as the history of rail transportation in postwar Taiwan and many other transnational histories of technology indicate, hybrid technology is a common phenomenon, reflecting the political status of countries, and their strategies to maintain sovereignty. Moreover, technological hybridity reveals the impossibility of totally self-sufficient national technology, and many transnational historians of technology already note this fact. However, knowledge, people, and artifacts do travel across borders seeking markets, political orders, innovation, and development, and components of technology would be constructed to form technological networks that combine elements from different sources. In some cases, even the technological systems in North America and Europe are hybrid in a transnational way.

Krige’s study on the trans-Atlantic coproduction of the gas centrifuge for uranium enticement in the 1960s shows how hybrid knowledge of gas centrifuges emerged in the cooperation of American and British scientists. He points out that all knowledge is admittedly ‘hybrid,' made up of bits and pieces of this and that, insofar as it is the product of a social process. But here another dimension is added: the national provenance of those discrete elements in the transnationally produced melange. In the coproduction field, scientists and engineers on both sides of the Atlantic defined ‘British’ or ‘American’ elements in the hotchpotch of knowledge that they produced in the late 1960s. And we more readily see that the affirmation of the national technology in the hybrid is also the performative expression of power[19].

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[19] Krige, John, “Hybrid Knowledge: the transnational co-production of the gas centrifuge for uranium enrichment in the 1960s” in *British Society for the History of Science* 45(3), (2012): Pp.341.

Therefore, according to this definition and the empirical studies, almost all technological systems are hybrid so that the concept of technological hybridity seems to be meaningless implying that this dissertation's case study of Taiwan shows nothing special. For example, National Highway No.1 in Taiwan was built by the Taiwanese government under American company's consulting in the 1970s, and we can find cars and trucks from many countries running on this transportation system. So, is this an example of technological hybridity? Why do we need to discuss the technological hybridity of rail transportation in Taiwan if all technology is hybrid? The concept of technological hybridity becomes meaningless if we exploit it in this way.

The mere mixture of technology from different countries cannot is not a meaningful idea of technological hybridity, and we need to limit the use of the idea in particular conditions to give it any analytical weight. According to my studies of rail transportation technology in Taiwan, I discuss the idea of technological hybridity in the three following conditions. First, the concept would be used when the hybridity can redefine or change the functions and meanings of the technology. Second, the concept would be used when the hybridity can mix different political and technological ideologies to work together even if they contrast with each other. Third, the concept would be used when the hybridity can reverse or at least change the power relations between the stronger and the weaker.

These three conditions do not exclude each other; instead, sometimes they can reinforce or generate each other. For example, different political or technological ideologies may lead to technology with different meanings or functions when the technology travels to a different country; or, when technology's functions or meanings change, technology can be a pivot to change the relations leading to technology derived from different ideologies being integrated as one system. In this dissertation, a historical analysis of transportation technology in Taiwan, my aim is to recognize the moments when technological hybridity mattered and to explain why and how the hybridity occurred by analyzing the temporal-spatial environment, actors' interests and strategies, and the interactions among different actors and technology. That is to say, how the American hegemony of science and technology, the development of the U.S.-Taiwan relations, and the actions and strategies taken by the Taiwanese created and shaped technological hybridity and how the hybridity shaped the city and the island country.

The American hegemony of science and technology created a suitable environment for the birth of technological hybridity of rail transportation technology. With this hegemonic power in the Cold War, the circulation of knowledge, people, and artifacts emerged in Taiwan, America, and other countries, and the Taiwanese government and

engineers took a variety of strategies to fulfill their local requirements, to satisfy their political and economic agendas, and to secure their autonomy, even though they did not always succeed. The change of the political and economic conditions, especially in U.S.-Taiwan relations, would provide limits and chances for the Taiwanese to create the historical opportunity for the advent of the technological hybridity of rail transportation technology.

This dissertation shows three types of technological hybridity that emerged in the history of the Taipei Metro and other rail mass transportation technology: the technological hybridity of knowledge, the technological hybridity of styles and functions, and the technological hybridity of systems. I do not argue that the three types of hybridity can include all meaningful modes of hybridity in the history of technology; rather, I emphasize that the classification of hybridity should be rooted in solid empirical cases and practical examples. Hence, the types of technological hybridity can be extended based on further research.

The Technological Hybridity of Knowledge

Krige's case study of the corporation of the U.S. and the UK in gas centrifuge technology reveals that technological hybridity is created by the transnational circulation of knowledge, people, and artifacts. The mechanism and actions creating hybridity are cooperations at a practical level, training, induction of ways of doing things, import of regulation, and co-production of knowledge by scientists or engineers from multiple countries. This case also shows that hybrid knowledge is not a mixture of knowledge in which we can easily recognize origins and define national boundaries between two or more countries; instead, hybrid knowledge emerges in a complex process that often blurs these very features.

U.S. Aid and the following Americanization of Taiwan's profession of transportation studies and planning were the basis for the future formation of hybrid knowledge. In the 1960s and the early 1970s, the American hegemony of transportation technology provided not only resources and knowledge but also the institution of a profession for the island nation to construct its infrastructures. The TPB, the institute, which was founded with American resources, became both the receiver and the producer of the knowledge of transportation and Taiwan's cities. Knowledge, as "information," as "expertise," as "know-how," crosses borders in many ways—in written or printed form (books, including textbooks and manuals, letters, newspapers, academic publications, technical reports, blueprints, trade journals) or embedded in devices (like an initial guidance system) as well

as in living things (like human beings and cloned animals) [20]. American transportation studies and planning was established in Taiwan with a series of practical actions.

After the mid-1970s, Taiwan started to introduce knowledge from Germany, Japan, and Britain with the institutes established with the help of the U.S. aid so that the mechanism of Americanization became the mechanism for producing hybrid knowledge. The boundary of knowledge from different countries was vague, but we can still observe how German and Japanese knowledge influenced Taiwan. First, Taiwanese began to regard the American experience of transportation as negative examples while they once followed it closely. Second, Taiwanese technical officials showed Taiwan's autonomy and mobility by seeking alternative sources of knowledge rather than limiting themselves to the U.S. Therefore, the process of making hybrid knowledge of transportation studies and planning after the mid-1970s also exhibits Taiwan's intention to change the relationship with the U.S. Third, the process of the making of the knowledge was marked by conflicts and negotiations among Taiwanese stake holders, German consultants, Japanese consultants, and American consultants. Moreover, the knowledge of transportation contained different political and technological ideologies leading to particular designs, so the making of hybrid knowledge during this period finally caused the hybridity of the designs of Taipei's mass transportation—the technological hybridity of styles and functions.

Last but not least, the history of the Taipei Metro shows that American knowledge of transportation studies and planning learnt in American cities like San Francisco and Washington D.C. entered Taiwan with the U.S. government's political momentum and determination to be compensated for the trade imbalance between the two countries. Furthermore, American consultants' works were based on other consultants' labors. Thus, the history of the technological hybridity of knowledge of transportation studies and planning is not merely the history of how Taiwan escaped from American factors becoming autonomous; instead, American knowledge could return to the country , making the process more complicated. There is no clear-cut way to distinguish which part of hybrid knowledge belongs to a particular nation-state, but we can recognize the mechanisms that produced it and the process by which different nations got involved.

The Technological Hybridity of Styles and functions

When we focus on the change of the styles and functions of technology, which travels from one place to another, especially for those which are oriented from West

[20] Krige, *American Hegemony*, Pp. 2.

Europe and North America and that travel to Africa and Asia, Frank Dikötter and David Edgerton are two scholars worthy of being discussed. In *Exotic Commodities: Modern Objects and Everyday Life in China*, Dikötter shows how Chinese in the early 20th century interpreted and redefined technology imported from western countries. Although Dikötter opposes the idea of hybridity because it implies that two ontologically distinct technologies are mixed, his work discussing the history of how technology was used in early 20th century China shows different kinds of mixture and hybridity of technology under the context of use[21]. Similarly, Edgerton's "creole technology" also emphasizes use instead of innovation to describe how catching-up countries modify and redefine technology that traveled to their lands to fulfill local demands[22]. Unlike Dikötter, Edgerton uses the word "creole," indicating the existence of technological hybridity. Both of them show that technological hybridity can change the functions and meanings of technology with its mixture, integration, or redefining of technology's style. That being said, Dikötter and Edgerton tend to limit their studies to single artifacts or small-scale technologies (like bicycles) , and, when it comes to a large technological system, their perspective hardly challenges the traditional center-periphery view and does not deal with the power relationship between stronger countries and the weaker.

On the other hand, Eden Medina's case study of cybernetics in Allende's Chile inspires us to discuss the change of styles and functions in transnational technological systems[23]. When cybernetics traveled to Allende's Chile, the Chileans did not only change its meaning but also its style, functions, and configuration. Her case study of cybernetics in Chile exhibits how technological hybridity of styles and functions happen in a postcolonial country. Moreover, we also find that the hybridity does not only mean the mixture or integration of artifacts but also refers to the assembly or reconstruction of ideology. Medina's study only involves the intersection between British technology and the Chilean local context leading to an analytic frame of global and local that overlooks the integration of technology from multiple technologically advanced countries as Edgerton and Dikötter do. Moreover, although Medina's story of the Cybersyn reveals the contradictions between technology and Chile's local economy, politics, and technological practice, it does not show how Chilean and the British engineers integrated the system

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[21] Dikötter, Frank, *Exotic Commodities: Modern Objects and Everyday Life in China.* (New York: Columbia University Press, 2006)

[22] Edgerton, David, *The Shock of the Old: Technology and Global History Since 1900*. (New York: Oxford University Press, USA, 2006), Pp.43-45.

[23] Medina, Eden, *Cybernetic Revolutionsaries* (Cambridge, MA: MIT Press, 2014).

with the nation-state. Instead, limited by its materials, it is just a story of how the technological system and the socialism embedded in it failed to be rooted in Chile. Integration cannot be the core of this great story.

The history of the Taipei Metro and Taipei's subterranean railways hence can serve as an example showing how the hybridity of styles and functions emerges in the integration of designs and artifacts with different, or even contradictory technical and political ideologies. The cases in Taipei are also evidence of how technology from multiple technologically advanced countries was integrated into one technological system thanks to the combined efforts of local technical officials, engineers, and international consultants. The Taipei Metro's network and affiliated designs are the most typical example. By following the British consultants' designs and experience in Britain and Hong Kong, the TPB and the Department of Rapid Transit System, Taipei City Government (DORTS) make the Taipei Metro's network L-shaped with four interchange stations built into the form of the cross-platform interchange. This design aims at distributing passengers to different stations avoiding over-concentration in a particular station. However, before the construction of the Taipei Metro, the German consultants helped the Taipei Railway Underground Project Office (TRUPO) to design and build the Taipei Main Station based on the concept of a "grand central station" trying to build the Taipei Main Station as the transportation center of the metropolitan. Thus, the designs contradicting with each other were integrated into one system serving the city.

The technological hybridity of styles and functions reveals the track of transnational technology, the autonomy of the technology receiving countries, and the conflicts, negotiation, and integration of a technological system involving technology from different countries. These series of actions are necessary for the process of technology transfer, so the analysis of the hybridity can help us to understand how a technology transfer worked. As Hughes argues, technological systems solve problems or fulfill goals using whatever means are available and appropriate; the problems have to do mostly with reordering the physical world in ways considered useful or desirable, at least by those designing or employing a technological system[24]. Hence, the hybridity of styles and functions shows how the problems the metro builders wanted to solve and in what order they tackled them. Moreover, the formation of hybridity also involves the interactions in the power relations among multiple countries so that we can observe the development of the power relations by exploring the technological hybridity of styles and functions.

[24] Hughes, "Evolution," Pp. 47.

The Technological Hybridity of Systems

"A technological system can be both a cause and an effect; it can shape or be shaped by society." Hughes states, "as they grow larger and more complex, systems tend to be more shaping of society and less shaped by it." Therefore, "the momentum of technological systems is a concept that can be located somewhere between the poles of technical determinism and social constructivism.[25]" In the history of transportation systems, especially metro systems, we can find much evidence echoing what Hughes argues. Matra's VAL(Véhicule Automatique Léger) system was the technological system gaining hard momentum in the 1980s and early 1990s for its tacit knowledge, efficiency, patent protection, complexity, and technological advancement. Having this momentum, as Chang argues, it traveled to Taiwan, generating the coproduction of the Brown Line as a technological system with Taiwanese technical officials and engineers[26]. Analytically, hard technological momentum carries particular meanings, ideology, and functions and a set of power relations and political order. Facing this kind of technological system, postcolonial countries like Taiwan seem to have no choice but replicate it domestically. So how did the Brown Line become a "hybrid metro?"

Peter Perdue modifies Hughes' idea by presenting the idea of the technological brake. First, technological brakes are as strong as momentum: large systems stop as well as change. Second, Hughes implies that large systems necessarily have greater momentum than small ones. The propulsion or braking of a system of elements depends on the tightness of the links between the elements, not on their complexity[27]. Thus, Chang's "coproduction of the technological system" can be seen as the weakening of VAL's technological momentum, meaning the transnational movement of technological systems makes them "more shaped than shaping society."

This dissertation shows this is only a part of the whole story. First, the first phase of the Brown Line experienced the modifications made by Taiwanese technical officials and engineers due to the Matra's withdrawing from Taiwan. Moreover, the second phase of the Brown Line, the Neihu extension line, is the product of the integration of the VAL 256

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[25] Hughes, Thomas P., "Technological Momentum" in *Does Technology Drive History? the Dilemma of Technological Determinism* edited by Merritt Roe Smith and Leo Marx (Cambridge, MA: MIT Press, 1994), Pp. 112.

[26] Chang, "Constructing the Taipei Metro Muzha Line," Pp. 179-180.

[27] Perdue, C. Peter, "Technological Determinism in Agrarian Societies" in *Does Technology Drive History: the Dilemma of Technological Determinism* edited by Merritt Roe Smith and Leo Marx (Cambridge, MA: MIT Press, 1994), Pp.182-183.

and the Bombardier's CITYFLO650. The accomplishment of the whole Brown Line involves four stages: first, the transnational technology transfer of the VAL system; second, the weakening of the momentum of the system and coproduction of the system in Taipei; third, the modification of the system by integrating local technology and the system; finally, the integration of two systems. Hence, I argue that the concept of the technological hybridity of systems can be a useful analytic tool to discuss the Brown Line of the Taipei Metro.

The hybridity shows the possibility of the transnational building of technological systems. The transnational building of the technological system does not mean merely adding local components or involving local actors; instead, it could involve the integration or combination of two or more technological systems. In this process, the meaning and functions of technological systems changed, and there would be new goals and orders that the hybrid systems tend to build. Moreover, the hybridity of systems reveals how the Taiwanese changed the power relations between the technologically advanced countries. The Taiwanese 'broke into' the technological system reshaping it as a hybrid one. The hybrid metro shapes and reshapes not only Taipei City and passengers' lives with particular forms but also the power relations between the catching-up country and the technologically advanced countries. In the new relations, the catching-up country, as the case of the Brown Line in Taiwan, can gain financial interests, end political storms, and realize the autonomy of the country as a nation-state, especially a new rising country like Taiwan.

Metro as a Nationalist Technology

In the case study of the project of Taiwan's High Speed Rail, Chang found that the notion of "hybrid engineering" in this project meant an engineering culture that values hybridity. He also discovered that Taiwanese politics and society gradually directed their engineers to pursue engineering optimization and non-dependence rather than seeking simply survival or perfection. He goes on to argue, "Taiwan's engineering culture of hybridity has not only been developed within its engineer community but has also been constructed by its politics and society." Thus an engineering culture of hybridity became a culture that the Taiwanese constructed and shared in their society[28]. My historical count of the Taipei Metro and the subterranean railways in Taipei echo Chang's argument that Taiwan's engineers and technical officials value hybridity for seeking non-dependence.

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[28] Chang, Kuo-Hui, "Technological Construction as Identity Formation: the High Speed Rail, Hybrid Culture and Engineering/Political Subjectivity in Taiwan," (PhD diss., Virginia Polytechnic Institute and State University, 2010), Pp.10-11.

This dissertation also reaches a similar conclusion of how technical practice and decision making generated the autonomy and subjectivity of Taiwan. However, this dissertation further takes the approach of social history to explore how the Taiwanese out of the engineering communities interoperate and shape the metro systems, finding a different phenomenon. Taiwanese passengers and citizens do not value hybridity as metro engineers do, and they shape the systems as users in a different way.

Edgerton points to an understudied aspect in the history of technology: maintenance. Maintenance is almost as widely distributed as use. As a consequence, maintenance and repair are the most widespread forms of technological expertise. Maintenance and repair have been the realm of the small trader and skilled workers. They were different from, marginal to and yet interdependent with the great systems of technics[29]. Edgerton also emphasizes the importance of the use of technology and argues that the historians of technology need to focus more on the technologies which are widely used instead of merely sticking to cutting-edge innovation[30]. Scholars who focus on users also reveal that users embed the new technology into their social or cultural context redefining how the technology is to be used, although their context and way may not be compatible with those which the designers had in mind[31].

Along these lines, this dissertation does not only discuss the design and construction of the rail transportation systems in Taiwan but also how people maintain and manage the systems and how users have used them, especially how Taiwanese have used the metro systems. First of all, the technical officials and engineers took American consultants' suggestions to build a spectacular metro system that would attract people to use it since they had a progressive consciousness of changing Taipei and Taiwan by building the Taipei Metro. Then, technical officials who were in charge of the operation of the metro system took a series of actions to make the system extremely clean and highly ordered passing new laws, promoting rider etiquette, and using different kinds of propaganda. They set cleanliness as one of the top goals of their operation. Besides the management of the metro's space, the operators of the system keep improving the maintenance and management, focusing on becoming the most efficient metro system in the world.

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[29] Edgerton, *Shock*, Pp. 80.

[30] Edgerton, David, "From Innovation to Use: Ten Eclectic Theses on the Historiography of Technology," *History and Technology* 16:2 (1999): Pp. 111-136.

[31] Oudshoorn, Nelly, and Pinch, Trevor edit, *How Users Matter: the Co-Construction of Users and Technology* (Cambridge, MA: MIT Press, 2005).

Taiwanese people echo the technical officials' ambition of making Taiwan modern. Despite a few cases of disorder in the Taipei Metro, people rapidly adapted themselves to satisfy the need to build a neat and ordered environment. Furthermore, they treat the etiquette and space in the metro system as constituting "metro culture" and as a source of national pride for Taiwan. Since the mid-1990s, Taiwanese national identity has grown so that the Taiwanese need symbols to show the uniqueness of Taiwan as a nation while the Taiwanese government has been excluded from mainstream international society. The metro culture and the Taipei Metro's efficiency became the subject for Taiwanese to show Taiwan's progress and kindness when facing the vast, powerful, and emerging China. Accordingly Taiwanese people highly value foreigners' appreciation of Taiwan's metro systems.

Taiwanese technical officials replicated the Taipei Metro's features, such as monumental architecture and a neat environment, when they developed later projects for rail mass transportation systems like the Taiwan High Speed Rail (TSHR) and Kaohsiung Rapid Transit System(KRTS). The Taiwan Railways Administration (TRA), the state-owned intercity railway operator, also tried to modify its railways and stations when it reformed some of its lines as commute railways. Taiwanese people and the rail transportation system operators also built the metro culture into the systems whether they were traditional railways, the high speed train, or metros. The phenomenon, I argue, can be called "Metrolization," which is derived from the Mandarin Chinese Jieyunhua (捷運化), meaning to make things metro alike.

Taiwanese technical officials and Taiwanese people have built a "Formosa technological sublime," a concept derived from David Nye's American technological sublime[32], to exhibit Taiwan's collective morality and nationality by building and showing spectacular technological systems. Interestingly, the Taiwanese do not take their railway manufacturing industries and the hybrid systems as a source of national pride; instead, they care more about how they introduced technology from advanced countries and integrated it into a good system. So, the Taiwanese do not have a techno-nationalist attitude towards rail mass transportation system, which emphasizes the nation's originality in technological innovation,[33] instead, they treat the metro and even the high speed rail system as a nationalist technology, as materials from which to construct a newly rising Taiwanese national identity.

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[32] Nye, David E., *American Technological Sublime*. (Cambridge, MA: MIT Press, 1994).

[33] Edgerton, *Shock*, Pp. 110.

Methodology

This dissertation is mainly based on three primary sources. First, the dissertation relies on government archives in Taiwan. However, many of the archives were classified for decades until I applied for declassification or the right to use them. For example, the archives "Subterranean Railway" and "Metro System" were classified ‘confidential’ for three decades until 2019. I applied for access appealing to Taiwan's National Archives' new policy that applicants can review the confidential documents about to be declassified without making copies.

The archives in the National Archives Administration, National Development Council (National Archives), is one of the primary sources of archival material. These archives include the documents of U.S. Aid, the Sino-American Fund for Economic and Social Development (SAFED), the TRUPO, and the project of Taipei Metro before 1986 when the project was transferred from the TPB to Taipei City Government. The archives of TRUPO and the Taipei Metro were also classified confidential until I applied to see them and asked for declassification.

The other source of archives is Academia Sinica’s archives of the Institute of Modern History. The archives have material on international consultants for transportation projects in the 1960s and 1970s, including the project for elevated railways in Taipei City and early studies of the subterranean railway project. For the history of the Taipei Metro since 1986, the archives and technical documents in the library of the DORTS contributed much to my studies. Finally, the library of the Institute of Transportation, Ministry of Transportation and Communication (IOT) provides plentiful materials about the history of the TPB. Furthermore, with the assistance of the IOT’s officials, I obtained a copy of documentation related to an outstanding senior member of the TPB, Dr. Chiang Yu-sheng (姜渝生). It contains an interview with him providing abundant details of how technology transfer worked in the TPB during its early days.

Second, I held ten interviews with the metro related technical officials and engineers including high-ranked supervisors of the related institutes, technical consultants within the government, international consultants, equipment suppliers, and system operators. These interviews were held during March and July 2019 in Taipei City or New Taipei City. The interviews provide many details about decision making, technical practice, political background, and the interactions with international consultants. The interviewees did not only tell stories about metro systems, transportation planning, and railways but also built my understanding of the transportation profession and technical

issues in rail transportation. Furthermore, their words can be clues for further searches in archives and technical reports and for crosschecking with archival materials. The interviewees also provided or lent copies of technical documents and written materials to me for this study.

Third, I also exploited the databases of newspapers and images for analysis or rebuilding the history. For the newspapers, I used the United Daily News' (聯合報) database to access the news during the 1960s and 1990s. These materials provide many contents for the early development of the projects of railways in Taipei and the construction of the social history of the Taipei Metro. For the news after 2000, I directly use medias' online materials since Taiwanese media has generated online news since 2000. Furthermore, I also used the National Repository of Cultural Heritage held by National Taiwan University to search for and acquire image materials.

Besides the resources above, publications and websites of the Taipei Metro also contributed to this dissertation. Moreover, technical reports about the projects of mass transportation systems and the Taipei Metro, which I found in Taipei Public Library and National Chiao Tung University Library, were also essential materials for this dissertation.

Chapter Summaries

The chapters of this dissertation roughly follow the history chronologically except for chapter 4 and chapter 5. The periods covered in each chapter overlap a little. In chapter 1, *The Island*, I provide a picture of U.S.-Taiwan relations since 1949 and their impact on the development of technology in Taiwan in these decades. After being defeated by the Chinese Communist Party in China, the KMT government had nothing but an island with 8 million people and the infrastructure left by the Japanese colonial government that had been badly damaged by WWII. However, the Korean War brought in U.S. Aid to help strengthen Taiwan's economic and technological power to confront communist China's threats. In the period of U.S. Aid (1950-1965), the KMT government and the U.S. coproduced American hegemony of science and technology contributing to Taiwan's construction of its technological capability and the establishment of institution needed for the future development of Taiwan transportation technology.

Chapter 2, *The TPB*, focuses on the history of the TPB (Transportation Planning Board). First, we learn how Taiwan's transportation planning and management science was imported in the context of the Cold War and under American hegemony. The establishment of the TPB initiated Taiwan's profession of transportation studies and planning, and it also benefited from U.S. Aid's extension, although the Aid ended in 1965.

I argue that the change in U.S.-Taiwan relations in the 1970s, when Nixon turned to mainland China as an ally to confront the Soviet Union, created a space for the Taiwanese government to seek alternative sources of knowledge of transportation planning, leading to technological hybridity of knowledge.

In chapter 3, *The Underground*, I go on to discuss technological hybridity in the implemented project: the TRUPO. This project "buried" underground the intercity railroad through downtown Taipei City as advised by German and Japanese consultants during the 1980s, after a decade-long argument of whether to build an elevated railway or a subterranean one. Along with the project of the Taipei Metro, we also find that different technological ideologies of mass transportation were realized in the same project leading to the hybridity of technological style and function. Taipei Main Station is one of the most typical examples.

Chapter 4, *The Taipei Metro I*, chapter 5, *The Taipei Metro II*, and chapter 6, *The Hybrid Metro* focus on the Taipei Metro. When the Taiwanese government started to build the Taipei Metro in the early 1980s, the U.S. government and American companies showed their ambition to get the business of Taipei Metro as compensation for the huge trade deficit between the U.S. and Taiwan at that time. Under American hegemony's protection, the Taiwanese government seemed to have no choice. However, the Taipei Metro was partly planned using British consultants' advice and also part of the mass transportation plan devised by Taipei Metropolitan using German consultants. Facing American political pressure, Taiwanese engineers and technical officials took hybrid approaches integrating knowledge, ideologies, and styles from these different countries into one metro system fulfilling their goal to build a modern metro system of which the country could be proud while maintaining Taiwan's autonomy as a nation-state. However, the American factors did not only mean political pressure and hegemonic power; in fact, American consultants contributed much to incubate Taiwanese engineers' profession of building a metro system. Moreover, the project of the Taipei Metro launched a massive mobilization of knowledge and human resources transnationally and within Taiwan. Chapter 4 concentrates on the mobilization of knowledge and human resources, while chapter 5 focuses more on the tension between the U.S. and Taiwan and Taiwan's hybrid strategies.

Chapter 6 primarily discusses the most special metro line in the Taipei Metro, the Brown Line. The case of the Brown Line demonstrates how the technological hybridity of systems happens and why it matters. The Brown Line has been the only automated guideway transit (AGT) line until today, and the decision to build it involved the conflicts

between the TPB and the Taipei City Government, and American efforts to integrate the TPB and Taipei City's plan of the Taipei Metro. In the design stage, the French firm Matra won the bid of the Brown Line system, transplanting its VAL system in Taipei. However, a series of accidents happened to the Brown Line leading to Matra's withdrawal from Taiwan. Taiwanese technical officials and engineers took a series of actions to modify the system, and, when they started to build the extension of the Brown Line, Taiwanese integrated the Bombardier's AGT system with the modified VAL as a hybrid technological system showing how technological hybridity changed the power relations between a catching-up country and a technologically advanced country.

Chapter 7, *The People*, takes a social history approach of to discuss how the Taiwanese people, who are passengers and citizens, interpret rail transportation systems in Taiwan and their technological hybridity. I describe their enthusiastic appreciation of "modernization" in the Taipei Metro, Taiwan High Speed Rail (THSR), or other newer metro systems, that they regard as vectors of national pride. The technical officials, engineers, system operators, politicians, media, and other Taiwanese people have shaped the metro systems and the THSR into a"Formosa technological sublime". It symbolizes the collective national morality and bestows an identity on the new rising nation-state by building efficient operation, breathtaking architecture, a neat and ordered environment, and a disciplined but considerate metro culture.

Chapter 2: The Island

U.S. Aid and Taiwan's Dependence on American Hegemony of Science and Technology

"Everything in the past is like dying in yesterday; everything in the future is like living in tomorrow. From now, no matter in public service or private life, all actions should be newborn. (從前種種譬如昨日死，此後種種譬如今日生，今後公私生活與工作，皆應從新做起，一切措施皆要新生。)" Chiang Kai-shek, 1950

"The material resources which we can afford to use for assistance of other peoples are limited. But our imponderable resources in technical knowledge are constantly growing and are inexhaustible"—Harry Truman, 1949

In October 1944 the Allies were about to launch Operation KINGII to get back the Philippines with their dominant fleets and air force. To prevent the Allies' troops from landing there, the Empire of Japan not only gathered almost all of its navy in Southeast Asia. It also launched a massive air strike on the U.S. Navy's carriers from Taiwan, also called Formosa, the island colony next to China. As we know, the empire's once-proud navy was quickly destroyed, as was the air force in Taiwan that only damaged two cruisers. Following General MacArthur's plan, America bypassed Taiwan, engaging the Japanese in bloody battles in Okinawa in 1945. Thus, when Japan surrendered, Taiwan was free from the occupation of American troops. The U.S. left Taiwan to Chiang Kai-shek, and his KMT[34] government. However, the KMT government's catastrophic failure in the Chinese Civil War and the following Korean War changed the historical trajectory of this island, that came under important American influence. Unlike in Okinawa, most of the U.S. there between 1950 and 1965 were not soldiers but engineers, managers, experts, and technical officials. We will call this period "the U.S. Aid period." Facing the new situation of the decades-long Cold War, Taiwan was not only the final fortress for the

[34] Kuomintang or Chinese Nationalist Party 中國國民黨 was founded by Dr. Sun Yat-sen in 1894 and was reformed into the KMT by Chiang Kai-shek in 1919. It had ruled Taiwan for over 50 years since 1949, and it is the biggest opposition party in Taiwan now.

"Chinese Nationalists" but also the showcase of the "free world" under American hegemony not only for the military but also for science and technology.

The initiating point of the development of Taiwan's metro systems and the subterranean railways in Taipei can be traced back to the importation of the transportation planning profession. Although U.S. Aid was not directly involved in this process, it defined the political and institutional framework for American hegemony over the science and technology of transportation studies and planning. To understand how U.S. influence was embedded in Taiwan we need to understand the historical environment in Taiwan after 1949 and how it impacted the transnational importation of knowledge, people, and artifacts. What was Taiwan's status from 1940 until 1965? What were the choices and the actions that Chiang Kai-shek and his KMT government took to deal with communist China's threats, and with changing relations with the U.S., while developing the former island colony left by the collapsed Empire of Japan? To answer these questions we must describe the existing railway systems in Taiwan at the time to understand the local context, especially Taiwan's Japanese colonial experience, so getting an idea of the rail mass transportation technology before the American factor began to play an important role in the country. This will help us analyze the role played by the U.S. in developing mass transport in Taiwan, and introduce us to CUSA, the ad hoc institute set up to cooperate with the U.S. to manage and to execute the technical and economic assistance projects supported by U.S. Aid.

Formosa, the Counterattack Base

The Chinese faced no peace after the victory won by bitter struggles with imperial Japan in 1945. It was followed by an even more severe civil war between the KMT government and the CCP (Chinese Communist Party). Chiang Kai-shek and his army faced terrible defeats in the series of battles with the PLA (People's Liberation Army), and Chiang and the KMT government moved from the mainland's capital, Nanjing, to Guangzhou, Chongqing, and Chengdu in 1949. On October 1st, 1949, Mao Zedong announced the establishment of the People's Republic of China (PRC) proclaiming that "the Chinese people have stood up!" at the Gate of Heavenly Peace (Tiananmen) in Beijing. Chiang had no choice but to retreat with his government to Taiwan in December of the same year[35]. At that time, the Republic of China (R.O.C.), as a member of the Allies, still did not sign any agreement with Japan to legally acquire the island although the KMT

[35] In fact, Chiang flew to Taipei several times for preparation of setting Taipei as his temporary capital in an earlier time in 1949.

government had controlled it for years de facto based on General MacArthur's General Order No. 1. The island was Chiang and the KMT government's final hope of survival.

At this time, the Truman Administration, disgusted with the KMT, believed that Taiwan would eventually be taken by the CCP without America's intervention. With the fall of Taiwan, the U.S. could develop its relationship with Beijing so that the problem of whether to recognize the PRC could be solved automatically[36]. Therefore, the Truman Administration refused to provide any military assistance or intervention to save the KMT government from its critical condition. However, Chiang still set a goal of "counterattack" in Taiwan and waited for proper timing and resources to go back to the mainland. Taiwan became the "Counterattack Base (反攻基地)" for the Chinese nationalists. The KMT government declared martial law in Taiwan before its retreat to the island and tried to rebuild its army with the assistance of former imperial Japanese officers[37]. It also initiated a series of agrarian reforms to prevent the rise of communism on the island and modified the organization of the party[38]. However, Taiwan and the KMT government were still under the pressure of the CCP's possible invasion due to Truman's attitude and policies toward the Civil War. Chiang's own position was also unstable since the Department of State considered abandoning him altogether[39], and did not even mention a real "counterattack."

On 25 June 1950, Kim Il-sung and his Korean People's Army (KPA) crossed the border between North and South Korea pushing the government of South Korea to the southeast corner of the peninsula within three months even though the U.S. decided to intervene in the war through the U.N. right after its eruption. After MacArthur invaded Incheon (Operation Chromite), the United Nations Command (UNC) reversed the situation pushing the KPA to the border between North Korea and China at the end of 1950. At the same time, the newly born PRC decided to send the People's Volunteer Army, which was composed of the PLA to support North Korea confronting the UNC, that was mainly made up of U.S. troops and its allies' forces. Chiang tried to persuade the U.S. to support his

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[36] Tucker, Nancy Bernkopf, *Taiwan, Hong Kong, and the United States, 1945-1992.* (Woodbridge, CT: Twayne Publishers, 1994), Pp. 32.

[37] Noshima, Tsuyoshi (野島 剛), *The Last Battalion: Chiang Kai-shek and the White Group* 最後的帝國軍人：蔣介石與白團. (2015); Lin, Hsiao-ting, *Accidental State: Chiang Kai-shek, the United States, and the Making of Taiwan*. (Taipei: Linking Publishing 聯經出版, 2016), Pp.219-221.

[38] Lin, Hsiao-ting. *Accidental State: Chiang Kai-shek, the United States, and the Making of Taiwan*. (Cambridge, MA: Harvard University Press, 2016), Pp. 134-136.

[39] Lin, *Accidental State*, at Pp. 158; Tucker, *Taiwan,* Pp.31-32.

military plan to invade the mainland to open a “second front” and to take pressure off the UNC. Alternatively he offered to deploy his Nationalist forces to get involved directly in the Korean War. The Truman Administration preferred to utilize the Nationalist’s military strength only to monitor mainland China, rather than for the war in Korea, believing this would best serve the U.S.’s interests in Far East[40].

Truman sent the Seventh Fleet to the Taiwan Strait to ensure that there was no military conflict there just two days after the eruption of the Korean War. Then, in April 1951, Truman relieved MacArthur, who supported the idea of the “second front” of his command. Chiang lost a vital ally supporting his counterattack goal, but he soon found that his best policy was to keep the extent of the mainland counteroffensive acceptable and manageable so as to ensure the legitimacy of his rule in Taiwan, which was now also the symbol of “Free China.[41]” After the inauguration of Eisenhower in 1952, the situation on the strait remained the same despite Eisenhower and his Secretary of State, Forester Dulles’ anti-communist position, and, during the following eight years, rhetoric in the Eisenhower Administration tended to be more belligerent than actively engaged[42].

In 1954, the PLA heavily bombarded Kinmen Island and other islands close to the southeast China coast, which were under the KMT government’s control, and then landed on the Tachen Islands in November, causing the First Taiwan Strait Crisis. Also, the prime minister Zhou Enlai proclaimed the goal of “liberalizing Taiwan by force.” The crisis precipitated by the PRC was deliberate, as it coincided with Dulles’s arrival in Manila. Mao Zedong intended the action to forestall extending the protection of the SEATO (the Southeast Asia Treaty Organization) to Taiwan. Such a calculated action, however, provided Chiang Kai-shek with perfect justification to push Washington toward the desired defense treaty[43]. Responding to the PRC’s bold actions, Eisenhower and Dulles sent the Assistant Secretary of State for Far Eastern Affairs Walter Robertson to Taiwan to negotiate and to sign a mutual defense treaty. After a two-month-long negotiation, the U.S. and the KMT government signed the Sino-American Mutual Defense Treaty in Washington, D.C., in December 1954. According to the treaty, if the R.O.C. came under attack, the U.S. was obliged to provide aid and military support and vice versa so that if communist China attacked Taiwan it would entail a military conflict with the U.S. too. It is

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[40] Lin, *Accidental State,* Pp. 198-199.

[41] Lin, *Accidental State*, Pp. 204.

[42] Tucker, *Taiwan,* Pp. 36.

[43] Lin, *Accidental State,* Pp. 228.

noteworthy that the Treaty only applied to the islands of Taiwan and Penghu (Pescadores Islands), excluding mainland offshore islands like Kinmen and Matsu, This was to discourage the KMT government's from embarking on any military action on mainland China.

In contrast, the safety of Taiwan, and of the KMT government, was secured, as well its legitimacy to represent China in the United Nations as the Republic of China. That is to say, Mao and the PLA could not cross the strait to merge Taiwan as a part of China, but nor could Chiang and his KMT government cross the strait to reach his counteroffensive goal of becoming the ruler of China again. Taiwan became a counterattack base which has never counterattacked[44], and, in Lin Hsiao-ting's words, an "accidental state."

The Railways: Japanese Colonial Context

In the accidental state, Chiang Kai-shek owned almost nothing but his broken army and the island itself. However, although Taiwan's economy and its infrastructure was severely damaged in WWII and the Chinese Civil War, this island, as a former Japanese colony, had its infrastructure, human resources, and an industrial base thanks to Taiwanese people, Japanese immigrants, and the Japanese colonial government's half-century of development. For example, Taiwan already had widespread power networks and railway systems all over the island before WWII. Moreover, during the War, the Japanese colonial government introduced heavy industries like chemical industries contracting Taiwan as the "South Bound Base (南進基地)" for the invasion of Southeast Asia. Many young Taiwanese were brought to Japan as supplement labor manufacturing military products in the late stages of WWII so that many Taiwanese received technical training from the Japanese[45]. Obligatory education for all, and the higher education system in Taiwan also prepared human resources needed for building the accidental state. After the end of WWII and the Chinese Civil War, Taiwan's industries still had a strong connection with Japan. Therefore, anyone who discusses the technological development of the country should not overlook the Japanese colonial context in Taiwan and the "Japanese factor" even nowadays, especially in rail transportation technology.

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[44] In fact, Chiang secretly launched several military actions invading islands in southeast China's coastal line in the 1950s and 1960s like Dongshan Island Campaign in 1953 and August 6th Campaign in 1965, and the KMT government also sent special forces or guerrilla into the mainland. However, these actions did not set a goal of permeant occupation of any land or just concentrated on information works.

[45] The Taiwanese documentary "Shonenko 綠的海平線" (2006) reveals the story of these young Taiwanese technicians. The English name of the documentary, Shonenko 少年工, means "teenager worker" in Japanese.

Nor should one overlook the elite intellectuals and the capitalists who left the mainland and moved to Taiwan, providing the KMT government with a basis for building a "Free China."

The railways are useful for illustrating the Japanese colonial heritage and how it affected the local context for the KMT government. The history of railways in Taiwan can be traced back to 1887 when Taiwan was under the governance of the Great Qing Empire. In the Sino-Franco War (1883-1885), the French fleets and troops attacked Taiwan and Pescadores, trying to block the Taiwan Strait. Although the French failed to invade Tamsui, the most important port in north Taiwan, and Taipei, the capital city of Taiwan Prefecture at that time, the Imperial government found that Taiwan had critical strategic value for its coastal defense. Thus, it upgraded Taiwan's administrative level to province-level after the end of the war and launched a series of modernization projects including coastal fortresses, the postal system, the telegraph system, power network, mining, and the railways. The first governor of Taiwan, Liu Mingchuan (劉銘傳), hired British engineers to plan and build a railway from Keelung to Hsinchu in 1887. Although Liu and his British engineers originally planned to finish the railway connecting the north port Keelung and the old capital Tainan in the south, Liu's successor ceased the ambitious plan due to financial restraints so that the railway only reached the principal city in north Taiwan, Hsinchu, in 1893.

However, after 1895 when the Japanese became the next rulers of the island, they found that the railway was in a critical condition because the workers (mainly soldiers) had built the railway without following British engineers' instructions and chose inappropriate materials and routes. For example, the bridge crossing the wide Tamsui River should have been built with steel, but the Chinese built a wooden one. The bridge only lasted eight years after its completion. The Japanese admired Liu's ambition, but lamented the failure of his project and rebuilt most of the railway in 1898[46]. After the ten-year-long construction period, the Japanese colonial government completed the West Coast Line connecting Keelung and the southern port city Takao.[47] For transporting materials to build the railway, the colonial government built the Tamsui Branch Line

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[46] Watabe, Keinosuke 渡部慶之助, *The Reading of Taiwan's Railway* 臺灣鐵道讀本 (Taipei: Taiwan Historica 國史館臺灣文獻館, 2006).

[47] Now Kaohsiung. The original Chinese character of Takao was 打狗, meaning "hitting dog" in the Qing period. Japanese regarded the name indecent and changed it into 高雄, naming after a place near Kyoto, with the same pronunciation in Japanese. After 1945, the KMT government took the "de-Japanization" policy in Taiwan so that it kept the same Chinese character but changed its pronunciation into Chinese, Kaohsiung.

connecting Tamsui harbor and Taipei, This Tamsui Line was the first railway built by the colonial government. After the accomplishment of the West Coast Line and Tamsui Line, the colonial government sequentially built the Coastal Line of the West Coast Line, the Yilan Line, the Pingtung Line, the Taitung Line (east coast), and other branch lines. It also planned to connect the Taitung Line with the Pingtung Line in the south and the Yilan Line in the north completing a railway network that encircled the island[48].

The private sector also contributed much to the development of railways in Taiwan. The Taiyang Mining Cooperation, which was founded by the Taiwanese Yan's family from Keelung, completed the Pingxi Line for transporting coal from mines so that the first railway built by the private sector was built by the Taiwanese instead of Japanese. Then, many Japanese also started to build their railways for transporting coal, wood, salt, and sugar cane all around the island, and many of these railways also provided passenger service. Taipower (Taiwan Power Company) built the Jiji Line for its massive Mingtan Dam project in 1921, slightly later than Yan's Pingxi Line. However, after the mid-1920s, the colonial government bought the private railways gradually. Hence, most of the railways were owned by the colonial government when the colonial period ended. The exceptions were the industrial railways. Then, when the KMT government landed Taiwan, the KMT government confiscated all Japanese property no matter whether they belonged to the colonial government or private companies so that all railways in Taiwan were under government and state-owned companies' control after 1945.

The railways in Taiwan have two gauges: 1067mm and 762mm. When Liu built the first railways in Taiwan, the British suggested using 1067mm due to Taiwan's mountainous geography. Coincidently, 1067mm became standard in Japan for a similar reason. Therefore, when the Japanese received the railways left by the Chinese government, they decided to keep the same gauge so that the cars and locomotives could be compatible between the newly gained colony and the new mother country. Thus, even today, Taiwan's main lines and the branch lines connecting the main lines are 1067mm rather than more poplar worldwide 1435mm. The 763mm gauge is mostly used in industrial railways like sugar railways and forest railways for dealing with complex terrain in mountain areas at a lower cost. In central and south Taiwan, the widespread sugar railways played an important role in mass transportation for decades until the late 1970s. One sugar railway connecting the big city in central Taiwan Taichung and south Taiwan

[48] This network was completed by the KMT government in 1992.

was 262.5km long and was planned to be a strategic railway if the PLA destroyed the West Coast Line.

Although Taiwan had widespread railway networks as the pictures below show, the Allies heavy bombardment and the Japanese empire's lack of materials for maintenance during WWII critically damaged the country's railway services[49]. Moreover, the KMT government expelled most Japanese technicians and managers, and Chinese technicians and managers were not familiar with the Japanese specifications used for the railways in Taiwan after WWII. Furthermore, the numbers of Chinese technicians could not fulfill the vacuum caused by the expelling Japanese. There were also shortages of materials like rails, sleepers, cement, gasoline, and coal, as well as money, so that Taiwan's railways faced a considerable challenge for recovery from the disastrous war[50].

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[49] Yu, Chien-Chou 尤健州, "The U.S. Aid and the Railway Construction in Taiwan(1950~1965) 美援與戰後臺灣鐵路的建設(1950~1965) " (Master's thesis, National Chung Hsin University, 2004), Pp. 46-51

[50] Yu, "U.S. Aid," Pp. 52-57.

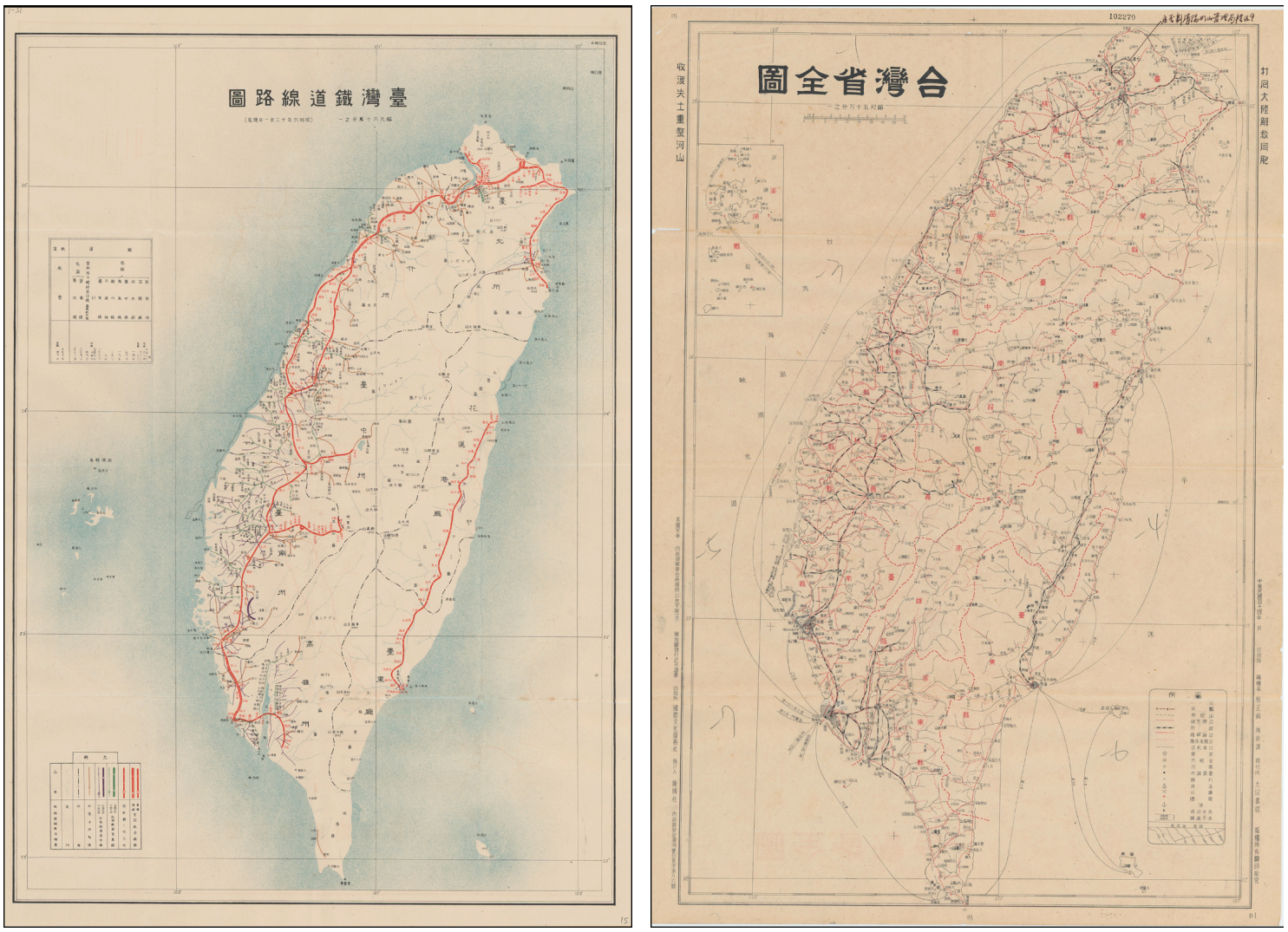

Figure 2.1: Taiwan's Railways in the 1920s (left)

Figure 2.2: Taiwan's Railways in 1955 (right)

The situation of the island's railways when the KMT government retreated to Taiwan reflects the whole picture of Taiwan's economy and society: an island which was severely damaged by the war, a failed regime lacking resources, and millions of people, including the 6 million local Taiwanese and the 2 million immigrants moving to Taiwan with the KMT government. Moreover, this island needed to face the possible invasion from the other side of the strait. At this time, 1949 and early 1950, the U.S. refused to provide both military and economic resources to its former partner in WWII, so Taiwan, Chiang Kai-shek, and the KMT government faced a life or death situation. However, the outbreak of the Korean War and the U.S. Aid that followed reversed a critical situation.

The U.S. Aid and the CUSA

The so-called "U.S. Aid", or "Mei Yuan (美援)" in Chinese, refers to the U.S.'s technological, economic, and military assistance between 1951 and 1965. This Aid was

based on the Mutual Security Act (MSA), which Congress approved in October 1951 as a response to the Korean War. The Act authorized economic and military aid to the nations friendly to the U.S. to strengthen mutual security and the individual and collective defense of "free countries," including Taiwan. For the U.S.' part, the Aid was divided principally into t economic aid, managed by the Economic Cooperation Administration, Mission to China and the Agency for International Development (AID),[51] and military aid, managed by the Military Assistance Advisory Group (MAAG). The AID and the MAAG were overseen by the American Ambassador in Taiwan[52].

The background to U.S. Aid is the following. The U.S.' military protection guaranteed Taiwan and the KMT government's safety because of the Korean War and the later development of a triangular relationship between the U.S., Taiwan, and China. But this only a part of the story about this accidental island state after 1949 and how it started to develop its technology including transportation. For Chiang and the KMT government, although the security of the regime in Taiwan was ensured, they needed to improve its military, economic, and technological power to confront communist China so that "Free China" could show its supremacy over its communist rival. For the United States, once its "Chinese ally" was secured, it needed Taiwan to be strong enough to prevent the PRC's possible invasion and to contain the PRC's moves in the game of the Cold War. Furthermore, it also needed to show that the members of the "free world" could live a better life than those in the communist camp, especially as it had "Free China" on its side while the Soviet Union had "Red China" in its camp. Moreover, the U.S. further tried to shape how Taiwan would and should improve its military, technological and economic power to ensure the security of America's hegemonic power in the western Pacific. For example, on the military side, while Chiang highly valued his Japanese military advisors for achieving his counterattack plan, the U.S. kept pressuring him to dismiss this military consulting group. As a result, the Japanese military consulting group kept a low profile for decades and its actions were also been restricted[53].

That being said, the U.S. also provided necessary military resources to the KMT government to confront communist China. For example, the R.O.C Air Force (ROCAF)

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[51] The United States Agency for International Development was founded in 1961 based on the Foreign Assistance Act passed on the same year. Before 1961, the Economic Cooperation Administration, Mission to China, which was founded in 1948 based on the Foreign Assistance Act signed by Truman, and its subsequent institutes were in charge of the U.S. Aid.

[52] Chang, Min-Hua, "The U.S. Aid and Taiwan's Post-War Economic Development, 1951-1965" in *AFRICAN AND ASIAN STUDIES,* vol.13, (2014): Pp.104-105.

[53] Noshima, *Last Battalion*.

holds a record in military history: the first to shoot down an enemy plane with a missile. On September 24, 1958, ROCAF's F-86 fighters shot down two PLA's MiG-17 with AIM-9 Sidewinder missiles. The U.S. provided both of the F-86 and the AIM-9. As mentioned above, military assistance was included in U.S. Aid.

The technological and economic aspects of U.S. Aid followed a similar logic. It did not only provide direct financial resources like donations and loans to Taiwan. It also provided experts, knowledge, and practical projects, improving the infrastructure and economic power of the island. In the process, the U.S. sent American consultants and technical officials to Taiwan, ensuring that Taiwan would follow the America path to develop its technology and economy, although, as the following chapters show, the U.S.'s ambitions might not always have been completely satisfied.

Even though U.S. Aid started in 1951, the cooperation between the KMT government and the U.S. government in science and technology started in 1927 when KMT established the government in Nanjing, China, while Taiwan was still a part of the Japanese Empire. However, their cooperation would profoundly influence the development of technology, economy, society, and politics in Taiwan after WWII. As the KMT came to power in 1927, it rapidly became apparent that this modern Chinese state would need to develop strategies to foster and manage technology transfer that could assist with national development[54]. From 1927 to 1937, ten years before the total military conflict with Japan erupted, the KMT Nanjing government established patterns that it continued to employ even after it relocated to Taiwan. First, it set up institutions to exploit the resources from the U.S. or other countries to promote modernization of science and technology. The Academia Sinica and the National Economic Commission were typical examples. Second, it recruited talented technicians or external advisors into these institutions. Third, it established a cooperative relationship with foreign governments or foundations through which knowledge and technology could be transferred[55]. Finally, despite reliance on the import of knowledge, especially from America, the KMT government adopted flexible strategies to avoid total economic and technological dependence on any foreign countries.[56] This was to enable the government to adapt to changing international and domestic circumstances by adjusting their approach to

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[54] Greene, J. Megan, "The KMT and science and technology, 1927-1980" in *Technology Between the US, China and Taiwan,* edited by Fuller, Douglas B. and Rubinstein Murray A. (London: Routledge, 2013), Pp.7.

[55] Greene, "KMT and science," Pp. 8.

[56] Tucker, *Taiwan,* Pp.5.

interacting with foreign states and businesses and creating new institutions when needed[57]. The model of the cooperation of science and technology between the KMT government and the U.S. government could be regarded as a prototype of coproduced American technological hegemony, as Krige has described, since the KMT government consented to introduce American resources and experts and adopted their flexible strategies.

The CUSA and the JCRR(1949-1965)

After the outbreak of the war against Japan, the cooperation between the KMT government and the U.S. was mainly economic and military assistance via the Lend-Lease Program and the U.S. involvement in WWII. However, after the end of WWII, the Truman administration hesitated to continue to provide aid to the KMT government deemed ineffective and corrupt. In 1948 the KMT was facing its devastating defeat in the severe Chinese Civil War at the hands of the CCP. Under intense pressure from the China Lobby, an advocate group that strongly backed the KMT government in the House and the Senate for decades, the KMT government and the U.S. government signed the Sino-American Economic Aid Agreement in Nanjing. Based on the agreement, the Council of United States Aid (CUSA) and the Sino-American Joint Commission on Rural Reconstruction (JCRR) were set up in Nanjing. Although the CUSA and the JCRR were already founded in 1948 and initiated some technical projects and reform programs in China, the two institutes started to play vital roles once the KMT government retreated to Taiwan.

The CUSA was chaired by the Premier (President of the Executive) Yuan, and populated by other ministers of government, though it was financially separate from the government and ministries, making it semi-autonomous[58]. This kind of special status inside of the KMT government would provide the CUSA and its subsequent institute with power and importance that it enabled it to have an impact on the development of technology, including mass transportation technology, in Taiwan.

In 1951, once the MSA was terminated, U.S. Aid flooded into Taiwan, and the CUSA continued its mission of managing the resources from this source, including direct financial and material assistance and technical assistance. U.S. economic aid of more than $1 billion equaled 43 % of gross investment during the decade and accounted for nearly 90% of the flow of external capital and donations. U.S. military aid freed local

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[57] Greene, “KMT and science,” Pp. 5.

[58] Greene, “KMT and science,” Pp. 12.

resources from the otherwise intolerably heavy defense expenditures[59]. For technical and economic assistance, the CUSA and the Mutual Security, Mission to China[60] formed the United States Aid Technical Assistance Committee to review technical and economic assistance projects and manage financial resources. This committee was composed of representatives from both Taiwan and U.S., including two members from the Mutual Security, Mission to China, two members from the JCRR, and three members from the CUSA. In 1958, the committee was reformed into the Joint Technical Assistance Committee with three committee members, and one of each from the Mutual Security, Mission to China, the CUSA, and the JCRR. The Committee could also establish consulting committees, and the convener of a consulting committee could recruit members from the three institutes for suggestions regarding training or technical assistance projects. The Office of Secretary of the Committee would review projects of technical assistance, recruit trainees, and compose assistance projects. The committee members of the Joint Technical Assistance Committee would review the projects brought by the Office. The Office would also communicate with the U.N. and other technical assistance units.

The CUSA and the Mutual Security, Mission to China hired the American consultants. G. White Engineering Co. as the consultant for arranging U.S. Aid. According to the agreement between White Engineering and the CUSA, White Engineering provided services of advisory and consultation assistance, pre-project work, development of authorized projects, individual assignments, and engineering and construction on specific projects for the CUSA's program for reconstruction, rehabilitation, and economic development in the area of "China," including Taiwan[61]. The fields included electric power, transportation, communication, mining, logging, public works, and general industry. For example, White Engineering helped the Taiwanese government to extend its power generating capacity by improving or building new generators in the 1950s, and Taiwan

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[59] Chang, David, "U.S. Aid and Economic Progress in Taiwan" in *Asian Survey*, Vol. 5, No. 3 (1965): Pp. 152.

[60] This administration was established in 1948 in Shanghai based on Foreign Assistance Act signed by President Harry Truman. The names of the institute which was responsible for aiding to "China" changed several times. In 1948 when it was established, its name was Economic Cooperation Administration, Mission to China. It changed its name into Mutual Security Agency, Mission to China in 1952. It changed its name again in 1955, becoming International Corporation Administration, Mutual Security, Mission in China. Finally, its last name, which was given in 1962, was Agency for International Development, U.S. Aid Mission to China.

[61] National Archives 國家檔案閱覽中心, "the Contract between the CUSA and the Engineering Consultants 美援會與美援工程顧問組合約," May 18, 1958.

gained at least 295,850 KW thanks to U.S. Aid before 1955[62]. Moreover, the American advisors even directed the Taiwan Power Company (TPC), a state-owned and the only power company in Taiwan, to improve its organization, accounting institution, and asset management[63]. U.S. Aid also provided loans to Taiwanese state-owned companies or private chemistry companies setting up the basis of the chemical industry in Taiwan[64]. The contracts between the CUSA and American advisors reveal that these American advisors also contributed their expertise to the food industry, road construction, and water supply. Moreover, besides hiring American advisors to provide technological services in Taiwan, the CUSA and the JCRR also sent Taiwanese technicians abroad to receive training. From 1951 to 1956, at least 1,160 Taiwanese technicians or officials went abroad for training or for other educational reasons. For instance, the Taiwan Power Company sent its technicians to America to receive training annually ever since. Wang Chang-chin (王章清, C. C. Wang), the future deputy of the Council for Economic Planning and Development (CEPD), who had been a significant actor in the development of rail mass transportation technology in Taiwan was also sent to the U.S. for a one-year internship in the Bureau of Public Roads[65]. Wang joined road-building projects in Porto Rico, Florida, and Pennsylvania. He also worked as a research assistant for a senior engineer in the Advanced Research Laboratory in the Bureau of Public Roads[66].

The JCRR has played a unique role in the period of U.S. Aid and the following decades. When the KMT government tried to persuade the U.S. government to sign the Sino-American Economic Aid Agreement, Y. C. James Yen (晏陽初, Yen Yang-chu), an educator and organizer dedicated to the rural reconstruction movement, actively lobbied Congress on passing the China Aid Act to fund the rural reconstruction movement in China. After the JCRR was founded, it launched a program to improve the living standard of China's rural area by rent reduction, the formation of cooperatives, agronomic and irrigation projects, and land reform. After the KMT government retreated to Taiwan, the JCRR's wide-ranging technical and financial assistance supported the Taiwanese

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[62] Lim, Pin-Yen 林炳炎, *V.S. de Beausset's Order of Brilliant Star* 保衛大台灣的美援 (Taipei: San Min Book 三民書局, 2016), Pp. 200.

[63] Lim*, V.S. de Beausset's Order*, Pp. 194-231.

[64] Lim, *V.S. de Beausset's Order*, Pp. 234-260.

[65] The current Federal Highway Administration.

[66] Institute of Modern History, Academia Sinica, *Records of Interviews of Pioneers in Taiwan's Urban Planning* 《都市計畫前輩人物訪問紀錄》, (Taipei: Academia Sinica 中央研究院, 2000), Pp. 24-28.

government's successful decentralized rural development strategy. That strategy's primary thrust was to raise the production and incomes of the island's thousands of small-farm families. It included land tenure reforms that secured families' titles to the land they tilled. It also included fostering local farmers' associations (cooperatives)[67].

During these fifteen years, there was almost no serious disagreement between the KMT government and the U.S[68]. Both the U.S. and the KMT government regarded communist China as a primary threat to the "free world," and the U.S. was willing to support the KMT government to antagonize China although it still did not encourage Chiang Kai-shek's counterattack plan. The fact that President Eisenhower visited Taipei in 1960 reveals the close relations between the U.S. and Taiwan. At the same time, because of the damage caused by WWII and the Chinese Civil War, Taiwan lacked technological power and infrastructure, and U.S. Aid contributed much to Taiwan's economic growth, social stabilization, and massive infrastructure like power systems. Therefore, in many technological fields, Taiwanese engineers and technical officials highly relied on American resources and experts. The best way to exploit limited resources was also heavily determined by American officials and consultants. Technological development in Taiwan did not only reflect its power but also its relations with the U.S.

The U.S. began to decrease its direct aid gradually when the time came in the 1960s because Washington believed that Taiwan's economy was strong enough to develop independently. In fact, after 1962, most of the U.S. Aid came to Taiwan in the form of loans. The decision, which began to take shape at the end of the 1950s, to terminate American economic aid to Taiwan derived both from the success of the effort, and the domestic U.S. need to discontinue a costly enterprise to free funds for other programs[69]. In fact, the financial resources included the loan from the U.S. Aid and coordination money. Therefore, as the previous section showed, the two governments used the existing funds to found the Sino- American Foreign Economic Development (SAFED) fund for future technology projects. Before the birth of the SAFED, in 1963, the CUSA was reformed as the Council for International Economic Cooperation and Development (CIECD) for applying and managing the resources of U.S. Aid (up to 1965), and as the SAFED (after 1965), and other technological and economic resources. The advent of the CIECD and the SAFED signaled the end of U.S. Aid. Taiwan, with its strong

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[67] Butterfield, S. H., *U.S. Development Aid - An Historic First: Achievements and Failures in the Twentieth Century.* (Santa Barbra, CA: Praeger, 2004), Pp. 48.

[68] Chang, "U.S. Aid and Economic Progress," Pp. 105.

[69] Tucker, *Taiwan*, Pp. 62.

economic growth in the 1950s and the 1960s, “graduated” from depending on U.S. Aid, and became an excellent example of the superiority of the American model of technological and economic development. However, this does not mean that Taiwan gained its total autonomy in technological development after 1965. Instead, it began to co-produce American hegemony in the domain of transportation studies and planning, that were shaped by American companies and consultants.

U.S. Aid and Taiwan’s Railways

The transportation infrastructure was also an essential part of U.S. Aid. The most famous examples were the Xiluo Bridge (西螺大橋) and the MacArthur Thruway. The Japanese colonial government started to build the Xiluo Bridge in 1937, but the construction was suspended because WWII led to a shortage of steel. With the funding from U.S. Aid and help from White Engineering’s consulting, the bridge was completed in 1953, becoming the second-longest bridge[70] in the world at that time. This bridge was the first road bridge crossing the Zhuoshui River (濁水溪). Before it was built those who wanted to cross the river needed to ride on trains or boats. The MacArthur Thruway was Taiwan’s first highway connecting Taipei and the northern port city Keelung. With the support of U.S. Aid, this road was completed in 1962 a month after General MacArthur’s death so that the KMT government decided to name this road in his honor[71]. The MacArthur Thruway and Roosevelt Road became only two roads that were named after foreigners in Taipei City.

[70] Its length is about 1,939m only shorter than the Golden Gate Bridge in the world at that time.

[71] This highway was partially merged into the National Freeway No. 1 and partially merged into local roads in Taipei and Keelung. The bridge at the start point of the highway, after the reconstruction in 1994, is named “MacArthur Bridge No.1 (麥帥一橋),” and the bridges completed in 1996 next it is named “MacArthur Bridge No. 2 (麥帥二橋)” in memory of this highway and General MacArthur.

Figure 2.3: The Xiluo Bridge[72]

[72] 國立臺灣大學數位人文研究中心。「新版國家文化資料庫 。」2010。http://doi.org/10.6681/NTURCDH.DB_NRCH/Collection.

Figure 2.4: The MacArthur Thruway[73]

The railways in Taiwan were also funded with U.S. Aid, that was badly needed after the damage caused by wars. U.S. Aid helped the Taiwan Railways Administration (TRA) which replaced the Department of Railways, Government-General of Taiwan 台湾総督府鉄道部 in charge of the railways. 1067mm gauge was used to rebuild the railway services. In 1948 after the KMT government and the U.S. signed the Sino-American Economic Aid Agreement in Nanjing, the U.S. sent teams to Taiwan to assess the situation, and then provided 1.5 million dollars as a loan to the TRA for purchasing materials and equipment for rebuilding railway services in Taiwan. Although continuous aid ceased when the U.S. decided not to support Chiang in the civil war, the TRA used the previous loan and its Taiwanese technicians to replace sleepers and rails, to fix locomotives and to rebuild bridges destroyed during wartime. Then, after U.S. Aid started to flow into Taiwan with the outbreak of the Korean War, the TRA obtained more Aid to buy eight steam locomotives, fifteen diesel engines for passenger trains, and necessary materials and equipment for

[73] 國立臺灣大學數位人文研究中心。「新版國家文化資料庫 。」2010。http://doi.org/10.6681/NTURCDH.DB_NRCH/Collection.

rebuilding its service. In 1951, the annual ridership and tonnage of freight both surpassed the peak in the colonial period[74].

After the TRA recovered its service role, it continued to exploit U.S. Aid to refine and to expand its facilities and equipment. The TRA unified and modified the specs of rails and sleepers, and replaced them to improve the quality of transportation. Moreover, the TRA also used U.S. Aid to purchase new locomotives from the U.S. and Japan. In the late 1950s, the TRA tried to buy diesel trains to replace old steam locomotives and to introduce a central train control system (CTC) into Taiwan for more efficient operation. To buy the diesel trains, the TRA paid NTD230,000,000 for the passenger cars and used NTD880,000,000 for spare parts for the trains. U.S. Aid also attributed 2.09 million dollars for the installation of the CTC system[75].

Figure 2.5: The type CT 270 locomotive purchased with the U.S. Aid[76]

[74] Yu, “U.S. Aid,” Pp. 58.

[75] Yu, “U.S. Aid,” Pp. 59-61.

[76] 國立臺灣大學數位人文研究中心。「新版國家文化資料庫 。」2010。http://doi.org/10.6681/NTURCDH.DB_NRCH/Collection.

Besides the purchase of hardware like locomotives, passenger cars, wayside facilities, and the control system, U.S. Aid also sponsored the TRA to send its technicians and managers to receive training aboard. Moreover, the Taiwanese government and the Agency of Mutual Security, Mission to China hired American consultants to help the TRA to improve its financial, operational, and management systems. The consultants were mainly hired by White Engineering, that was in charge of the execution of the projects supported by U.S. Aid, and then sent to the TRA to provide professional services[77]. However, American consultants' experience was not always brought in by the TRA. For example, the TRA disagreed with the American advisor who used to work on the Pennsylvania Railway as vice president as regards the usage of trains and operating focus. It did all it could to persuade the American advisor to follow its suggestions, rather than adopt his proposals. For example, the American advisor suggested that the TRA focus more on freight and short distance passenger transpiration due to his experience in the Pennsylvania Railway. The TRA persisted with its policy of relying more on intercity passenger service[78].

In sum, U.S. Aid contributed much to the recovery of Taiwan's railway service and its improvement. However, we find that the railways in Taiwan kept their Japanese specs, and U.S. Aid only helped its recovery and its improvement of the same track instead of thoroughly changing them as urged by the American consultants involved in the projects. Moreover, we also find that U.S. Aid did not directly get involved in any new line construction or comprehensive plan of the railway system. The TRA built some new lines during this period but only followed the plan left by the Japanese, for example, the Neiwan Line. One obvious American factor in the TRA was the locomotive and diesel trains bought from the U.S., though it also bought trains from Japan. The other American factor that is revealed in the TRA's management and operation is the training received by technicians and managers sent to the U.S. However, even today, the TRA still uses the Japanese index system for its maintenance and procurement, and the TRA seemed not to follow the American advisor's suggestion for its operation in the 1950s and the 1960s. Therefore, despite U.S. Aid's contribution to the recovery of the railway service in Taiwan and its improvement, the TRA and its railways did not yet walk in the tracks of "Americanization." And this is not even to mention the idea of technological hybridity that I discuss in the introduction and later chapters. U.S. Aid saved Taiwan's railways as it

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[77] Yu, "U.S. Aid," Pp. 82-89.

[78] Yu, "U.S. Aid," Pp. 101-102.

saved the KMT government and the island itself, but it did not transform them as it transformed other technological fields at the same time. All the same, I must emphasize that U.S. Aid and the background framing it produced already set the stage for the American hegemony of science and technology of transportation. The Americanization and the future hybridity did not happen on the TAR's track before 1965 but would happen later at a higher level: the production of knowledge.

U.S. Aid and the American Hegemony of Science and Technology

If the contribution of U.S. Aid to Taiwan's transportation, especially railways, was mainly on recovery or construction of particular cases like the MacArthur Thruway, the question arises: what is the meaning of U.S. Aid for the technological hybridity of rail mass transportation? First of all, we can easily find that U.S. Aid provided not only financial and material resources to Taiwan but also its technical consultants and experts in practical projects. Furthermore, these consultants did not merely do all the jobs for their clients, and instead, they co-worked with Taiwanese technical officials and engineers so that the Taiwanese could learn how Americans practice their jobs in different technological fields. Besides, many of the projects supported by U.S. Aid would send technicians and managers to the U.S. to receive education and training. Therefore, although Taiwan's railways or transportation system remained on the stage of recovery of individual construction cases, other technological fields like power, agriculture, and the textile industry already took the path of "Americanization." The Cold War context and the institutions it spawned for the execution of the U.S. Aid was in place, and these institutions and context can be regarded as the origination and background for the future Americanization of transportation science and the subsequent hybridity.

To understand the meaning of U.S. Aid in our discussion of technological hybridity, I argue that we need to put U.S. Aid into an analytic frame of the U.S.' global strategies in the Cold War. U.S. Aid's emphasis on technical assistance to boosting the receiving countries' technological power by following American models, echoes Truman's inauguration speech about his foreign policy. Thus when he mentioned the fourth object of his foreign policy announcing the so-called "Point Four Program:"

"We must embark on a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas. More than half the people of the world are living in conditions approaching misery. Their food is inadequate. They are victims of disease. Their

economic life is primitive and stagnant. Their poverty is a handicap and a threat both to them and to more prosperous areas. For the first time in history, humanity possesses the knowledge and skill to relieve suffering of these people. The United States is pre-eminent among nations in the development of industrial and scientific techniques. The material resources which we can afford to use for assistance of other peoples are limited. But our imponderable resources in technical knowledge are constantly growing and are inexhaustible."

By emphasizing the problem of “underdevelopment” among the members of the “human family,” the president conveyed the idea that the destitute societies of the non-Western world were not trapped in a necessary condition of “backwardness” by the particularities of race or culture. The transmission of investment capital, technical knowledge, and activist values, moreover, could dramatically accelerate their productivity and progress, enabling them to leap the gap toward liberal modernity. Development would alleviate the desperation in which radicalism flourished[79]. America’s scientific and technological advancement here, in the Cold War, became not only the means to confront Soviet competition in many different fields, including the economy, military, and culture. It was also an indispensable part of its global strategy. This part of the strategy was based on the view of American exceptionalism— the idea that the United States had a unique role and mission in history and that America’s interests were not narrow and parochial but embodied the interests of all with the goal, as defined by Woodrow Wilson, ”to make the world safe for democracy.[80]” The U.S. exploited its predomination of resources and knowledge to attract the neutral countries like India to join the “Free World” or at least not to join the communist campaign.

Nonetheless, I need to add two points. First, American technical assistance was not limited to the non-Western countries or neutral countries; instead, the U.S. also provided technical assistance to its allies and west European countries. Second, despite exploitation of its immense military, economic, and technological power, the U.S. did not merely strengthen its allies or make non-Western countries productive preventing the growth of radicalism, but also tried to insert the “American model” into countries to reshape the economic, scientific, technological, social, and political orders. John Krige’s case studies of the international cooperation of science and technology in Europe provide much insight. In Western Europe, before Truman announced the Point Four Program, the

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[79] Latham, *Right Kind of Revolution,* Pp. 11.

[80] Krige, *American Hegemony,* Pp. 6.

Marshall plan not only provided economic aids to Western European countries for economic and social recovery but also for rebuilding their science[81]. After the Point Four Program was announced, Krige keeps pointing out, the U.S. government provided financial aid, experts, collaboration projects, and education and training to help Europe to reconstruct its scientific communities and knowledge-producing mechanisms. The U.S. was also dedicated to integrating transnational scientific institutes, and American foundations like the Ford and Rockefeller Foundations also joined in the reconstruction of science in postwar Europe[82]. The goal of using scientific and technological power was to shape a global environment with the political order which did not threaten its dominant status. Krige calls this kind of effort and power the American hegemony of science and technology, and the U.S. used the hegemonic power globally in the Cold War period for decades. By sharing knowledge, Americans tried to use its dominant power to shape the world[83].

One of the essential characteristics of the American hegemony of science and technology is the co-production of both the U.S. and the aid receivers' consent for building the hegemonic power. The power gap between the U.S. and its technical assistance-receiving countries was not only a threat but also a lure to these countries. However, when one speaks of consensual hegemony, it does not mean that the Europeans always agreed to do what the representatives of the United States suggested or always accepted the proposals that they made. On the one hand, the local elites and scientists accepted American aid and the American model with their consent and cooperation when they found the American model appealing to their requirement; on the other hand, they might turn the American model down or find alternative options. In Krige's case studies of postwar Europe, Europeans willingly cooperated in the reconstruction of their scientific capacity; they had little choice, and they were given enough latitude to adapt the American model to local circumstances, or even to react against it all together. Latham also finds that postcolonial leaders in South Asia often followed Soviet models of development plans and the promotion of foreign and domestic investment and they frequently stressed the crucial role of a powerful central government in controlling a large public sector while glad to receive the U.S.' assistance[84].

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[81] Krige, *American Hegemony,* Pp. 15-56.

[82] Krige, *American Hegemony,* Pp. 75-225.

[83] Krige, *Sharing Knowledge*.

[84] Latham, *Right Kind of Revolution*, Pp. 67-68.

Returning our focus to the discussion of U.S. Aid in Taiwan. Taiwan or the R.O.C. was a country that should not be overlooked when we discuss the Cold War in Asia, especially when we focus on the transnational history of science and technology. It has been America's foremost economic, political, and strategic partner for decades either as an ally confronting communist China during the 1950s and 1960s or as leverage of the U.S.-China relations during the 1970s and 1980s. Moreover, Taiwan received much technical assistance from the U.S. during the Cold War and, with that assistance, became one 'emerging' country with strong economic growth and considerable technological power. Furthermore, especially in the period of U.S. Aid, the KMT government, facing the critical issue of survival and the enormous weight of American power, built the institutions needed for co-working with American consultants and technical officials. The government surrendered partial autonomy to its protector in exchange or financial resources, materials, knowledge, and military protection so that the accidental state could not only survive the communist threat but also gain technological power until the moment when it retrieved its autonomy. For the U.S., it could consolidate its ally next to China confronting communist competitors and shape the showcase of the American model without eroding the legitimacy of being the leader of the "free world" by leaving Taiwan partial autonomy and some control of its economic and technological policy.

Thus I argue, first, that the history of Taiwan's technological development and of American technical assistance in Taiwan need to be examined under the structure of t U.S. global strategies revealed and initiated by the Point Four Program in the Cold War. The approach followed by scholars like Krige and Latham in their studies of Europe and South Asia can also be exploited in the case of Taiwan. Furthermore, the idea of American hegemony of science and technology would be useful when we talk about the U.S.' technical assistance in Taiwan. As the discussion in the later chapters shows, the U.S. used its predominant financial and technological resources to help Taiwan to build its profession of transportation planning and inserted the American model of transportation studies and planning into Taiwan with the technical consultants, technical documents, education training, and technological artifacts. At the time, Taiwanese technical officials and political leaders were also willing to receive American resources and to follow American advisors' suggestions forming the coproduction of the American hegemony of science and technology of transportation. Furthermore, transportation technology was not the only instance, and we may find a similar situation in agriculture, the textile

industries, defense industries, and many technological or industrial fields. In this sense, “U.S. Aid” exemplified the American hegemony of science and technology.

The case of railways shows the variation of the development track between different technological fields, although the recovery and improvement of the railways should recognize U.S. Aid’s support. As regards the development of the railways and transportation technology in Taiwan during the period of U.S. Aid, we cannot find indisputable evidence showing that American support led to the Americanization of Taiwan’s railways or the whole transportation system. Instead, the Japanese context left by the colonial period played a more prominent role when the TRA started to learn from America in the management phase and bought trains from America. However, we cannot just conclude that the railways were an exception to the American hegemony of technology; instead, we can conclude that U.S. Aid built the institutional and political stage for the Americanization of transportation studies and planning in Taiwan. In fact, before 1965, the most critical mission for the TRA was to recover, extend, and improve its service, meaning that it did not have enough time and resources to reform the whole railway system into the American model. Frankly, rebuilding the whole network along American lines was unrealistic. Thus, Taiwan’s railways received U.S. Aid, but the coproduction that occurs in hegemonic power relations did not happen yet. We need to move our focus to the period of the CIECD and the SAFED from 1965 to 1979 to see how hegemony was built and how it worked in detail in the field of transportation technology.

Chapter 3: The Transportation Planning Board (TPB)

The Founding of Transportation Planning in Taiwan and the Transportation Planning Board 1966-1972

"On education, in fact, that was the most satisfying and pleasant part for me although I accomplished it unintentionally[……]the main reference was the things that the guys in the University of Pennsylvania used in urban planning projects at that time, and I taught urban planning and transportation all together discussing their relations. (提到教育這部分，事實上也是我覺得最滿意也及安慰的事情，也是無心插柳.....主要就是參考賓州大學他們當時都會區計畫那套東西，我上課就是把都市計畫跟交通一起講，講兩者關係如何)" Dr. Chiang, Yu-sheng, 2010.
"The central government should perform more leadership in transportation planning and coordination. If the newly founded Transportation Planning Broad would like to be effective, it needs to have professional experts, and they should have strong analytical ability. (中央政府應在運輸計畫與配合方面發揮更多之領導力。新成立之運輸計畫委員會如欲產生效果，即需有專職之工作人員，且需具有堅強之分析能力)" Edward Prentice, American transportation economist, 1970.

Dr. Chiang Yu-sheng's Story

In 1968, Chiang Yu-Sheng[85], a graduate student of the Private Chinese Culture University (PCCU) majoring in architecture and urban planning, was invited by his advisor, Yeh Chang-Chu (**葉昌鑄**), to his office in downtown Taipei City. Chiang was quite nervous about this invitation since he had been absent from Prof. Yeh's class for almost half of a semester, spending most of his

[85] Dr. Chiang, Yu-sheng 姜渝生 (1943-2011) was a professor of transportation and urban planning in National Cheng Kung University, Tainan, Taiwan. Before he went to Massachusetts Institute of Technology pursuing a Ph.D. degree in transportation planning, he worked as an assistant in UHDC from 1968 to 1970 and chief of planning group in TPB from 1970 to 1975 when are the first five years of TPB. The material about Dr. Chiang's experience comes from his interview in a booklet that was sent in his funnel in memory his contribution to transportation and urban planning in Taiwan. He was also a poet publishing his works in literary magazines.

time running his literary magazine. However, Prof. Yeh told Chiang that he had the highest score in the midterm exam of his class, and he also appreciated his writing, so he invited Chiang to join the transportation group as a writing assistant in the Urban Housing and Development Committee (UHDC) of the CIECD (Council for International Economic Cooperation and Development, formed from the Council for U.S. Aid, CUSA). To deal with the financial pressure on his literary magazine, Chiang agreed. In this role he worked with Prof. Yeh, his Taiwanese teammates, and international consultants deployed by the U.N., completing his master's thesis, *Research on the Transportation Demand in Taipei (台北運輸需求研究)*. This led to a career as an urban and transportation planning scholar. In the preface of his master thesis, he writes:

"I learned mechanical engineering but obtained nothing, then I turned to architecture also gaining nothing. So, I happily studied urban planning. However, with calm observation and thinking, I found that there are so many urban issues that it is difficult to study even one-tenth of them, so I decided to specialize in urban transportation. Here I finally realized that human dwelling, life and death, and moving and remaining where you are, follow certain rules. It is not determined by destiny but, at least, human nature makes it inevitable. Thus I began to study the development and limitations of human behavior and the knowledge of management as methodology, so that I could gradually exploit the knowledge and enjoy my studies for years."

In 1970, Chiang and the entire transportation group in the UHDC were transferred to the newly founded Transportation Planning Board (TPB) in the Ministry of Transportation and Communication. This institute had played a vital role in the history of transportation in Taiwan, contributing their experience and learning to transportation studies and planning with the international consultants. However, Chiang found that he needed to learn more than he could get in the TPB, so he left it and went to MIT to pursue his Ph.D. degree in transportation planning in 1975. After his return, Chiang became a leading scholar in Taiwan, dedicating much time and effort to many urban and transportation planning projects for decades. Sadly, he passed away from cancer in 2011 at the age of 68.

Chiang's early career occurred during an essential moment in Taiwan's transportation studies and planning, and it shows how Taiwanese and international consultants founded the profession and how the transnational knowledge of transportation evolved in Taiwan. In the second half of the 20th century, the birth of a metro system, or even a line, started to be based on scientific studies of population, traffic flow, economic activities, and regional development rather than business or political leaders' instincts and rather elementary traffic engineering calculations. Transportation studies and planning,

what we can call the making of the knowledge of streets and a city, would decide whether, which, how, and when a metro line would be built. Therefore, we cannot ignore the history of transportation studies and planning in Taiwan if we want to write the history of Taipei's subterranean railway and the Taipei Metro. Furthermore, the institutions for technology transfer built while U.S. Aid flowed and the U.S. played a hegemonic role in Taiwan, as well as the changes in U.S.-Taiwan relations, created a suitable environment for the making of hybrid knowledge and technology in the Taipei Metro and influenced the development of transportation studies and planning in Taiwan. In fact, Taipei's subterranean railway and the Taipei Metro can be seen as the extension of the history that Chiang had experienced.

The UHDC and its Transportation Group

When U.S. Aid ended in 1965 the KMT government had anticipated the change and had prepared for the moment. It reformed the CUSA as the CIECD to gain more resources for Taiwan's technological development. Changing the name meant changing the mission. Although the chairs of the CIECD were not the Prime Minister (except for the first chair, Chen Cheng, who was also the final chair of the CUSA), the CIECD retained its semiautonomous status within the government. Its financial resources were taken from the government budget and the chairs of the committee, Yen Chia-kan and Chiang Ching-Kuo, who succeeded Chiang Kai-shek as the president of the R.O.C. as presidents after Chiang's died, were at the highest level of the regime. Thus even though U.S. Aid ended, the institution built using U.S. Aid lasted Moreover, the reformation reflects the KMT government's efforts to seek resources for technological and economic development in Taiwan rather than America. The KMT government lost the whole of China in the Civil War, but the R.O.C. had had China's seat in the U.N. and was one of the permanent members of the United Nations Security Council until 1971. The KMT government had already applied for some technical assistance projects from the U.N. in the 1950s[86]. From 1960, the KMT government also applied for the United Nations Special Fund for more considerable financial and technical resources, and it applied for the program of transportation and infrastructure in 1965 when U.S. Aid ended.

Like the technical assistance projects in the U.S Aid program, the U.N. Special Fund also deployed consultants to Taiwan working with Taiwanese engineers and

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[86] Wu, Shu-Fong 吳淑鳳, "The Examples of the Historical Materials of the U.N.'s Technical Assistance to Taiwan in the Academia Historica 國史館藏聯合國技術援臺史料" in *Academia Historica Research Newsletter* 國史研究通訊 No.2 (2012): Pp. 175.

technical officials. At the same time the CIECD sent Taiwanese to developed countries to receive education and training. For instance, the Taiwanese government applied to a project for the development of livestock industries on hillsides to the U.N. Special Fund, that was approved in 1960 before the advent of the CIECD. In this project, the Taiwanese government established a research center in the Livestock Institute, Taiwan Province Government, and two demonstration pastures. The demonstration pastures were used to show how a hillside pasture should be run and to train professional technicians. The U.N. also deployed two international advisors to Taiwan to study the potential of the development of hillside livestock industries, and Taiwanese officials also took the chance to invite the international advisors to provide short-tern education training and workshops for them hoping that every Taiwanese technical official and technician could work independently after the international advisors left. Besides, the project also provided scholarships to those who joined the project to receive further training aboard[87]. CUSA's archive also shows that the U.N. Special Fund helped the Taiwanese government to study and to plan the development of the Wu River and the Zhuoshui River, including economic studies of land reclamation with international experts[88].

Before we move our focus to the UHDC and its transportation group, we need to look at urban planning and transportation planning in Taiwan before 1965. Although Taiwan lacked experts in urban planning when the UHDC was established, Taiwan still had a basis of urban planning left by the Japanese. In 1900, the Japanese colonial government devised the first urban planning project in Taiwan's history for the newly founded Taichung City and proposed another project for the capital Taipei City. Then, in the following decades, the Japanese devised and implemented 72 urban planning projects in Taiwan, and established their laws for urban planning. After the KMT government retreated to Taiwan, it adopted the Japanese projects and laws for over two decades. Some plans are even used a half a century later. For example, Daan Forest Park, which is also called "Taipei's Central Park," is often called "Park No.7" because the Japanese planned this park as the seventh park in Taipei City, and Taipei City Government completed it in 1994. Wang

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[87] Wu, "Examples," Pp. 176-177.

[88] National Archives 國家檔案閱覽中心, "the Contract between the CUSA and the Engineering Consultants 美援會與美援工程顧問組合約," November 19, 1962.

Chang-chin (abbreviated as C.C. Wang), who was the director of the Bureau of Public Works in Taiwan Provincial Government[89] at that time, mentioned:

"Urban planning is fundamental for the construction for cities, and so-called public works, without urban planning, will seem groundless, especially for the construction for cities……At that time, the city's and country's government neither had the budget nor the professional human resources needed so the Bureau of Public works had no choice but to take on the job of urban planning[90]"

Wang's words reveal the plight of lacking experts for urban planning in the KMT government. Moreover, thanks to Taiwan's strong economic growth in the 1950s and 1960s, the lack of human resources and professionals became even worse. Wang's colleague, Lin Tzu-yu (林子瑜), points out the problems:

"Because of Taiwan's development at this time, the direction of people's movement was obvious: dramatic urbanization brought shock, and even some sections between Taipei and Taoyuan of the Provincial Highway No.1 were still unpaved with only four lanes, not even to mention central and southern Taiwan……Without urban planning, the government could not acquire land for broadening roads. The other issue is population. People rushed into cities in a short time, and most of them were young people who moved out of rural areas due to a lack of jobs. They mostly needed to build their home in the cities, hence the problem of a shortage of schools emerged. Again, without urban planning, we did not know where to build new schools and could not levy land, either.[91]"

For the transportation part, the Ministry of Transportation and Communication (MOTC) and the Taiwan Provincial Government had technical offices to set rules and specs for traffic engineering. The TRA also built some branch lines following the Japanese colonial government's plans. Moreover, at this time, Taiwan did not have any comprehensive transportation plan nationwide, not to mention a plan or even

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[89] According to the KMT government's definition and the constitutional structure of the R.O.C., the KMT government was the only legal government representing China even though it only ruled Taiwan, Pescadores, Kinmen, and Mazhu. The KMT government sill kept Taiwan Provincial Government 臺灣省政府 and Fujian Provincial Government 福建省政府 (for Kinmen and Mazhu) symbolizing its legal ruling position of whole China and the connection with China instead of reforming its government's organization to fit the size of the land it ruled. After 1998, most of the affairs of the two provincial governments were replaced by other institutes, and the two provincial governments kept downsizing. In 2018, the Taiwanese government terminated all budgets for the provincial governments and only kept the positions of government and the name to comply with the constitution.

[90] Academia Sinica, *Records of Interviews,* Pp.30-31.

[91] Academia Sinica, *Records of Interviews*, Pp. 224.

transportation studies at the municipal or regional level. The KMT government did have a basis for urban and transportation planning, but, ironically, the basis exposed how the government lacked experts, professionals, and resources because even the law for urban planning was inherited from the Japanese without significant changes.

In this critical situation, the Taiwanese government submitted applications for projects to the UN Special Fund. The U.N. approved the projects in 1966. After approval, CIECD established the UHDC for implementing urban planning projects, transportation planning projects, the legislation of urban planning, and for human resources planning. The secretary of the CIECD held the position of chairman of the UHDC, and the ministry of the interior served as convener. C.C. Wang took the position of executive secretary while serving in the Bureau of Public Works in the provincial government as the director. The UHDC had 17 to 19 committees and ten research groups with foreign advisors who were dispatched by the U.N. The U.N. advisory group was led by Donald Monson who was an adviser to President Truman's Commission on Urban Problems and engaged in many urban planning and urban renewal projects in the U.S., Europe, and South America[92]. Donald Monson's wife, Astrid Monson, an urban sociologist, was also a member of the advisory group, and she worked for the UHDC without charge. These international advisors would cooperate with Taiwanese counterpart experts in different ad hoc groups, and many young people who majored in urban planning or related professions would be recruited into these groups[93]. This is how Dr. Chiang, his colleagues, and his advisor Prof. Yeh started to work in the UHDC.

Table 3.1: the members of the UN Advisor Group

The Members of the UN Advisor Group*			
Unit	Title	Name	Nationality
UN	Chief Advisor	Donald Monson	US
UN	Deputy Chief Advisor	Karl J. Belser	US
UN	Transportation Advisor	Lewis R. Coyle	US
UN	General Research Advisor	Alfred Schinz	Germany
UN	Urban Society Advisor	Paul E. Kovennock	US

[92] Chen, Shiang-Qin 陳湘琴, "A Historical Research on the "Urban Planning Act" Presented by Urban and Housing Development Committee (UHDC)and U.N. Advisor Group 都市建設與住宅計畫小組（UHDC）和聯合國顧問團研議台灣「都市計畫法」之歷史研究" in *Journal of Environment & Art* 環境與藝術學刊, NO.9(2011): Pp.47-67.

[93] Academia Sinica, *Records of Interviews,* Pp. 47.

The Members of the UN Advisor Group*			
Unit	Title	Name	Nationality
UN	Urban Planning Advisor	Edmund T. Ames	US
UN	Financial and Urban Administration Advisor	Alek A. Rozental	US
UN	Housing Advisor	Samuel S. Zadik	Israel
UN	Housing Advisor	Eric R. Gold	Canada
UN	Transportation Economics Advisor	Edward Prentice	US
UN	Educational Training Advisor	Sigurd Ghava	US
WHO	Environmental Hygiene Advisor	Benedicto L. ?**	Not sure
CIECD	Land and Housing Advisor	Astrid Monson	US

* The chart is generated by Chen, Shiang-Qin, *Supra*, at Pp. 54. ** Data lost.

After the KMT government submitted its application to the U.N., the United Nations Development Programme (UNDP) sent Monson to Taiwan to investigate the situation there. While working at John Hopkins University with a WHO fellowship as a visiting scholar, C.C. Wang often went to New York to discuss Taiwan's case with Monson and U.N official Kenneth Watts. This may have played a role in the U.N. decision to approve Taiwan's application. [94].

C.C. Wang asked international advisors to study Taiwan's environment, to look out for problems specific to the country, and to present working projects and schedules. Every advisor and his counterpart needed to report what they did weekly in a meeting held with him. At the same time, the international advisors started classes for young members in the UHDC and students who studied or worked in related institutes, introducing them to urban planning theories and case studies in the advanced countries. " At that time," C.C. Wang mentions in the interview for the oral history of the early development of urban planning in postwar Taiwan. " The fifth floor of the old Taiwan Cement Building on ZhongShan N. Road had an atmosphere of a research institute of

[94] Academia Sinica, *Records of Interviews*, Pp. 46. After the application was accepted, one of Wang's friends working in the Embassy of the R.O.C. suggested that Wang apologize to the minister who was in charge of economic affair since Wang got involved in the diplomatic mission without informing the diplomat who was supposed to be responsible for it. Wang did so.

urban planning even though it had no sound of students' reading[95]." During 1966 and 1972, the UHDC completed about 250 working events and reports on urban planning, housing policies, land exploitation, transportation, administration, environment, industries and economy, and other events. The significant examples were the plan for the New Town Project of Linkou[96], the draft of the Housing Law, and the transportation studies of Taipei City[97]. Furthermore, the supervisors in the UHDC planned to establish a department of urban planning at the National Taiwan University (NTU), where the international advisors could hold classes for the new department. Unfortunately, the NTU did not have enough space to house a new department. Coincidently, National Chung Hsing University (NCHU) planned to build an institute for urban planning and the UHDC helped NCHU to establish an institute there. National Cheng Kung University (NCKU) also founded its department of urban planning at this time.[98]. In sum the advent of the UHDC boosted the foundation of the profession of urban planning in Taiwan.

According to the list of international advisors, most of them came from the U.S.; only a few came from elsewhere. Together they contributed much to the profession of urban planning in Taiwan, incubating young experts, setting the standards of urban planning, and joining practical projects directly. It is worth stressing that, although the reformation of the CIECD and the arrival of the U.N. advisors were the response of the KMT to the termination of U.S. Aid, and intended to secure other sources of technical assistance, American expertise remained the primary resource in the process of building Taiwan's profession of urban planning. Although this indicates the Americanization of urban planning in Taiwan during the period of the UHDC, some care is needed before drawing such a conclusion. For example, one needs to establish the content that the American advisors taught their Taiwanese students, to know whether Taiwan's urban plans followed American cases or models when American advisors were involved in the projects, and how Taiwanese planners did their research and planning after their advisors

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[95] Academia Sinica, *Records of Interviews,* Pp. 47.

[96] Linkou District, New Taipei City (新北市林口區) is an administrative district next to Taoyuan City which used to be Linkou Township, Taipei County. Linkou was designed as a satellite city in Taipei Metropolitan to release the pressure of overpopulated in central Taipei Metropolitan. In fact, during the recent decades, Linkou's population has risen dramatically due to the accomplishment of National Freeway No.1, industrial areas near it, universities, hospitals, and the metro line connecting Taipei City and the Taoyuan International Airport.

[97] Chen, "A Historical Research," Pp. 50-53.

[98] Academia Sinica, *Records of Interviews*, Pp. 121.

left. Dr. Chiang's statements and the CIECD's archives suggest, however, that there was indeed a gradual Americanization of the knowledge of transportation.

The transportation group's missions in the UHDC were to make traffic flow surveys and to cooperate with the urban planning group. In these missions, Lewis R. Coyle, the advisor for the transportation group, mainly directed the members of the group to calculate the numbers of vehicles on roads and rings. Moreover, when C.C. Wang was forming an ad hoc group to deal with the problem of the railways crossing through Taipei City, Coyle not only attended the meeting but also set the study procedures, including what data the ad hoc group needed and how the study should be run. Taking this approach, he emphasized that the railway problem could not be disassociated from the overall transportation problem in the Taipei area. Coyle thus brought the need for transportation research, which was just becoming mature in the U.S., to Taiwan[99]. Also, he brought the *Highway Research Record (HRR)*[100] to the UHDC. The *HRR* presented new transportation research and case studies in America to the members of the transportation group so that they could exploit its method and theory in their mission. Dr. Chiang mentions that many studies were completed with the procedures and methodology revealed in the HHR. Also, as C.C. Wang mentions, Prof. Yeh invited Coyle to offer courses for the members in the UHDC, although Dr. Chiang did not attend the course. By working with Taiwanese technical officials, Coyle could demonstrate how an American transportation planner did research and a planning project using his experience working in American cities. By bringing his experience and the journals to Taiwan, young Taiwanese experts like Dr. Chiang would directly absorb the knowledge and methodology based on American case studies.

Dr. Chiang's words exhibit how consultants planted American experience in the transportation group's works. During his service in the transportation group, Dr. Chiang decided to choose "Research on Transportation Demand in Taipei City" as his masters thesis topic. He believed that he needed to follow the experience of American transportation research by making home visits so that he could understand urban citizen's transportation behavior. With the data collected from home visits, he could form a quantitative model of transportation in Taipei. Prof. Yeh agreed to his plan and recruited

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[99] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會 36-10-001-070.

[100] *HRR* was a transportation research journal published by the Transportation Research Board, the National Academies of Science, Engineering, and Medicine debuted in 1963. It became the *Transportation Research Record* (TRR Journal) in 1974.

many college students in PCCU to help Dr. Chiang's study. Prof. Yeh also used a set of the same methods to investigate traffic flow and transportation behavior in Taipei City. In one of the most important research reports of the transportation group of UHDC, "*Comprehensive Transportation Research in Taipei Area*," Prof. Yeh, in 1969, followed the approaches of transportation studies in Detroit, Chicago, and Philadelphia to investigate the usage of land and building, traffic flow, and citizen's transportation behavior. Prof. Yeh and his students ran 14,562 home visit surveys, a 15 hour-long car blocking survey, and attraction point surveys of taxis and buses. Coyle's primary job in 1969 was to consult and to help the operation of this research project. For example, when the transportation group faced a problem of building their predictive model of traffic flow, Coyle asked one of the officials of the Federal Highway Administration, U.S. Department of Transportation to send two copies of "*Traffic Assignment Manual*" to Taiwan. Thus the transportation group could follow the direction of the manual to complete their model, and we can see, again, that an American advisor brought written documents from the U.S. into the transportation group for his Taiwanese students to learn how to do research.

However, Dr. Chiang points out that Coyle was not an expert in transportation planning but rather of traffic engineering and investigation. For example, once he met Coyle in Prof. Yeh's office, and Coyle asked him what the definition of a "trip" was, this being the basic idea of transportation planning. Dr. Chiang told the interviewer: " the advisors in the UHDC contributed a lot in ideas, policies, and the institution of transportation planning, but they did not contribute that much to planning practice and planning method, maybe, because of advisors' background, at least in transportation planning." If we go back to read Coyle's study procedure, we can also find that he mainly provided the concept of how to do transportation research instead of explaining practical planning methods. That being said, Dr. Chiang might be partially wrong because, as he mentioned, he was not familiar with the other American advisor in the transportation economy group in the UHDC, Edward Prentice.

The Birth of the TPB

The SAFED

Before we enter into the story of the TPB and Edward Prentice, we need to follow the history of the Sino-American Fund for Economic and Social Development (SAFED)[101] since the SAFED fueled the birth of the TPB and many technical assistance projects of rail

[101] This Fund had lasted until 2006 when it merged into the newly funded National Development Fund.

mass transportation. Besides reforming the CUSA as the CIECD, the other action the KMT government took to deal with the termination of U.S. Aid was the establishment of the SAFED. The U.S. began to decrease its direct aid gradually by the 1960s because the U.S. believed that Taiwan's economy was strong enough to develop independently. In fact, after 1962, most U.S. Aid came to Taiwan in the form of loans. The decision, which began to form at the end of the 1950s, to terminate American economic aid to Taiwan derived both from the success of the effort, and the domestic U.S. need to discontinue a costly enterprise to free funds for other programs[102]. In fact, the financial resources included the loan from U.S. Aid and coordination money. The two governments used the existing fund to found the SAFED, which directed $200 million in local currency assets generated by established aid programs into economic development rather than allow such monies to be absorbed by other areas of the budget[103] for future technological projects. In 1963, the CUSA was reformed as the CIECE for applying and managing the resources of the U.S. Aid (before 1965) and, the SAFED (after 1965), and other technological and economic resources. Moreover, the KMT government founded the Committee of the SAFED which was composed of the president of the Central Bank of the R.O.C., the Minister of Finance, the Minister of the Economy, and the Comptroller of the Executive to manage and to review project spending of the SAFED's money. The CIECD and the JCRR were in charge of executing the projects. As with U.S. Aid, the projects supported by the SAFED focused on agriculture, R&D, education, industrial improvement, technical transfer, and infrastructure. For example, nuclear plants, the development of Kaohsiung Harbor and Keelung Harbor, Zengwen Dam which is the biggest dam in Taiwan, water supply, many industrial projects, and education projects all received the SAFED's support[104].

One other feature of the SAFED was that it was not part of the Taiwanese government's main budget system until 1983, enjoying the independent status within the government. With this status, the CIECD and the JCRR could implement the projects that they preferred to launch cutting-edge technological projects. Li Kuo-ting (李國鼎, abbreviated as K.T. Li), the important technical official in the KMT government, mentions that how the SAFED's money was used did not need to be approved by the U.S., unlike

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[102] Tucker, *Taiwan,* Pp. 62.

[103] Tucker, *Taiwan*, Pp. 109.

[104] Li, K.T. 李國鼎 and Yang, Su-feng 劉素芬, *K. T. Li: My Taiwan Experience* 《李國鼎：我的台灣經驗》. (Taipei: Yuan-Liou Publishing 遠流出版, 2005), Pp. 147-187.

U.S. Aid[105]. However, I have found that there was both a Chinese version and an English version of the standard forms for applying for the SAFED's support. Therefore, I suspect that American consultants or technical officials might at least have been involved in the process of reviewing or assessing each project practically.

In sum, the establishment of the SAFED combined with the reformation of the CIECD extended the institutions built for managing U.S. Aid, though some changes need to be noted. First, the SAFED guaranteed the semiautonomous status of the CIECD after its reformation and the termination of U.S. Aid. Like the financial resources from U.S. Aid, the SAFED remained out of the ordinary budget system of the KMT government, meaning there was a higher priority for the projects supported by it. Thus, officials at the top of the KMT government could make decisions for technological and economic development without having to deal with objections from other departments within the government. The SAFED also provided flexibility for technical officials to execute their duty in the projects.

Second, the SAFED was rooted in U.S. Aid so that it would extend the technical projects consulted by American advisors in the first years after its establishment. Hence, Americanization in technological fields would be easily constructed with American advisors' efforts and Taiwanese technical officials' learning. Third, nonetheless, unlike U.S. Aid and the CUSA, American technical officials were not involved in the decision-making and execution of the SAFED and the projects supported by it, as K.T. Li mentions. Instead, Americans joined the technological projects as consultants hired by the Taiwanese. That is to say, the KMT government and its technical officials gained autonomy in this change, and the autonomy revealed and emphasized the consent phase of the process of importing American models. Therefore, I argue, although the U.S. Aid period ended in 1965, the period of "receiving aid from America" remained, and the co-production of American hegemony of science and technology continued. The early development of the TPB supports this argument.

The TPB

On September 22nd, 1969, the U.N. signed a contract with Nathan Associates Inc., an American economic consultant, for its Special Fund project in Taiwan. According to the contract, Nathan Associates Inc. needed to send a transportation economist to Taiwan, helping the Taiwanese Government to execute a transportation economic research project for nine months. The Taiwanese government was obligated to provide members to

[105] Li and Yang, *K. T. Li*, Pp.177.

form a project group working with the economist. Edward Prentice was the economist dispatched to Taiwan, and his research team was the “transportation planning group” in the UHDC. Prentice arrived in Taiwan in November 1969, starting his investigation at once. After nine months, the Taiwanese government extended the project for one more month, and the SAFED paid the cost of the extension [106].

In the 10-month-long project period, Prentice investigated Taiwan’s economic development, transportation demand, and transportation infrastructure, pointing out that Taiwan’s transportation infrastructure was not compatible with Taiwan’s strong economic growth. He and his colleagues provided some suggestions for Taiwan’s transportation construction at all levels, including international trade, hardware development, fee rate of transportation service, and the organization and human resources needed for transportation planning.

At the beginning of the research report, he mentioned that the most difficult challenge was to find one “Chinese” transportation economist to work with. He turned to the help of Donald Fritz, a transportation economist from another American consulting firm, De Leuw Cather International so that they could complete the project. At that time, De Leuw Cather was consulting on the project of National Highway No.1, that was in the planning stage[107]. Subsequently, he strongly suggested that the Taiwanese government establish a professional institute for transportation planning so that the decision-making of transportation policy would not be bogged down in government bureaucracy. He went on to recommend to the Taiwanese government that the new professional institute should have a high-level economist with master or Ph.D. degree and 15-year-long experience of service for transportation policies, an economist, a statistics expert, a financial expert, a data collector, an engineer of transportation systems, and three transportation engineers with experience of road, railway, and sea transportation, respectively. Moreover, he also recommended that the Taiwanese government hire a high-level economist focusing on investment, a system economist for statistic’s and evaluation, a financial expert, and a system engineer from international companies for less than two-year-long service in

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[106]The Transportation Planning Board, the Summary of the Transportation Economic Report for Taiwan, the R.O.C. by the U.N. Advisor Edward Prentice.

[107] The National Freeway No.1 is also called Dr. Sun Yat-sen Freeway. The freeway connects the northern harbor city Keelung and the southern harbor city Kaohsiung passing Taipei, Taichung, and many cities on the west part of Taiwan. The project of the freeway was initiated in 1970, and most of the MacArthur Thruway was merged by it. In 1978, the freeway was open to the whole line.

Taiwan[108]. Interestingly, according to the report, the decision to establish the TPB was already made when Prentice wrote the report. We may argue that the idea to establish a professional institute emerged when Prentice was working on his research with Taiwanese colleagues.

Fu Chai-Chi (傅家齊), the first executive secretary of the TPB write these words in the first article of the *Transportation Planning Journal Quarterly* (運輸計畫季刊)[109]:

"Transportation includes railways, shipping, harbors, and aviation, and these parts are related to each other, so the planning of transportation needs to be comprehensive. Especially our transportation infrastructure seems backward with the strong economic and social growth in the decade…...the opinion of establishing a transportation planning and negotiating institute began in 1950, and the Ministry of Transportation and Communicate (MOTC) established a transportation planning communication group to promote the research, planning, and communication of transportation construction. This group was merged into the CIECD, becoming the transportation group[110], and the CIECD hired the transportation economist, Mr. Prentice, establishing a transportation planning group[111] for research on transportation economics in Taiwan with the UN Special Fund. The report suggested that our government establish a professional transportation planning institute for gaining more power for transportation construction……MOTC merged the transportation group, the transportation planning group and the Technical Office, into the TPB to meet the urgent need of transportation system planning. Thus, our government can execute comprehensive transportation planning with experts from home and abroad[112]."

On August 1st, the Transportation Planning Board was established. With this decision, Dr. Chiang, Prof. Yeh, and most members of the transportation group moved from the UHDC to the TPB, and the transportation group was dismissed while two members stayed in the UHDC helped the CIECD in the U.N. Special Fund projects. Many of Prof. Yeh's students who graduated from PCCU were members of the planning

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[108] The Transportation Planning Board, the Summary of the Transportation Economic Report for Taiwan, the R.O.C. by the U.N. Advisor Edward Prentice.

[109] The Journal is published by the TPB and its successor the Institute of Transportation, MOTC.

[110] It was the transportation group in the UHDC.

[111] It was the transportation planning group in the UHDC.

[112] Fu, Chia-Chi 傅家齊, "The Introduction of Transportation Planning Board 運輸計畫委員會介紹" in *Transportation Planning Journal Quarterly* 運輸計畫季刊, Vol. 1, No. 1 (1971): Pp.2.

department in the TPB, and Fu asked Prof. Yeh to be the chief of the department. He refused, citing his age, recommending Dr. Chiang to be the chief. Therefore, Chiang became the first chief of the planning division of the TPB. Because the transportation group in the UHDC was a temporary institute in the KMT government, we can the TPB Taiwan's first professional institute in charge of transportation studies and planning.

The TPB was inside the MOTC, and the Minister of Transportation and Communication served as chairman. 19 committee members represented related ministers and local governments such as the MOTC, Taiwan TRA, Taipei City Government, the Ministry of Defense, the JRCC, and the CIECD. The committee members gathered once every two months to discuss the issues brought by different divisions within the TPB. When the TPB was established, it had six divisions: the information division, planning division, transportation engineering division, industry division, economic division, and secretary division[113]. The main missions of the TPB were setting transportation policy, deciding the priority of transportation construction, transportation, and economic research, analyzing existed transportation infrastructure and services, reviewing transportation service fees, and feasibility studies of transportation construction projects. The divisions of the TPB would present their reports or suggestions to the committee for review, and once they were approved, the reports or suggestions would be sent to the CIECD or Executive Yuan (the Office of Prime Minister) for approval. After the CIECD or Executive Yuan's approval, the projects or suggestions would be put into a legislative procedure and would be costed. The committee members and the operational process of the TPB show that the TPB did have a certain degree of power to make decisions about transportation projects, especially its close relationship with the semi-autonomic institute CIECD. Furthermore, we need to note that the financial resources supporting the TPB came from the SAFED instead of the regular budget in the government.

Like the UHDC, TPB also hired international consultants to help their research and planning projects, with many of them coming from American companies in the first few years of the TPB. For example, the TPB hired Dr. Mowell, a transportation planning expert from Nathan Associates, as an advisor of comprehensive transportation planning using the loan from the World Bank in 1972. Moreover, Donald Fritz, the economist from the De Leuw Cather Inc. who helped Prentice to complete his transportation research project, was hired by the TPB as an advisor, and we find his articles or speeches printed in the

[113] Fu, "Introduction," Pp.4.

Transportation Planning Journal Quarterly. The way that foreign advisors cooperated with Taiwanese technical officials was similar to how the UHDC cooperated with the advisors. First of all, one critical approach was to introduce or to translate American transportation planning studies, manuals, and official documents bringing knowledge of transportation planning into the TPB. Even today, I can find many transportation planning studies or manuals of highways in the library of the Institute of Transportation[114]. For instance, I found that the TPB edited, in 1971, "*Readings in Model Split*," which collects papers about the Split Model, a quantitative model for calculation of traffic flow on freeways in urban areas, and a case study in Phoenix. Moreover, foreign advisors would give speeches or publish papers in *Transportation Planning Journal Quarterly* to spread their experience of their profession. Lastly, and maybe the most important, many foreign advisors would join the TPB's projects directly.

In the first three years of the TPB, the Board seemed to follow an "Americanization" approach as the transportation group in the UHDC. Things changed after 1972 when the TPB started to run its enormous mass transportation projects for Taipei Metropolitan. From February 21st to 28th, 1972, U.S. President Nixon visited Beijing, and at the end of that year, the Republic of China lost its highly important and symbolic role as the single representative of China in the U.N. and on the U.N Security Council. This diplomatic catastrophe for Taiwan and the decline of the U.S.-Taiwan relationship lay ahead in the 1970s, ushering in a new phase of American hegemony in science and technology that did not amount to Americanization.

Nixon, Autonomy, and Hybridity

The EPC and the CEPD

The United Nations General Assembly Resolution 2758 in 1971 and Nixon's visit to Beijing changed the U.S.-Taiwan relations and Taiwan itself, but the dramatic change did not happen overnight. In the late 1960s, the antiwar and civil rights movement were increasingly influential in the U.S. creating substantial political pressure on Lyndon B. Johnson. Richard Nixon won the presidential election in 1968. In his first year in office, he announced what later was called the Nixon Doctrine, a broad framework for Asia's future without massive U.S. troop deployments[115]. Meanwhile, on the Soviet side, Leonid Brezhnev tried to stabilize his domestic power through tighter central planning, more

[114] It is the successor institute of the TPB.

[115] Sutter, Robert G., *US-China Relations* (Lanham, MD: Rowman & Littlefield Publishers, 2018), Pp.64.

restrictive controls on intellectuals, and intensive militarization, crushing the ideological challenge developing in Czechoslovakia by sending tanks to repress protestors in the s-called Prague Spring on 20 August 1968. To the leaders of the Chinese Communist Party (CCP) Brezhnev's actions were perceived as a potentially mortal threat to China, heralding invasion and an effort to install a more pliable regime in Beijing[116]. In fact, the deterioration in Sino-Soviet relations had started earlier because of Nikita Khrushchev's De-Stalinization policy, suspension of technological and economic assistance to China, and his capitulation in the Cuban Missile Crisis. Finally, a military conflict broke out between the PLA and the Red Army on the Zhenbao (Damansky) Island where both China and the Soviet Union claimed sovereignty in March 1969[117].

The political situation in both the U.S. and China created an incentive to build a closer relationship. Nixon's National Security Advisor Henry Kissinger and a small group of top aides focused on the advantages for the U.S. in a new relationship with China with regard to handling the difficult process of reaching an acceptable peace agreement to end the U.S. involvement in the Vietnam War and in dealing with the Soviets in arms limitation and other negotiations from a position of greater strength. A new order in Asian and world affairs featuring positive US-China relations seemed much less costly and more compatible with U.S. interests than the previous confrontation with and containment of China[118]. Through "Ping-Pong Diplomacy" and some back-door diplomacy between Kissinger and Zhou Enlai, the U.N. General Assembly passed Resolution 2758 ensuring that the PRC would replace the R.O.C. as the only formal representative of China in the U.N. This included the R.O.C.'s seat of the Permanent Members of the United Nations Security Council. In the next year, Nixon visited China and the U.S. and China signed the first of three Joint Communiqués ensuring the normalization of U.S.-China relations. Eight years later, the Carter Administration terminated formal diplomatic relations between the U.S. and the KMT government. With that, the Sino-American Mutual Defense Treaty became invalid, although Congress did pass the Taiwan Relations Acts promising to ensure Taiwan's security, and establishing informal diplomatic relations between the U.S. and Taiwan.

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[116] Tucker, *Taiwan*, Pp. 100.

[117] After the conflict, China controlled the island, and Russia admitted China's sovereignty on the island in 1991.

[118] Sutter, *US-China Relations*, Pp. 69-70.

For Taiwan's technological and economic development and the CIECD, the most significant impact was the loss of the resources from the U.N. Moreover, although, before 1979, the diplomatic relations between the R.O.C. and the U.S. remained, and the cooperative programs for technological and economic development continued (for example, the construction of Sun Yat-sen Freeway (National Highway No. 1) and many projects supported by the SAFED), the fact that the KMT lost its legitimacy as representing China was a source of great uncertainty for the government. Not to mention that Nixon and Kissinger's moves led to huge doubts about the reliability of the U.S. For the KMT government, it provided a strong incentive to improve its technological power and decrease its dependency on the U.S.

As the "brain" of the technological and economic development in the government with substantial financial resources out of the government budget system, the CIECD changed its mission. In 1973, the CIECD was reformed as the Economic Planning Council (EPC), and then reformed as the Council for Economic Planning and Development (CEPD) in 1977. The EPC and later, the CEPD were still in charge of the execution of the projects funded by the SAFED, and enforced their power to plan Taiwan's technological and economic development. Moreover, the CEPD also played the role of integrating ministries in some critical technological and economic issues. For rail mass transportation technology, the CEPD determined whether and how a metro system project would enter the construction stage. This institute remained one of the leading institutes until 2014 when it was reformed as the National Development Council (NDC), though its role was not limited to the exploitation of the resources from the U.S.

Transportation Technology in the Changing Period

The change in U.S.-Taiwan diplomatic relations brought about by Nixon and Kissinger in 1972 did not terminate overnight the process of building the profession of transportation planning by leaning from American advisors. However, we see some signs of the beginning of the technological hybridity of transportation technology in Taiwan. Many transportation projects consulted by American companies and advisors kept going, and the TPB still hired American advisors and introduced American knowledge for building the profession of transportation planning in Taiwan. But the KMT government did not lose its formal relationship with the U.S. after 1972. Furthermore, unlike in the Truman era, Nixon did not seek to abandon the KMT government and Taiwan, and the military protection guaranteed by the Mutual Defense Agreement remained so that American technical assistance and advisors did not need to leave Taiwan immediately. Nonetheless,

the change in diplomatic relations subtly changed the import of knowledge and experience into Taiwan in the 1970s.

In the early 1970s, the KMT government launched a series of enormous technological and economic projects with the so-called Ten Major Construction Projects (十大建設) to strengthen's Taiwan's power and to ensure the survival of the regime. Many of them were products of the cooperation with American consultants and companies. For example, the construction of the first nuclear plant started in 1971 with the cooperation of GE and Westinghouse. For transportation, the KMT government launched the projects of Taichung Harbor and Suao Harbor to deal with Taiwan's steady expansion of international trade. It also initiated the project of the new international airport at this time. The National Freeway No.1, as I mentioned, was planned and constructed with the American company De Leuw Cather consulting. Also, although the TPB was not involved in the freeway project, De Leuw Cather's advisor Donald Fritz did not only help Prentice to diagnose Taiwan's transportation systems, but also worked with the TPB closely, providing education training, technical documents from America, and giving lectures introducing concepts of transportation planning to Taiwanese technical officials.

All the same, the KMT government and its Taiwanese technical officials did not follow the American model wholly once Taiwan gained partial autonomy with the termination of U.S. Aid and more durable technological power. In contrast, at the same time, the TPB and many technical officials in the KMT government seemed to be willing to learn how Americans made knowledge or to complete massive technological projects with the help of Americans. The TPB's Transportation Planning Journal Quarterly at the time when the TPB was founded provides some clues since the contents of the journal reveal the technical officials' concerns and thinking. First of all, we can find many articles focusing on the issues related to the major transportation projects like airport traffic analysis, electrified railway, and harbor charges. Second, we see the introduction of theories or case studies from America. Some of them were published in Chinese translation, and some were in English, and they include articles by American advisors like Donald Fritz. Third, one thing that needs to be noted is that many articles about Japanese experiences appear in the journals. In vol.1, no.1, we can find "Report on Harbor Charges and Related Problems in Japanese Ports" and "Traffic Forecasting Method in Japan with Some Implications to the Problem of Transportation Planning in Taiwan." In vol.1, no.2, we also find "Achievement of High-speed Railway Service in Japan" and "Cost Allocation of Urban Street and Railway Grade Separation Investment in Japan." In an article introducing the World Bank's loan policy for transportation projects, a section translating

the manual of the Overseas Economic Cooperation Fund[119] (海外経済協力基金) showed how to apply for the loan from the fund in Japanese Yen. With the loan from Japan, the countries would not only receive the financial support from Japan, but also gain Japanese materials, machines, and technical assistance[120].

Moreover, the CIECD and the TRA's achievements shows that when the top of the KMT government decided to consider rebuilding the railways in Taipei City under the ground instead of in an elevated form in 1972, the top level of the government searched for alternative technical assistance to that provided by the U.S.. The deputy of the CIECD, Fei Hua (費驊), wrote from Tokyo mentioning that he had discussed the issue of rebuilding the railway in Taipei City and the future subway system with Dr. Kaku Mao-Lin (or Kuo Mao-Lin, 郭茂林) who was a famous Taiwanese architect working in Japan. He pointed out that, as regards the underground railway, first, if an underground railway was built 20m-deep beneath the ground, the cost would be three times more than one built 1.5m-deep. Second, the Taiwanese government could send engineers to Japan to study actual cases, and the TRA would be responsible. Third, Dr. Kuo's Taipei office could cooperate with Dr. Kuo's Japanese firm to introduce the cases to be studied. For the future subway system, first, Dr. Kuo recommended one urban transportation expert of the University of Tokyo, Prof. Yasojima (八十島), to come to Taipei studying Taipei's transportation for one week. Second, the CIECD could hire Prof. Yasojima. Third, the Taiwanese government could send related data to Dr. Kuo, and he could submit it to Prof. Yasojima so that he would study it before coming to Taiwan[121]. Furthermore, a meeting held by the MOTC passed a resolution that the CIECD would ask the West German government to recommend consultants to Taiwan joining the feasibility research stage of the project to rebuild the railway in Taipei City underground. German consultants would serve in Taiwan in the same way in which they consulted for TRA's container freight rail study. Then, the MOTC sent an official document to the CIECD to ask the German authorities to

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[119] It was merged with the Japan Export-Import Bank (日本輸出入銀行) into the Japan Bank for International Cooperation (国際協力銀行), and it was a part of foreign aid in Japan.

[120] The Transportation Planning Board,"The World Bank's Future Loan Policy for Transportation 世銀未來運輸貸款的政策" in *Transportation Planning Journal Quarterly,* Vol. 1, No. 3 (1971): Pp.122-123.

[121] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," Jan 29, 1972.

recommend consultants to join the subterranean railway project. The MOTC also provided a summary of the project[122].

In sum, although the TPB and other institutes in the KMT government did not cease to cooperate with American consultants after the change in U.S.-Taiwan relations brought by Nixon's move, Taiwanese technical officials and top levels of the KMT government began to think and even to take action to exploit alternative resources for Taiwan's infrastructural projects. These attempts, I argue, were both imposed by its new autonomy and sought to enhance that autonomy. The termination of U.S. diplomatic recognition and the establishment of the TPB meant that Taiwan at least had a basis for transportation studies and planning even though it still lacked experts. Therefore, in each project, the technical officials had a certain leeway to seek different possible consultants other than those from America. Such attempts can also be interpreted as efforts to enhance the autonomy of technological development, especially in the stage of learning about transportation systems. First, technical officials could now seek more ideal models and experience for the local demand. Second, it led to a clearer recognition in the government that a particular knowledge about cities and roads would lead to a particular solution to the problems, and the solution would contain technology made by American, thus, leading to technological dependence. Third, the change in the U.S.' diplomatic policy stimulated Taiwanese leaders and officials to decrease dependence on America, leading to technological hybridity of the rail mass transportation in Taiwan in the following two decades.

The Transnational Transportation Planning Science

Taiwan's technical officials, top-level leaders, and American advisors constructed the basis of the profession of Taiwan's transportation studies and planning in the late 1960s and the early 1970s. Creating UHDC's transportation group and the TPB were substantial achievements, and the process of the establishment of the two institutes has three noteworthy features. First of all, it shows that the history Taiwan's transportation studies and planning can be regarded as a transnational history of transportation studies and planning from the U.S. to Taiwan. Second, it suggests that the U.S.-Taiwan relation provided momentum for the Americanization of Taiwan's transportation technology and triggered the attempts of hybrid strategies for technological autonomy. Third, the establishment of transportation studies and planning can be interpreted as involving the co-production, with the Taiwanese experts and sections of the government, of an

[122] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," Jan 29, 1972.

American hegemony of the technology of transportation. Put differently these three conclusions reveal that the U.S.-Taiwan relations created not only the Americanization of Taiwan's transportation technology but also a breeding ground for the technical hybridity of transportation technology.

Be it the UHDC or the TPB, we can observe that American advisors and consulting companies introduced the way that Americans built their knowledge about cities for transportation planning through cooperation in specific projects, education and training, and by drawing on an expanding archive of technical documents. In this way American advisors' experience traveled from America to Taiwan and interacted with the local context to generate knowledge for transportation studies and planning. Jonathan Zeitlin points out that Americanization after the second world war led Western European countries and Japan to reshape their domestic industries in the image of the U.S., above all by using the 'American model' of mass production—the high-volume manufacture of standardized goods using special-purpose machinery and predominantly unskilled labor —together with the host of 'systematic' management techniques, organizational structures and research and marketing services developed for its efficient administration and effective exploitation[123]. The transportation planning profession that was injected into Taiwan was also a kind of Americanization, although it did not really involve mass production. In the coming age of the automobile in American cities in the 1910s and 1920s, American engineers developed transportation engineering to reshape American cities to cope with the dramatically increase in the number of automobiles.[124] Then, with the development of highways and the Federal Government's support for the interstate highway systems and the rise of urban transportation in the 1950s and the 1960s, the U.S. built systematic methodologies to acquire knowledge that could be used in transportation planning including house interviews, integrating traffic flow and land use, and model building for urban transportation[125].

Although the American model of transportation planning was based on the motorization of American cities, in the 1960s and the 1970s, engineers and government began to encourage alternatives. Public funding began to benefit other urban

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[123] Zeitlin, Jonathan, "Introduction: Americanization and Its Limits: Reworking US Technology and management in Post-War Europe and Japan" in Jonathan Zeitlin and Gary Herrigel ed. *Americanization and Its Limits* (New York: Oxford University Press, USA, 2000), Pp.2-3.

[124] Norton, Peter D., *Fighting Traffic: The Dawn of the Motor Age in the American City* (Cambridge, MA: MIT Press, 2008)

[125] Weiner, Edward, *Urban Transportation Planning in the United States: History, Policy, and Practice*, 3rd edition (New York: Springer, 2008).

transportation modes. In belated recognition of the interdependence of transportation modes, highway engineers renamed their profession transportation engineering[126]. What Taiwanese technical officials like Dr. Chiang learned from American advisors and the technical documents from the U.S. were the same patterns: combining land use and traffic flow calculation in transportation studies, house interviews, and traffic model building. Taiwanese technical officials also learned how to do transportation research from the case studies of American cities like Philadelphia, Los Angles, and Phenix. Although inevitably American advisors and their Taiwanese students would not entirely copy the American way of making knowledge of Taiwanese cities, we can still conclude the Americanization of transportation studies and planning in Taiwan.

U.S.-Taiwan relations provided the basis of the Americanization of transportation technology despite the termination of U.S. Aid. What supported the establishment of Taiwan's profession of transportation planning was the institutes, the CIECD, and the SAFED, which were derived from the CUSA and the money provided by the U.S. What maintained the institutes built to manage U.S. Aid was the close U.S.-Taiwan relations in confronting the communist regime in the 1960s. During this period, Taiwan not only played a role of monitoring China with its strategic position and military power but it also exhibited economic and technological achievement by exploitation of the American model. Furthermore, the termination of U.S. Aid meant the Taiwanese government gained some autonomy for technological development despite their high dependence on American advisors. With the resources from U.S. Aid and other subsequent technical assistance, Taiwanese technical officials at least acquired organization, knowledge, and experience to hire consultants and to launch projects. However, once the U.S.-Taiwan relations changed in the 1970s, the increased autonomy led Taiwanese political leaders and technical officials to seek possible alternative sources, especially Japan and European countries, of technical assistance that were a better fit to local needs and enhanced their autonomy. Moreover, these attempts finally developed into practical technological hybrid strategies and actions leading to the technological hybridity of rail mass transportation in the following years. Even then, in the case of transportation studies and planning, we see that American consultants still occupied a significant role.

This phenomenon reveals how the co-production of American hegemony of transportation studies happened in the late 1960s and the early 1970s. As I mentioned in the last chapter, U.S. Aid only helped Taiwan to recover and to improve its transportation

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[126] Norton, *Fighting Traffic*, Pp. 8.

infrastructure and railway management, so that we can hardly conclude that U.S. Aid launched the coproduction of the American hegemony of science and technology as it did in other fields. However, the establishment of the UHDC and the birth of the TPB shows how Americanization of the making of knowledge of cities and streets for transportation planning was constructed with Taiwanese technical officials' cooperation and American advisors' contribution. We especially need to note that the Taiwanese government already gained some autonomy to consider and to hire consultants. But, it still chose American advisors and companies to help it build the profession and the mechanism of producing knowledge for transportation planning. This did not happen because America's overwhelming military power and its protection obliged the KMT government to choose the American model instead of others; in fact, it was the superiority of transportation studies and planning in the U.S. that attracted Taiwanese technical officials to step on the road of Americanization.

Krige's studies on postwar Western Europe reveal that building consensus required not only the active collaboration of national elites who shared the economic, political, and ideological ambitions of the United States—and had sufficient legitimacy and power to impose their conception of the path that Europe should take on those who thought otherwise; it also required a subtle refashioning of European identity, a gradual implantation of American norms and practices, selectively adapted to local conditions—and the withering away of any illusions that Soviet Communism could provide the liberating life-world that it promised[127]. In Taiwan, we can find a similar development in the UHDC and the TPB. The KMT government not only hired American experts to complete particular transportation projects but also believed that the methods Americans used for transportation research could reform and improve Taiwan's transportation systems. Taiwan's newly gained autonomy in the late 1960s and early 1970s led it to choose the path of American hegemony of transportation studies and planning; it was not imposed from without. What is more the termination of U.S. diplomatic recognition was not the end of the American hegemony of technology for Taiwan's transportation technology; instead, it was the beginning.

The consensual characteristic of the American hegemony of technology inherently contains the possibility of hybrid knowledge and technology in American technical assistance because the hegemonic power allows for a degree of autonomy for the assistance-receiving countries. Taiwanese political leaders and technical officials'

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[127] Krige, *American Hegemony,* Pp. 255.

attempts to introduce Japanese and German technical assistance in the early 1970s indicated the future road of hybridity, especially at the time when Taiwan finally initiated the massive practical rail mass transportation projects aiming at changing its capital, Taipei, and the KMT government faced disastrous diplomatic developments in the 1970s and the 1980s.

Chapter 4: The “Underground”

The Taipei Railway Underground Project 1967-1989

“The DEC, the German consultants who were hired by the TRUPO, is the technical consultants of the Deutsche Bahn, and it shares the technical specialists with the DB. In other words, the DEC’s technical basis has the DB’s strong support, so its technical level and experience are reliable.(地鐵處所聘用的ＤＥＣ也是德國國鐵的顧問，與德鐵共享技術專家。也就是說，ＤＥＣ的技術基礎是得到德鐵的強力支援，因此他們的技術水準與經驗是很可靠的).” General Tong Ping (董萍), 1998.

“Transportation academia and urban planning experts all agree that it is impossible to match the increasing demand for roads and parking space in cities, especially in central business districts, without destroying urban life functions and the city’s features. Los Angles and Detroit were mobilized in their early years. Their mobile-centered policy has already proved to be a total failure, and the consequence is silence in the city center after dark, the extension of residential areas to suburbia, the waste of precious land resources for building roads, and the severe pollution problems. (運輸界與都市發展專家均同意，在不摧毀都市生活機能與都市特性的條件下，完全不可能趕上街道與停車場需求的急增，尤其是在中心商業區。洛杉磯與底特律這兩個都市很早即以摩托化，其以汽車為主的運輸政策已經證明徹底的失敗，其後果是下班後各都市中心的死寂、私人住宅向郊區展延、浪費昂貴的道路土地資源，以及嚴重的污染問題等。)” Deutsche Eisenbahn Consulting, 1977.

“Marching Forward”

In 1990, Lim Giong (林強), the musician who won dozens of musical awards in his career including Prix du Jury Cannes Soundtrack Award, launched his first album *Marching Forward* (向前走). It caught the attention many Taiwanese not only for the rock-n-roll style Taiwanese song but also the video that went with the main song, “Marching Forward." Before this song, most of his songs sung in Taiwanese were in a melancholy tone with an old Japanese Enka-style soundtrack. By contrast “Marching Forward”

expressed bright hope with its rock-n-roll performance and inspiring lyrics. The lyrics describe a country boy riding on a train bound for Taipei to make his career, full of boundless hope and ready to fight for his future in the modern city Taipei — especially after he stepped into the newly built Taipei Main Station. In this music video, echoing the music and lyrics, Lim and his dancers wore blue jeans and white t-shirts singing dancing in the vast hall of the Taipei Main Station and aisles on the underground level. Many Taiwanese talked about his music, dress, and hairstyle. However, they also talked about Taipei Main Station's huge hall, underground platforms, and its modernized appearance. Two years later, Wu Bai (伍佰), another singer who also sings rock-n-roll in Taiwanese, released a song that began "Ride on the subterranean railways to here[128]……" showing a young man's anxiety and confusion of being in Taipei. The Taipei Main Station and the underground railway became the face of the city after its completion in 1989 since the Taiwanese had never ridden on a train in a subterranean tunnel and had never seen such a large station building in Taiwan.

The Taipei Main Station and the underground tunnel were so conspicuous that the Taiwanese easily regarded it as a symbol of the changing city, though there is much more to the railway than meets the eye. First, the subterranean railway had four tracks instead of two, though the passengers could not readily know that until they realized that the Taiwan High Speed Rail (THSR) that opened in 2006 used two of the tunnels. Second, two "hidden stations" are located between the Taipei Main Station and the Songshan Station, and one is located between the Taipei Main Station and the Wanhua Station. These three stations are not open to passengers, and they open only for emergencies. The existence of the four tracks and the hidden stations are a puzzle that needs explaining. Moreover, once the subterranean railway extended to the Banqiao Station and the Nangang Station[129], people would quickly find that the Taipei Main Station was the only station without high-level buildings among all the underground stations in this subterranean railway, another puzzle needing an explanation.

The answer to the puzzles lies in the history of the design and construction of the railway. The construction of the subterranean railway in Taipei and the new station was not completed in a few years. Rather, the "march forward" of the railway and the station

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[128] "Tall Building" 樓仔厝 in Wu Bai's first album *Loving Others is a Happy Thing* 愛上別人是快樂的事 released in 1992.

[129] After the completion of the project of the subterranean railway in Taipei City in 1989, Taiwanese government kept rebuilding the railway and stations into underground leading to a 17km-long subterranean railway and five underground stations and three emergency underground stations.

had gone through a decade-long process of strugge and negotiation, and it involved the making of the knowledge of Taipei City, technological conflicts, competition with communist China, and the dramatic change in U.S-Taiwan relations. These factors do not only explain why the subterranean railway took so long to be accomplished but also how the railway and the station were constructed. I argue that the project of the subterranean railway in Taipei City is the extension of the development of the profession of transportation planning.

Moreover, this project reveals the technological hybridity of knowledge, functions, and styles. Americanization was not the only solution for Taiwan and Taipei to build and to rebuild its mass transportation system. Instead, other sources of knowledge and technological ideology found a way into Taipei, and the Taiwanese integrated them, shaping the railways and stations in Taipei, especially the Taipei Main Station.

Taipei's Railways during the 1960s and the 1970s

When the KMT government retreated to Taiwan, there were several railways in Taipei and its suburban area. The West Coast Line (縱貫線), which has been the central intercity railway since its completion, crossed Taipei City from east to west, connecting the harbor city Keelung to the north, Yilan to east, and central and south Taiwan to south. Besides the mainline, five north-south branch lines connected it for industrial purposes and commuting. The northward Tamsui Line connected the Taipei Main Station, Shilin (士林) residential area, Beitou hot spring resorts, and the old harbor town Tamsui (淡水). The southward Xindian Line, which was the first railway built by the Japanese private section in Taiwan, started from the Wanhua Station passing National Taipei University, the municipal water facilities finally reaching Xindian so that the coal in the southern outskirts of the city could access the West Coast Line. This line also transported people who wanted to enjoy the lake resorts in Xindian. The other two lines in Taipei and New Taipei were mainly for industrial and military purposes, so people living in the city did not know very much about them.

In 1965, the TRA stopped the Xindian Line's service because of the exhaustion of coal resources and the decreasing number of passengers, and most of the traffic carried on the railway was displaced to the road system. Therefore, the main line, or the West Coast Line, and the northward branch line, the Tamsui Line, were the only two railway lines in Taipei City. Although the Xindian Line became the first branch railway demolished, the TRA railway passenger service entered its golden age at that time. In 1968, the ridership of railways in Taipei City reached its peak: 7,490,101 person-trips in the year.

Among the stations, the Taipei Main Station undoubtedly had most ridership, and, the Tamsui Line's Beitou Station's ridership was more than other stations on the West Coast Line claiming the second place[130]. This fact shows that the Tamsui Line as a commuter railway contributed much to Taipei's mass transportation.

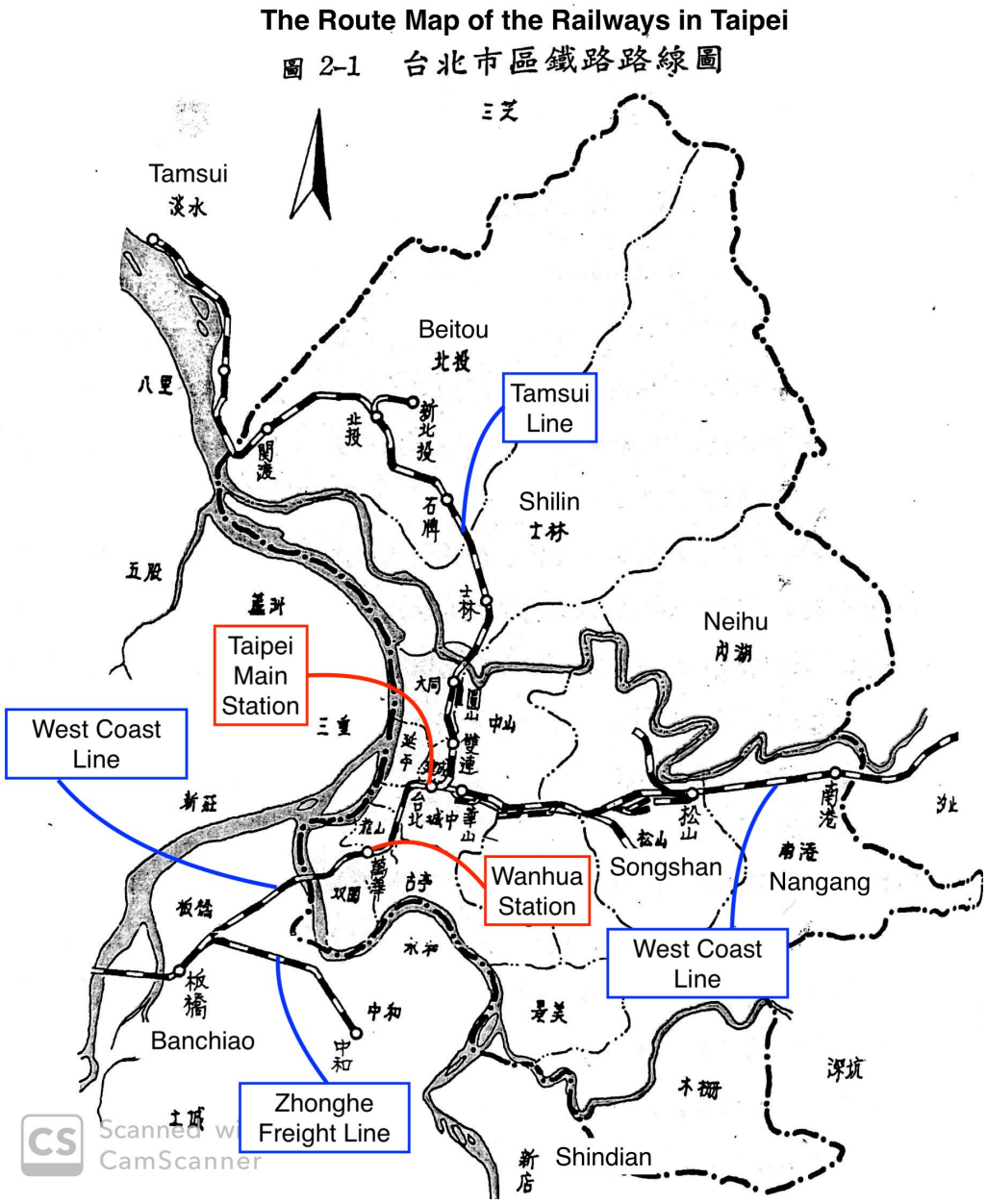

Figure 4.1: The Railways in Taipei before 1988[131]

[130] Taipei City Archives 台北市文獻委員會, *The Economic Chronography of Taipei City, No.6, Chapter of Transportation* 《臺北市志卷六經濟志交通篇》. (Taipei: Taipei City Archives 臺北市文獻委員會, 1988), Pp. 246-248.

[131] The Transportation Planning Board, *The Improvement of the Railways in Downtown Taipei Report* 《臺北市區鐵路改善研究報告》. (Taipei: Transportation Planning Board 交通運輸計畫委員會, 1977), Pp. 16. The author adds the English names of places, stations, and railway lines and the English of map titles.

Nevertheless, the peak only lasted for a short time. The number of automobiles and scooters dramatically increased with the population growth in Taipei Metropolitan, with Taiwan's strong economic growth, and the building of more roads. An increase in the number of automobiles symbolized the economic achievement of the island country and the growing city, but it ironically created a congested traffic situation at the same time. One of the founding fathers of Japan's high-speed train the Shinkansen, Shima Hideo (島秀雄), observed the situation when he visited Taipei in 1969. In his two-week stay, he found nothing but a total mess of Taipei's traffic. Especially in the morning and at sunset, the whole city was almost paralyzed. If Taiwanese did not figure out a solution to the severe situation, the traffic in Taipei City would be not only chaotic but completely blocked by traffic jams when Taipei's population reached 2.5 million[132]. When Shima visited Taipei, Taipei's population was about 1.5 million. The population reached 2.5 million in 1985, just 16 years since the father of the Shinkansen gave his advice. The increase in population did not mean an increased ridership of railway services. The ridership of the railway in Taipei City decreased to below half in only four years[133] showing that people tended to use cars and scooters instead of trains.

Table 4.1: The Growth of Population of Taipei City[134]

Year	1905	1945	1966	1968	1975	1981
Population	100,000	335,000	1,178,427	1,604,543	2,043,318	2,220,436
Growth rate	X	335%	352%	36%	27%	8.6%

The decline in ridership and the growth of automobiles and scooters changed people's attitudes toward railways. In 1968, t*he Economic Daily News* released an editorial arguing that the solutions to traffic congestion in Taipei were increasing roads' surface area, building parking lots and expressways, replacing aging cars, and solving the

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[132] The United Daily News 聯合報 "Building Rail Rapid Transit System in Taipei: the Interview of Japanese Engineering Expert Shima Hideo 建立台北鐵路捷運系統 訪日本工程專家島秀雄一席談." *The United Daily News*, May 21, 1969.

[133] Taipei City Archives , *Economic Chronography of Taipei City*, Pp. 248.

[134] Sources: *The Improvement of the Railways in Downtown Taipei Report* (1977) and *The Comprehensive Report of the Metro Plan for Taipei Metropolitan* 《臺北都會區大眾捷運系統計畫綜合報告》. (Taipei: Transportation Planning Board 交通運輸計畫委員會, 1983). The population before 1967 did not include the population of Neihu, Nangang, Muzha, Jingmei of Beitou, and Shilin, so the population growth between 1966 and 1968 included the growth caused by Taipei City merging these townships. However, in the 1960s, these townships were not that populous like today, so the population growth at that time was intense.

problem of level crossings. This editorial especially pointed out that the “unnecessary railway” Tamsui Line should be demolished[135]. In the early 1970s, whether or not to demolish the Tamsui Line became a hot issue in newspapers and among citizens. The United Daily News released a series of articles discussing this issue[136], and the TRA also considered removing this branch railway[137]. One of the articles even took the Xindian Line as an example to show how successful development had been after the branch railway vanished. The level crossing issue was the main reason for advocating the demolishment of the Tamsui Line, and, in fact, these actors also argued that the West Coast Line in Taipei caused the same problems. First, the railways and the level crossings in the city caused traffic congestion. Second, the railway also split economic actives and development on one side of the track from that on the other. Level crossings in the crowed city were also dangerous for vehicles and pedestrians.

These opinions implied that Taipei City should welcome an automobile era by building more roads and parking lots rather than keeping the disused railways. This idea echoed the trend of mobility policy in American cities at that time. Moreover, Dr. Chiang, in his interview, also mentioned that many diplomats living in Shilin needed to enter downtown Taipei City by passing through the level crossing so that the congestion problem was annoying. The West Coast Line still played a vital role in intercity transportation and freight so that they only persuaded the KMT government to remove the Tamsui Line, but the problems caused by level crossings still needed to be solved. Thus, the newly founded profession of transportation studies and planning needed to face its first challenge of solving the traffic problem in the capital city. Perhaps to the surprise of the members of the profession, this challenge lasted for decades.

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[135] The Economic Daily News 經濟日報. “The Total Solutions for the Traffic Problems in Taipei City 台北市交通問題的治本之道.” *The Economic Daily News*, October 9, 1968.

[136] Chen, Chu-hua 陳祖華. “The Elevated Railway and the Tamsui Line Issue 鐵路高架與淡水線存廢問題.” *The United Daily News*, March 5, 1970; Chen, Chu-hua. “The Tamsui Line Should be Demolished Earlier! 淡水鐵路支線早該拆除了! “ *The United Daily News*, July 11, 1971.

[137] Chen, Chu-hua. “The TRA Principally Agree to Remove the Tamsui Line 拆除北淡鐵路建議省鐵路局原則同意.” *The United Daily News*, July 12, 1971.

Figure 4.2: A level crossing damaged by a bus in Taipei City in 1971[138]

The Death of the Elevated Railway Project

In 1967[139], the deputy of the Council of International Economic Cooperation Development (CIECD), K.T. Li (Li Kuo-ting, 李國鼎), and the minister of transportation, Sun Yun-suan (孫運璿) instructed C.C. Wang to study how to solve the traffic and safety problems caused by the 18 level crossings in Taipei City in a meeting of the CIECD. As the previous chapters show, like K.T. Li and Sun Yun-suan, C.C. Wang was highly trusted by the top of the KMT government, especially the future national leader Chiang Ching-kuo so that he was sent to the U.S. to share programs several times and had the power to reach the U.N. directly. Moreover, he was also assigned to a provincial level political

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[138] 國立臺灣大學數位人文研究中心。「新版國家文化資料庫 。」2010。http://doi.org/10.6681/NTURCDH.DB_NRCH/Collection.

[139] C.C. Wang mentions the meeting was in 1968, but the archives of the CIECD shows that C.C. Wang's ad hoc group for the issue of the railways in Taipei held the first meeting on September 13, 1967, and the record shows the CIECD's meeting determining to set an ad hoc group was one day ahead of the ad hoc group meeting. Thus, when C.C. Wang received his assignment was 1967 instead of 1968. Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-070.

position to accumulate experience. At this time, he also started to be assigned to special missions of transportation programs. As the commissioner of the Public Works Department, Taipei City Government at that time, C.C. Wang ran an ad hoc group and invited his former colleagues in the UHDC, international advisors and local experts in the UHDC, to study this issue[140]. The UHDC and the TRA shared the cost evenly[141].

Initially, C.C. Wang and his experts thought they could simply solve the problems by building grade separations rather than moving the railways to different places or adopting other expensive options. However, they found that they did not have enough space to build ramps for grade separation in the crowded city. The group also found it difficult to rebuild the railways underground because of financial constraints imposed by the government at that time, and because they feared they could not deal with the emission problem in underground tunnels (all trains in Taiwan were powered by either coal or diesel before the mid-1970s). To build elevated railways for the West Coast Line and the Tamsui Line did not cost too much, while problems of noise and view could be solved by engineering. Thus building an elevated railway seemed to be an appropriate option to solve the level crossing problem. As I mentioned in chapter 2, the American advisor Lewis Coyle joined this group, providing the research agenda for the feasibility study of building elevated railways in Taipei City[142].

While the ad hoc group studied the elevated railways, citizens also presented their ideas to solve the level crossing problems. One citizen suggested that the government rebuild the West Coast Line to cross the Tamsui River from the Taipei Main Station directly to connect to the Banqiao so that the railway and the Wanhua Station could acquire a large amount of land for development and traffic congestion in this busy area could be solved. The government did not need to spend too much on the construction of tunnels or an elevated track[143]. An owner of an engineering company suggested that the CIECD build a “great wall” style building above the railway for kilometers connecting two sides of

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[140] Academia Sinica, *Records of Interviews,* Pp. 57.

[141] Academia Sinica Archive 中央研究院近代史檔案館, “CIECD Central File”行政院國際經濟合作發展委員會, 36-10-001-070.

[142] Academia Sinica Archive 中央研究院近代史檔案館, “CIECD Central File” 行政院國際經濟合作發展委員會, 36-10-001-070.

[143] Academia Sinica Archive 中央研究院近代史檔案館, “CIECD Central File” 行政院國際經濟合作發展委員會, 36-10-001-070.

the railway and boosting business activities[144]. Although these kinds of suggestions were presented to the UHDC and high-level technical officials like the executive secretary of the UHDC, Chang Tzu-hsiuan (張祖璿), the technical officials declined the suggestions due to their being technically or financially impossible. Rebuilding the railways into elevated form seemed to be the best solution for Taipei.

Although Dr. Chiang did not join the ad hoc group, Prof. Yeh attended the meetings, and Dr. Chiang studied the report for the improvement of the railways in Taipei, written by Coyle and the ad hoc group. Dr. Chiang regarded the project as being the first professional transportation planning effort made in Taiwan. However, the study was not supported with comprehensive transportation studies of Taipei, leading to the difficulty of generating solid arguments to support the conclusion that elevated railways should be built in Taipei. Calculating traffic flow and evaluating service level amounted to only reviewing the existing system rather than planning for the future system. Prof. Yeh told Dr. Chiang that the ad hoc group was handicapped by having only a six months do the research, as suggested by Coyle. After Dr. Chiang saw the report, he found that not only was the time needed for research underestimated, but also that the data in the report required that the railways and the stations in Taipei should not be moved. C.C. Wang's story may echo Dr. Chiang's experience. The experts of the ad hoc group had failed to include the prediction of the increased ridership of the West Coast Line, and they asked C.C. Wang to go back to the UHDC to solve this problem. After C.C. Wang had heard different opinions from his experts, he drew a curve on a blackboard showing the predictions of the ridership, humbly adding that this curve was a product of "empiricism" rather than of solid scientific studies[145].

C.C. Wang's story may reflect the limitation of the ad hoc group, and, as Dr. Chiang said, the ad hoc group's limitations led to strong opposition. One retired army general published his opinion in a magazine arguing that the West Coast Line should be moved to the southern edge of Taipei City and the Tamsui Line should be demolished. He also sent his article to the CIECD asking for support[146]. Moreover, two ministers without portfolio

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[144] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-070.

[145] Academia Sinica, *Records of Interviews*, Pp. 58-59.

[146] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-070.

also opposed the project of an elevated railway[147]. Dr. Chiang also mentioned that the official report caused massive opposition to the elevated railway.

However, C.C. Wang's prediction curve and the ad hoc group's efforts were not in vain. In January 1968, K.T. Li, Minister Sun, and the director-general Fei Hua showed their support for the elevated railway project in a series meetings among top political leaders in the KMT government[148]. Despite the opposition of the two minister without portfolio, C.C. Wang's project received not only K.T. Li and Minister Sun's support but also that of the prime minister and vice president Yen in the meeting of the Executive Yuan[149]. C.C. Wang presented photos of elevated railways around the world in the meeting to show those present how elevated railways looked and how to deal with the noise issue and visual shock in cities. Vice president Yen decided to approve the project. He then took C.C. Wang to the National Security Council, presenting the project in front of Chiang Kai-shek for approval. In both of the meetings of the Executive Yuan and the National Security Council, C.C. Wang used the "empirical curve" of ridership prediction as data to persuade top leaders of the government, and, after his presentation, Chiang Kai-shek approved the project.

In 1969, C.C. Wang received the Eisenhower Exchange Fellowships to visit America, where he asked American engineers and professors about his "empirical curve" because he felt guilty about pushing the project in this way. However, the American experts replied to him that they sometimes would take the same approach when they had no choice but to believe the information they had, and the curve also needed to be empirical so that it could persuade others[150].

After the project was approved, the KMT government set up a "directing group," led by Minister Sun, to execute the elevated railway project in 1969. The directing group decided to apply for a loan from the Asian Development Bank (ADB), and the CIECD also

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[147] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-070; Academia Sinica, Records of Interviews, at Pp. 58.

[148] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-070.

[149] In the constitutional structure of the government of the R.O.C., "Yuan (院)" are the highest level institutes representing five powers of the state—executive, legislature, judiciary, examination, and control. Thus, the president fo Executive Yuan is the highest leader of executive power in the state so that this position would be regarded as the same as the meaning of prime minister in the context of western politics.

[150] Academia Sinica, *Records of Interviews*, Pp. 58-59.

asked the ADB to recommend engineering consultants to do the feasibility study[151]. In August 1969, the ADB decided to hire the British consultants Freeman, Fox, Wilbur Smith & Associates to do the evaluation study, while the ADB would provide a loan to Taiwan after the feasibility study concluded that the elevated railway project was feasible and worthy[152]. In September, the evaluation study team with eight British experts arrived at Taipei to study the city and the project. In November, the evaluation study team recommended the elevated railway project, and American consultants Bechtel and Japanese National Railway mailed to the CIECD expressing their interests to participate in the project. The ADB approved the loan application for 5 million dollars and sent the technical assistance contract to the CIECD in February 1970. The ADB also agreed that the KMT government hire Japan Transportation Consultant Inc. (日本交通技術株式会社) supported by the Japanese National Railway for the project, after reviewing the draft of contract[153].

In March, the Asian Development Bank approved $540,000 for the design of the elevated railways. The elevated railway project would have two sections; the first section was 4 kilometers long from 0.75km of the Wanhua Station to the Huashan Freight Station; the second section was 3 km long from the Taipei Main Station to the Yuanshan Station on the Tamsui Line[154]. It seemed that the Japanese factor would enter Taiwan's transportation technology in 1970 since the ADB, unlike tU.S. Aid, was led by the U.S. government.

However, before the ABD allocated the loan for the design of the elevated railway in September 1970, K.T. Li, the minister of finance at that time, informed the president of the ADB, Watanabe Takeshi (渡辺 武), that the KMT government had decided to suspend the elevated railway project because they were studying the feasibility of the electrification of the entire railway system in Taiwan[155]. It was true that the KMT

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[151] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-070.

[152] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-070.

[153] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-070.

[154] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-070.

[155] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

government started to plan to electrify the West Coast Line in the 1970s, but the electrification of the railway cannot explain why the project was suspended all of a sudden when everything was ready to start. Although K.T. Li mentioned that the reason why they should suspend the elevated railway project while the electrification railway project began to be on the way was just a measure being taken “for the time being,” technically, Taipei could still complete the elevated railway first and then electrify the railway. The electrification of the West Coast Line was completed in 1979, meaning that the KMT government had enough time to build the elevated railway first and then electrify it along with other sections of the whole West Coast Line. K.T. Li’s explanation for the suspension of the elevated railway project is thus not plausible

Defensive reasons may explain the suspension of the project, but some doubts remain. In the technical report *The Research Report for the Tamsui Line Issue*, we can find that the KMT government decided to cease the project for civil defense reasons[156]. *The Improvement of the Railways in Downtown Taipei Report* also [157] said that the railways in Taipei City should be rebuilt as subterranean railways rather than elevated railways. The retired army general also mentioned the transportation in Taiwan would be totally jammed if the PLA bombed the elevated railway in his suggestion to the CIECD. Another citizen also suggested that the CIECD consider building subterranean railways to protect the people from a nuclear attack by mainland China’s PLA[158]. However, if defense arguments mattered, why did Chiang Kai-shek and the National Security Council approve C.C. Wang’s elevated railway project? Notably, the members of the National Security Council, including Chiang himself, were experienced officers. Moreover, when the TPB invited Japanese and German consultants to study the improvement of the railways in Taipei in the late 1970s, the consultants also regarded the elevated railway as the best choice for Taipei, and the officials did not use defense reasons to reject their suggestions[159]. National defense reasons might only partially explain why the KMT government suspended the elevated railway all of a sudden

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[156] The Transportation Planning Board, *The Research Report for the Tamsui Line Issue* 《淡水線鐵路存廢問題研究報告》. (Taipei: Transportation Planning Board 交通運輸計畫委員會, 1975), Pp. 1.

[157] The Transportation Planning Board, *Improvement of the Railways,* Pp.12.

[158] Academia Sinica Archive 中央研究院近代史檔案館, “CIECD Central File” 行政院國際經濟合作發展委員會, 36-10-001-070.

[159] National Archives 國家檔案閱覽中心, “The Subterranean Railway in Taipei City Feasibility Study 為台北市地下鐵路初步可行性研究事希知照洽辦由,” January 14, 1972.

C.C. Wang's story may provide a clue for this puzzle. When the loan from the ADB was about to be allocated, the newly appointed chairman of CIECD Chiang Ching-kuo, son of Chiang Kai-Shek and his successor of the KMT government, announced the suspension of the elevated railway project and pointed out that an underground railway would be the only option for the improvement of the railroad in Taipei City. He also warned C.C. Wang: " Do not mention an elevated railroad anymore! [160]" The decision to suspend the project seemed to come from the top of the KMT government. Kao Yu-shu (高玉樹), the minister of transportation and communication at that time, elaborated in his oral history interview: " Suddenly, an order coming from the top asking that everything should be stopped. Finally, we realized that the Communists had built a subway line in Beijing[161], and someone reported it to the Old President (Chiang Kai-shek). The Old President said, 'If Communists can make it, we can make it, too!' and ordered an underground railway instead[162]. " Although I cannot find other evidence to verify Minister Kao's words, we can still find that the KMT government decided to build a subterranean railway in Taipei in the late 1970s, despite the advice of international consultants. Three years later, Chiang Ching-kuo personally asked C.C. Wang to study the subterranean railway option in Taipei[163] showing that the insistence of building an "underground" system came from the top of the regime. In sum, the elevated railway project in Taipei was not suspended but actually died in September 1970, and it is plausible that Chiang Kai-shek and his son killed the project, perhaps because of political competition with communist China. Japan's contribution to Taiwan's rail mass transportation technology was, in any event, delayed.

The Fate of the Tamsui Line

The death of the elevated railway project brought the issue of the Tamsui Line back into the picture because this branch railway line still occupied space in the crowded city, and its level crossings still blocked traffic flow. Moreover, the proposed resolution of these problems, elevated railways, was gone. Those advocating the demolition of the railway were heard again. As we saw in the previous section shows, the those who favored demolishing the railway appeared in 1968, and their voices became stronger after the

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[160] Academia Sinica, *Records of Interviews*, Pp. 59.

[161] This line was Line 1, Beijing Subway, which was completed in 1969.

[162] Lin, Chung-Sheng 林忠勝, *Memoirs of Kao Yu-Shu* 《高玉樹回憶錄》 (Taipei: Avanguard 前衛, 2007), Pp.182.

[163] Academia Sinica, *Records of Interviews*, Pp. 59-60.

elevated railway project was stopped for about one year. Facing people who clamored for removing the Tamsui Line, the TRA promised that it would establish a team to evaluate different options for the railway. The TPB, the professional transportation planning institute within the KTM government, took on the mission of evaluation of the Tamsui Line instead of the TRA.

While the TPB was studying whether to remove the branch railway, opponents began to lobby for keeping it. One legislator argued that the government should keep the Tamsui Line because the Provincial Government planned to rebuild Tamsui Harbor and the branch line would play an essential role in transporting freight[164]. The next January, Taiwan Provincial Council also suggested keeping the Tamsui Line because of the Provincial Government's Tamsui Harbor plan[165]. The plan to rebuild Tamsui Harbor did not materialize, but other reasons supported the existence of the Tamsui Line. In 1973, the executive secretary of the TPB, Fu Chia-chi, indicated that the Tamsui Line should not be demolished, and it should be a part of the future metro system of Taipei[166]. A transportation journalist also supported the existence of the Tamsui Line since Taipei City lacked buses to compensate for the demand fulfilled by the Tamsui Line[167]. We need to note Fu's opinion since his voice represented the TPB's viewpoint. The TPB, according to its study written by its international consultant, released its conclusion about the future of the Tamsui Line in the December of the same year suggesting that the Tamsui Line should be maintained for its irreplaceable commuting function and that it should be integrated into the future metro system[168].

However, Minister Kao and his colleagues in the Ministry of Transportation and Communication (MOTC) did not agree. On September 8, 1974, the United Daily News reported that the conclusion of the Tamsui Line's future made by the TPB did not satisfy the MOTC. The MOTC transferred this case to its technical office for review, and

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[164] The Economic Daily News. "The Tamsui Line, Law Maker Opposes to Demolish 台北淡水鐵路 立委認不宜拆除." *The Economic Daily News*, July 27, 1971.

[165] The Economic Daily News. "Port Authority of Keelung Plans to Build Tamsui Harbor 淡水建港基港局積極規劃中." *The Economic Daily News*, January 31, 1972.

[166] Wang, Chia-cheng 王家政. "Metro System for Taipei, Plan Sketched 台北地區捷運系統 有關單位畫出藍圖." *The United Daily News*, August 17, 1973.

[167] Wang, Chia-cheng. "The Tamsui Line Should Not be Demolished 淡水鐵路不能廢棄." *The United Daily News*, March 3, 1974.

[168] Wang, Chia-cheng. "The TPB Stands for Tamsui Line 運輸計劃會主張 保存淡水線鐵路." *The United Daily News*, December 19, 1973

concluded that removing the railway and building bus land on the same route would have the highest economic effect. In the December of the same year, Minister Kao said building a bus expressway to replace the Tamsui Line railway was an excellent idea[169]. Then, in January 1975, the TPB completed a confidential report providing the same conclusion that Minister Kao and the MOTC had arrived at: removing the railway and building bus expressway on its route. This report provides comprehensive studies of the area where the Tamsui Line passed, arguing that the railway had played an essential role in commuting between Tamsui, Beitou, Shilin, and downtown Taipei City. It agreed that if the government removed the railway, rebuilding a road on the route, the route would generate severe traffic congestion. But rebuilding it as a metro line or building an elevated or subterranean railway to solve level crossing problems would face major financial obstacles. Therefore, the report concluded, it was preferable to remove the railway and rebuild it as a bus-only expressway first and then, when the government had enough money, integrating the route into the future metro system would be the best choice[170].

There are two odd points about this report. First, the TPB concluded that it was preferable to keep the Tamsui Line in 1973, but the MOTC, the nominal upper level of the TPB, refused to accept this conclusion, asking its technical office to modify the study. Remember that the TPB was a professional institute supported by the SAFED and the CIECD so that its budget did not come from the MOTC. Furthermore, the committee members of the TPB included high ranking officials from other ministries and local governments. We should also note that Minister Kao was an exclusive member of the cabinet led by Chiang Ching-kuo because he was the only local Taiwanese without party membership of the KMT. Before Kao became the minister of transportation and communication, he defeated KMT's candidates twice in municipal elections in Taipei City, so he was a dissenting voice to the authoritarian KMT government. Second, no team member's name is given in the report, as was usually the case with such technical reports. According to United Daily News, the TPB hired an international consultant to write the report, but we cannot find any authors other than "the Transportation Planning Board" in the report. These two points strongly imply that was considerable disagreement between the TPB and the MOTC.

These internal conflicts meant that this report did not answer the question of whether the Tamsui Line should be demolished or not but rather fueled the conflict. In a

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[169] Wang, Chia-cheng. "Bus Rapid System on the Route of the Tamsui Line 淡水線鐵路原址 建公車捷運系統." *The United Daily News*, December 21, 1974.

[170] The Transportation Planning Board, *Tamsui Line Issue*.

symposium with officials and local leaders discussing the Tamsui Line and the report, many opposed the conclusion of the report arguing that the MOTC just wanted to demolish the railway and that integrating it into the future metro system was just an excuse to calm down its opponents. The TRA also opposed the conclusion and argued that if the central government's goal was to reform the Tamsui Line into a metro line, it was not necessary to demolish the railway; it should simply upgrade it in anticipation of a detailed plan[171]. Minister Kao reinforced his support for building a bus-only expressway on the Tamsui Line's route in an interview. He argued that it was the most economical solution for the Tamsui Line because the government did not have enough financial resources to build a metro system in Taipei before the completion of all Chiang Ching-kuo's "Ten Major Construction Projects[172]. However, the Taiwan Provincial Government mentioned that the Tamsui Line should be kept rather than removed even though it also mentioned that the plan of the Tamsui Harbor would not be continued[173]. Finally, at the end of 1975, C.C. Wang, as Minister Kao's deputy at that time, announced that the future of the Tamsui Line would be determined after a comprehensive transportation study for Taipei's mass transportation[174]. Thus the Tamsui Line escaped the fate of being demolished.

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[171] Wang, Chia-cheng. "The Tamsui Line Issue, MOTC Prepares Three Options 淡水線鐵路存廢問題 交部訂三個方案." *The United Daily News*, February 4, 1975.

[172] Wang, Chia-cheng. "Before the completion of "Ten Major Construction Projects, No Dealing with the Railways in Downtown 十項建設完成之前 暫不處理市區鐵路." *The United Daily News*, February 25, 1975.

[173] Wang, Chia-cheng. "Chief Hsieh: No Plan for Tamsui Harbor, Tamsui Line Remain 謝東閔主席昨天表示 淡水港暫時不擴建北淡鐵路仍維現狀." *The United Daily News*, May 23, 1975.

[174] Wang, Chia-cheng. "The Tamsui Line's Fate To Be Decided Next Year 淡水線鐵路存廢 明年底才能決定." *The United Daily News*, December 20, 1975.

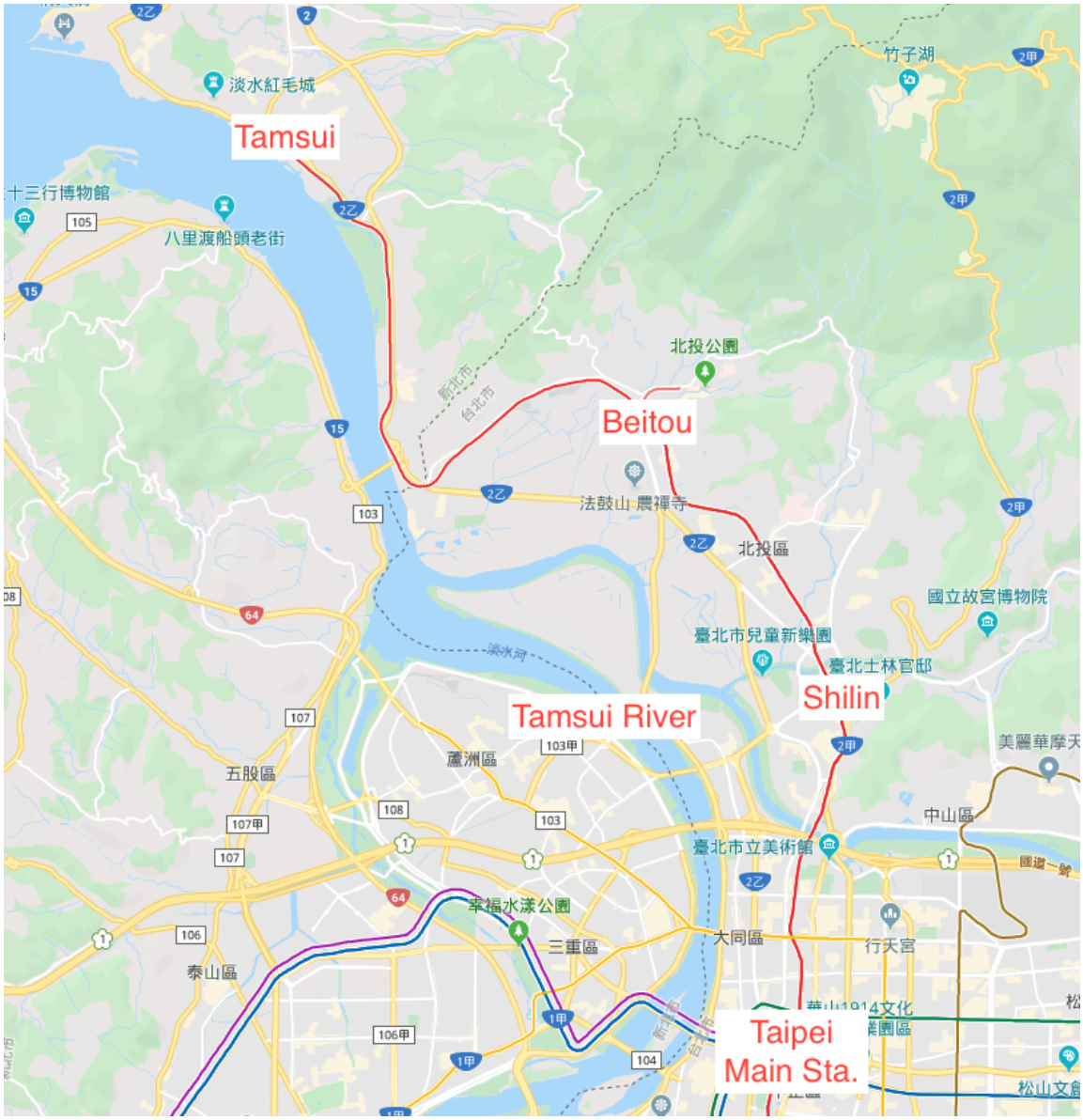

Figure 4.3: The Route of the Tamsui Line Railway[175]

[175] This map was made of the Red Line of the Taipei Metro, which is on the same route as the Tamsui Line railway.

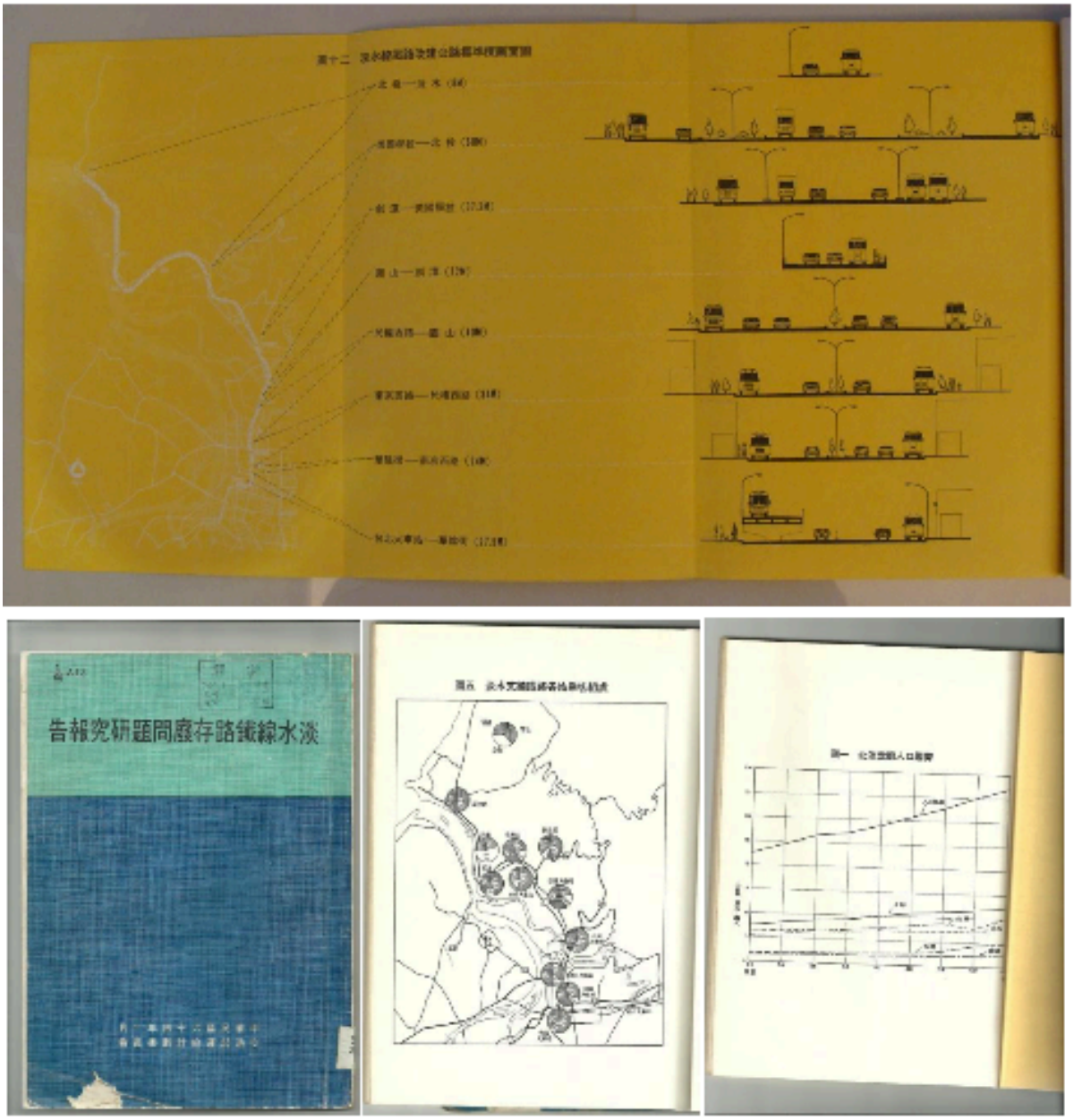

Figure 4.4: ***The Research Report for the Tamsui Line Issue***

In 1976, Minister Kao resigned as the minister of transportation and was assigned as the minister without a portfolio because of a train accident on the West Coast Line. This buried his idea of the bus-only expressway connecting Tamsui and Taipei in the archive. Some people think that Kao's idea of the bus-only expressway and its timing, 1976, was inspired by the completion of the first bus rapid transit (BRT) system in the world that opened in 1974, the Rede Integrada de Transporte (RIT) in Curitiba, Brazil. However, no evidence can prove this, though his idea of the bus-only expressway, according to the TPB's report, shares many similarities with the RIT, e.g. the independent right-of-the-road for buses and especially designed stations. Actually, Minister Kao never mentioned Curitiba when he stated his idea of the bus-only expressway. If his idea had

been implemented, this bus-only expressway might have been regarded as one of the pioneering BRT systems, as was Curitiba's RIT.

Like the death of the elevated railway project, the story of the Tamsui Line shows how politics interacting with the making of knowledge of the city influenced the planning for mass transportation in Taipei. Minister Kao's unusual political situation and the TPB's semiautonomous status decided the fate of the Tamsui Line. Minister Kao once had a chance to realize his innovation in the local context by combining the TPB's ability of knowledge-making and the MOTC's administrative power. However, as a dissenting voice within an authoritarian government, his action undoubtedly faced stiff challenges from his colleagues who were trusted by top people in the government, ensuring its failure. Furthermore, the Tamsui Line was integrated into a broader picture of Taipei's, even of Taiwan's, future mass transportation development, as C.C. Wang revealed: it involved solving more than mere level crossing problems. The TPB and the technical officials like C.C. Wang aimed at not only building a subterranean railway to satisfy Chiang Kai-shek and his son's political ambition but also planning the whole mass transportation system of Taipei Metropolitan so that they could change the city, the country, and the way how they managed and governed the accidental island state.

Figure 4.5: The Tamsui Line Railway in the 1980s[176]

"Underground" Suspended Simultaneously

It was not only Minister Kao's innovative bus-only expressway that faced a setback, but also the subterranean railway project in Taipei City, even though the top of the KMT government pushed it. The death of the elevated railway project in Taipei City meant the birth of the subterranean railway project, and the timing of both the death and the birth coincidentally happened when, in the early 1970s, U.S.-Taiwan relations began to decline. In January 1972, a meeting of the TRA suggested that the minister of transportation, Minister Kao's predecessor, ordered that the railways in Taipei City should be underground, and a feasibility study should be the first step. Although the minister requested the TRA to take responsibility for this project and to hire experienced consultants, the TRA thought the TPB might be more suitable for the project since this project seemed too big and complicated for the TRA. The meeting also mentioned, as Chapter 2 shows, that the deputy of the CIECD, Fei Hua, wrote a letter from Tokyo

176 國立臺灣大學數位人文研究中心。「新版國家文化資料庫 。」2010。http://doi.org/10.6681/NTURCDH.DB_NRCH/Collection.

mentioning that he had discussed the issue of a possible project for building the underground railway with the famous Taiwanese Japanese architect, Kaku Morin (郭 茂林, Kuo Mao-lin in Chinese). Kaku did provide not only his professional opinions to Fei but also introduced a Japanese expert to Fei for consulting on the underground project and the future metro system[177]. Furthermore, the MOTC then asked the CIECD to ask the West German government to recommend suitable consultants to studied the subterranean railways in Taipei[178]. As I argued earlier, Taiwanese technical officials' series of actions indicate a determination to pursue technological autonomy.

The government remained engaged. Like the elevated railway project, C.C. Wang formed an ad hoc group (abbreviated as the subterranean railway group) whose members included C.C. Wang himself, Prof. Yeh, an international consultant from the American company Nathan & Associates, the executive secretary of the TPB, Fu Chia-chi, and officials from the MOTC and the TRA to study the subterranean railway project in 1972. The first meeting confirmed the conclusion that the CIECD needed to ask the BRD government to recommend German experts from among the consultants supported by the Deutsche Bahn —Deutsche Eisenbahn Consulting (DEC) — because the DEC was joining the project for the electrification of Taiwan's West Coast Line railway and had experience in building a subterranean railway[179]. Initially, Deputy Fei agreed to send a letter to ask West Germany[180]. However, only three days after the first meeting of the subterranean railway group, he told the MOTC that it should hire experienced consultants on its own rather than ask the CIECD for help[181].

Why did Deputy Fei and the CIECD change their minds suddenly? The CIECD's following document to the MOTC suggests a possible answer. In June 1972, the CIECD sent a document to the MOTC mentioning that it had received a letter from the Japanese consultant, Pacific Consultants International (パシフィックコンサルタンツ株式会社, PCI), and that PCI had the experience of consulting Tokyo, Osaka, and other cities' subway

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[177] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," Jan 29, 1972.

[178] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," May 15, 1972.

[179] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

[180] National Archives 國家檔案閱覽中心, "The Subterranean Railway in Taipei City Feasibility Study 為台北市地下鐵路初步可行性研究事希知照洽辦由.", May 15,1972.

[181] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

projects so that it believed that the PCI could be an excellent choice as consultant on the subterranean railway project. Thus, the CIECD recommended the MOTC to let the PCI compete for the business of consulting on the project[182]. Although many other consultants put in requests, including companies from the UK, Belgium, and the U.S., according to the archives, the CIECD did not recommend them as it did the PCI[183]. Therefore, I firmly believe that the CIECD or at least Deputy Fei himself preferred the Japanese company to consult on the project, especially when we realize Deputy Fei's connection in Japan.

That being said, C.C. Wang's subterranean railway group did not accept the CIECD's recommendation. The group hired six committees to review the companies joining the bidding, and they concluded that the American company Parsons & Brinckerhoff (P&B) was the best among the international consultants[184].

P&B's victory seems to signal a reinforcement of the American hegemony of mass transportation technology. However, Deputy Fei's actions and the fact that the TRA hired the German firm DEC as consultant on its projects later is significant. Taiwanese technical officials started to introduce alternative resources for their making of knowledge and even for practical projects rather than follow their American advisors as they used to do before 1972 when the KMT government started to face its diplomatic setbacks. Furthermore, when the technical officials of the Taipei City Government and a journalist saw the P&B's report, they complained that the P&B did not understand Taipei City's environment, and their opinion appeared in a national newspaper. The China Engineering Consultants Incorporated (CECI, 中華顧問工程司), the cooperator of the project and the consultants founded by the MOTC, asked the TRA to clarify and to defend the P&B's project[185]. This story shows that Taiwanese technical officials had doubts about the American consultants and the confidence to challenge them. Finally, although the P&B completed its study, providing a plan to build a 5km underground railway for the West Coast Line and a 3km one for the Tamsui Line in November 1974, the KMT government dropped it for financial

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[182] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

[183] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

[184] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

[185] National Archives 國家檔案閱覽中心, "Sending the P&B's Study of the Subterranean Railway in Taipei City 檢送「美派森斯公司研究台北市區鐵路地下化報告」一份," November 16, 1974.

reasons[186]. The improvement of Taipei's railways remained the same, and the subterranean railway project, like the Tamsui Line issue, needed a total solution to be implemented and to be changed. This solution had to be much bigger than an engineering plan.

Carter, Mass Transportation, and the Deutsche Bahn

Planning Made by Taiwanese Only

In February 1973, the American consultant of the TPB suggested that Taipei City Government initiate a comprehensive study of the transportation system in Taipei Metropolitan. After receiving the suggestion, Taipei City Government thought that the development of the city progressed while it had no solid transportation plan, so Taipei City Government expressed its will to take on planning jobs and asked the MOTC to provide resources to assist it. Taipei City Government estimated the study would cost about NTD24,000,000 (about 6,000,000 US dollars according to the currency rate at that time) for two years (1974 and 1975), and it hoped that the CIECD, the MOTC, and the City Government could share the cost evenly so that the three institutes would spend 4 million NTD (about 100,000 US dollars at that time) in 1974. The MOTC and the CIECD accepted Taipei's request for financial support, but the CIECD thought "Taipei Metropolitan" included not only Taipei City but also Taipei County[187] and other local governments under Taiwan Provincial Government so that Taipei City alone could not deal with such an integrating work. Thus, the CIECD recommended the MOTC and the TPB to be in charge of this mission, and it also suggested that the TPB applying for funding from the SAFED[188].

In September 1974, the MOTC and the TPB applied for funds from SAFED and the newly reformed succeeding institute of the CIECD, the Economic Planning Council (EPC). The first lines of the application cited Chiang Ching-kuo's words in a meeting of the Executive Yuan in April 1974: "On transportation, the main mission is to develop mass transportation……this is an urgent job, and the MOTC should take action immediately." Then, it mentioned that the number of automobiles increased with the growth of income in Taiwan so that the disfunction of car-centric transportation was already leading to

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[186] Academia Sinica, *Records of Interviews*, Pp. 60.

[187] Now New Taipei City.

[188] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

pollution in cities. Furthermore, this situation also wasted much land and energy, and both land and energy were rare in Taiwan. Therefore, Taiwan needed to develop mass transportation to replace cars[189].

The transportation planning project included transportation networks in the metropolitan area, an analysis of urban development, transportation data analysis, long-term plan studies, and transportation system evaluation. The terrain covered included Taipei City, Taipei County, Keelung City, Yilan County, Taoyuan County, and parts of Hsinchu County, meaning that about one-third of Taiwan would be studied. The SAFED and the EPC approved the application and provided the funding as the TPB asked. The project, unlike similar projects earlier, did not hire any international consultant to help with the research process or provide education training although one document mentioned that the TPB might budget for international advisors if necessary in the future; instead, the EPC and the TPB decided to do the research and planning with technical officials and local experts.

In August 1975, the Chinese Institute of Engineering held a conference on urban construction, whose content related to mass transportation planning. The draft of the proposal of the project of the mass transportation planning for Taipei Metropolitan attracted the Executive Yuan's attention. In the same month, the publishers went to the Executive Yuan to present their works to the vice-premier. The vice-premier ordered the EPC and the TPB to operate the project by following the works presented by the local experts. Again, as C.C. Wang did previously, the TPB formed an inter-ministerial group for the project of mass transportation planning for Taipei Metropolitan (abbreviated as the mass transportation group) including members from different but related ministry and local governments. The executive secretary of the TPB at that time, Huang Chia-he (黃嘉禾) was the convener of the group. In one meeting of the mass transportation group, Huang encouraged members of the group to join the researches and planning or to deploy other technical officials to the project[190]. No one mentioned hiring international advisors in this massive planning project, revealing the confidence of the technical officials and Taiwanese experts.

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[189] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

[190] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

Figure 4.6: The Range of the Mass Transportation Planning for Taipei Metropolitan[191]

Besides technical officials within the government, the mass transportation group also contracted with local consultants to run sub-projects. For example, the state-owned CECI got the contract to analyze Taipei's urban development, one local consultant was in charge of studying transportation fee rates, and newly founded MAA (亞新工程顧問公司) was in charge of studying new mass transportation system at that time[192]. Although no document reveals that the EPC, the TPB, or the whole KMT government intentionally used only technical officials and local Taiwanese experts to do the massive and decisive

[191] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

[192] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

transportation planning projects, no evidence shows any international advisor or consulting company involved in this project before 1977. In the meeting records of the mass transportation group, we do not see any international advisor appear even though an American advisor in the TPB bolstered the project. Therefore, I think that the technical officials and political leaders intentionally did not invite international experts into the large scale transportation planning project. My informant, who started to work for the SAFED and the CEPD in 1979, may verify my argument. He mentions that the TPB and some local experts believed that they could complete the project without any assistance from international consultants so that the TPB did not hire any international advisor for the project. However, even the technical officials in the TPB knew that the outcome was not satisfactory, so they had no choice but to invite foreigners back[193]. In the era when the KMT government was losing its ground in the international system, Taiwanese political leaders and technical officials tried to use only local experts to plan Taipei's mass transportation system pursuing autonomy. However, they had no choice but to turn to international consultants again. Interestingly, they were not American.

The Return of the PCI and the DEC

In early 1977, the TPB started to negotiate with the German DEC about sending advisors to Taiwan to help the Taipei Area Mass Transportation System Planning Studies, and, in February, after several negotiations, the DEC agreed to deploy three experts to Taiwan[194]. In the document asking the EPC and the Executive Yuan to agree with the plan, the TPB stated that "the Taipei metropolitan mass transportation system studies involve many complicated factors on a massive scale so that asking international advisors to help in proper timing would be a good option……We do not have anyone with experience of planning, designing, and constructing a mass transit system, so we need to hire international consultants and their experience."

On April 18th, the three German advisors, Horst Weigelt, Alfred Wild, and Dietrich Lehnert, started their works with Taiwanese technical officials[195]. Horst Weigelt was the most senior member of the consulting team, and he was the head of the department for

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[193] The interview of the TP03.

[194] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

[195] Transportation Planning Board 運輸計畫委員會, *Final Comment Report of Taipei Area Mass Transit System Planning Work Program.* (Taipei: Transportation Planning Board 交通運輸計畫委員會, 1977), Pp. 1.

the new rapid railway in Hamburg with special expertise of mass transit systems, new transport systems for city and long-distance traffic, and system engineering for transport and rapid transit planning. Alfred Wild was a project manager for the management assessment of research for the mass transit system. The leader of the team, Dr.-Ing. Dietrich Lehnert was a technical expert for the planning, design, and reconstruction of mass transit systems, railway stations, sidings, and the marshaling yards at the DEC. Each of the advisors worked in Taiwan for about one or one and a half person-months, so they did not do the study from zero but provided turn keys to help Taiwanese technical officials reach reliable and satisfying conclusions and plans for Taipei's future mass transportation systems. The German consultants helped the TPB to generate some solid suggestions for the mass transportation system planning, including building a metro system and rebuilding the railways on the same routes. In the beginning, the German consultants preferred an elevated railway[196], but they finally listed all recommended options for the Taiwanese government to choose from[197].

German consultants brought many vital ideas and planning philosophies into Taiwan despite their short period of service. First of all, they strictly criticized the American model of urban and transportation planning. *Final Comment Report of Taipei Area Mass Transit System Planning Work Program* states, "transportation academia and urban planning experts all agree that it is impossible to match the increasing demand for road and parking space in cities without destroying urban life functions and the city's features. Los Angles and Detroit were mobilized in their early years. Their mobile-centered policy has already proved to be a total failure, and the consequence is silence in the city center after dark, the extension of residential areas to suburbia, and the waste of precious land resources for building roads[198]." Compared with the words in the UHDC period, they suggested that American cities were no longer worth learning about since they had failed socially. Although Taiwanese engineers and technical officials still used the research methods learned from American advisors in the institute, which was founded with American resources and suggestions, they turned to follow Germany's ideas and philosophy of how to build a mass transportation system in a city. We can also find that

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[196] The Transportation Planning Board, *Comments on Taipei Area Mass Transit System Planning Work Program.* (Taipei: Transportation Planning Board 交通運輸計畫委員會, 1977), Pp. 4-7.

[197] The Transportation Planning Board, *Final Comment*, Pp. 215.

[198] The Transportation Planning Board, *Comments on Taipei Area*, Pp. 7.

the DEC brought the concept of a “Central Station” or “Transportation Center”[199] to the TPB so that they could plan to reconstruct the Taipei Main Station into a center of urban transportation for the whole metropolitan area. Also, a commuter railway, transforming the existing railways into a metro-like transit system instead of building an independent metro system, was another new concept brought by the DEC. Therefore the DEC strongly suggested not removing existing railways but building a detour instead[200]. These two concepts, or designs in practice, are commonplace in Germany, even the whole of Europe. Moreover, with the assistance of the German advisors, the TPB got the first recommended network for Taipei’s future metro system, and we see that it brings in the concepts of “central station” and “commuter railway as a part of the metro system” for two apparent features (see Figure 3.7). First, most of the metro lines would reach the Taipei Main Station. Second, the east-west purple line with the mark of “S1” refers to the West Coast Line, and the north-south purple line refers to the Tamsui Line with the mark of “U1”. The purple lines mean the metro lines would open during 1982 and 1987, and “S1” and “U2” mean S-Bahn and U-Bahn[201]. Therefore, the DEC not only planned to integrated the Tamsui Line into the future metro system but also planned to rebuild the West Coast Line as the “S-Bahn” in Taipei as a part of the metro system.

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[199] The Transportation Planning Board, *Comments on Taipei Area*, Pp. 8.

[200] The Transportation Planning Board, *Comments on Taipei Area*,, at Pp. 3.

[201] In German, Stadtschnellbahn, S-Bahn, means “rapid urban railway,” and Untergrundbahn, U-Bahn, means “underground railway.” However, when British consultants planned the Taipei Metro, they regarded the “S” as “suburban” so that this line was called “suburban line” in the 1980s.

Figure 4.7: The metro network recommended by the DEC[202]

Two things need to be noted. First, although their service was brief, the requirement of hiring the German advisors was submitted to not only the minister of the EPC but also the prime minister and the highest leader of the country de facto at that time, Chiang Ching-kuo[203] revealing hiring German advisors to deal with Taipei's mass

[202] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

[203] Chiang Kai-shek died in 1975, and his vice president Yen Chia-kan succeed the presidency. However, Chiang Ching-kuo was the president of the KMT after Chiang Kai-shek died instead of Yen, and Chiang Kai-shek already arranged him as his successor in the last years of his life. Therefore, when President Yen's term ended in 1978, Chiang Ching-kuo "naturally" became the next president of Taiwan.

transportation was an important issue. Second, the archives show that the short-term service cost the KMT about 2 million NTD (about 115,000 West Deutsche Mark)[204] meaning this service occupied almost 10% of the enormous two-year-long study project. The price also shows the importance of the German advisors in the whole project and how difficult it was for the TPB researchers to work alone. If the technical officials were not confronted with tough challenges in their studies, they would not have needed to ask the most senior member of the government, Chiang Ching-kuo, to spend such a big budget on hiring the advisors who would work in Taiwan less than two months.

Besides the DEC, the TPB and the TRA also hired the Japanese consulting company, the PCI, to study the elevated railway in Taipei City at the same time. In this study, the PCI was asked to help the TPB to evaluate the most suitable height of the elevated railway, concluding that 15 meters would be the answer. Before the PCI came to Taiwan, the DEC already suggested that 15 meters would be the best choice for the elevated railway[205], so the TPB hired the PCI was to check whether the DEC's conclusion was right or not. The TPB further invited advisors from both the DEC and PCI to work together to write *The Improvement of the Railways in Downtown Taipei Report* revealing the Taiwanese technical officials' supervising strategies despite their weaker profession of transportation planning.

In a meeting in 1978, the TRA and two deputy ministers of transportation did not agree with the PCI's conclusion that 15 meters would be the best choice, and they also questioned the idea of an elevated railway. The chairman of the organizing body, the CECI, even suggested ending the study, and the minister of transportation agreed[206]. In addition to this opposition in this meeting, the Department of Defense vehemently opposed building 15-meter-high elevated railways in Taipei City because it thought the high-level elevated railway could cause massive damage if the PLA bombarded it. Thus, the DoD strongly recommended building a detouring railway instead of improving the existing railways[207]. The TRA presented a document depicting the opposition to the elevated railway in detail, stressing the difficulty for arranging the flow of trains and effects on its freight business. However, the TRA also opposed the project of the subterranean

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[204] Academia Sinica Archive 中央研究院近代史檔案館, "CIECD Central File" 行政院國際經濟合作發展委員會, 36-10-001-071.

[205] The Transportation Planning Board, *Comments on Taipei Area*, Pp. 6.

[206] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," August 2, 1978.

[207] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," August 15, 1978.

railway for the same reasons and suggested leaving railways on the ground, solving level crossing problems by building a separate intercross[208]. K.T. Li, who was minister without a portfolio at that time, also stated the PCI's study could not gain general consent among all officials, but he also expressed his opposition toward the MOTC's suggestion of building a detouring railway. K.T. Li wisely understood that the conflict was not going to solved easily in such a chaotic atmosphere. So, he said: "We already decided to hire international consultants to do more studies so that I hope relevant agencies can take an objective attitude toward different options letting experts do their job and can listen to experts' opinions discussing with economic and technical perspectives. On the final decision, the CEPD or higher level will conclude taking political factors into consideration[209]."

Within the KMT government, which was an authoritarian regime at that time, who was higher than K.T. Li, who had been minister of finance, minister of the economy, and was a powerful minister without a portfolio? There must have been very few. In this sense, the top of the KMT government might not want to reproduce an American hegemony of transportation technology again, even though they needed to hire international consultants for help, because the U.S. seemed not to be trustworthy. Therefore, using German and Japanese consultants could be seen as a strategy to maintain Taiwan's autonomy while building its mass transportation systems.

The DEC's total Victory

On October 5, 1978, the prime minister, Sun Yun-suan, held a meeting in the Executive Yuan to discuss the railway issue in Taipei. The meeting concluded that the MOTC would hire experienced consultants to do further studies and that the consultants needed to evaluate the three possible options: the elevated railway on the same route, the subterranean railway on the same route, and the detour railway[210]. Although the Council for Economic Planning and Development (CEPD), which was reformed from the EPC in 1977, and the Executive Yuan's document did not directly reveal the "consultants" as being the DEC, the terms of reference for the consultant which was passed from the MOTC to the CEPD was for the DEC. The DEC would cooperate with the state-owned

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[208] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," August 18, 1978.

[209] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," September 27, 1978.

[210] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," October 14, 1978.

local consultants CECI[211]. However, Fu Chia-chi, who was the counselor of the CEPD, passed a note to C.C. Wang, who was the deputy minister of the CEPD, pointing out that the MOTC and the TPB seemed to consider the subterranean railway the best option if there was no serious technical problem. Moreover, the CEPD would not express any opinion if the MOTC insisted so[212]. Before the DEC and CECI presented their final report of the evaluation of the three options, they completed the technical feasibility study for the subterranean railway in Taipei concluding that there was no technical problem that could not be overcome i.e. the subterranean railway was the best choice[213]. Therefore, although the top-level leaders like Prime Minister Sun, and the minister of the CEPD, Yu Kuo-hwa (俞國華), opened a discussion space for the three options, in fact, top leaders and the high-level technical officials already preferred the option of the subterranean railway on the same route although it was the most expensive option. Two months later, the DEC presented *the Evaluation Study of Railway Improvement Projects in Taipei City*, recommending the option of the subterranean railway on the same route. This report also suggests making extensive for the West Coast Line in the whole Taipei Metropolitan, rebuilding the Tamsui Line as the first section of the future metro system, and starting the plan of Taipei's metro system[214]. Although many citizens sent their opinions opposing the subterranean railway, on July 19, 1979, the Executive Yuan approved the project of the subterranean railway.

The KMT government did not easily accept the DEC's plan before it decided to choose the underground option; instead, it took a series of actions to review and to check the DEC's studies. First, as the TPB did in 1977, C.C. Wang asked the Chinese Institute of Engineering to invite a Japanese railway expert, Yukawa Ryuji(湯川　龍二), to visit Taipei and to review the DEC's on-going study[215]. Moreover, the MOTC also launched a comparative study of the DEC's plan and the P&B's plan in April showing the KMT government's attitude of not totally relying on the DEC. Finally, the Executive Yuan chose the DEC's plan, and then, the MOTC hired the DEC as the consultants for the project. The

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[211] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," November 23, 1978.

[212] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," January 26, 1979.

[213] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," April 9, 1979.

[214] The Deutsche Eisenbahn Consulting GMBH and the China Engineering Consultants, Inc. *Evaluation Study of Railway Improvement Projects in Taipei City.* (Taipei: Transportation Planning Board 交通運輸計畫委員會, 1979), Pp. 5.

[215] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," May 22, 1979.

KMT government had a chance to introduce an American model for its railway in the capital city, but it decide not to do so.

Furthermore, just one month before the Executive Yuan approved the DEC's plan, the American consultants, the De Leuw Cather International, wrote a letter to C.C. Wang expressing their will to join the subterranean railway project. C.C. Wang only passed the letter to the deputy minister of transportation taking no further actions. We should note that 1979 was the year when President Carter announced the end of formal diplomatic relations between the U.S. and the R.O.C. and of the Mutual Defense Treaty along with the normalization of the Sino-American relationship, putting the KMT government in an even more critical plight. Though some in the Carter administration were concerned with preserving important US ties with Taiwan after normalization with China, Carter seemed contemptuous of congressional backers of Taiwan[216]. Furthermore, there was not only the decline of diplomatic relations but also of technical assistance and cooperation. In September 1978, the Embassy of the United States in Taipei told the KMT government to terminate all technical and economic cooperation programs based on the Sino-American Economic Aid Agreement, including the JCRR and the SAFED[217]. The KMT government reformed the JRCC as the Council of Agriculture in 1979 when the U.S. terminated the formal diplomatic relations with the R.O.C., meaning that that there would be no official technical cooperation with the U.S. on agriculture anymore. Nonetheless, the CEPD cited a clause in the Sino-American Economic Aid Agreement to refuse to terminate the SAFED, continuing its operation in 1979[218]. In defiance, the KMT did not return the SAFED's money but continued with its projects, and integrated the SAFED into its regular budget system. Although the CEPD and the SAFED were still key institutes to determine vital technical and economic programs, the semi-autonomous institute derived from U.S. Aid started to lose its special status.

This was the low-point of the U.S.-Taiwan relationship, meaning that the U.S. government could not push the Taiwanese government to accept all of their demands, and the Taiwanese government would have space to turn down American bids. In the case of electrification of the West Coast Line[219] and the later Taipei Metro, we see that the

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[216] Sutter, *US-China Relations,* Pp. 74.

[217] National Archives 國家檔案閱覽中心, " The Agreement of the SAFED and the Management Committee 中美基金協定及管理委員會," October 9, 1978.

[218] National Archives 國家檔案閱覽中心, " The Agreement of the SAFED and the Management Committee 中美基金協定及管理委員會," March 10, 1981.

[219] Chang, "Constructing the Taipei Metro Muzha Line," Pp. 191.

U.S. government pressured the KMT government to let American companies get business. This kind of situation did not happen in 1979. Although the 1970s was a massive setback for Taiwan's diplomacy, it also created a space for Taiwanese technical officials to import more diverse knowledge and technology for their future rail mass transportation system. For the Taiwanese government, the 1970s was a time to run their flexible transnational technology strategy. From the perspective of American hegemony in science and technology, the Taiwanese resisted the American model and assistance, seeking alternative resources from Germany and Japan when its relationship with the U.S. turned sour. The interactions of international politics, conflicts within the KMT government, different types of knowledge-making, and practical technological studies determined the DEC's total victory and, finally, the destiny of the Tamsui Line and the West Coast Line in Taipei.

The TRUPO

In 1980, the Chair of Taiwan Provincial Government invited the commander of the R.O.C. Army and General Tung Ping (董萍), the president of the Chung Cheng Institute of Technology, which was a military school belonging to the Ministry of National Defense (MND), to his house for dinner. Although General Tung did not know the chair, he still accepted the chair's invitation. After the dinner, the Chief of General Staff informed General Tung that the Chair of Taiwan Provincial Government hoped that he would be the Director-general of the TRA. The MND had already agreed this assignment, reporting it to President Chiang Ching-kuo. General Tung answered, "I have no personal opinion but to follow the order." So, he terminated his four-decade-long career as a military officer who had experienced the bloody war against imperial Japan and the severe China Civil War starting his service in a transportation agency[220]. Almost at the same time, the Executive Yuan established the Preparatory Engineering Office of the Taipei Underground Railway Project co-working with the TPB, and General Tung held the concurrent post of the chief of the Office as the Director-general of the TRA.

Besides the project of the subterranean railway in Taipei City, the TRA also had the project of the improvement of the East Coast Line, that needed to deal with the mountainous terrain that the railway would pass through. Therefore, General Tung asked the DEC, the general consultants of the subterranean railway project, to provide advice to the TRA. The German experts suggested that General Tung invite Austrian experts to join

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[220] Tung, Ping 董萍, *Going Through the Key Age: from Fighting Wars to Dedicating to Construction* 走過關鍵年代：兵馬倥傯到投身建設 (New Taipei: Tung Ping,1998), Pp.91.

the project because Austria had a similar environment for its railway and had a rich experience of building tunnels for railways. Finally, with the assistance of German and Austrian experts, the improvement of the East Coast Line was completed in 1982. General Tung rode on the first train after the completion of the project, enjoying the first achievement of his service in a transportation agency. However, General Tung experienced a heart attack at the end of 1982, almost losing his life. After he recovered in the spring in 1983, he presented his reassignment to Li Teng-hui (李登輝), the Chair of Taiwan Provincial Government at that time, and the next president of Taiwan, and Chair Li agreed. However, the Preparatory Engineering Office of the Taipei Underground Railway Project was reformed as the Engineering Office of the Taipei Railway Underground Project (TRUPO) to deal with the implementation of the subterranean railway, so General Tung accepted the minister of transportation's invitation and kept serving as the chief of the TRUPO. At the same time, he quit the Director-general of the TRA. Six years later, the "underground," including the fourth generation Taipei Main Station was completed, and General Tung could enjoy another significant achievement of his civil service.

From 1980 to 1989, General Tung experienced the most critical period of the subterranean railway in Taipei. It was not only because the subterranean railway finally became real but also because the TURPO, the DEC, other international consultants, and other Taiwanese officials shaped the railway into a technological system with a hybrid style leading to the stations and underground tunnels having designs derived from Germany, Japan, Britain, and America.

The Taipei "Hauptbahnhof"

When the DEC studied Taipei's Metropolitan's mass transportation systems, it already brought the idea of the central station, or "Hauptbahnhof" meaning "main railway station" in German, into Taiwan, and, the Taipei Main Station would be the result. In fact, the English translation of the station, Taipei Main Station, already reveals this idea, and Taiwanese technical officials also used "central station" to refer to the future Taipei Main Station. When the project went into the design stage, the DEC implemented the idea by setting the specs of the future Taipei Main Station. The DEC produced a volume describing the TMS (Taipei Main Station) planning principles that show how it designed the new station. First, because the DEC thought that the space available for the new TMS, its building, plaza, and other necessary facilities, was minimal due to the existing and planned future roads, and buildings, the planning of the new TMS had to be made with utmost care to make optimal use of the limited space available for necessary

functional areas. The DEC also mentioned that the new TMS should be given a logical, clear and clean design as an integrated transportation center so that the station would serve not only the railway but also the future metro system and other transportation systems and that the passengers of different means of transportation would not collide with each other. The passengers of the railway and the metro system would also interchange inside the station.

The site chosen for the station was on a stretch of earth above a submerged body of water that could disturb the station and tunnel structure. The DEC recommended using additional concrete to overcome its troublesome effects rather than building a higher station on stilts. The DEC did not want the station itself to attract too many people causing congestion. Thus, the DEC and the TRUPO-TPB team designed the new Taipei Main Station with three floors on the ground and three underground floors. Moreover, the DEC and the TURPO also designed the new station with a Chinese Palace appearance to be a landmark for the city[221].

[221] National Archives 國家檔案閱覽中心, “Subterranean Railway 地下鐵,” October 11, 1984.

Figure 4.8: The DEC's conceptual design of the Taipei Main Station[222].

The idea of pouring concrete rather than building a higher station caused many concerns for the Taiwanese officials because it would cost more money without generating any future income or business benefit. Thus the idea of building the Taipei Main Station with a high-level architecture rose. Facing the concerns, the TRUPO hired the CECI to study the possibility of building a higher station. As General Tung stated to the Executive Yuan, the CECI's study supported the DEC's idea, concluding that building a high-level station would cost more than it would earn. However, it recommended building a high-level building near the station to exploit the land's value[223] Despite the CECI's study and the DEC's additional explanation[224], the Prime Minister Sun asked the TRUPO to consider building a seven-story station instead of pouring concrete beneath the station to overcome disturbances caused by underground body of water[225]. The TRA

[222] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," October 11, 1984. The Chinese sentence under the picture means "original plan: taking Chinese roof with glazed tile and caisson ceiling, a pure Chinese style architecture.

[223] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," November 14, 1984.

[224] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," October 11, 1984.

[225] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," October 18, 1984.

also suggested moving its headquarters into the new station so that the land of its old center could be developed for business use, and it was willing to pay 900,000,000 NTD for building an additional four floors[226]. Fu Chia-chi, the counselor of the CEPD, even mentioned a possible option of building a 20-story or higher station to exploit the value of the land in downtown despite his doubts about the idea[227]. At the same time, the "Taipei Mass Rapid Transit Group (TMRT)" which was planning the Taipei Metro with the British Mass Transit Consultants (BMTC) also opposed the DEC's design. First, the BMTC said that the design with three levels underground would cause for pedestrian traffic and had the added inconvenience of transferring to the metro system [228] although the Prime Minister Sun asked the TURPO if it was possible to build three levels underground reduce the budget[229]. Second, the BMTC and the TMRT believed that mass transportation systems should be highly integrated with the city's business development rather than merely providing transportation service. The Japanese and American experts asked for advice also did not buy into the DEC's design[230].

After the TRUPO and the DEC negotiated with the TMRT and the BMTC on the underground issue, the BMTC successfully persuaded the DEC that the Taipei Main Station would have four levels underground for railways and metro's platforms and a concourse level[231]. Moreover, t Prime Minister Sun finally determined that the new Taipei Main Station would be a seven-story building with four floors underground, and the TRA would move into the station building[232]. Nonetheless, the TRUPO cut one floor off causing the Taipei Main Station to end up as a six-story central station with four floors underground due to the DEC's strong insistence[233].

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[226] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," November 20, 1984.

[227] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," November 14, 1984.

[228] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," November 14, 1984.

[229] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," October 18, 1984.

[230] The interview with TP03.

[231] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," November 14, 1984.

[232] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," December 15, 1984.

[233] The interview with TP03; Huang, Ling-Ming 黃令名 "The Awkward Rail Toward 'Modern': Interpretative Flexibility of Taipei MRT and MRT Technology as a Form of Life 通往「現代」的曲折軌道：臺北捷運的詮釋彈性與科技生活形式" in *Taiwanese Journal for Studies of Science, Technology and Medicine*, No.22 (2016): Pp. 39.

Thus did the Taiwanese get the first underground station ever in Taiwan with a broad plaza, a vast lobby, limited business facilities, and six floors above ground. Because of the decision to build only a six-story station, the TURPO had no choice but to pour tons of concrete to stabilize the station preventing it from water damage[234]. However, as we will see in the next chapter, the Taipei City Government finally built two Japanese style underground cities with the Taiwanese Japanese architect Kaku Molin's design and two American style underground malls thanks to the American metro consultants' advice, leading to many business activities attracting many people aiming at neither riding trains nor using the Taipei Metro. One surprising thing is that Taipei City is still waiting for the high-level building near the Taipei Main Station today even though Taipei City Government followed the CECI's recommendation and planned a space for it[235]. The station finally was the product of the negotiation between German ideas for a station and other rival concepts. It shows how an artifact can have a technological style that is generated by integrating different ideas and styles which may conflict with each other.

Figure 4.9: The lobby of the Taipei Main Station

[234] The interview with the TP03.

[235] The location for the planned high-level building is the Taipei Main Station of Taoyuan Metro which is the station of the metro line connecting the Taoyuan International Airport and downtown Taipei City. The station and the metro line opened in 2017, and it is about 300m from the TRA Taipei Main Station. Taipei City Government opened bids to invite companies to build the high-level building above the metro station, but it failed several times due to corruption, business fraud, and national security issue caused by Chinese capital.

Figure 4.10: The appearance of the Taipei Main Station[236]

S-Bahn, or Not

In October 1983, the TMRT and the BMTC completed the study report of the Taipei Metro. Their studies inherited the DEC's study of Taipei Area's mass transportation system, including the idea of the S1 Line. The TMRT and the BMTC recommended a metro network which was based on the DEC's study[237], and it integrated the subterranean railway as the Blue Line of the system naming it "S Line," referring to "suburban line." However, the BMTC was very skeptical of the DEC's "track sharing strategy," meaning that the intercity trains, freight trains, and the metro trains all used the same tracks. In contrast, it suggested that the Taiwanese government build two tunnels for four tracks so that the S Line would not interrupt intercity trains and freight trains[238]. As we may see in many cases in the U.K. or in those that used British consultants like Hong Kong's MTR

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236 "臺北車站-維基百科，自由的百科全書" https://zh.wikipedia.org/wiki/臺北車站. Accessed on October 28, 2019.

237 The Transportation Planning Board, *The Comprehensive Report of the Metro Plan for Taipei Metropolitan* 臺北都會區大眾捷運系統計畫綜合報告 (1983): Pp. 19-20, and Pp. 43-44.

238 National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," February 12, 1984.

(Mass Transit Railway), British planners do not exclude the design of using intercity railways as a part of a metro system, but tend to separate intercity trains and metro trains by building additional tracks.

Facing the British challenge, the DEC argued that "track sharing" means nothing else than using the same and existing track facilities and signal systems for rail-bound commuter services and other railway services, although the DEC was not in charge of planning the Taipei Metro. To cope with the increasing transportation demand in a conglomerated place like Taipei, the government needed to add additional commuter trains that called for greater track capacities. To make full use of the given track capacities, the simultaneous operation of commuter and all other railway services have to be organized accordingly, at first by proper coordination of train schedules. Thus, track sharing is primarily a matter of organizing railway operations. The DEC emphasized that track sharing had worked efficiently in Germany's S-Bahn, and doubts about track sharing were simply due to misunderstanding the concept[239]. The DEC was not opposed to building two additional tracks for the subterranean railway, but it thought that by organizing trains accordingly, all railway service could adequately run on the West Coast Line in Taipei City. Moreover, it also pointed out that track sharing would make the S Line open to service faster and that, according to the TRUPO's plan, all railway services, including intercity, metro, and freight, would only share the two tracks for about four to five years. Therefore, because of lower cost, it supported its original design[240].

The British and German consultants at least all agreed that they should integrate the railway into the metro system. The Americans took an even more radical attitude toward the German S-Bahn idea. In 1985, the CEPD hired the American consultants Taipei Transit Consultants (TTC), which was mainly composed of the DMJM (Daniel, Mann, Johnson & Mendenhall) to integrate the metro plans presented by the TPB/BMTC and Taipei City Government (see the following chapters). The TTC strongly suggested that Taipei exclude the subterranean railway from the metro system instead of building an independent Blue Line on the east-west Zhongxiao Road, replacing the role of the S Line. Therefore, the DEC and the BMTC's plans to build new commuter stations on the West Coast Line would be unnecessary. The TRA also stated, earlier than the advent of the TTC, that the West Coast Line in Taipei was almost full with intercity service and freight

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[239] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," March 6, 1984.

[240] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," November 27, 1985.

service, so track sharing and even the S-Bahn like subterranean railway was completely unfeasible[241].

General Tung and the TRUPO sent their argument supporting the DEC's idea, and their concept for the Taipei Main Station, to the CEPD, insisting that track sharing was feasible and the S-Bahn like S Line would be the most efficient option. General Tung failed to convince the CEPD. Counselor Fu wrote many notes on the TURPO's document expressing his disagreement with its argument[242]. Fu even wrote a note to the minister of the CEPD at that time, Chao Yao-tung (趙耀東), arguing that the S-Bahn service was only feasible by buying new trains and organizing services well, without sacrificing service quality of the Taipei Metro. Moreover, he pointed out that the DEC failed to provide a solution to level crossings in the section of the West Coast Line which was not to be rebuilt as an underground yet. If the government took the DEC's design, it would cost a great deal of money to build grade separation of roads and the railway, or it would face traffic congestion and development gap caused by level crossings. Counselor Fu also criticized the BMTC for its indifferent attitude toward the DEC's design, although it did not wholly agree with the idea of track sharing. Minister Chao agreed with Counselor Fu's statement so that the CEPD sent Fu's statement to the MOTC as the CEPD's opinion[243].

Finally, the CEPD approved the TTC's metro network killing the idea of building the S-Bahn in Taipei. However, when the decision was made in 1986, the construction of the subterranean railway was already on its way. Therefore, two interesting things happened. First, in the extension project of the subterranean railway in Taipei City, the TURPO kept building tracks in the two tunnels, and this arrangement starts from the Banqiao Station to the Nangang Station lasting for about 16km. Also, one of the two tunnels with two tracks was rebuilt as a part of Taiwan High Speed Rail (THSR) after 2000 so that the high-speed rail could reach downtown Taipei City and its east end, Nangang, without an additional massive construction program in the crowded city. We may conclude that the THSR should thank the death of the "Taipei S-Bahn" for the gift of tunnels and the tracks. Second, the TURPO still completed the supposed-to-be commuter stations, but the TRA has never opened the stations, arranging them as stations for evacuation in an emergency. Therefore, Taipei has three 'secret' stations buried underground and hopes that they will never be used.

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[241] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," May 25, 1984.

[242] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," November 27, 1985.

[243] National Archives 國家檔案閱覽中心, "Subterranean Railway 地下鐵," February 12, 1986.

Was the DEC's idea wholly wrong? Or, was the German-style S-Bahn not suitable to Taiwan? About two to three decades after the TURPO was reformed as the Railway Reconstruction Bureau (RRB) in 2002, the RRB built S-Bahn like elevated or subterranean railways in Hsinchu, Taichung, Kaohsiung, and even a part of New Taipei City calling the projects "metro railways" due to cheap cost and the TRA's competition with the THSR for intercity transportation service. The RRB also planned similar projects in Taoyuan and Chiayi. This is another story and issue to be discussed in the 21st century.

Hybrid Knowledge and Style

In the 1970s, the American hegemony of mass transportation technology ended, and the hybrid knowledge of Taipei and its transportation replaced it, leading to the hybrid technological style of the subterranean West Coast Line in Taipei. Two factors contributed to the end of technological hegemonic power. First, the increasing autonomy of Taiwan's transportation studies and planning profession. Gaining the ability to make knowledge transformed Taiwanese technical officials' consent to the American hegemony to the ambition of walking their way and adopting the strategies of introducing alternative knowledge resources. Second, the decline of the U.S.-Taiwan relations created the space for Taiwanese to extend the autonomy gained from their American teachers, trying to do it themselves and hiring other teachers. If Nixon and Carter did not turn the U.S.-Taiwan relations to the ice point, the American hegemony of transportation technology might have lasted since the U.S. retained its superiority to Taiwan at that time, and there many American engineering consulting companies like the De Leuw Cather and the P&B were doing business in Taiwan.

When Taiwanese technical officials established the TPB and the profession of transportation studies and planning, as the previous chapter states, they revealed their intention to lower the dependence on American hegemony of the profession by considering a Japanese technical assistance program and hiring the DEC to consult the TRA's operational problems. However, Taiwanese technical officials and their leaders did not suddenly change the orientation of the transportation profession from the U.S. to others. Instead, in the earlier projects, including the elevated railway project in Taipei and the study of the Tamsui Line, they still relied on American advisors' help to generate the knowledge of the railways and the city helping the political leaders to make decisions. C. C. Wang's ad hoc group for studying the subterranean railway projects even chose the P&B to consult the project. Nonetheless, when the TPB started its ambitious program for the mass transportation system in Taipei Metropolitan in 1976, not only American

consultants were absent but also other international consultants. When it found it too challenging to complete the program without international consultants' assistance, it turned to German and Japanese companies rather than American companies. Therefore, Taiwanese technical officials effectively withdrew their consent to the co-production of the American hegemony of transportation technology. However, they failed to do everything on the planning of Taipei's mass transportation systems alone and asked German and Japanese experts for help leading to hybrid knowledge of mass transportation technology, especially rail transportation.

To the objective circumstances in the 1970s, the decline of the U.S.-Taiwan relations created a space for the Taiwanese to disrupt the American hegemony of transportation technology. In the 1950s and 1960s, the KMT government had no choice but to introduce American resources and models into Taiwan for improving Taiwan's technological and economic power to confront communist China. The driving force was the close U.S.-Taiwan relations created by the Korean War and the following Cold War context. After the context changed with Nixon's visit to Beijing and Carter's termination of formal diplomatic relations between the two governments, not only was the driving force of Americanization weakened. So too was the power of the U.S. government to influence technological choices in Taiwan. The U.S. government obliged the KMT government to include American companies in the project of the electrification of the whole West Coast Line. Moreover, as we will see in the following chapters, the U.S. government obliged the KMT government to change international consultants from a British one to an American one and to accept the "the U.S. only" policy of procurement of the metro cars. A similar situation did not happen in 1979 when the KMT government was about to launch the large projects of the subterranean railway and the Taipei Metro. Thus, I argue that Carter's diplomatic policies not only caused a disaster for the KMT's diplomacy and legitimacy as the ruling power in Taiwan but also created a space for Taiwanese technical officials to pursue different technical assistance other than that provided by America so generating the hybrid knowledge of mass transportation studies and planning.

When the TRUPO started to implement planning in the early 1980s, the Taiwanese technical officials did not rely on their consultants entirely. Instead, they used consultants from other countries to review the German designs, and they also had acquired the confidence to express their concerns. When American intervention appeared in the mid-1980s in the Taipei Metro project, technological hybridity happened both in planning and following practical designs. The Taipei Main Station was the product of the process of hybridity. Its architecture was the outcome of the negotiation of the German idea of the

central station, with inputs from British, Japanese, and American experts and the local demands in Taiwan. Although these ideas and demands might even conflict with each other, the Taipei Main Station still became a station serving people in the transportation systems for decades, and it is the example of how a hybridity of technological style emerged. The subterranean railway with two tunnels, four tracks, and three mysterious hidden stations also illustrates technological hybridity of functions and styles. The story of the TRUPO, the subterranean railway, and the main station shows that a technological system can be a consequence of technical practice, making of knowledge, technological ideas, the needs of political economy, and, as I keep emphasizing, the development of international politics, especially in a technological catching-up country like Taiwan.

Chapter 5: Taipei Metro I

Mobilization of Knowledge and People: 1979-1997

"We already knew that the Executive Yuan was about assigning Chi Pao-cheng (**齊寶錚**) to be charged in the project of the Taipei Metro, and I just guessed the reasons why he made an appointment with me. As we sat in Sheraton's coffee shop, he directly told me: "Hsiao Lai (**小賴**, Paul Lai's nickname), let's work together! (我們已經知道行政院原則上決定派齊寶錚負責台北捷運這個專案，當然那時候我只是懷疑他為什麼突然找我。我們在喜來登的咖啡廳見面，他一坐下來來就說:「小賴，我們一起打拼!」)" Paul Lai, 2019

"The MRT will become a showcase for the Republic's technology, with the potential to attract an increasing volume of foreign contracts for ROC suppliers. The MRT will serve an important function in the technological education of the nation by providing a resource of specialist skills and experience in transit engineering and operation." BMTC (British Mass Transit Consultants), 1982.

In the following three chapters, we discuss the history of the Taipei Metro. Our focus is different in each chapter, although they do overlap in important ways. This chapter highlights the mobilization of knowledge and people for designing and building the Taipei Metro and how the Taiwanese learned and benefited from the international consultants, mainly American and British consultants; the next chapter focuses on the tension and conflicts between Taiwanese and international consultants and the strategies to deal with them. Chapter 6 concentrates on the Brown Line and its empirical and theoretical specificities.

The City

Taipei Metropolitan or Taipei area mainly refers to Taipei City, New Taipei City (Taipei County before 2010), and Keelung City and sometimes includes Taoyuan City (Taoyuan County before 2014), and part of Hsinchu. The core of the metropolitan, downtown Taipei City and satellite cities belong to New Taipei City, is located in the Taipei Basin surrounded by mountains to the east, west, south, and volcanos in the north. Taipei City itself is divided into northern and southern sections by the Keelung River. Beitou,

Shilin, and Neihu (內湖) are in the north part of Taipei. These three districts have dense populations in the residential area, and in fact they were the suburban area of the city for decades until the 2000s. Beitou has a national park which is famous for its volcanos, and a hot spring resort on the edge of the volcanos while also being a residential area. The Japanese colonial government specially built a branch line railway of the Tamsui Line to reach the hot spring resort. Shilin was the zone where Chiang Kai-shek lived, and embassies of other countries were situated there, Many people living there commute to downtown Taipei City. Neihu, once an agricultural area, has been a rising business district hosting many companies' headquarters in the past two decades. The south part of Taipei City is the core of the metropolitan area and even of the country. The central government, business districts, hospitals, universities, and monumental architecture concentrate in this area so that jobs, entertainment, dwelling, and public affairs are plentiful. The western part of this area is the old downtown of the city, and the city has expanded toward its east, finally reaching Nangang, the east gate of the city. Besides Keelung River, Taipei International Airport, the downtown airport for Taipei like Hanada Airport for Tokyo or Ronald Reagan Airport for D.C. Washington, also roughly divides the two parts of the city.

Although New Taipei City surrounds Taipei City, the most apparent boundary between the two is the Tamsui River and its tributaries. People from central and south Taiwan coming for education and jobs build their new home on the left bank of the Tamsui River, leading to many satellite cities of Taipei City, and these cities are even more populous than Taipei City. On the outskirts of these cities, industrial areas contribute jobs and economic outcomes to the metropolitan zone and even to the country. For example, Foxconn, the biggest consumer electronic products manufacturer, was born in Tucheng (土城) which is about 15km away from downtown Taipei City. Therefore, in such a big metropolitan conglomeration, people and vehicles move day and night for everyday life and business actives, causing colossal traffic flows in both the east-west direction and the north-south direction crossing rivers and streets.

At the dawn of the Taipei Metro project in the late 1970s and the 1980s, Taipei was a city suffering from traffic congestion, lacking parking space, and poor quality mass transportation. After experiencing oil shocks twice, Taiwan's economic growth remained strong due to Taiwan's thriving manufacturing industries. During 1975 and 1985, Taiwan's GDP per person had grown from 981 dollars to 3,315 dollars. With the strong economic growth, urbanization also became faster, leading to the population growth in Taipei Metropolitan. In 1972, about 1.89 million people lived in Taipei City, and, in 1980, Taipei City's population reached 2.22 million. Moreover, the satellite cities in Taipei County, also

gained tens of thousands of people at the same time. New residents transformed many small towns into industrial areas and residential districts with dense populations leading to heavy traffic caused by commuting between Taipei City and these newly rising cities. Combining population growth and economic growth, the numbers of automobiles and scooters in Taipei Metropolitan also dramatically increased. In 1981, Taipei City had 105,460 cars[244], and the number increased almost four times, reaching 399,746 in 1988[245]. The increase in the number of cars and people in the city in such a short time caused severe traffic congestion and a critical shortage of parking space. Moreover, people living in Taipei stopped using mass transportation, mainly buses, due to severe traffic congestion. In the early 1980s, the private automobile ownership increased on average by almost 16% annually, double the rate of increase of buses. The Taipei City Government spent three and half years building a new parking deck in downtown Taipei providing 1,400 parking spaces. However, Taipei City gained the same number of cars in just five days![246]. After 15 years, what the father of the Shinkansen, Shima Hideo, anticipated in 1965 became a truth: Taipei's traffic was chaotic in the 1980s.

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[244] The Transportation Planning Board, *The Comprehensive Report of the Metro Plan for Taipei Metropolitan* 臺北都會區大眾捷運系統計畫 (1983): Pp. 13.

[245] Source: The Ministry of Transportation and Communications, R.O.C. https://stat.motc.gov.tw/mocdb/stmain.jsp?sys=100.

[246] Yang, Tzu-pao 楊子葆, "The Urban Political Economy of Metropolitan Transportation Policy in Taiwan: A Critique of the 'Taipei Mass Rapid Transit System Program' 台灣都市交通政策的政治經濟學分析——台北都會區大眾捷運系統計畫之個案研究" in *Taiwan: A Radical Quarterly in Social Studies* 台灣社會研究季刊, Vol. 3, No. 2-3 (1990): Pp. 52-53.

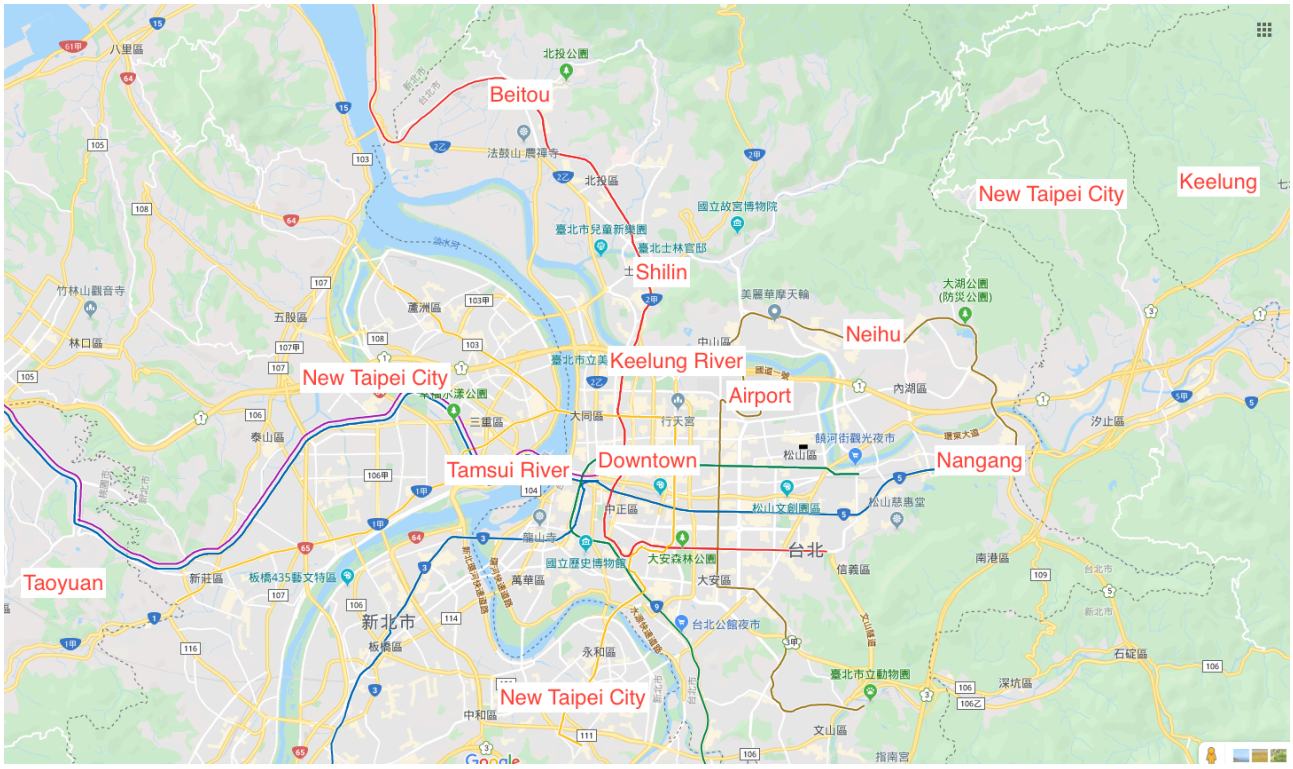

Figure 5.1: Taipei Metropolitan

The level crossing problems were only a part of the traffic disaster in Taipei. The TPB (Transportation Planning Board) and the DEC (Deutsche Eisenbahn Consulting) did studies planning mass transportation for the metropolitan area in 1977, and concluding that Taipei did not only need to bury the West Coast Line railway underground, but also needed to build a metro system. Although the DEC roughly planned a metro network in its study for Taipei's mass transportation systems, the KMT government only determined that the DEC and the TRUPO (Taipei Railway Underground Project Office) were in charge of the subterranean railway while someone else would take charge of building the metro system. The only professional institute for transportation planning, the TPB, again, took the job of planning the Taipei Metro after it passed the subterranean railway project to the TRUPO.

Figure 5.2: Traffic Congestion in Taipei in 1983[247].

The TMRT in the TPB

In 1979, the TPB started its mission of planning the Taipei Metro. First of all, it established the “Taipei Mass Rapid Transit Group (TMRT)” recruiting members from the TPB and elsewhere Wang Ching-jui (王慶瑞), who was the successor of Dr. Chiang as the chief of the planning division in the TPB after Dr. Chiang went to the U.S. to pursue a Ph.D. degree, became the leader of the TMRT. Wang named the future metro system “Jie-yun (捷運)," meaning rapid transit rather than underground or subway distinguishing the TRUPO’s “underground” project[248]. The first question for Wang and his TMRT was who could help them to plan the system. Although the technical officials knew how to do transportation studies and evaluation, the case of the subterranean railway and the mass transportation system planning for Taipei showed that they still could not complete a planning project on their own. Not even to mention that none of them had any experience of planning or even using metro systems. The MOTC (Ministry of Transportation and

[247] 國立臺灣大學數位人文研究中心。「新版國家文化資料庫 。」2010。http://doi.org/10.6681/NTURCDH.DB_NRCH/Collection.

[248] The interview with TP08.

Communication) presented a draft, which was written by Counselor Fu in the CEPD (Council of Economic Planning and Development), for improving mass transportation in cities, ordering the MOTC to hire experienced consultants for the metro project[249]. Hiring international consultants was needed to start their planning mission. So, the TMRT faced other questions. Who would be the consultants? How did they find an appropriate consulting company to work with? Although the TPB had the experience of cooperating with international consultants like the DEC and the De Leuw Cather, it did not know which consultants had abilities and experience to consult a transportation system, which was just as incredibly complicated as a metro system.

A possible candidate was suggested to the Taiwanese government. Emanuel Cassuto, a close friend of Giulio Andreotti who was the prime minister of Italy from 1976 to1979, secretly visited Taipei, meeting C.C. Wang twice to seek opportunities to serve the Taipei Metro project for Centre Européen de coopération Internationale, which was a French company, and other Italian companies[250]. The TPB and the CEPD decided not to hire them as the international consultants for the metro project, however.

In 1980, one young technical official joined Wang's team. He was the son of a diplomat with a degree in transportation planning in the U.S., David Poo (濮大威). Because of growing up outside Taiwan for most of his childhood and teenage years, David Poo was a native English sparker. Thus the TMRT asked him to write technical documents for hiring international consultants. David Poo asked his classmates and professors at college and graduate studies who had the experience of hiring consultants, or hired them as consultants himself, to help him write the technical documents. Two of David Poo's senior classmates flew to Taiwan to tutor him, and he used the manual of the Fédération Internationale Des Ingénieurs-Conseils (FIDIC) to draft the documents. First of all, David Poo and the TPB presented the qualification documents and posted advertisements to invite engineering companies to bid. Five companies were put on the shortlist. The TPB set up a committee with members in and out of the TPB to evaluate these companies. The British Mass Transit Consultants, which was a joint venture led by Freeman, Fox, and Partners, won the first place for its experience of Hong Kong's MTR (Mass Transit Railway), and the American company De Leuw Cather was in the second

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[249] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," May 7, 1979.

[250] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," October 8, 1978, and May 7, 1979.

place[251]. Besides hiring international consultants, the TPB also aimed to incubate local experts out of the government, so, as it did in the case of the subterranean railway project, it hired the CECI (Chinese Engineering Consulting Incorporated) as the local counterpart of the BMTC. With this arrangement, not only the members of the TMRT could obtain experience and profession bought by the BMTC. So too could the local engineers from the CECI so that the CECI could be home to the Taiwanese consultants of the future. serving the cases in and out of Taiwan.

On the practical level, the BMTC contributed much to technology transfer and know-how to plan a metro system. For the former, the technology transfer was based on job training, meaning that the BMTC worked with Taiwanese technical officials and engineers together rather than merely providing written documents. In the process of cooperation, the Taiwanese would see how British experts were doing their calculations, making every decision, making plans, and managing the design and planning process. For example, members of the TMRT admire the BMTC's "documentation" very much[252]. Documentation means that every calculation, meeting record, technical decision, and plan should be recorded and accordingly organized into files. The BMTC even had one expert who did nothing but keep a written record of everything; the BMTC called this effort "file engineering.[253]" Documentation had two purposes. First, the planning process could be efficient and systematic, avoiding duplication and inconsistency. Second, technology transfer could also be systematic, and newcomers could find references to every detail of the planning. Besides documentation, the BMTC also introduced an essential institution for planning a metro system, which was "coordination groups." Because a metro system would involve many factors and professions such as station, rail, train control, power system, operation, architecture, and development, each planning topic needed the coordination of members in different professions. For example, when the planners and engineers were planning a station, the station coordination group and traffic coordination group would need to discuss how to design this station's exits location, the width of stairs, and the speed of the escalators since the traffic coordination group knew the prediction of the people and traffic flows. The station coordination group needed to design where passengers should enter and leave the station[254].

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[251] The interviews with TP05 and TP08.

[252] The interviews with TP03 and TP08; Huang, "Awkward Rail," Pp.36-37.

[253] The interview with TP08.

[254] The interviews with TP05 and TP08.

At the conceptual level, the BMTC's ideas were generated from their experience in the U.K. and Hong Kong and were expressed in the metro network and the corresponding design. Unlike the DEC's network based on the idea of central station and transportation center, the BMTC and the TMRT presented an "L-shape" network meaning that every metro line would be L-shaped instead of straight. The purpose and the outcome of this design were to make many transferring stations rather than one central station so that passengers would be distributed to these stations. Therefore, take the current Taipei Metro network as an example, the Taipei Main Station would not be overloaded because passengers could change trains in the stations like the Zhongshan Station, the Ximen Station, the Chiang Kai-shek Memorial Hall Station, and the Dongmen Station. However, the absence of a "central station" might also increase the frequency of transfers reducing a traveler's motivation to ride on the metro system. The L-shape design itself can solve part of the problem. Again, the network map of the Taipei Metro shows how it works. We can find that passengers need to transfer only once from any station to any other station except those on the Brown Line. So, the frequency of transfer in the metro system decreases.

Figure 5.3: The network of Taipei Metro

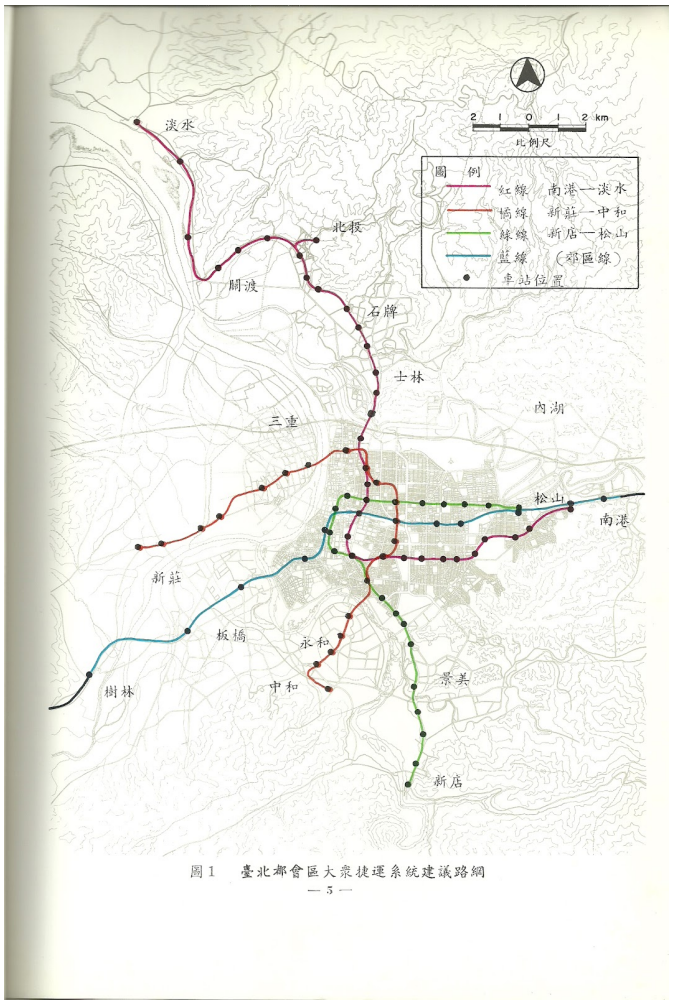

Figure 5.4: The metro networks recommended by the BMTC (left)

Figure 5.5: The metro networks recommended by the DEC (right)[255]

Another way to solve the problem of frequency of transfer is the design of "cross-platform interchange." The design of cross-platform interchange is to build two tunnels (for different directions) of the same line arranged up and down rather than parallel so that the two metro lines become parallel between the platforms on different floors when the two different metro lines meet at an interchange station. With this design, most of the passengers who need to transfer can change lines on the same platform without walking upstairs or downstairs, decreasing the effort of making the transfer so that riding on the metro system becomes more attractive and the number of rides can increase. This design originated in Britain, and the BMTC used it in their projects of the MTR in Hong Kong.

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[255] The Transportation Planning Board, *The Briefing Report of the Metro Plan for Taipei Metropolitan* 《臺北都會區大眾捷運系統計畫簡報》. (Taipei: Transportation Planning Board 交通運輸計畫委員會, 1983), Pp. 5; The Transportation Planning Board, "*The Comprehensive Report,* Pp. 4.

This design combining the L-shape network exhibits the British consultants' focus on operation and management after the completion of a metro system because decreasing frequency and efforts of changing lines would attract people to use the metro rather than taking the automobile, increasing ridership of the system.

As the previous chapter shows, the BMTC and the TMRT did not only work on their Taipei Metro project. They embedded their planning and designs into the larger picture of Taipei's mass transportation systems planned by the DEC and its counterpart in the TRUPO. Then, they also coordinated with the DEC and the TURPO's subterranean railway project for the issue of the S1 line and the design of the Taipei Main Station. Thus, British experience and designs derived from British cities and Hong Kong traveled transnationally to Taiwan and were integrated with those coming from Germany and Japan, creating the hybridity of knowledge and styles, and the American hegemony of transportation technology seemed to vanish totally. However, the change in U.S.-Taiwan relations could remove American contributions from Taiwan's mass transportation, but it could also bring it back: after all, Taiwan and the KMT's remained vulnerable to mainland China's military threat.

The Return of America: the TTC

Taiwan and the KMT Government's Plight

The termination of the formal relationship and the mutual defense agreement between the U.S. and the KMT government did not mean that Taiwan lost all military protection by the U.S. In March 1979, Congress and the Senate passed the Taiwan Relations Act (TRA). The Act declared that "in furtherance of the principle of maintaining peace and stability in the Western Pacific area, the United States shall make available to Taiwan such defense articles and defense services in such quantity as may be necessary to enable Taiwan to maintain a sufficient self-defense capacity as determined by the President and the Congress" and requires "such determination of Taiwan's defense needs to be reviewed by United States military authorities in connection with recommendations to the President and the Congress." The Act also gave power to the U.S. government to establish America in Taiwan (AIT) as being in charge of the informal diplomatic relations between the U.S. and Taiwan. Although the Act did not guarantee military intervention from the U.S. if China invaded Taiwan, Taiwan still highly relied on the American military power in the Western Pacific to secure its autonomy and the survival of the regime.

The victory of Ronald Reagan as U.S, President in 1980 again brought hopes to the KMT government that the diplomatic relations between the R.O.C. and the U.S. would be

restored, especially since Reagan heavily condemned Carter's handling of Taiwan during the presidential election. However, Reagan backed away from the stance of restoring the formal U.S.-Taiwan relationship and declared he would base his policy on the TRA[256]. In 1982, the U.S. and China signed the August 17 Communiqué[257] which stated that America and China would further strengthen cultural, technological, and economic ties and that the U.S. government may gradually decrease its sale of weapons to Taiwan. Although Reagan presented “Six Assurances[258]” to Chiang Ching-kuo and Taiwan emphasizing that the U.S. did not agree to set a specific date for ending arms sales to Taiwan, and other assurance related to Taiwan’s safety, Reagan’s actions shattered the hope of restoring formal relations between the two countries. At the same time, the Chinese government proposed the “Three links (三通)," meaning postal, commercial, and transportation links for promoting the unification of both sides of Taiwan Strait in 1979 when the KMT lost its formal recognition by the U.S. Then, in 1983, China’s leader at that time, Deng Xiaoping (鄧小平), announced the policy of “One country, two systems (一國兩制)" for the future unification of Hong Kong and Macao pressing the KMT government to follow the same principle “to bring Taiwan back to its motherland.” Thus, the KMT government was facing China’s military and political threats and in the crisis of its legitimacy of ruling Taiwan.

Besides the political pressure from the U.S. and China, the huge trade deficit between the U.S. and Taiwan was another problem that the Taiwanese government needed to face. In the 1980s, Taiwan’s manufacturing industries became more thriving due to cheap but high-quality labor force exporting tons of goods to the U.S. while this island country did not have the corresponding purchasing power to buy American products. In 1985, the trade deficit between the U.S. and Taiwan was about 11.7 billion dollars, and the numbers increased to about 14.3 billion in 1986 and 17.2 billion in

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256 Sutter, *US-China Relations,* Pp. 76.

257 The Shanghai Communiqué announced in 1972, the Joint Communiqué on the Establishment of Diplomatic Relations in 1979, and the August 17 Communiqué in 1982 are called the “Three Communiqué” which are essential bases for the normalized relations between the U.S. and China.

258 The “Six Assurance” were that “we did not agree to set a date certain for ending arms sales to Taiwan,” “see no mediation role for the United States between Taiwan and the PRC,” Nor will we attempt to exert pressure on Taiwan to enter into negotiations with the PRC,” “there has been no change in our longstanding position on the issue of sovereignty over Taiwan,” “we have no plans to seek revisions to the Taiwan Relations Act,” and “ the August 17 Communiqué, should not be read to imply that we have agreed to engage in prior consultations with Beijing on arms sales to Taiwan.” In 2016, Congress passed the text of the Six Assurance as the resolution.

1987[259]. The U.S. government pressured Taiwan to buy more American products and services to compensate for the trade deficits. However, due to the August 17 Communiqué and Reagan's policy concerns, Taiwan could not purchase military equipment like F-16 Fighting Falcon fighters: the American products Taipei was eager to get the most since Taiwan's air force was using from the old and notoriously unreliable F-104 Starfighter[260]. In this context, massive infrastructure projects like the Taipei Metro became targets of the U.S. government, and, coincidently, the Taipei City Government created a chance for Americans to involve in the Taipei Metro.

The Advent of the TTC

In 1982, the Taipei City Government started to study newly developed automated guideway transit systems (AGT) that used driverless cars, and set a "medium-capacity transit group" to plan a metro system. The system would use an automatic system so that the city would have a smaller system in advance of the completion of the TPB and the BMTC's metro system so releasing the pressure of traffic congestion in Taipei[261]. In 1984, Taipei City submitted its plan to the Council of Economic Planning and Development, so the CEPD had two metro system plans, one from the TPB and one from the Taipei City Government. In one internal note in the CEPD, the counselor Fu Chia-chi provided two suggestions about the two metro systems. First, the government needed to launch an integration study to solve the conflict between the TPB and the Taipei City Government; Second, the CEPD should be in a neutral position rather than hosting the integration study, or the CEPD would lose its standpoint of judging the conflict between two institutes[262]. Thus, Counselor Fu concluded, the MOTC should be in charge of the integration study. However, the MOTC did not believe the newly developed driverless transit was reliable, taking the same position as the TPB[263].

In July in the same year, Ralph Stanley, the Urban Mass Transportation Administrator in the U.S. [264] from 1983 to 1987, visited Taiwan. His mission was to

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[259] Branch, Foreign Trade Data Dissemination. "Foreign Trade: Data." U.S. Trade with Taiwan, April 21, 2009. https://www.census.gov/foreign-trade/balance/c5830.html#1985.

[260] The R.O.C. Air Force owned 247 F-104 Starfighter during 1960 and 1998, and 114 of them finally crashed, killing 66 pilots.

[261] I provide more details about how the medium-capacity transit project started in the chapter 6.

[262] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," August 6, 1984.

[263] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," August 23, 1984.

[264] The director of the Urban Mass Transportation Administration (UMTA). The UMTA was formed in 1964, and it was reformed as the Federal Transit Administration in 1991.

“convince” the Taiwanese government to open the metro project to bids from the U.S. so that the trade imbalance between the U.S. and Taiwan could be mitigated. Many metro-related companies followed Ralph Stanley’s visit to Taiwan forming the “United States Transit Trade Mission to Taiwan.” Ralph Stanley and the members of the U.S. Transit Trade Mission to Taiwan read both of the TPB and the Taipei City Government’s planning reports and showed that the U.S. could help the Taiwanese government to solve this conflict[265]. In October, thirteen companies participating in the U.S. Transit Trade Mission to Taiwan formed the “United States-Taiwan Transit Group (USTTG)” in D.C. listing tasks for the integration study of the two metro plan. The USTTG also told the CEPD that it would apply to the U.S. Trade and Development Program (USTDP) for financial support for the integration study Taipei[266]. After the approval of the USTDP, the USTTG signed a memorandum with the CEPD and decided that three of its members, the DMJM, the De Leuw Cather, and the TRAAC, to form a joint venture to do the integration study[267]. The officials of the AIT visited the CEPD asking the CEPD’s attitude toward the USTTG’s proposal[268].

[265] National Archives 國家檔案閱覽中心, “Metro System 捷運系統,” August 23, 1984.

[266] National Archives 國家檔案閱覽中心, “Metro System 捷運系統,” November 17, 1984.

[267] National Archives 國家檔案閱覽中心, “Metro System 捷運系統,” December 4 and 7, 1984.

[268] National Archives 國家檔案閱覽中心, “Metro System 捷運系統,” December 7, 1984.

Table 5.1: The members of the USTTG

Table 5.1: The members of the USTTG	
Name of Firms	**Products or Service**
Bechtel International, Inc.	Construction and engineering consulting
De Leuw Cather International Ltd.	Transportation and engineering consulting
DMJM International	Construction consulting
General Electric Technical Services Co., Inc.	Power systems
General Railway Signal Company	Signal control systems
General Signal Corporation	Signal control systems
Gibbs & Hill, Inc.	Construction consulting
Morrison-Knudsen International Engineering Company, Inc.	Construction
The Ralph M. Parsons Company	Technology systems and infrastructure engineering
TRAAC International Consultants	Construction consulting
United States Trading Company	Trading
WABCO-Westinghouse	Railway equipment
Westinghouse Electric Corporation	AGT systems, power systems, and railway equipment

At the same time, France also sought to enter the metro business in Taipei. The director of the France Aisa Trade Promotion Association (FATPA; Association française pour le développement du commerce avec L'Asie[269]), Francis Geronimi introduced the SOFRETU (Société française d'études et de réalisations de transports urbains) which was the state-owned transportation engineering consultants created by the RATP (Régie Autonome des Transports Parisiens) Group to Yu Kuo-hwa, the prime minister of

[269] It was association formed by the French government in 1978 for promotion of Franco-Taiwan trade, and it had been the first institute set by the French government since Charles De Gaulle terminated the formal Franco-Taiwan relations in 1964. In 1991, the FATPA was merged into the France Office in Taipei (Bureau Français de Taipei), which is an AIT alike informal diplomatic institute representing the French government in Taiwan.

Taiwanese government. The minister of the CEPD, Chao Yao-tung met the SOFRETU's representative and manager in December 27, 1984. The SOFRETU's representative expressed its interest in joining the integration study of the metro system[270].

However, Counselor Fu had already listed three possible options to reply to American's proposal and decided to hire the three American consultants without the support of the USTDP[271]. Therefore, Chao had no choice but to express his regret to French[272]. Then, in March 1985, the three American companies formed the Taipei Transit Consultants (TTC) to cooperate with the CEPD in initiating the integration study for the Taipei Metro. Six months later, the TTC finished the study making the metro network with five rail rapid transit lines and one automated transit line. Because the decision-making process reveals the tension between the U.S. and Taiwan and Taiwan's strategies, I will provide more details on how Counselor Fu and the CEPD made their decision in the next chapter.

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[270] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," December 31, 1984.

[271] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," December 7, 1984.

[272] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," December 31, 1984.

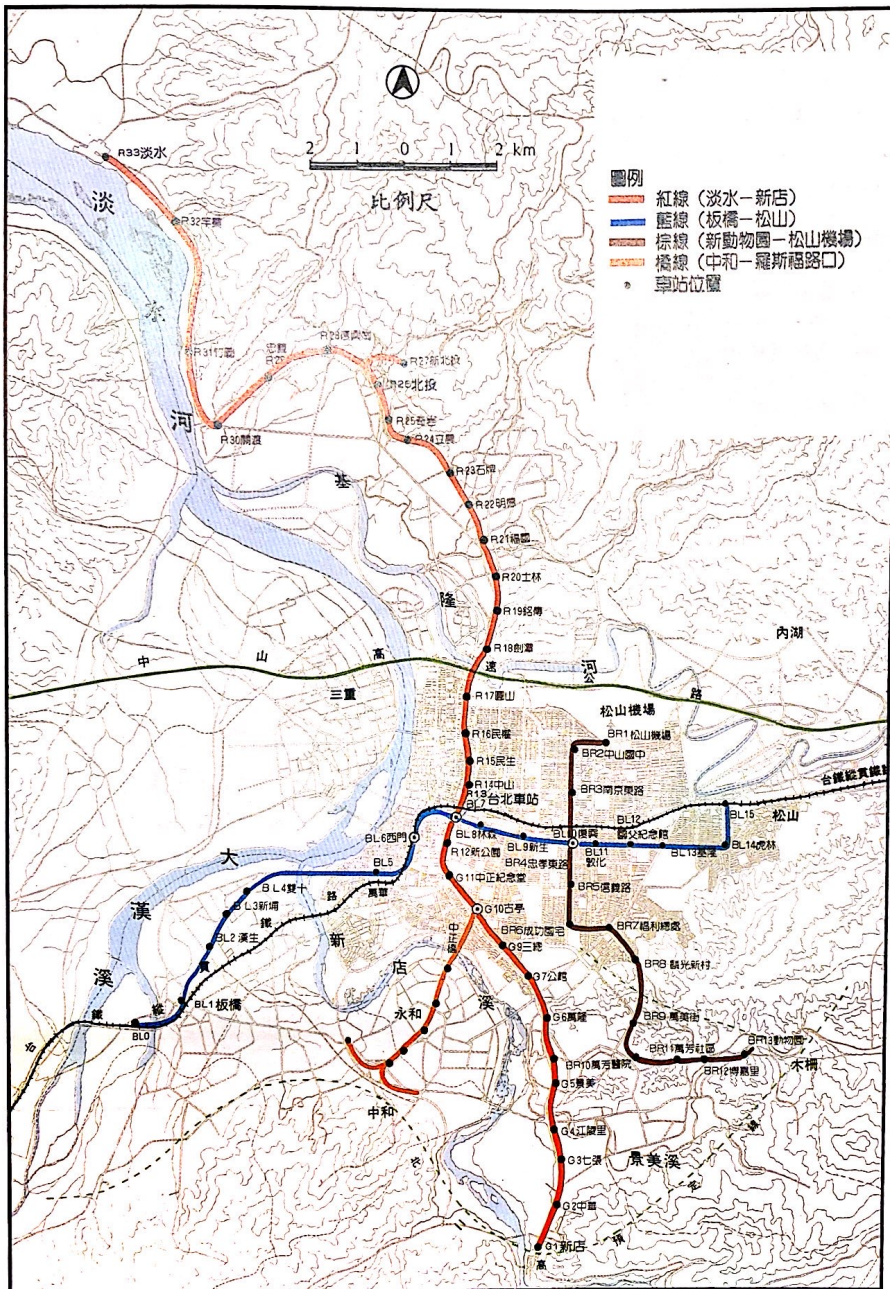

Figure 5.6: The first phase network of the Taipei Metro recommended by the TTC[273]

The Birth of the DORTS

Who would be in Charge?

While the U.S. government and American companies tried to get involved in the Taipei Metro project, the Institute of Transportation (IOT - the reformed TPB as of 1985) and the BMTC continued their job. First of all, the IOT prepared to hire the BMTC as the

[273] The Department of Rapid Transit System, Taipei City Government 臺北市政府捷運工程局, *1989 Annual Book of the DORTS* 《中華民國七十八年捷運年刊》. (Taipei: The Department of Rapid Transit System, Taipei City Government 臺北市政府捷運工程局,1990), Pp. 25.

general consultants for the whole project so that the IOT and the BMTC could work together following the British Mass Transit Consultant's working list. Then, the IOT asked the DEC to review the working list. After months-long negotiations of the working list and paying a substantial consulting fee, the IOT signed the contract with the BMTC and the CECI, hiring them as the general consultants of the Taipei Metro project in March 1985 when the CEPD signed the contract for the integration study. At the same time, Taipei City Government also hired local consultants co-working with American advisors from the consultancy firm DMJM, further planning the Brown line. After the TTC finished the integration study, the Executive Yuan announced an importation decision: the Taipei City Government would be responsible for the Taipei Metro rather than the MOTC or any new institute[274].

In December 1985, the CEPD listed three possible options as to which agency would take the responsibility of building and operating the Taipei Metro to the Executive Yuan, although the TTC had already provided their suggestion in their integration study. The TTC suggested that the Taiwanese government form four institutes, respectively in charge of regional planning, engineering of the metro system, operation of the metro system, and supervising all public facilities, including the metro system for Taipei Metropolitan. However, the CEPD thought the TTC's suggestions were only based on its experience in the U.S., so it listed alternative options of its own. First, using the precedent of how the government built the Shimen Dam (石門水壩), the Executive Yuan set up an inter-departmental committee whose members included relevant ministers and local governments in charge of the construction of the Taipei Metro. The committee would recruit professional human resources to implement the plan, design, and construction of the Taipei Metro. When the construction was about to be completed, the Taipei City Government would form an agency for operating of the system. Second, the MOTC formed a department for the metro system, and, when it came to issues involving province and cities, defined a negotiation mechanism to deal with related affairs. Third, Taipei City Government set up agencies for construction program and operation[275].

The mayor of Taipei City and the Taiwan Provincial Government preferred the first option while the minister of transportation and the controller of the ministry of finance

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[274] The Department of Rapid Transit System, Taipei City Government 臺北市政府捷運工程局, *1987 Annual Book of the DORTS* 《中華民國七十六年捷運年刊》. (Taipei: The Department of Rapid Transit System, Taipei City Government 臺北市政府捷運工程局,1987), Pp. 33-35.

[275] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," December 17, 1985.

preferred the third option. The CEPD mentioned that the IOT and the MOTC strongly opposed the automatic system so that the option of the MOTC setting an agency to be in charge of the Taipei Metro project might automatically overlook the automatic metro line[276]. At this time, Taipei City Council deleted the responding budget for the subterranean railway project so that the Executive Yuan thought that Taipei City should take full responsibility for the project preventing inconsistency between central and local government[277]. Therefore, the Executive Yuan decided that Taipei City Government should establish an agency to implement the Taipei Metro project.

"Heroes" from All Around the World

In June 1986, Taipei City Government established the preparatory office of the Department of Rapid Transit System (DORTS), and, thanks to C.C. Wang's recommendation, who was the deputy of the CEPD recommendation[278], Chi Pao-cheng, took office as the director of the preparatory office and then the first commissioner of the DORTS. He was the deputy of the Ret-Ser Engineering Agency (RSEA)[279], an served on the Veterans Affairs Council. In fact, in April, Paul Lai (賴世聲) received a phone call from Commissioner Chi, and he invited Paul Lai to have a cup of coffee in Sheraton Hotel, Taipei. Paul Lai, the son of the Chief of the General Staff, was the youngest chair of a national university in Taiwan at that time. He had a Ph.D. degree in civil engineering from MIT, and he was temporarily transferred to the state-owned BES Corporation[280] as the manager of business development. After he was transferred to the BES, he visited Paris to study the metro system in Paris and the TGV, the high-speed rail in France since the BES anticipated that it would join the project of the Taipei Metro. Moreover, Paul Lai already knew that the government preferred Chi to lead the future DORTS, so, before he met Commissioner Chi, he was guessing the reason why Commissioner Chi would like to

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[276] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," December 17, 1985.

[277]s The interview with TP08.

[278] Liu, Pao-Chieh 劉寶傑, and Lu, Shoa-Wei 呂紹緯, *The Lesson of NTD 444,400,000* 《四千四百四十四億的教訓》. (Taipei: China Times Publishing 時報文化, 1995), Pp. 13.

[279] The Ret-Ser Engineering Agency 榮民工程處 was a state-owned enterprise set in 1956, and the purpose of it was to provide veterans jobs since most of the soldiers retreated from China with the KMT government so that they would have no social network or ability to find a job in Taiwan once becoming veterans. The RSEA had involved many construction projects in Taiwan and abroad, including Taichung Harbor, the National Freeway No.1, and infrastructure projects in Africa, Southeast Aisa, and Midwest. In 2009, the Ret-Ser Engineering Agency was privatized as RSEA Engineering Corporation.

[280] The BES Corporation was reformed from the Bureau of Engineering Services, Ministry of Economy in 1959. It was privatized in 1994.

meet him. When Chi sat on the chair in the Sheraton's coffee shop, he directly asked Paul Lai to be his deputy in the preparatory office. After consideration, Paul Lai decided to leave his faculty position at the National Taiwan Institute of Technology[281] and the BES joining the preparatory office of the DORTS[282].

Since the, the massive mobilization of knowledge of engineering and human resources in Taiwan started. First of all, Commissioner Chi brought many of his colleagues in the RSEA to join the DORTS. At the time, many of the engineers from the RSEA had just completed the job of the "Ten Major Construction Project. Therefore, the RSEA's experience also entered the project of the Taipei Metro. For example, Commissioner Chi and his colleagues from the RSEA introduced quality assurance institution and configuration management into the DORTS for pursuing higher quality of the construction[283]. Then, the members of the TMRT, like David Poo, also joined the Department of Rapid Transit System. Many of them were assigned to the office of planning. David Poo was assigned to the job of management of the international consultants. Many members of the medium capacity transit group and technical officials in the Taipei City Government also joined the DORTS. Technical officials working in other agencies were also invited or attracted to the DORTS. For instance, the first deputy commissioner of the DORTS came from the Freeway Bureau, MOTC, because of his profession of electrical engineering. He also introduced some of his colleagues to the DORTS[284].

Besides these government institutes, many technical officials came from different agencies and even from out of the government. For example, the first deputy chief engineer, Dr. Konrad Tzeng (曾水田), was on the faculty of the Chung Cheng Institute of Technology, Ministry of National Defense, with a military rank. Many retired officers also joined the DORTS with Chi from the RSEA because of the RSEA's role of providing jobs to veterans. Moreover, some retired officers came from the Combined Service Forces, MND, which was the military agency focusing on R&D of weapons and related systems. [285] General Tung Ping's service in the TRA and the TRUPO echoed this phenomenon. Liao

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[281] Now National Taiwan University of Science and Technology.

[282] The interview with TP03.

[283] Chinese Taipei Tunneling Association 中華民國隧道協會, *The Interviews of Taiwanese Experts of Tunneling No.1*《臺灣隧道工程人物專訪集 第一輯》 (New Taipei: Chinese Taipei Tunneling Association 中華民國隧道協會, 2003), Pp. 132-134.

[284] The interview with TP02.

[285] The interview with TP06.

Ching-lung (廖慶隆), the commissioner of the DORTS in 1993, was faculty of the National Taiwan Institute of Technology — another example of the engineers in the DORTS coming from outside of the government. Because Commissioner Chi decided to start the construction of all the metro lines in the first phase network determined by the CEPD and the TTC at once, the DORTS continually expanded its size. At the end of 1987, the DORTS had 562 employees, and 9 of them had Ph.D. degrees. Moreover, 175 of them had master's degrees, and 221 of them had a bachelor degree[286]. In 1989, the number of the employees in the DORTS reached over 1000[287].

For the future cooperation with international consultants to ensure the professionalism of technical officials in the DORTS, Paul Lai interviewed every applicant for technical jobs in English[288]. Therefore, many engineers with graduated degrees in the U.S. or even Ph.D. degrees entered the DORTS. Indeed, all meetings in the DORTS during the construction period of the first phase network were in English only since the international consultants could not speak in Chinese except for a few bilingual consultants. Commissioner Chi and Paul Lai fought for and got budgets to provide much higher wages to the officials of the DORTS than others employees of the Taipei City Government at that time[289]. In their investigation survey of the Taipei Metro, Liu and Lu, journalists of China Times, stated, “heroes came from all around the world” and joined the DORTS[290].

The project of the Taipei Metro also mobilized many international consultants, their professionalism, and experience into Taipei, Before the establishment of the preparatory office of the DORTS, the IOT formed the “office of the Taipei Metro” in advance, and it had 120 Taiwanese and 50 international consultants from the BMTC[291]. After the establishment of the preparatory office of the DORTS and then the DORTS, the BMTC kept consulting Taiwanese for the basic design of the metro system. However, in March, the DORTS reopened the bid of the general consultants of the whole project, and the American joint venture, the American Transit Consultants (ATC), replaced the British Mass

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[286]s Liu and Lu, *The Lesson*, Pp. 18.

[287] The Department of Rapid Transit System, Taipei City Government, *1989 Annual Book*, Pp. 209.

[288] The interviews with TP03 and TP09.

[289] The interview with TP03.

[290] Liu and Lu, *The Lesson*, Pp. 17.

[291] The Department of Rapid Transit System, Taipei City Government, *1987 Annual Book*, at Pp. 35.

Transit Consultants as the general consultants of the Taipei Metro. The ATC was formed by Bechtel, the P&B, and Kaiser Engineering. These consultants were involved in metro projects in the U.S. such as Washington's WMATA (Washington Metropolitan Area Transit Authority), Atlanta's MARTA (Metropolitan Atlanta Rapid Transit Authority), and San Fransisco's BART (Bay Area Rapid Transit). Moreover, before the ATC got the business, the DMJM won the business of consulting the one driverless line, the Brown Line. Therefore, their experience and knowledge of metro systems traveled from North America to Taipei.

Besides international consultants, the Taipei Metro mobilized local state-owned consultants. The CECI, which was involved in the subterranean railway project and the TMRT's study, continued to work as the counterpart of the BMTC and the ATC. Sinotech Engineering Consultants, which was the state-owned consulting company focussing on the construction of power plants, especially nuclear power plants, also joined the metro project. Sinotech had a joint venture with Bechtel due to their cooperation in the project of a nuclear power plant in north Taiwan, and the joint venture also worked as local consultants in the projects[292]. Finally, the MAA Group Consulting Engineers(亞新工程顧問), which was a newly formed private engineering company established in Taipei and Singapore co-worked with the DMJM consulting the design and construction of the Brown line. In sum, before the initiation of the implementation of the Taipei Metro, the mass transportation system and technology in Taipei only involved those who had expertise in transportation studies and planning in Taiwan. But, when this massive project was ready to be implemented, much more Taiwanese engineers, planners, and technical officials were mobilized as the transnational movement of the knowledge, experience, and later artifacts came to Taipei with the British or American consultants.

Working in the Same Office

The mobilization of human resources and the transnational movement of knowledge and experience does not necessarily mean that technology transfer happened or that the technological hybridity emerged, but practical mechanisms and strategies were needed. The most important policy was "working in the same office (合署辦公)." The meaning of "working in the same office" was that the international consultants directly joined the project working with technical officials and local consultants in the same office

[292] Hu, Yi-chin 胡以琴 and Sun, Yi John 孫以濬, "General Consultants and Development of the Taipei MRT Project 臺北捷運總顧問與捷運工程發展- 回顧與期盼" in *Rapid Transit Systems & Technology*《捷運技術》No. 48 (2014): Pp. 63.

rather than merely providing educational training or working in separate offices, meeting Taiwanese only if they had questions[293]. This policy had three advantages. First, the experienced international consultants could ensure the quality of the designs and the engineering because they were directly responsible for the project. Second, Taiwanese could directly benefit from international consultants' experience and profession in the actual design work. Taiwanese engineers could see and hear how the consultants built traffic flow prediction models, calculated the structure of the architecture, designed the stations, and integrated different phases of a metro system. Third, the Taiwanese could take positive actions to learn what they wanted to learn from international consultants. This policy was not only followed by the DORTS, local consultants, and international consultants but also written into the consulting contracts.

When the TPB formed the TMRT in 1981, the latter adopted this policy, forming the triangular relations of the TMRT, the CECI, and the BMTC. After the DORTS was established, it continued this policy and expanded its range. Between 1986 and 1996 when the design and the construction of the Taipei Metro was implemented, the DORTS set up six offices to deal with different technical and management issues: planning, civil engineering and architecture, electrical and mechanical system design, construction management, operation, and joint development[294]. The international consultants, no matter whether they came from the BMTC or the ATC, would work in each office cooperating with the local consultants and the technical officials of the DORTS according to their profession. For example, the BMTC and the ATC deployed transportation planning experts to the office of planning, building the prediction model of the transportation development in Taipei Metropolitan, planning the extensive network of the Taipei Metro and drawing up traffic management plans for the roads and streets in Taipei during the construction period. Therefore, Taipei got the prediction models, which is Taipei Rapid Transit System Model (TRTS), the metro network, and management plans, and Taiwanese engineers could gain hands-on experience of the whole process so that they could run it independently in the future[295]. Moreover, the contracts with the international consultants were signed about every two years, and the number of international consultants would

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[293] The interviews with TP03, TP04, TP05, TP06, TP08, and TP09.

[294] The office of joint development was set later in 1988 because Commissioner Chi planned to set a public development company to execute joint development. However, because of the City Council's opposition, he decided to set the office within the DORTS.

[295] The interviews with TP03 and TP04.

gradually decrease as the contracts were revised so that the Taiwanese would not become over-reliant on the international consultants ensuring technology transfer[296].

Taiwanese American consultants, Hu Yi-chin and Sun Yi John, have provided a vivid picture of how the international consultants transferred their expertise and experience to Taiwanese technical officials and local consultants. The leader of the consultants in the office of civil engineering and architecture, Kevin Peterson, was good at drawing and, in the coordination meetings of stations, he could rapidly provide striking sketches of the arrangement of facilities in stations so that other engineers could easily understand the impact of their opinions or suggestions on the stations and their surrounding environment[297]. The TRTS model is another example that shows how technology transfer succeeded. After the international consultants helped the DORTS to build the first version of the TRTS, and, with the decrease of the consultants and then their leaving, the DORTS and local consultants keep developing further versions of the Taipei Rapid Transit System model with the extension of the network of the Taipei Metro.

Overseeing the technical offices, the DORTS set up the chief engineers office to supervise and manage all technical affairs, and Paul Lai was employed as the first chief engineer when the DORTS was officially established. The international consultants also set up the project management group and its project manager as the counterpart of the chief engineers office.

Besides the offices in the headquarter of the DORTS, there were district project offices in charge of different lines of the Taipei Metro. The East District Project Office was in charge of the Brown Line. The DMJM and the MAA's consultants worked with the technical officials in this office.

The outcome of the policy of "working in the same office" was not only the metro system itself. Taiwanese engineers interacted and learnt from the international consultants and acquired documents that could direct how the DORTS should develop the Taipei Metro once the international consultants left. First, after the international consultants and Taiwanese engineers solved one technical problem or obtained a conclusion of a technical issue, they would compose one technical report so that technical officials and engineers could use it again if they faced similar issues. Second, the international consultants helped the DORTS to complete planning manuals. The planning manuals defined the specs of components in the metro systems in detail, so the quality and the

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[296] The interviews with TP03, TP04, and TP06.

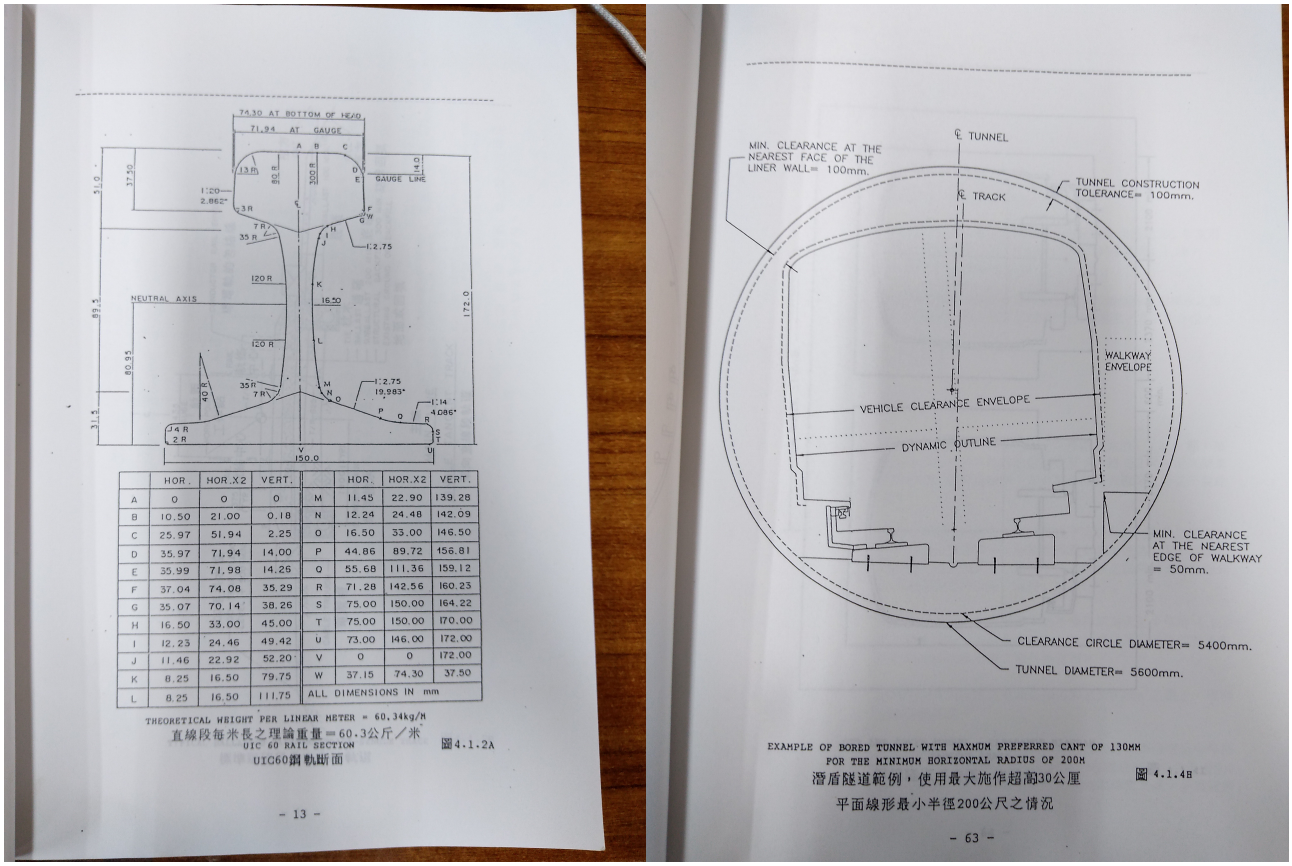
[297] Hu and Sun, "General Consultants," Pp. 64.

design patterns could be guaranteed for consistency[298]. For example, the planning manuals set the standard of the width of the stairs of the stations in the Taipei Metro, ensuring that people could move smoothly and could evacuate rapidly in an emergency[299]. The manuals also carefully defined the components of every facility in the system and the detailed specs of things like rail, ballast, and sensors, and the engineers could follow the definitions and specs to plan and to design the metro system. Before the DORTS hired an architect to design stations, they already knew what the functions of the stations would be, what the size of different areas had to be, the speed of the escalators, and even the width of the stairs. Before it purchased components for the facilities or trains, it already knew what kinds of materials could be used in what components, and what parts should be purchased for the technological products used in the system. Therefore, even without the same international consultants, the DORTS and its contractors can now build a new line or new station with the same quality and standard. If the international consultants' experiences in London, Hong Kong, Washington, San Fransisco, and Atlanta had not traveled to Taipei, we can imagine how difficult it would have been to compose such detailed manuals. The Brown Line, as we will see in chapter 6, faced the painful process of its construction due to the DMJM's lack of experience of building an automatic transit system so that the DORTS could not compose such detailed manuals and specs as we find in manuals for the traditional railway metro line[300].

[298] The interview with TP03.

[299] The interviews with TP03 and TP04.

[300] The interview with TP02.



	HOR.	HOR.X2	VERT.		HOR.	HOR.X2	VERT.
A	0	0	0	M	11.45	22.90	139.28
B	10.50	21.00	0.18	N	12.24	24.48	142.09
C	25.97	51.94	2.25	O	16.50	33.00	146.50
D	35.97	71.94	14.00	P	44.86	89.72	156.81
E	35.99	71.98	14.26	Q	55.68	111.36	159.12
F	37.04	74.08	35.29	R	71.28	142.56	160.23
G	35.07	70.14	38.26	S	75.00	150.00	164.22
H	16.50	33.00	45.00	T	75.00	150.00	170.00
I	12.23	24.46	49.42	U	73.00	146.00	172.00
J	11.46	22.92	52.20	V	0	0	172.00
K	8.25	16.50	79.75	W	37.15	74.30	37.50
L	8.25	16.50	111.75	ALL DIMENSIONS IN mm			

Figure 5.7: The Planning Manuals of the DORTS

Figure 5.8: The Planning Manuals of the DORTS[301]

American Experience and Bilingual Consultants

One phenomenon is worthy of note regarding technology transfer in the project of the Taipei Metro: the involvement of Taiwanese American and returning-students. Besides David Poo, who joined the project of the Taipei Metro in the early stage, many engineers had studied and got degrees in the U.S. Paul Lai was another example. He received a degree in civil engineering at MIT so that he could easily communicate with the international consultants and set up English interviews for the applicants who wanted to enter the DORTS. Paul Lai's policy led to the presence of those who once studied in the U.S., meaning the American experience did not only come from American consultants but also the members of the DORTS. The DORTS' technical officials' American experience had advantages for the project. Firstly, those who had the experience of living in the U.S. knew more about how to communicate with English-speaking consultants. With the policy of "working in the same office," technology transfer heavily relied on personal interaction between Taiwanese engineers and international consultants. If Taiwanese

[301] The pictures show the 11th version of planning manuals completed in 1997.

found it difficult to communicate or to interact with international consultants, they would find it difficult to actively learn from the consultants[302]. Secondly, some of those who studied in graduate programs in the U.S. had experience in the management of projects, just what a newly established institute like the DORTS lacked, especially for those who served as supervisors[303].

In addition to the engineers of the DORTS, many Taiwanese Americans, Taiwanese who studied in the U.S., and Hong Kong people working for American companies also joined the metro project as consultants or suppliers. According to Hu and Sun, at least twelve ATC's consultants were Taiwanese American, Chinese American, or Hong Kong people[304]. These consultants had bilingual abilities and multiple cultural backgrounds so that they could be intermediaries between international consultants and Taiwanese engineers. For example, when technical officials, local consultants, and international consultants investigated the location of a future station, technical officials and local consultants would put more weight on citizen's reactions or on whether citizens would protest or not. International consultants often did not understand this due to their experience in American cities. At this time, the bilingual consultants could help them to understand each other, enabling them to reach joint conclusions[305]. Furthermore, for technology transfer, some Taiwanese technical officials made significant progress due to bilingual consultants' efforts[306].

American supervisors were often not happy with Chinese-speaking consultants' bilingual ability and cultural backgrounds because they could not understand the conversation between the bilingual consultants and Taiwanese technical officials and thought that they were talking about something that they did not want the American managers to know. Moreover, those bilingual consultants who had grown up in Taiwan would also face tension with some Taiwanese technical officials and local consultants because of their higher wages and status[307]. Some of the bilingual consultants or Taiwanese American engineers working for international suppliers stayed or returned to

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[302] The interviews with TP03 and TP06.

[303] The interviews with TP03 and TP06.

[304] Hu and Sun, "General Consultants," Pp. 66.

[305] The interview with TP04; Hu and Sun, "General Consultants," Pp. 66.

[306] The interview with TP03.

[307] The interviews with TP04 and TP05.

Taiwan, continuing to dedicate their effort to mass transportation projects after the contracts were over[308].

Besides the BMTC and the ATC, many other international companies, especially American companies, were also involved in the construction of the Taipei Metro as professional advisors in a specific subproject, as construction management advisors, as counterparts of local contractors, and as equipment suppliers. For example, T. Y. Lin International's Taipei branch did not only join the construction of the railway metro lines but also joined the driverless system team led by Matra and participated in the construction of the Brown Line. As an American engineering company founded by a Chinese American, T. Y. Lin, it had run its branch in Taipei for many years and hired many Taiwanese engineers, especially Taiwanese American and Taiwanese who had the experience of studying or working in the U.S. "In the 1980s," said one of my informants, "many American Taiwanese and returning-students went back to Taiwan creating an international environment. Some of them joined the electronic manufacturing industries while some of them joined the transportation system building, and everybody can see their contribution[309]." Although the DORTS, its consultants and suppliers did not have Taiwanese American superstars like Morris Chang (張忠謀), who was one of the founding fathers of the Taiwan Semiconductor Manufacturing Company (TSMC), or Simon Sze (施敏), who invented non-volatile semiconductor memory with his colleagues, the Taiwanese Americans and returning-students did contribute to changing Taipei with their professional knowledge, experience, and the artifacts mobilized by them.

Mobilization of Knowledge and People

As the capital city of the island state when Taiwan was a rising economic power and undergoing dramatic urbanization, Taipei faced a crucial challenge of traffic congestion in the 1980s. To overcome the congestion problem, the KMT government eventually initiated projects for mass transportation systems. One was the subterranean railway in Taipei, and the other one was the Taipei Metro. From the TMRT in the TPB and the following IOT, the Taiwanese technical officials introduced British consultants into Taiwan so that British ideas of mass transportation systems and designs entered Taiwan integrated with the subterranean railway consulted by German consultants. The change of the U.S.-Taiwan relations again bought change to the development of mass

[308] The interviews with TP04, TP05, and TP10.

[309] The interview with TP10.

transportation technology in Taiwan. The huge trade deficit between the U.S. and Taiwan drove the U.S. government to pressure the KMT government to hire American consultants. Therefore, in the stage of realizing transportation planners and engineers' ideas and designs, American contributions returned to Taiwan. At the same time, the government started to mobilize Taiwanese professional human resources, including Taiwanese Americans and returned-students who had studied their profession in the U.S. Hence, the initiation of the project of Taipei Metro was not just the beginning of construction of a metro system. However, it was also a transnational mobilization of knowledge, experience, and people. The goal of the mobilization was to reshape Taipei's transportation systems and even life in the city.

The mobilization of knowledge and people can be categorized into different types. First, Taiwanese technical officials mobilized knowledge and people transnationally from the U.K, and the U.S. In doing so, their knowledge derived from the metro systems in Britain, Hong Kong, San Fransisco, Washington D.C., and Atlanta would travel to Taiwan and be integrated with Taipei's local context. Second, the project of the Taipei Metro also mobilized more Taiwanese engineers from agencies within the government, military, state-owned consultants, national universities, and private companies. On the one hand, the Taiwanese engineers contributed their professional knowledge and effort to the construction of the Taipei Metro. On the other hand, they were the receivers of the knowledge and experience of metro systems that traveled transnationally with the international consultants meaning that these engineers would be the future human resources of mass transportation technology in Taiwan. As a result, the Taipei Metro was also a project aiming at incubation, and the policy of "working in the same office" was the strategy championing this goal.

Moreover, the Taipei Metro also mobilized Taiwanese/Chinese American and returning-students studying in the U.S. Taiwanese Americans and Taiwanese returning-students, like David Poo and Paul Lai, brought their profession and American experience back to Taiwan, and, especially those who worked for the ATC and international suppliers, played an important role in helping the communication between the international consultants and Taiwanese engineers. Therefore, their involvement was also a part of technology transfer and human resources incubation, a phenomenon that echoes Wang's study of American science and technology's spread in China[310]. Last but not least, we need to note that the U.S. government's interruption of the project of the Taipei Metro led

[310] Wang, Zuoyue, "Transnational Science during the Cold War: The Case of Chinese/American Scientists" in *Isis* Vol. 101, No. 2 (June 2010): Pp. 367-377.

to American companies' involvement in the Taipei Metro, which is why so many Taiwanese/Chinese Americans joined the projects. The mobilization of these people were driven by the changing U.S.-Taiwan relations in the 1980s.

The mobilization also teaches us a lesson. Although the American hegemony of mass transportation technology in Taiwan ended in the late 1970s, American supremacy in this field over Taiwan still existed. Taiwan could introduce alternative resources like Germany and the U.K. to help its development of mass transportation systems, but, once the U.S. leveraged its political hegemony over Taiwan, Taiwanese technical officials and political leaders, especially those who worked in the CEPD, would again agree to introduce American knowledge and experience. The American hegemony of technology did not exist, but the way how the hegemonic power operated remained because the American political hegemony was remained, though it even though it had retreated for some years in Carter's period. This does not mean that Taiwan would return to the track of Americanization of its mass transportation technology once the project was on the way, and the TRUPO and the DEC ad already acquired the land to build the subterranean railway.

When the knowledge, experience, and people traveled to Taipei, all of the actors realized, materialized, and integrated the knowledge and experience through their technical practice making design blueprints into stations, tunnels, elevated ways, power systems, signal systems, and even a metro company so that they did not only plan Taipei. They also reshaped Taipei. The technological hybridity of knowledge and styles went further and deeper. That being said, the mobilization of the transnational knowledge and people in the project did not inevitably lead to the hybridity. We need more details about the process of hybridization to assess its importance, especially since it involved considerable tension and conflict, rather than cooperation, between Taiwanese and American engineers.

Chapter 6: Taipei Metro II

Dancing with America: 1979-1997

"The superiors told me: 'national security is more important,' hoping me to weigh national security more. The old gentlemen who were friendly to me, such as K.T. Li, talked to me: "many policies were determined with the non-technical perspectives so that things could be in line with the national interest. Do you get it? (他們跟我講說：「國家安全為重。」希望我以國家安全為重。好像對我比較友善的老先生，像李國鼎跟我講說：「很多事情是非技術層面做的決策，才會符合國家利益，這樣子你聽不聽得懂？」)" Anonymous informant, 2019.

"Our interest is also a direct result of our industry's unique capabilities to address these problems. Equally important, we view American participation in Taiwan's transit projects as a singularly significant opportunity to reduce the growing bilateral imbalance of trade, which would assist in relieving the political pressures for protectionism mounting in the USA." Ralph L. Stately, Urban Mass Transportation Administrator (1983-1987), 1984.

In this chapter, we focus on the tension between the DORTS (Department of Rapid Transit System) and the international consultants, especially the American consultants. By discussing this tension, we look at the DORTS' strategies to complete the first phase network of the Taipei Metro and to incubate Taiwanese metro experts on one hand, and to seek alternative resources which it regarded as needed maintaining its autonomy on the other hand. In this way it will become clear how technological hybridity, be it at the knowledge phase or the material phase was manifest in the Taipei Metro.

The TTC, the ATC, and Reagan

Why the TTC?

In 1984, the counselor of the CEPD (Council for Economic Planning and Development), Fu Chia-chi (傅家齊), was thinking about how to integrate two metro networks proposed by the TPB (Transportation Planning Board) and Taipei City Government. Moreover, he was also thinking about how to reply to the U.S. government's proposal of purchasing American professional services to reduce the trade deficit

between the two countries. Counselor Fu concluded that an integration study of the two systems was necessary, but was unsure which international consultants to hire. With the Urban Mass Transportation Administrator, Ralph Stanley's coordination, thirteen American metro related companies including Bechtel, the P&B (Parsons and Brinckerhoff), and De Leuw Cather, formed the U.S.-Taiwan Transit Group (USTTG) to provide technical suggestions about the integration of the two metro networks to the Taiwanese government. Moreover, the USTTG applied to the U.S. Trade and Development Program (USTDP) from the Federal government to provide US$500,000 for this study. Stanley specifically stated that buying American companies' professional services for the Taipei Metro would compensate for the imbalanced trade between the U.S. and Taiwan. At the same time, the German consultants, the DEC (Deutsche Eisenbahn Consulting), and the British consultants, the BMTC (British Mass Transit Consultants), were serving the TRUPO (Taipei Railway Underground Project Office) and the TPB (Transportation Planning Board). Furthermore, other countries like France also showed their interest in providing consulting services. Facing this situation, Counselor Fu first excluded the Ministry of Transportation and Communication (MOTC) as the agency in charge of the integration study because the MOTC strongly opposed the Taipei City Government's idea of building an automated guideway transit (AGT) metro system. Also, the DEC planned the S1 line, which caused a severe controversy so that he excluded the German and British consultants since they were working for the agencies belonging to the MOTC. Eventually Counselor Fu listed three possible candidates as consultants for the integration study[311].

First, he accepted the USTTG's proposal to hire the three American companies, the DMJM[312], the De Leuw Cather International, and the TRAAC International Consultants, as consultants for the integration study. If the Taiwanese government chose this option, the USTDP would pay all consulting fees to the American companies, and the USTDP could also pay the cost of the local counterpart after negotiation. Second, the CEPD paid the consulting fees but still hired the three American companies as international consultants. Third, the CEPD paid the consulting fees and opened a bid to all qualified international consultants, including American companies[313].

For the first option, Counselor Fu found that only six companies were consultants among the members of the USTTG, so hiring the American companies as the consultants

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311 National Archives 國家檔案閱覽中心, "Metro System 捷運系統," December 4 and 7, 1984.

312 It was pronounced "Dim-Jim," meaning the abbreviation of the four founders, Phillip Daniel, Arthur Mann, S. Johnson, and Irvan Mendenhall.

313 National Archives 國家檔案閱覽中心, "Metro System 捷運系統," December 7, 1984.

would undermine the objectivity of the process. Furthermore, if the Taiwanese government received the proposal of hiring the American consultants for free, it would no longer really be a 'client' in the program, and the U.S. would have too significant an effect on Taiwan. Against this, Counselor Fu listed two advantages: the CEPD could save money, and this option could fulfill the U.S. government's demand. For the third option, Counselor Fu mentioned that the U.S. government highly valued the business. Indeed, Ralph Stanley led the members of the USTTG to visit Taiwan in July 1984, and then in November and December, the officials of the American Institute in Taiwan (AIT) visited the CEPD twice discussing this case. Thus, if the CEPD opened the bid for this case to other countries, the U.S. government would be extremely disappointed. Moreover, to maintain the objectivity to review the TPB and Taipei City Government's metro system proposals, the CEPD needed to exclude the German and British companies. Therefore, the French state-owned SOFRETU (Société française d'études et de réalisations de transports urbains) would be an option due to its abundant experience of consulting metro projects. But, the SOFRETU had a deep connection with another French-Egyptian engineering company, the Interinfra Group lowering the chance for SORETU to win the bid leading to the consequence that American companies including the DMJM, the De Leuw Cather, the Ralph Parsons, and the P&B would still win the bid. Finally, opening a bid would spend much more time than directly hiring consultants. Therefore, although the CEPD needed to spend half of a million US dollars to buy the consulting service without competition, the Counselor Fu recommended the second option: the CEPD directly hiring the USTTG's members as consultants of the integration study. The minister of the CEPD, Chao Yao-tung (趙耀東), agreed with Counselor Fu's suggestion[314].

Counselor Fu's reasoning and the CEPD's decision shows two crucial things First, when the Taiwanese government was thinking about the planning and construction of the Taipei Metro, the U.S.' attitude was weighted heavily. As I mentioned in the previous chapter, Taiwan and the KMT government faced a political crisis in the early 1980s after it lost most countries' formal recognition. Facing the rising democratic movement at that time, the KMT government's legitimacy to maintain its authoritarian regime was eroded by losing international recognition as the only legal representative of China. Furthermore, China also announced its unification project, "One nation, two systems," at this time, weakening the KMT government position. Therefore, American military and political protection became even more vital, and the U.S.' dissatisfaction with the imbalance in

[314] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," December 7, 1984.

trade between the two countries became something that could not be ignored. Second, Counselor Fu noticed the importance of autonomy, no matter as a nation or as a client of a metro study project. To satisfy the U.S., Counselor Fu decided to hire the three American companies directly. However, he refused to receive American financial support in this case because he understood that Taiwan would lose its power of choosing suppliers and contractors when the project started to be implemented if Taiwan accepted the support. Using the same logic, he excluded German and British consultants for the objectivity of being a client. So, Taiwan avoided losing its power and judgment not only to the U.S. but also to other countries, so securing its relative autonomy.

The important 6 months

The Taipei Transit Consultants (TTC) was the joint venture of the three members of the USTTG, the DMJM, the De Leuw Cather International, and the TRAAC International Consultants, and all of them were consultants. The DMJM focused on structure and architecture, and the De Leuw Cather, as we saw in the previous chapters, was the expert used for transportation consulting the project of the National Freeway No.1. The TRAAC was a relatively small consultant based in Washington, D.C., with a Chinese American leader at that time. The advisors deployed by the three companies in Taiwan needed to integrate the two metro networks, — one by the Ministry of Transportation and Communication (MOTC) consulted by the British consultants and one by Taipei City Government planning to use the newly developed Automated Guideway Transit system —, into a single system in only 6 months (from March 1985 to September 1985). However, many important decisions were made in the 6 months.

First of all, the TTC and its local counterpart, the state-owned CECI, generated the first phase of the network for the Taipei Metro and the recommend extension network. This network had four essential features. First, it was the network with both a rapid rail transit (RRT) system and an AGT system. Second, most of the BMTC's designs were embedded in this network, including L-shape network and cross-platform interchange. Third, the S1 line was replaced by the Blue Line, which was parallel to the Taiwan Railways Administration's (TRA) West Coast Line as the main east-west metro line. Finally, the TTC planned to used the Red Line to connect Neihu, the newly developed central business district in eastern Taipei, and downtown. Among these four features, only the fourth one finally did not become true while the Brown Line using the AGT system became the one connecting Neihu, while the other three were implemented becoming a part of the Taipei Metro today.

For the first feature, the integration study of the two networks was not only a scientific study but also a political negotiation, a conflict, a competition between the technical officials[315]. Although the CEPD initiated the integration study to obtain a neutral position for the decision making, the CEPD could not easily deny all requirements submitted by the Taipei City Government, especially at the time when the democratic movement was thriving in the 1980s. Moreover, the mayors of Taipei City were mostly rising stars within the KMT government such as the president of Taiwan Lee Teng-hui, so the CEPD would have difficulty to decline Taipei City's opinion even though technical officials in the MOTC strongly opposed to build an AGT metro line in the system[316]. In fact, besides Taipei City Government, C. C. Wang, the deputy of the CEPD at that time, also supported Taipei City's idea of building a driverless metro system. C. C. Wang even arranged for K. T. Li to visit Japan's AGT systems in Osaka and Kobe, trying to exploit K. T. Li's reputation to gain support. Therefore, before the integration study started, the decision to include a driverless AGT system was taken[317].

For the second and the third features, the TTC and the CEPD did not have enough time to change the BMTC's designs too much, so what they could do was to make some minor changes and to follow most of the BMTC's plans. One of the critical differences was the cancellation of the S1 Line. The BMTC did not champion the idea of using the TRA's railway to run the metro system, either, but it still put it into its plan due to German consultants' insistence[318]. The advent of the TTC and the integration study provided an opportunity for Taiwanese officials and British consultants to abandon this design so that Taipei lost a chance to build an S-Bahn like commuter railway as the chapter 3 shows. Moreover, according to the TTC's American experience, the metro system was supposed to run independently rather than including traditional railways. Therefore, the American experience matching the TRA's lack of enthusiasm to run the S1 Line and the BMTC's opposition led to the end of the conflict of the S1 Line.

The TTC's integration study set the basic scheme of the Taipei Metro, and it also started the mixture of American and British designs. First, the Taipei Metro's network contained both British and American ideas about the metro system. Second, the TTC

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315 Wang, Hung-kai 王鴻楷. *Bureaucracies' Decision-making Ability: the Case of the Taipei Metro* 《官僚之決策能力——台北捷個案為例》. (Taipei: National Science Council Project Reports 行政院國家科學委員會專題研究計畫成果報告,1995), Pp. 54.

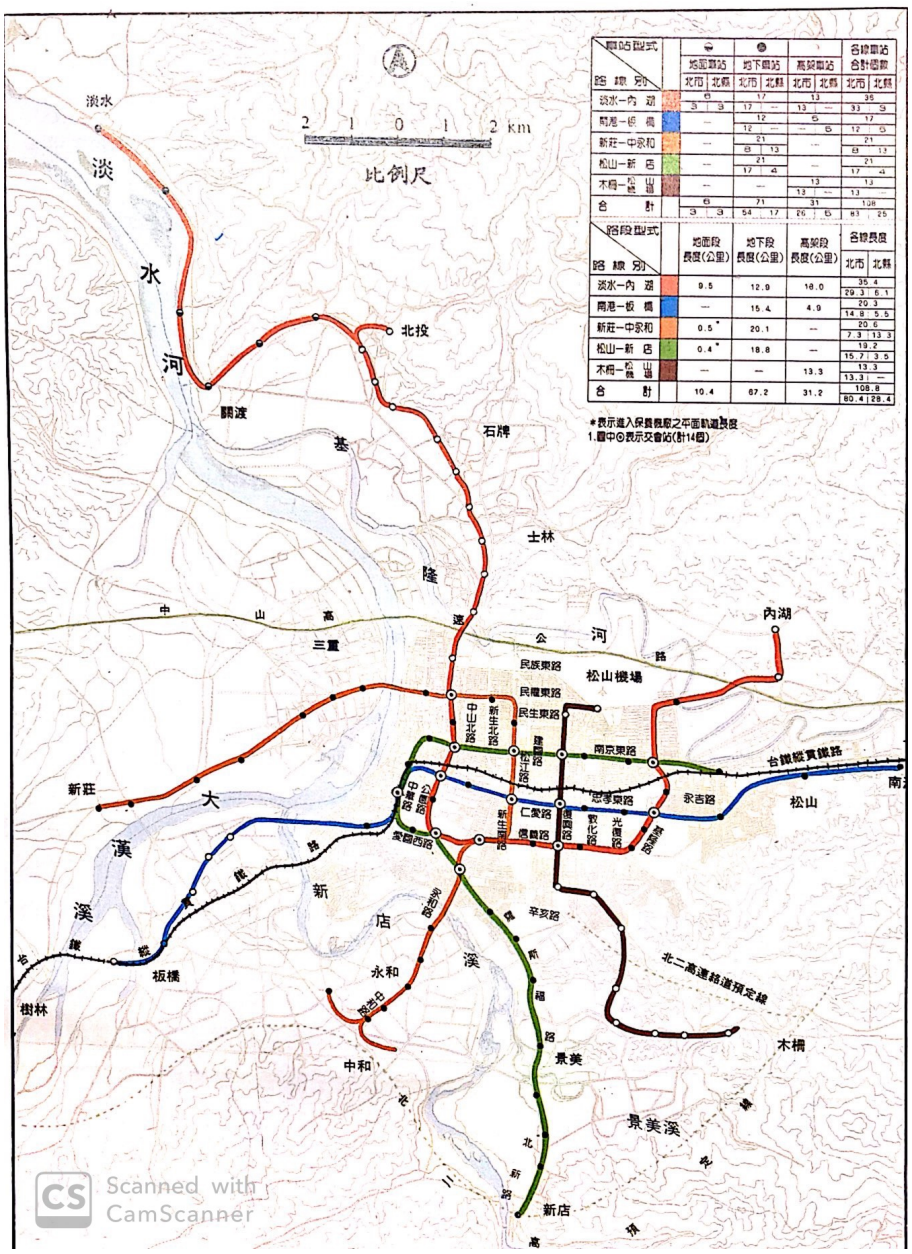
316 Huang, " Awkward Rail," Pp. 50-60.

317 The interview with TP05.

318 The interview with TP08.

revealed how the U.S. government intervened in the project of Taipei Metro. The intervention by other institutions, the USTTG, the AIT, and Ralph Stanley's actions, more or less determined the future. So, the TTC was just a beginning. In the stage of implementation, in which all ideas and designs would finally come into physical existence, the deeper and broader transnational design mixture showing the technological hybridity would emerge before people's eyes.

Figure 6.1: The Recommended Extensive Network by the TTC[319].



The American Transit Consultants

After the network, systems, and the agency in charge, the DORTS, were fixed, hiring international consultants to help the DORTS to complete the project was the next

[319] The Department of Rapid Transit System, Taipei City Government, *1987 Annual Book,* Pp. 27.

step. Before the establishment of the Preparatory Office of the DORTS (abbreviated as the Preparatory Office), the MOTC set up an office for implementing the Taipei Metro. The office recruited those who came from the TMRT in the IOT (Institute of Transportation), and local consultants from the CECI, and the BMTC. Among the consultants, there were 120 local consultants and 50 international consultants[320]. At the same time, the Taipei City Government also continued to plan the AGT metro systems with the help of National Ciao Tung University (NTCU, 國立交通大學)[321], three Japanese scholars from the University of Tokyo, and the transportation professor of University of Pennsylvania Vukan Vuchic who is famous for his studies of metro system planning[322]. Therefore, the planning process of the Brown Line and other metro lines using the RRT system seemed to be separated, although the two systems were integrated into one network. In February 1986, when the TTC just completed the integration study, Taipei City Government directly invited eight American companies to provide technical proposals for consulting the Brown Line. After the establishment of the Preparatory Office in December in the same year, the DMJM won the contract of consulting the only AGT metro line in the Taipei Metro.

However, the BMTC was still the general consultant of the Taipei Metro except for the Brown Line. For about one year, the BMTC and the local consultants helped the Preparatory Office and later the DORTS with work of detail design so that the DORTS could generate specs to open bids to local and international construction, power supply, system, and architecture firms[323]. Hiring the BMTC seems to have been a reasonable decision since the BMTC had been in Taipei for five years, so that it was already familiar with Taipei and its Taiwanese counterparts. Moreover, despite the TTC's integration study, the basic structure and most of the designs of the Taipei Metro planned by the BMTC and the TMRT were still ensured.

Nonetheless, the 500,000-dollar business of the integration study was not enough to satisfy Ralph Stanley and the USTTG's ambition of compensating for the trade deficit

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[320] The Department of Rapid Transit System, Taipei City Government, *1987 Annual Book,* Pp. 35.

[321] One of the top university famous for engineering fields in Taiwan. This university was established in Hsinchu in 1958 in the name of "recovery" of Ciao Tung University in China, which is known as Shanghai Jiao Tong University nowadays. No matter "Ciao Tung" or "Jiao Tong," the Chinese name of the universities is both "交通" meaning "transportation" in Chinese.

[322] Taipei City Government 台北市政府, *The Comprehensive Report of the Planning for the First Line of the Medium Capacity Transit System in Taipei* 《台北市中運量捷運系統優先路線系統規劃綜合報告》. (Taipei: Taipei City Government 台北市政府,1986), Pp. 1-2.

[323] The interview with TP03 and TP05.

between the U.S. and Taiwan. In September 1985, the AIT forwarded Ralph Stanley's letter to Taiwan's ministry of foreign affairs, in which Stanley wrote:

"From the time of my visit in 1984, I have often received warm greetings and positive responses from Taiwan, indicating a continuous interest in seeking United States sources to fulfill Taiwan's transit needs. Furthermore, I am pleased that the United States sources of rail passenger cars are still under consideration in Taiwan. However, there have been incidents which are unfortunate. For example, soon after our visit last year, the British Consultant, BMTC, was sole-source contracted as the MRT General Consultant without competition. We wish to encourage more open opportunities whereby United States participation may be possible in Taiwan[324]."

The Taiwanese government understood Ralph Stanley's message, although he said, "the USTTG was never intended to seek contracts, but was conceived of as a marketing entity[325]." In November 1986, the Preparatory Office started to compose the strategies and process of hiring long-term general consultants when it had just signed a contract with the BMTC for another six-month service to extend the previous contract from May 1985 to September 1986[326]. This action meant that the Preparatory Office was ready to open a bid for general consultants instead of directly hiring the BMTC after its formal establishment as the DORTS. The BMTC was not happy with the development since it realized this action was intended to replace it with American consultants, but the Preparatory Office did not exclude the BMTC from competing for the bid. It used the reason that the BMTC's contract of serving the Preparatory Office was merely the extension of the contract signed by the TPB so that it was necessary to go through the bidding process[327].

The Taipei City Government selected seven related officials and seven external experts to form the committee to review general consultants for the Taipei Metro. The committee decided to invite companies to satisfy the following requirement: the three best candidates in the bid for the planning of a mass transportation system in Taipei in 1977 and the bid of the consulting service for the TPB to plan the Taipei Metro in 1980, the consultants for the integration study of the two metro networks, the best three candidates in the bid of the consultants for the Brown Line, and the best candidates

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[324] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," September 4, 1985.

[325] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," September 4, 1985.

[326] The Department of Rapid Transit System, Taipei City Government, *1987 Annual Book*, Pp. 317.

[327] The interview with TP03 and TP05.

verified by the BMTC in the bid of consulting services for detailed design of the Taipei Metro. Thus, the committee invited seven international consultants to compete for the bid of general consultants, and five firms submitted their proposal. They were the BMTC, the DEC, the DMJM, and the Morrison-Knudsen, the De Leuw Cather and the L. C. Transit System Inc., and the American Transit Consultants (ATC)[328]. Then, according to the materials provided by the consultants, the committee chose the three best candidates (the BMTC, the ATC, and the De Leuw Cather) for the final round. In the final round, the proportion of the scores of the bid was that qualification review of the firms counted 25%, service proposal counted 50%, and oral presentation counted 25% The committee members would provide their ranking of the three firms in the oral presentation using the sum of the ranks from all committee members to decide the firm's scores in this part.

The competition of the three consulting companies was a competition between their experience and political momentum. The BMTC was strong candidate that had experience of Hong Kong's MTR (Mass Transit Railway) and its service in the TPB, both most robust resources to secure its business in Taipei. However, Ralph Stanley and the USTTG's actions showed that this British joint venture had weak political momentum to help it to win the competition even though many Taiwanese technical officials who once worked in the TPB strongly supported it[329]. The De Leuw Cather, which was an American professional transportation engineering consulting company, had the experience of consulting Singapore's MRT (Mass Rapid Transit) and its long-term connection with the Taiwanese government. Moreover, it was a member of the USTTG so that it enjoyed the political momentum created by Ralph Stanley. But, no matter its achievements in Singapore or Taipei, the De Leuw Cather could not bid for the consulting business alone due to its limited range of skills, so it cooperated with the British company L. C. Transit. Finally, before the bid for the general consultants of the Taipei Metro, no one knew the American consultants, the ATC. The ATC was a joint venture of Bechtel, the P&B, and the Kaiser Engineering[330], and two of them were the members of the USTTG. Finally, although the BMTC got the highest score in qualification review and service proposal, the ATC won the bid due to its highest score in the oral presentation[331].

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[328] The Department of Rapid Transit System, Taipei City Government, *1987 Annual Book*, Pp. 317-318.

[329] The interviews with the TP05 and TP08.

[330] Kaiser Engineering was acquired by the ICF group in 1988.

[331] The interview with the TP05.

The Bechtel Corporation, even nowadays, is the largest American comprehensive construction engineering company, and it has been involved in many infrastructure projects worldwide. The Taipei Metro was not its first business in Taiwan. In the 1970s and 1980s, the KMT government launched the project of nuclear plants after the Oil Shock, and the Bechtel worked for Taiwan Power, which is the state-owned and only power company in Taiwan, as nuclear plant experts. Furthermore, Bechtel and the state-owned consultants belonging to the Ministry of Economy, Sinotech (中興工程顧問), set up a joint venture consulting company to serve Taipower's projects. In the field of metro systems, the Bechtel cooperated with the P&B, which was an expert in transportation planning, especially rail transportation, in the project of Atlanta's metro system, MARTA (Metropolitan Atlanta Rapid Transportation Authority), and the project of BART (Bay Area Rapid Transit).

Moreover, Kaiser Engineering, which was an expert in power and electricity systems, also cooperated with the two firms in the project of the BART. The Bechtel itself also consulted the project of the WMATA (Washington Metropolitan Area Transit Authority) in Washington, D.C. The three American metro projects, MARTA, BART, and WMATA, were the products of the rise of urban transportation planning in the 1960s and the 1970s in the U.S. Therefore, the ATC was the agent introducing American experience and knowledge of its mass transportation technology into Taiwan.

The ATC also had a unique political resource: its connection with the Reagan administration. George Shultz, Reagan's second Secretary of State, started to work in Bechtel in 1974 as the vice president and then became the president of the large engineering group. The president of Bechtel was the last job that Shultz did before he became the Secretary of State, creating massive political momentum for the Bechtel to pursue business opportunities globally, especially in cases like the Taipei Metro where the U.S. government intervened in an authoritarian regime[332]. With American experience of metro projects and powerful political momentum, the ATC kicked out the BMTC, gaining the business of consulting the Taipei Metro. However, the story above shows that the Taiwanese government did not merely replace the BMTC with the ATC but held a bid hiring external committee members to review the companies, so Taiwanese technical officials still maintained their formal autonomy when facing pressure directly from the U.S. No evidence shows how the U.S. government pressured the DORTS and the higher level of the KMT government to replace the BMTC with American consultants, but officials of

[332] The interview with TP04.

the DORTS at that time all pointed out that it was the U.S. government that made the DORTS changed its general consultants[333], and we have no difficulty in imagining how it would happen given how the TTC appeared in Taipei. We need to note that the ATC was not an inexperienced company, but, according to the political economy context of Taiwan in the mid-1980s, the sentence I cited from my anonymous informant can more persuasively explain the victory of the ATC: “many policies were determined with the non-technical perspectives so that things could be in line with the national interest. Do you get it?”

The Mixture of American and British Designs

With the policy of “working in the same office," as we discussed in chapter 4, the ATC transferred its American experience, knowledge, and designs into Taipei. However, like the TTC, the ATC, local consultants, and the DORTS kept many of the BMTC’s designs and integrated them with the American designs into one system. Thus, in today’s Taipei Metro, people can easily find what designs are British and what designs are American. In this section, we focus on the network, the stations, the architectures, and the rail.

Although the TTC recommended that Taipei to continue to develop the L-shape network designed by the BMTC in the future, the Executive Yuan only approved the first phase of the network and decided that it would review and approve metro projects line by line instead of the whole network at once[334]. Hence, the TTC’s integration study did not secure the L-shape network despite its support for this design. In fact, in the first phase of the network, the Red Line and the Green Line would be run as one line directly connecting Tamsui and Xindian rather than two lines. In this stage, the L-shape was not a reality yet. After the ATC took over as general consultant, its experts and the DORTS decided to follow the BMTC’s network planning four L-shape metro lines, the Red Line, the Green Line, the Blue Line, and the Orange Line and four stations with cross-platform interchange design which accompanied the L-shaped network to decrease passengers’ efforts of changing trains when they planned the extensive network. Among all the existing lines and lines under construction now[335], the ATC contributed to all of them

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[333] The interviews with TP01, TP03, TP04, TP05, TP06, and TP08.

[334] The interview with TP01; The Department of Rapid Transit System, Taipei City Government, *Supra*, at Pp. 173.

[335] 2020. They are the Yellow Line (Circle Line) and the Light Green Line (Wanda-Zhonghe-Shulin Line 萬大-中和-樹林線).

except the Light Green Line, which was planned and designed by the DORTS and Taiwanese consultants[336]. Therefore, the ATC secured the BMTC's network leading to an interesting phenomenon. The German consultants, the DEC, designed the Taipei Main Station with the idea of the Hauptbahnhof to fulfill Taipei Main Station's role as the transportation center to deal with massive traffic and people flow gathering in one place. However, the BMTC and the two American consultants planned a network aiming at distributing passengers to different stations lessening Taipei Main Station's loading. These two designs contradicted each other in abstract, but in practice they worked together smoothly as parts of the mass transportation system in Taipei, showing the technological hybridity of style and function.

[336] The interview with TP04.

Completed MRT Routes

Routes completed for operation include the Wenhu, Tamsui-Xinyi, Songshan-Xindian, Zhonghe-Xinlu, and Bannan lines, totaling 136.6 km with 117 stations.

Approved MRT Routes under Design and Construction

Approved MRT routes currently under implementation are the Circular line Phase I, the Xinyi eastern extension, the Wanda-Zhonghe-Shulin line Phase I, the Wanda-Zhonghe-Shulin line Phase II, the Circular line north section & south section, and the Xinzhuang line (Xinzhuang Depot), totaling 60.6 km. When all routes are completed, the MRT network will reach 197.2 km in total. (The construction of the Danhai light rail, the Sanying line, and the Ankeng line, which are located in New Taipei City, is the responsibility of the New Taipei City Government.)

Planned MRT Routes

Routes planned for future expansion include the Circular line east section, the Mingsheng-Xizhi line, and the Shezi, Shilin, and Beitou light rail transit network. When all routes are completed, the MRT network of Taipei Metropolitan Area will extend for a total of 270 km with an average of over 3.6 million daily passenger trips.

Figure 6.2: The Map of the Taipei Metro and its Future Vision

In addition to the network, the ATC mostly followed the station specs suggested by the BMTC; it did some modifications based on their experience in American cities[337]. First, the ATC set the specs for a station with a larger size for two reasons. The ATC abandoned the BMTC's idea of using overhead lines to provide power to trains and used the third rail for the power supply so that the diameter of the tunnel was supposed to be smaller to lower the cost of construction. However, the ATC still set tunnel specs with a larger diameter to create more comfortable space for passengers in the trains leading to larger stations. Second, for the same reason, other sections of stations which were not impacted by the size of tunnels also became larger[338]. The design of a larger station was derived from the ATC's experiences and philosophy in the American metro systems, WMATA, BART, and MARTA, built in the 1970s. American planners of metro systems hoped to attract people out of their automobiles to metro systems so that they could reshape the way that Americans moved in cities. In their view, be it in stations or trains, the environment needed to be comfortable and attractive, or Americans would not ride on metro systems, leaving their cars at homes In his study of the history of the WMATA, Schrag argues that WMATA was the product of the Great Society liberalism which believed that public investments should serve all classes and all races, rather than functioning as the last resort[339]. When the technical officials visited the BART through the ATC's introduction, one BART employee told the Taiwanese in the train with ample space and sofa-like chairs, "the BART is going to compete with automobiles so that everyone can hold their mobility equally," thus, "the stations and the trains should be comfortable to attract people to use them[340]"

The top technical officials in the DORTS, like commissioner Chi and Paul Lai, highly appreciated this idea [341]. The BMTC's design of a station followed a programmatic philosophy focusing more on the station's functions, building costs, and operation, so it paid less attention to architecture and style of stations[342]. The DORTS and the ATC thought differently. The DORTS formed a "station-style group," inviting many influential Taiwanese architects to provide suggestions for the styles and architectures of the

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[337] The interview with TP09.

[338] The interviews with TP08 and TP09.

[339] Schrag, Zachary M., *The Great Society Subway: a History of the Washington Metro.* (Baltimore, MD: Johns Hopkins University Press, 2014), Pp.5.

[340] The interview with TP09.

[341] The interviews with TP03, TP08, and TP09.

[342] The interview with TP08.

stations[343]. It even specially held a seminar to discuss the style of the stations on the Red Line because most of the stations on this line are on an elevated track above the ground and it believed the visual effect was remarkable. Finally, the seminar concluded that the architecture of the stations should exhibit a "modern interpretation of traditional Chinese architecture.[344]" Thus, now we can see the Red Line's elevated stations and the stations on ground level all follow this instruction with Chinese style appearance and architectural language. The DORTS even built the monumental and dragon-like Jiantan Station as the symbol of the Taipei Metro. In other underground stations, the DORTS also arranged many artworks to make the stations attractive. Nowadays, if we visit the Taipei Metro's stations, which were built later or the stations in other Taiwan's metro systems, we can find that monumental architecture and artworks have become a defining feature of Taiwan's metro system.

Figure 6.3: The Xinbeitou Station[345]

[343] The interviews with TP08 and TP09.

[344] The Department of Rapid Transit, *The Q&A of the Project of the Taipei Metro*《台北都會區捷運系統建設計劃問答專輯》. (Taipei: The Department of Rapid Transit System, Taipei City Government 臺北市政府捷運工程局, 1988), Pp. 29.

[345] The terminal station of the branch line, Xinbeitou Line, of the Red Line. "Xinbeitou 新北投" means "new Beitou" in Chinese. TP09 provides this picture.

Figure 6.4: The Jiantan Station[346]

Finally, the ATC also changed the specs of the rails of the Taipei Metro. Initially, the BMTC used the Pandrol, which was invented by a British company as fasteners of rails and rubber straps to fix rails on the block. Nonetheless, the ATC abandoned this design; instead, it used the Vossloh invented in Germany[347]. The ATC thought the Pandrol might be shaken loose by metro trains so that it followed the experience of LA's metro system using the Vossloh. Hence, the DORTS' construction contractors needed to purchase the Vossloh from Germany, leading to the fact that Taiwan's metro systems set the standard of rails of metro systems with German specs instead of either British or American specs since no American company produces this component[348]. Besides this fastener, the ATC also modified the design of the structure, adding concrete cubes to absorb stray current caused by high-voltage current from the third rail because the stray current would cause galvanic corrosion damaging rail and other metal parts on rail[349].

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[346] TP09 provides the picture.

[347] Pandrol and Vossloh are also the British and German companies' names of rail components suppliers who invented the two artifacts.

[348] The interview with TP09.

[349] The interview with TP09.

Figure 6.5: The Pandrol Fastener[350]

Figure 6.6: The Vossloh Fastener[351]

[350] "Pandrol-Wikipedia" https://en.wikipedia.org/wiki/Pandrol. Accessed on November 27, 2019.

[351] "Vossloh North America" http://www.vossloh-north-america.com/us/products-and-solutions/products-and-services/rail-fastening-systems/dff-systems/. Accessed on November 27, 2019.

Strategies of the Taiwanese

The ATC was the product of the political momentum of the U.S.-Taiwan relations, and, in fact, its experience of American metro systems was still immensely superior technologically to the Taiwanese. But, the Taiwanese technical officials and engineers were not wholly inexperienced, and there was tension between the American consultants and the Taiwanese clients, especially when many Taiwanese who that they were forced to receive the American professional service. Taiwanese technical officials could not be sure whether the suggestions and designs provided by the ATC were the best or not. Moreover, the Taiwanese even found that some of the American advisors were not qualified or helpful[352]. For example, in the case of the power supply system for the Red Line, Siemens, which was the supplier of this system, pointed out that the ATC's design might cause harmonic resonance of current so that the power supply system could be damaged. Siemens corrected the design solving the problem, but the DORTS paid additional money for this modification[353]. In some extreme cases, some of the American advisors got into conflicts with Taiwanese yakuza due to prostitution, gambling, or love affairs[354]. Even at the highest level of the relationship between Taiwanese clients and American consultants, the DORTS tried to guarantee its autonomy as the client and the representative of the country even though America still held technological superiority — as did counselor Fu when he faced the pressure from the U.S. Hence, the DORTS, as the TPB did in earlier days, took some strategies to deal with the tension.

The first strategy was to use the international consultants to review each other's designs, a strategy that was not something new to Taiwanese technical officials. When the TPB hired the DEC to consult the subterranean railway project, the TPB also hired Japanese consultants to review the DEC's ideas. The DORTS followed a similar approach, but the particular methods varied in several ways. For planning and civil engineering, the DORTS asked the ATC to hire some of the BMTC's British, Pakistani, and Hong Kong experts as advisors continuing to serve the project of the Taipei Metro since the ATC did not have enough experienced metro planning experts[355]. Furthermore, these former BMTC's consultants were highly appreciated by the Taiwanese officials and cooperated well with some Taiwanese officials. Thus, after the consultants returned to their consulting

[352] The interviews with TP05, TP06, TP07, TP08, and TP09.

[353] The interviews with TP03 and TP06.

[354] The interview with TP05.

[355] The interview with TP05.

jobs, the DORTS officials often asked them to review American consultants' plans and designs to make sure it got the best outcomes[356].

As for the whole new AGT system, the VAL (Véhicule Automatique Léger), provided by France's Matra, and the consultants lack of experience of AGT system, the DMJM, the DORTS took two actions to check and to review Matra's work. First, it asked the only two users at that time of the VAL, Lille in France and Jacksonville, FL, for opinions to deal with the system and with Matra. The DORTS weighted Jacksonville's opinions and experience more since it was not a French city[357]. On the other hand, the DORTS also asked the ATC to check the DMJM and Matra's designs as a favor, although the Brown Line was out of the ATC's worklist according to the contract[358]. In some specific cases of deigns and engineering, the DORTS would hire project advisors instead of seeking the American general consultants' service, and many of the project consultants were Japanese firms[359].

Furthermore, after the detail designs of the whole system were ready, the DORTS still controlled the power of biding, preventing the American consultants from giving favors to American firms except for items that Taiwanese companies could not provide, such as signal control system and trains. Indeed, Chang has pointed out that the DORTS had the mission of incubating local civil engineering firms in the construction of the Taipei Metro, so it separated bids of system and of construction so that Taiwanese firms could get the business of civil engineering in the Brown Line[360]. Indeed, the general reports of each line of the Taipei Metro show that there was no tendency in which American companies got more contracts in the bids of civil engineering, environmental engineering, and design lots than local companies or companies from other countries[361] echoing my informants' responses to the question if hiring American consultants caused American companies to win more business than their competitors[362]. Local engineering firms, especially the state-owned companies like BES (Bureau of Engineering Service)

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[356] The interview with TP03.

[357] The interview with TP01.

[358] The interviews with TP01 and TP10.

[359] The interview with TP09.

[360] Chang, "Constructing the Taipei Metro Muzha Line," Pp. 159-224.

[361] For example, see *The General Report of the Red Line of the Taipei Metro* 《臺北都會區捷運捷運系統淡水線工程總報告書》.

[362] The interviews with TP01, TP03, and TP06.

Engineering[363] (中華工程公司), CECI, Sinotech, and the CTCI Corporation, played essential roles in building the Taipei Metro.

However, this strategy does not mean that American companies did not have any advantages as regards getting new business. When choosing suppliers for the fields in which Taiwanese companies had no experience, the ATC's service would frequently favor American companies even though it did not intend to do so. For example, in the bids for the signal control system for RRT metro lines, the General Railway Signal Company (GRS)[364] which was a member of the USTTG beat its British competitor, winning the contract because it was more familiar with American signal control specs, and the ATC was also more familiar with its products[365].

In this case, the DORTS made a trade-off decision to reserve its and the future operator of the system, the Taipei Rapid Transit Corporation's (TRTC), autonomy. The DORTS opened a bid for the signal control system for all RRT metro lines rather than call for individual bids for each line. This decision had a disadvantage. The signal system supplier, the GRS, and later Alstom, became the only supplier of parts of the system and the extended lines' signal system so that the TRTC would pay more for it. However, this decision had several advantages. First, trains could run on any line of the network making it far easier for the TRTC to schedule train services. The BMTC designed the L-shape network and cross-platform interchange for distributing passengers and decreasing the effort of changing lines. This design also made it possible for different lines to connect by pocket tracks because the tunnels of different lines became parallel when they were close to each other in the interchange stations with cross-platform interchange. For realizing this feature, the signal control system had to be the same for both. The other advantage of this decision was that the TRTC could make train manufacturers compete with each other lowering the price of trains because the whole metro network already had unified specs of trains so that any train manufacturer could join the bids for an electric multiple-unit train[366]. Future development seems to verify this strategy. In the bids of type C371 and C381 trains, the winner of the bids, the Kawasaki Heavy Industry (KHI, 川崎重工業株式会社), contracted with the Taiwanese half state-owned rolling stock manufacturer, the

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[363] BES means Bureau of Engineering Service which was the bureau within the Ministry of Economics Affairs. At this time, BES Engineering was a state-owned engineering company rather than a bureau. This company was privatized in 1994.

[364] The GRS was acquired by the Alstom in 1998.

[365] The interviews with TP02 and TP06.

[366] The interview with TP02.

Taiwan Rolling Stock Corporation (TRSC, 台灣車輛股份有限公司) lowering its cost so that the Taiwanese company could share the business.

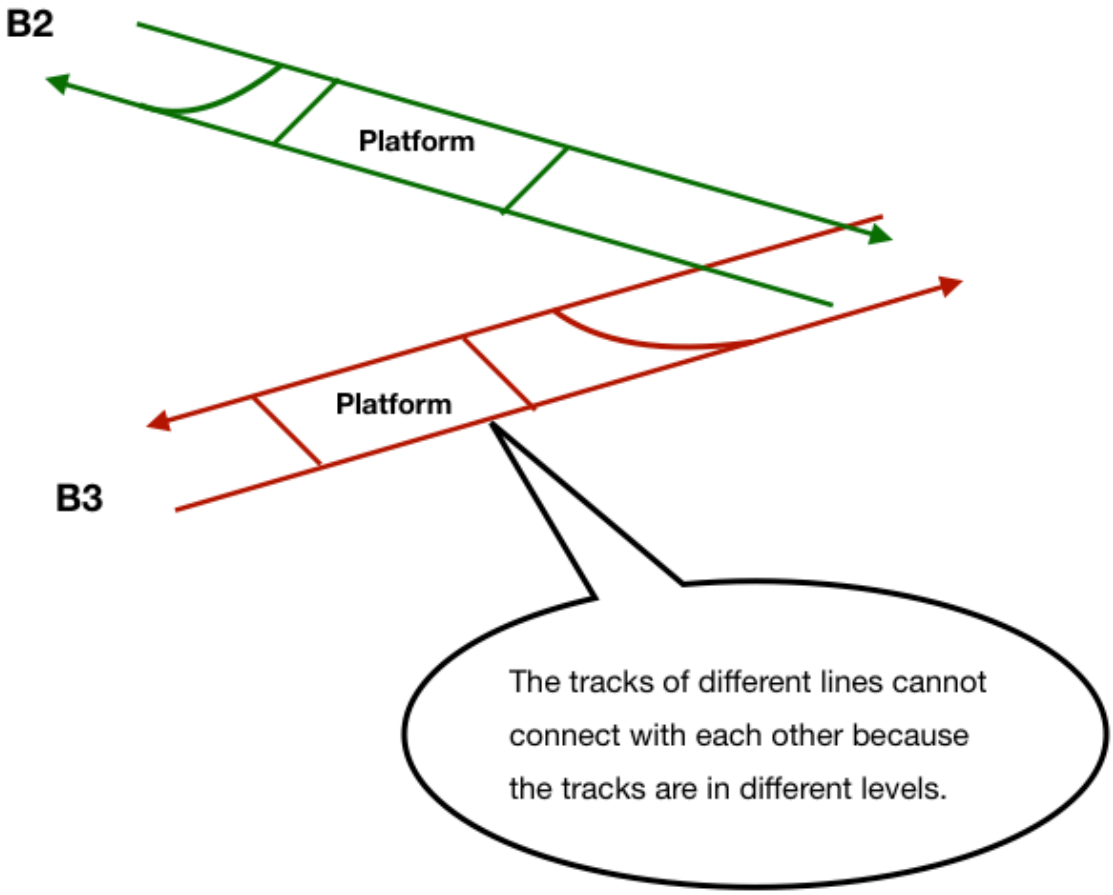

Figure 6.7: The Track Arrangement without Cross-platform Interchange

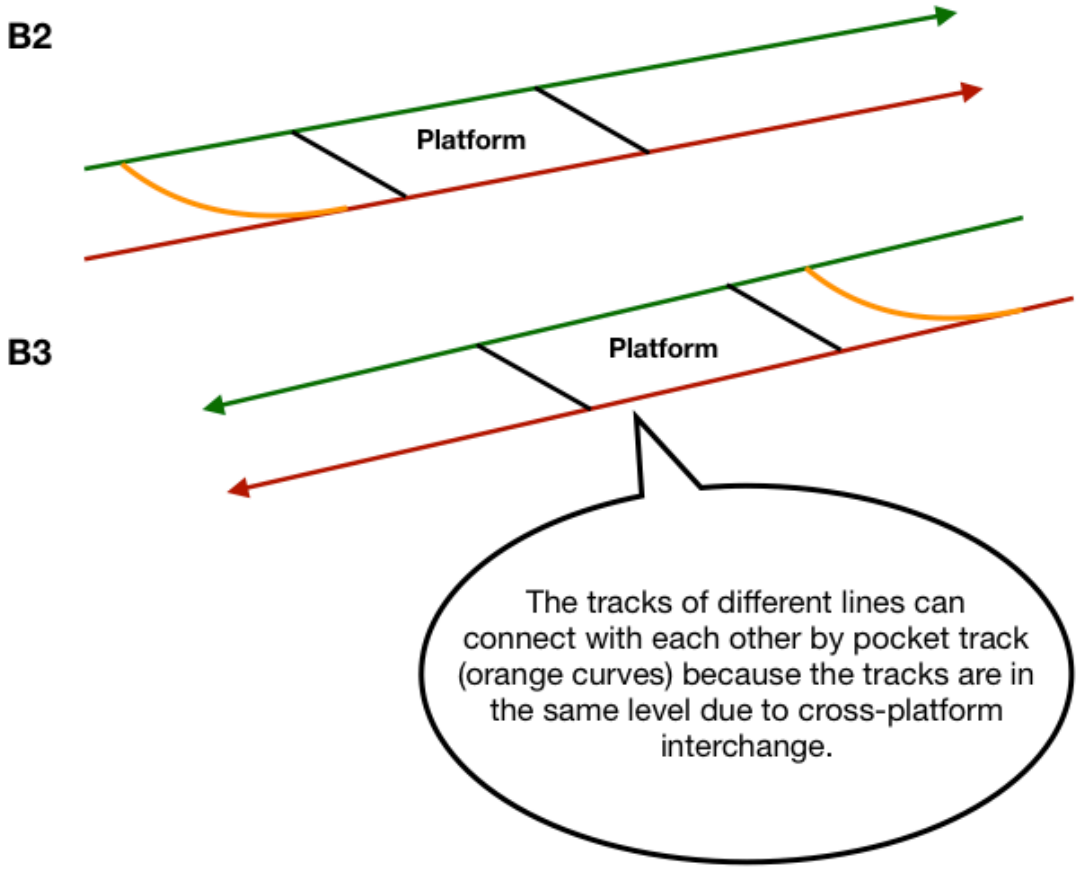

Figure 6.8: The Track Arrangement with Cross-platform Interchange

Japanese American Cars

The DORTS took the strategy of opening a bid for the signal control system for the whole RRT network so as to secure its and the TRTC's freedom to lower the cost of new trains and to create opportunities for Taiwanese firms to join the train business in the future. However, the U.S. government and American companies did not only aim at getting the business of general consultants and building the signal control system; they also targeted train manufacturing. Indeed, the consulting service could only provide hundreds of jobs for Americans, and these jobs were limited to highly-educated experts. The U.S. government wanted to create more jobs for American workers using its political leverage in the project of the Taipei Metro to reach its goal of reducing the trade deficit between the two countries. Train manufacturing became an ideal option for the U.S government.

In fact, in Ralph Stanley's letter sent in September 1985, he already mentioned that the remaining members of the USTTG—General Electric Corporation; the General Railway

Signal Company; Transit America; Westinghouse Electric Corporation; and Wabco-Union Switch and Signal—would continue their cooperative marketing strategy in Taiwan and pursue contracts on the Taipei MRT Project individually or in a joint venture as hardware and equipment needed were tendered for[367]. Under this pressure, the DORTS opened the bid of the system for the Brown Line in 1987 ahead of the bid of trains for other lines, and it took the "American-European only" policy aimed at excluding Japanese firms but including European firms in the competition. The policy had two outcomes. First, the intention to exclude the Japanese seemed to be meaningless because Mitsubishi and Hitachi used the names of the Mitsui USA and Sumitomo USA to join the competition. Second, the policy of including European led to the victory of the Matra, the only European firm among firms submitting technical proposals. This outcome disappointed the U.S. government and related American firms, and the political pressure intensified

In spite of the pressure, Paul Lai, as the chief engineer of the DORTS, still insisted that the bid for trains for the RRT metro lines should not be "American only" because he and his colleagues in the DORTS found that there was no "true" American company manufacturing electric multiple-unit trains in the U.S. In fact, all American electric multiple-unit train manufacturers were owned by other countries' firms. Therefore, he and the DORTS thought that the bids of electric multiple-unit trains for the RRT metro lines should at least be open to European countries as was for bid of the system for the Brown Line[368]. The Executive Yuan and the CEPD decided to compromise. The prime minister, Yu Kuo-hwa, directly ordered the DORTS to take an "American only" policy in this bid.

Paul Lai and the DORTS was right. The DORTS received technical proposals from three "American" train manufacturers: Breda Transportation USA, Bombardier USA, and Union Rail Car Partnership (URC). Breda Transportation USA was the subsidiary of the Italian railway equipment manufacturer, Società Italiana Ernesto Breda[369]. To compete for Taipei Metro's bid, the Breda designed an electric multiple-unit train with Hitachi's motors and Breda's bogies, and it had the experience of making trains for the WMATA and the subway of LA. Bombardier USA was the subsidiary of the Canadian huge transportation technology group, the Bombardier. According to its technical proposal, the Bombardier's

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[367] National Archives 國家檔案閱覽中心, "Metro System 捷運系統," September 4, 1985.

[368] The interview with TP03; Liu and Lu, *The Lesson,* Pp. 142.

[369] The Breda was merged with another Italian railway equipment manufacturer, Ansaldo, in 2001, forming the AnsaldoBreda. The AnsaldoBreda was acquired by the Hitachi in 2015, reforming as the Hitachi Rail Italy (HRI), becoming one of the biggest railway equipment manufacturers in the world.

electric multiple-unit train would have motors from GE, traction control, and power equipment from Westinghouse. Moreover, the WABCO (Westinghouse Air Brake Corporation) would supply the friction brake system to the Bombardier. Thus, three members of the USTTG joined the competition on Bombardier's trains, although no actual American train manufacturer could fight for the bid.

The URC was once called the United Rail Car Partnership. It was the Japanese firms KHI and Nissho Iwai's (日商岩井) joint venture in the U.S. In fact, the establishment of the URC was due to the U.S. government's "Buy America" provision so that the Japanese manufacturers could provide electric multiple-unit trains to American cities, mainly New York and New Jersey. Compared to Bombardier, the URC would only use the WABCO as the supplier of the brake system, and other Japanese companies and their American subsidiaries would supply most of the parts of the URC's trains. Therefore, to the USTTG's interests, the Bombardier would be the best candidate to win the bid.

However, to many people's surprise, the little known URC beat the Bombardier and the Breda winning the business in September 1988 because of its lowest price. The next March, Representative John Dingell and Senator Patrick Leahy released a press release attacking the DORTS and the URC. Senator Leahy even criticized the URC as a scam since this Japanese American subsidiary could not fulfill the requirement of " theBuy American" policy which demanded that 50% of the parts of a train should be manufactured in the U.S. while the Bombardier could easily reach 80% if it won the contract[370]. But, the DORTS and the Commissioner Chi denied the accusation emphasizing that the bid had followed a rigorous and open process, and the DORTS continued the purchase process of the URC's trains, Type C301 (ironically, Taiwan was suffering from being on the watch list of the Congress Section 301 Special Report at that time). Frankly, the URC did have experience of providing electric multiple-unit trains to American metro systems, and its establishment was due to " theBuy American" policy, so the American politicians' criticisms seemed to be groundless. In the DORTS' view, Japanese electric multiple-unit trains had a much better reputation than the North American's, and the URC did provide a better price. Three decades passed, and Taiwanese technical officials and passengers of the Taipei Metro regard Type C301 as a reliable train nowadays[371]. Thus, the victory of the URC might be not only the victory of

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[370] Liu and Lu, *The Lesson*, Pp. 142-143.

[371] The interviews with TP01, TP02, TP03, and TP06.

Japanese companies but also the victory of Taiwanese technical officials to maintain their autonomy as the client of the metro system.

Therefore, the “American only” bidding policy still had a side effect, namely a fantastic global trip for the trains. First of all, Kawasaki needed to produce key components of the trains in their factory in Hyogo Prefecture, Japan. Then, Kawasaki transported these components to the URC’s factory in Yonkers, NY, crossing the Pacific and Panama Canal. After the URC had assembled the trains, these trains would cross back to the other side of the Earth, finally reaching Taiwan. On these trains, we see two metal plates showing the manufacturers’ names instead of one, and the names on them are the Kawasaki and “the Union Rail Car Partnership from Yonkers, NY, the U.S.” The subsequent bids of electric multiple-unit trains for the RRT network have never taken the "American only” policy again because of the change of the international situation. Therefore, the Type C301 became the only type to have experienced a global trip and to have two metal name plates.

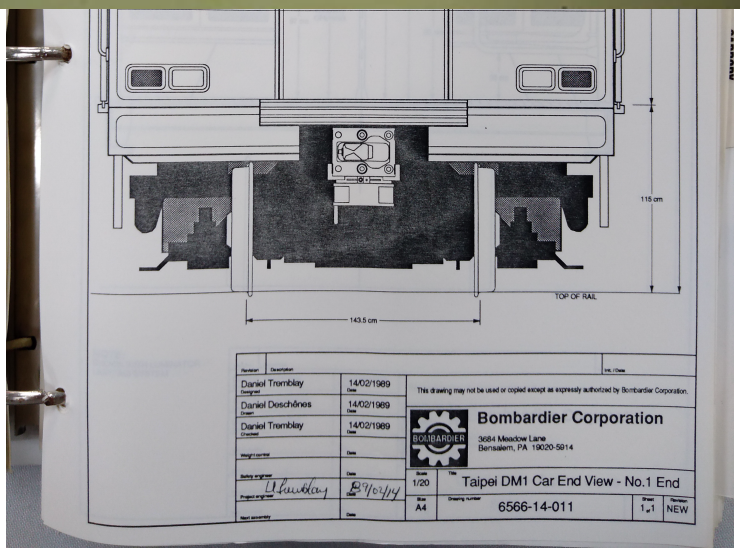

Figure 6.9: The Picture in the Bombardier's Technical Proposal

Figure 6.10: The Exterior View Plan in the URC's Technical Proposal

Figure 6.11: and 6.12: The Name Plates on the Trains Type C301[372]

Joint Development and Underground City

Joint Development means that the government or the operator of a metro system cooperates with the property owners who have properties supposed to be parts of facilities like the station and other basic components to develop business facilities. So, all actors involved in the development can generate profit thanks to the development, and

[372] 台北捷運301型電 wiki/台北捷運301型電聯車. Accessed o

the government does not need to spend an enormous budget to acquire land and buildings from property owners. The metro operator can build department stores, apartments, or underground malls to generate income, and the original property owners and investor of the joint development can share the profit. In this sense, joint development involves rewarding systems of development, institutions, regulations, particular designs of stations, and the affiliated business.

When the BMTC was still the general consultant of the Taipei Metro project, the British consultants and Taiwanese technical officials anticipated that the Taipei Metro could not solely rely on the income of tickets. So, the British consultants suggested that the Taiwanese organize a schedule for joint development. However, the BMTC did not present detailed information on the regulation of joint development, strategies for collecting funds, types of activities in the properties after the development, and the environmental evaluation of joint development[373]. Therefore, the DORTS contracted with universities and local consultants to plan joint development projects on the Red Line and to institutionalize joint development[374].

In the beginning, commissioner Chi planned to set up a public development company to implement joint development for higher efficiency and profit. However, he found that the company would not have public power to negotiate with the property owners, and the DORTS needed to acquire these properties for building stations and other necessary facilities. So he changed the plan of joint development setting up an office of joint development within the DORTS[375]. With the establishment of the office, the DORTS first hired a Hong Kong advisor to help the office to plan the process of joint development, and then sent two American consultants to the DORTS[376].

Although the U.S. had the superiority of many technologies of metro systems over Taiwan, it did not have much more experience than Taiwan and other countries at a practical level. The American consultants could not provide many practical suggestions to the DORTS since the American metro systems did not have many cases of joint development, though American scholars had produced theoretical works about it[377]. Dr.

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[373] The Department of Rapid Transit System, Taipei City Government, *1987 Annual Book*, Pp 181.

[374] The Department of Rapid Transit System, Taipei City Government, *1987 Annual Book*, Pp. 182-183.

[375] The interview with TP09.

[376] The Department of Rapid Transit System, Taipei City Government, *1987 Annual Book*, at Pp. 181; The interview with TP09.

[377] The interview with TP09.

Hwang Ti-chang's (黃荻昌) travel report reveals the American metro systems' lack of experience. Dr. Hwang spent about a month studying American metro systems' joint development in Philadelphia, Washington, D.C., New York, Baltimore, LA, and San Francisco. He concluded that Taipei needed to take the institution of value engineering in LA as a reference so that the Taipei Metro could analyze how much cost and profit would be produced by the project and how to plan the development of its facilities, especially in the stations downtown. Moreover, he also appreciated the rewarding system of joint development in New York. However, as regards examples and the practical design of joint development, Dr. Hwang mentioned that the Taipei Metro should avoid the problems of the operation of the Penn Stations in New York and Philadelphia. He also only suggested that Taipei take New York, Washington, and Philadelphia's designs as reference rather than learning from these cases. Indeed, after the period of service, the two American consultants only provided some design sketches and standard processes of joint development, providing limited assistance to the DORTS[378]. The other problem faced by the DORTS was that the cases of joint development in American cities were joint development among public agencies while Taipei needed the experience of joint development of government and the private sector[379]. Thus, the DORTS studied the cases and institutions of joint development in Hong Kong and Japan combing American experience to set up institutions and to help the central government to define laws for joint development[380].

The ATC's design of the underground malls also shows that the American consultants did not have impressive knowledge or ideas about business facilities in metro systems. Because the Red Line and the Blue Line's tunnels were built by the "cut and cover" approach instead of tunnel boring machines, the ATC thought building underground malls above the tunnels would be better than covering the completed tunnels with dirt. However, the American consultants did not carefully design the underground malls from the viewpoint of development[381]. Instead, they just designed two underground malls, and each of them connected three stations and had single-aisle and stores in one or two rows. Taiwanese technical officials and engineers quickly found that

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[378] The interview with TP09.

[379] The interview with TP09.

[380] The Department of Rapid Transit System, Taipei City Government, *1989 Annual Book,* Pp. 99.

[381] The interviews with TP03 and TP09.

this kind of design would not be suitable for Taipei[382]. Therefore, the Bureau of Public Works, Taipei City Government, as we discuss in chapter 3, hired the Kaku Morin Group (KMG) which was founded by the Taiwanese Japanese architect, Kaku Morin to study how to build better underground malls in the Taipei Metro, and it passed this project to the DORTS for implementation[383].

The KMG introduced Japanese style underground malls into Taipei due to Kaku's Japanese experience. First of all, the KMG's underground malls have two aisles rather than one so that it would have stores in three or four rows meaning more business facilities. Second, these underground malls were well organized into different areas, and different areas had particular kinds of stores. Therefore, the underground malls defined by the KMG are just like small department stores with bookstores, restaurants, coffee shops, and varieties of stores carefully arranged. The KMG also designed small plazas in underground malls for street artists or special events. We can find the same features in the underground malls in Japanese metro systems.

Because two of the Japanese style underground malls and one American underground mall surround the Taipei Main Station, three different types of designs of business facilities of a metro system are found in the same station zone: German, American, and Japanese styles. The Taipei Main Station itself follows German consultants' idea of the central station with limited business facilities and ample space for people flows. The American style underground mall on the Red Line connects the Taipei Main Station, the Zhongshan Station (中山站), and the Shuanglian Station (雙連站) with a single aisle and one or two lines of stores. The Japanese style underground malls are on the north side and west side of the Taipei Main Station with abundant business activities attracting many people to shop, to date, and to eat in the beautiful underground world. Therefore, the Taipei Main Station became a typical example of technological hybridity of styles and functions because German, American, and Japanese consultants contributed their efforts, profession, and experience or inexperience into the same station and metro system. However, Taiwanese technical officials and engineers' integration and strategies were the main driving force to make it come together as a concrete system

[382] The interview with TP09.

[383] The interview with TP09.

Figure 6.13: The American Style Underground Mall on the Red Line[384]

Figure 6.14: The Japanese Style Underground Mall next to the Taipei Main Station[385]

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[384] 中山地下街-維基百科，自由的百科全書: https://zh.wikipedia.org/wiki/中山地下街. Accessed on December 4, 2019.

[385] 誠品站前店-維基百科，自由的百科全書:https://zh.wikipedia.org/wiki/誠品站前店. Accessed on December 4, 2019.

Hybridity Emerged while Dancing

The American hegemony of mass transportation technology did not exist in Taiwan in the 1980s when Taipei City began to implement the project of the Taipei Metro, but two things still played a vital role in this large project. First, the U.S. was the hegemonic political power over Taiwan at that time. Notably, the KMT government faced a severe political crisis of legitimacy as ruling Taiwan after its lost many countries' formal diplomatic relations, including the U.S. China, simultaneously, continued to pressure Taiwan with political and military threats. Second, the U.S. still had the superiority of metro technology because of its development of metro systems in the 1960s and the 1970s. The massive trade deficit between the U.S. and Taiwan created apolitical momentum to combine these two facts leading to the return of American mass transportation technology in Taiwan. However, the return of American experts and their technology did not necessarily mean that Americanization occurred again in the 1980s. Taiwanese technical officials and engineers had become more experienced, and other international consultants from Germany, Japan, and Britain with abundant experience of metro systems were helping Taiwan. Therefore, a series of negotiation and strategies occurred between the DORTS and the American consultants in the project of the Taipei Metro to maintain Taiwan's autonomy of building even though Taiwan had no choice choice but to hire the American consultants and follow an "American only" policy in the bid for electric multiple-unit trains for the RRT network.

Thus technological hybridity emerged in the process of negotiation, compromise, and resistance of the Taiwanese. Facing political pressure from the U.S., Taiwanese technical officials, on the one hand, accepted American professional services and its technological superiority; on the other hand, they adopted several strategies to check the quality of the service and the artifacts. First of all, they had international consultants from different countries to check each others' works. Moreover, the alternative resources from Britain, Europe, and Japan compensated the professional deficit of American consultants and suppliers. Third, the DORTS insisted on their position as the client of the project. Finally, they sought local resources to help them to complete the metro system. These strategies themselves were a series of actions of mixing knowledge or artifacts, and their products, the network, the stations, the trains, and the underground malls, hence are hybrid. Technological hybridity was both the means and the outcome in the Taipei Metro.

In the cases which we discuss in this chapter, we can find the following phenomena. First of all, the knowledge or artifacts generated with different ideas were

integrated into one system, making the system workable. The network and the stations of the Taipei Metro were a typical instance. The DORTS followed the British consultants' plan building the L-shape network with four stations with cross-platform interchange, but it also followed the American consultants' experience and ideas designing larger stations and trains. The Taipei Main Station even shows how different technological ideas contradicting each other were integrated as one. Furthermore, with the return of the American experts, the DORTS redefined the meaning of the Taipei Metro, trying to shape it as a symbol of the progressive nation with its monumental architecture of stations. Last but not least, we need to note the reason why the DORTS launched the strategies was its attempt to change the power relationship between it and the U.S. while the KMT government needed to fulfill the requirement from the U.S. at the same time.

By combining the discussion in this chapter and the last chapter, the total picture of the relations between Taiwanese and international consultants became clear. The change of the U.S.-Taiwan relations caused by the imbalanced trade and the KMT government's political crisis in the 1980s drove the American metro technology to travel to Taiwan. The Taiwanese technical officials exploited the American professional service and artifacts, which might not be most appropriate for the Taiwanese but were still predominant in building the Taipei Metro. The DORTS also mobilized human resources and knowledge in and out of Taiwan in this project, building not only the system but also the ability to build more. However, the Taiwanese knew that the American consultants and suppliers might not be able to provide the best output for them.

Moreover, they also aimed at guaranteeing their autonomy in the project. Therefore, a tension between Taiwanese and Americans was inevitable. To deal with the tension, the Taiwanese took a series of hybrid strategies leading to the technological hybridity of mass transportation technology. In some sense, I would like to use "dancing" as a metaphor for U.S.-Taiwan relations in the project of the Taipei Metro. But, it was only a part of the story between Taiwanese technical officials and international consultants/ suppliers of the Taipei Metro because the problem of autonomy and the power relationship between technologically dominant countries and the catching-up country, Taiwan, did not only arise with America; alternative sources of expertise could also produce their own problems.

Chapter 7: The Hybrid Metro

The Brown Line 1982-2010

“If Matra does not pull, we pull! (馬特拉不拉，我們自己拉！).1998 ," Chen Shui-bian (陳水扁）, Mayor of Taipei City(1994-1998) and the president of Taiwan(2000-2008).1996 ,

“A key feature of the seamless integration with the existing Muzha line will be the deployment of the CITYFLO ATC technology. Proven in other urban and airport applications, the CITYFLO ATC will be overlaid onto the existing system with minimal service disruption.” Michael E. Fetsko and Marc Drolet, Vice President, Project Management, Bombardier, and Vice President, Signaling, Bombardier, 2005.

In 1996 when I was ten years old, the first metro line of the Taipei Metro, the Brown Line, opened. Like many Taiwanese, my father took me to the Taipei City Zoo by riding Taiwan’s first metro line. We did not even go to the zoo because our purpose was to see the metro line itself. The Brown Line was the only metro using the automated guided transit (AGT) system in the Taipei Metro until 2020, so, in the passengers’ eyes, this metro line does not have a driver, and its trains are running on concrete rails with rubber tires rather than steel wheels on steel rails. When we left the terminal station, the Taipei City Zoo Station, the system experienced a shutdown for about five minutes. People on the train were stunned but did not panic, and some of them started to laugh at the Taipei City Government and at the French firm Matra that built the trains. People interested in the metro line had already heard many news reports, rumors, and criticisms about this metro line. One candidate for mayor in the municipal election in 1994 even claimed that he would tear down the Brown Line because it had suffered tire explosions, fire accidents, and the councilor had strong doubts about the quality of its construction. I still remember that many questions crossed my mind, like “why does this metro line have no driver?” ” Why do the trains use rubber tires?” And “ why does this line have so many problems?”

After 13 years, the extended phase of the Brown Line, the Neihu section, opened. The extensive phase project did not only involve building the extended line in Neihu connecting to he Blue Blue Line in Nangang. It also required but integrating the existing system and trains with the new one manufactured by the Canadian transportation group,

Bombardier. Thus the Brown Line is a unique case of system integration of two different driverless and patented systems. However, the Brown Line experienced frequent shutdowns after the new phase opened, and was severely criticized leading to the resignation of the commissioner of the DORTS. Ten years have passed, and the Brown Line has run smoothly for years like other lines in the Taipei Metro. Thus more questions about the Brown Line arise. How did the DORTST integrate the two different systems? Were the difficulties encountered in the Brown Line 's extension phase avoidable? How did the DORTS (Department of Rapid Transit System, Taipei City Government) and the TRTC (Taipei Rapid Transit Corporation) overcome the problems needed to make the metro line work smoothly? No matter whether it failed or succeeded, these facts make the Brown Line the most unusual line in the Taipei Metro. In this chapter, we try to answer to the questions above by discussing the Brown Line's history.

The Prologue: the TMCTS

In 1982, the TPB (Transportation Planning Board) and the BMTC (British Mass Transit Consultants) had just completed the report of their plan of the Taipei Metro, and the Taipei City Government initiated another metro project in cooperation with the Institute of Transportation, National Chao Tung University (NCTU). In their technical report completed in 1983, they argued that the Taipei Metro would only serve the main corridors connecting suburban areas and downtown Taipei City while the minor corridors within Taipei City would be served by buses. However, buses seemed not to be an efficient means to provide service in these corridors since it was impossible to include areas for roads so that traffic congestion in these corridors would remain critical. The solution to this problem was to introduce a new type of metro system, which was newly developed in America, Europe, and Japan, a system that was cheaper, flexible, and had a high quality of service . It was called a "medium-capacity transit system (MCTS)" because its capacity was between railway transit and bus[386]. The so-called MCTS referred to the driverless metro systems with smaller architecture and higher automation levels developed in the late 1970s and the early 1980s. At that time, only a few systems provided service, and they belonged to four companies: the Matra's VAL (Véhicule Automatique Léger; France), the Westinghouse' Automated People Mover (APM; America), the UTDC's (Urban Transportation Development Corporation) SkyTrain (Canada), and Japan's New Transport

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[386] Taipei City Government 臺北市政府, *The Development Plan of the Medium Capacity Transit System for Taipei City I: System Analysis* 《台北市中運量捷運系統之發展規劃壹：系統分析》. (Taipei: Taipei City Government 台北市政府, 1983): Pp.3.

System (NTS, 新交通システム). Nowadays, these systems are called “automated guided transit,” AGT.

The main advocate for introducing the automatic system into Taiwan was Dr. Wang Chuan-fang (王傳芳), who was on the faculty of the Institute of Transportation, NCTU, and the municipal advisor to the Taipei City Government. In December 1980, the TPB held a three-day seminar on mass rapid transit inviting several American guest speakers, including two faculty of the University of Pennsylvania, one faculty of the University of Virginia, and a former executive director of the Chicago Transit Authority. One of the faculty at the University of Pennsylvania was Vukan Vuchic, who was dedicated to promoting mass transportation and metro systems throughout his career. Vuchic introduced various kinds of mass transit technology to his Taiwanese audiences, and the driverless systems caught Dr. Wang’s eye. At that time, as we said above, transportation corporations in France, Japan, and the U.S. were developing automatic transit systems, and Dr. Wang kept introducing the latest information into Taiwan, studying it with his colleagues and students[387]. The automated transit systems like the Matra’s VAL had a shorter construction period and lower cost due to its smaller architecture, but it had much higher capacity because its automated technology could shorten the time between trains. Therefore, Dr. Wang concluded that an automated transit system would be a solution to traffic congestion of Taipei and other cities in Taiwan before the completion of metro systems using traditional rail transit. For better understanding in Taiwan, he called this kind of system “medium-capacity transit” rather than “automated guided transit." He argued that the automated transit system could provide service to the routes where traffic flows were smaller than those served by traditional railway metro lines but larger than those where buses could provide service[388]. He used a metaphor to explain the function of the automated transit system: big cats walk through a big hole, and small cats walk through a small hole. How about medium-size cats? Let them walk through medium-sized holes[389]!

As the advisor to Taipei City Government and a transportation scholar, Dr. Wang’s advocacy gained Taipei City Government and C.C. Wang’s attention. In 1981, Taipei City Government contracted with the Institute of Transportation, NCTU to start the study of

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[387] The interview with TP01.

[388] The interview with TP01.

[389] Chang, Chih-jung 張志榮, *Urban Metro: Planning and Design II* 《都市捷運:規劃與設計(下)》. (Taipei: San Min Book 三民書局, 1998): Pp. 542.

the automated transit system and its possible exploitation in Taipei City. In the system analysis report, the research group suggested that the system could serve the routes which the metro system planned by the TPB could not serve, and it devised a “premetro” strategy. The so-called “premetro” strategy meant that a route would have several development stages graduating progressively towards building a regular metro line depending on its traffic flow. If a route’s current traffic flow was not high enough to support a metro line, the government should only use buses to serve it until its traffic flow grew large enough to move to the next stage, at which the government should build a "medium-capacity transit system" to serve the route. If a route with a "medium-capacity transit system" had a higher traffic flow to support a metro line or transit system with higher capacity, the government needed to plan to upgrade the system or build a traditional metro line [390]. In this strategy, “medium-capacity transit” was defined as a transit system with an independent route, certain degrees of speed and numbers of trains, and a capacity of 5,000-20,000 passengers per hour[391]. On this basis, the research group suggested several possible lines connecting the newly opened Taipei City Zoo, the new central business district in the east side of Taipei, and downtown[392].

The next year, Taipei City Government formed the “Taipei Medium-Capacity Transit System Group (TMCTS)” to plan a driverless system in Taipei. Dr. Wang was in charge of this research group. The TMCTS studied different systems worldwide including the VAL systems in Lille, the APM system in Miami, the Tokyo Monorail connecting Haneda Airport and downtown Tokyo, and the NTS systems in Kobe and Osaka[393]. It also recommended two lines that aimed at connecting the City Zoo, the new business district in the east, and the Taipei Main Station according to the traffic prediction of different areas within Taipei City[394]. Taipei City Government submitted this project to the CEPD (Council for Economic Planning and Development) asking for budgets and approval. As we discussed in the previous chapter, the U.S. government and American companies tool this opportunity to

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[390] Taipei City Government, *System Analysis*, Pp. 72-73.

[391] Taipei City Government, *System Analysis,* Pp. 107.

[392] Taipei City Government 臺北市政府, *The Development Plan of the Medium-Capacity Transit System for Taipei City II: Network Planning* 《台北市中運量捷運系統之發展規劃貳：路線規劃》. (Taipei: Taipei City Government 台北市政府,1983): Pp. 118.

[393] Taipei City Government 臺北市政府, *The Comprehensive Report of Taipei Medium Capacity Transit System Development Plan* 《台北市中運量新捷運系統發展計畫綜合報告》. (Taipei: Taipei City Government 台北市政府, 1984): Pp. 103-105.

[394] Taipei City Government, *Comprehensive Report*, Pp. 91.

interrupt the project of Taipei Metro, leading to the integration study held by the TTC (Taipei Transit Consultants). The TTC and the CEPD decided that the Brown Line, which connects the City Zoo and downtown Taipei, would be the only metro line using the automated transit system. The metro line connecting the new business district and the Taipei Main Station was planned as the Blue Line using a conventional railway transit system, as we discussed in the previous chapters.

Matra's Triumph

After the establishment of the DORTS, the group determined that the Red and the Brown Lines would be the first two lines to be constructed. For the construction of the Brown Line, the DORTS took different bidding strategies seeking suppliers and contractors from other lines, which used conventional systems. For the other lines, the DORTS opened bids for the signal control system, cars, power supply systems, civil engineering, and other events individually so that Taiwanese companies could bid for the business except for the signal control system, cars, and power supply systems, which only international suppliers were able to provide. With similar logic, the DORTS also opened civil engineering parts to Taiwanese companies. However, it combined the signal control system, cars, architectures, and the power supply system as a system bid open to American and European companies as requested by the U.S. government. This policy had two consequences. First, it invited Matra, which was one of the pioneers of driverless transit systems at that time, and, second, it aimed at excluding Japanese companies. Not only Matra but also the General Electric Company (GEC) from the U.K. submitted technical proposals to the DORTS' call for bids, though Japanese companies still joined the bidding. Moreover, the Canadian company owned by the Government of Ontario, the UTDC (Urban Transportation Development Corporation), also submitted its technical proposal through its American branch.

Including Westinghouse, six companies bid for business on the Brown Line: Matra from France, the UTDC from Canada, the GEC from the U.K., the Mitsui U.S.A., and the Sumitomo of America from Japan[395]. Westinghouse was the only "pure" American company and member of the USTTG (the U.S. Taiwan Transit Group) among all the American companies, and it presented its APM system to pursue the system bid of the Brown Line. In the 1960s, the Westinghouse already initiated a new type of transportation system using rubber tires and an automated system and built a demonstration system in

[395] The technical proposals from these companies are stored in the DORTS' library in Taipei. The technical information in this section directly comes from them.

Philadelphia. Then, in the 1970s and the 1980s, Westinghouse installed its APM system in 8 airports including Tampa International Airport, McCarran International Airport in Las Vegas, Sea-Tac International Airport, Miami International Airport, Hartsfield-Jackson Atlanta International Airport, Orlando International Airport, Gatwick Airport in England and one resort area, all before 1988 when the system bid of the Brown Line was open. The APM system had only one example as an urban transportation system, which was Miami's Metromover beginning to operate in 1986. Another system coming from North America was UTDC's Skytrain. Unlike many other automatic systems, the Skytrain, which connects Vancouver International Airport and downtown Vancouver, is powered by linear motors, and its trains run on steel rails. Because the trains only used electromagnet instead of whole motors, the Skytrain had higher speed than its competitors.

Mitsui and Sumitomo, as two giant Japanese trading groups, did not produce transportation equipment, but they were coordinators of two Japanese systems. Japanese companies often take a similar strategy to seek substantial business projects. What Mitsui represented was Hitachi's Monorail systems, which served in Tokyo to connect the city to Haneda International Airport in the 1960s and to Kitakyushu in the 1980s. Mitsui actively promoted Kitakyushu's system since it was new and had a higher degree of automation. The most distinctive feature of the Monorail system was that the trains did not run on concrete tracks or steel rails; instead, they were held on a concrete track by their rubber tires so that the architecture surrounding them was minimal. Sumitomo submitted the Mitsubishi Heavy Industries (三菱重工業株式会社) and the Niigata Engineering's (新潟鐵工所[396]) NTS system. Like APM and VAL, NTS also exploited communication technology to increase its degree of automation, and it also used concrete tracks and rubber tires for better acceleration and braking so that the passengers could enjoy more trains per time slot. The NTS' examples were Osaka's Newtram connecting Itami Airport and downtown Osaka and Saitama's Newshuttle.

The GEC and the Matra were the two European companies bidding for the Brown Line's business. GEC had a long relationship with Taiwan's railway while the Matra's VAL system caught much attention all around the world at that time. In the project of electrification of the West Coast Line of the TRA (Taiwan Railway Administration), GEC was the supplier providing electric locomotives and the first electric multiple units for the

[396] Niigata Engineering went bankrupt and dismissed in 2001, and other Japanese industrial groups acquired its business units. Its rail transportation department became a subsidiary of IHI Corporation renamed as Niigata Transys (新潟トランシス) continuing to develop driverless transit systems.

intercity express trains, Type EMU100. In the bid for the Brown Line, GEC did not give a particular name for its system, but it would introduce the one it built for the Docklands Light Railway (DLR) in London. Although the GEC's system was also driverless and with light structures, it still used traditional steel rails for its trains.

Matra presented its VAL256, the number meaning that the width of the car was 2.56m, to the DORTS based on its VAL208 for Lille and Chicago O'Hare International Airport. At the time when computing power was not as powerful as today, Matra's system used a brilliant idea to reach driverless operation. On the VAL's concrete tracks, there were transmission line assembly (TLA) loops, and trains with antennas would scan the TLAs sending a signal to a central train control center that calculated where the trains were. Furthermore, the computers in the trains were embedded a program ordering how long trains would pass one TLA loop meaning trains would be fast when they passed through a larger TLA loop while they would be slower when they passed a smaller TLA loop. Thus, by arranging different sizes of TLA loops, the system could not only manage trains on tracks but also control their speed without a driver using relatively low computing power. However, like its personal rapid transit (PRT) system, the ARMIS, Alstom provided trains to the Matra because the Matra could not manufacture trains. What Matra had was the train control program and the patent for the means to control trains using the TLA.

To select the winning system, the DORTS set up a committee with members in and out of the Taipei City Government. Each member would list their first, second, and third preferences and the system gaining the highest sum of the individual rankings would win the bid. Among the 15 committee members, only Paul Lai voted the UTDC's Skytrain in first place while other committee members chose the Matra's VAL256 as the best choice[397].

Matra's victory raised a considerable controversy even though it was a pioneer in the development of automated transit systems. First of all, the decision to include European companies in the competition seemed to be the reason why Matra won the bid. Moreover, as with the consultants, "buy American" was supposed to be the policy adopted to help the KMT government to reduce pressure from Washington to close the trade deficit, yet a French company took the business under the DORTS' supervision.

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[397] The interview with TP03; Liu and Lu, *The Lesson,* Pp. 137.

Indeed, a Taiwanese newspaper pointed out that Matra was the "lucky underdog" beating Westinghouse, which was regarded as the possible winner in the bid[398].

The most sensitive issue was that there were rumors that the KMT government tried to purchase Mirage 2000 fighters and La Fayette class frigates from France after the U.S. refused to sell F-16 Fighting Falcon fighters to Taiwan. Matra's defense department had a close connection with the fighters' and frigates' manufacturers, Dassault and Direction des Constructions Navales Services (DCNS). After Matra's victory, the Taipei City Council questioned the DORTS as to whether it chose the Matra system as part of a deal that included buying French fighters[399]. In fact, in 1989, Taiwan successfully purchased Mirage 2000 fighters and La Fayette class frigates from France. It is plausible to assume then that procurement of French fighters and warships in the 1980s, when the KMT government had difficulty in acquiring advanced weapons from the USA, went along with the decision to prefer Matra over Westinghouse[400]. However, we have no definite evidence to prove the rumors so far.

Let us put aside the rumors about national defense issues. We can still explain Matra's triumph in the bid for the Brown Line. Besides cost, the Taiwanese committee weighed two abilities of the competing systems heavily: the degree of automation and passenger capacity. Although Dr. Wang and the TMCTS believed the automated transit system was suitable for the route connecting the City Zoo and downtown Taipei City, the DORTS found that traffic flow on this route would be as large as other metro lines. Therefore, the DORTS hoped not only that the driverless system could run more cars per train but also that waiting time for passengers would be as short as possible. The former meant bigger trains or more cars per train; the latter meant a higher level of automation. We also need to note that the DORTS and Taiwanese technical officials wanted to build an advanced mass transportation system to make Taipei a modern city, for which the degree of automation became an index.

Moreover, the traffic flow on the route could increase due to the city's growth and expansion, so the possibility of expansion of capacity would also an advantage. According to this criterion, Mitsui/Hitachi's Monorail was the first to be excluded. Although the trains had the most abundant space and the Mitsui and the Hitachi stated

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[398] Lin, Cheng-mei 林貞美. "Matra from France, the Lucky Underdog! 法國馬特拉公司走運了！" *The Economic Daily News*, May 1, 1988.

[399] Wang, I-chung 王一中. "Lost in Arbitration! Look Back the Awkward Road of the Metro 仲裁敗訴 回首捷運崎嶇路." *The United Daily News*, December 3, 2000.

[400] The interviews with TP02, TP03, and TP05

that the Monorail had an automatic train operation (ATO) system, they still recommended the DORTS to deploy one driver on each train for increasing departure frequency. However, despite sending one driver on each train, the shortest gap between trains was 120 seconds, which was longer than the other competitors. In this sense, the Monorail could not be recognized as a driverless transit system, so it was not “modern” enough.

The VAL256 also had the second shortest peak gap distance among the six systems thanks to its higher automation level. The GEC’s system, the Monorail, and the NTS could operate one train per 120 seconds at peak time while the VAL256 could operate one per 109 seconds. The Skytrain had a similar gap time with the VAL; it was the speediest due to the lightness of its trains. But, it was less comfortable to ride on the trains[401]. Also, the size of the car was smaller than the VAL256, and it only used 2-car trains so that it would have less capacity than the VAL256 because Matra promised that they could integrate two 2-car trains (married-pair) into one 4-car train initially and three married-pairs into one 6-car train if necessary in the future. Westinghouse's APM system was the only one that had shorter peak gap time than the VAL256, but the capacity also hindered it from beating the VAL256. One APM car could carry only 78 passengers while the VAL256’s car could carry 114 passengers. Besides its system’s superiority of peak gap time and capacity, Matra successfully included many Taiwanese companies, including the state-owned BES (Bureau of Engineering Service; 中華工程公司) Engineering Corporation, the CTCI (Chinese Technical Consulting Incorporated, 中鼎工程公司), and Haigo Shen & Associate (沈祖海建築師事務所) in the project. By contrast, others only included one or no Taiwanese company into their teams. In sum, the VAL256 was the technological system fitting the DORTS and Taipei’s technological context creating stronger technological momentum than its competitors.

I argue thus that VAL256’s higher automation level and higher capacity than its competitors can explain Matra's triumph over its competitors, notwithstanding the possible bias introduced by the rumored connection with the national defense deals for the Mirage 2000 and La Fayette class frigates. Furthermore, the DORTS’s determination to include European companies into the bid to show their autonomy was the driving force of Matra’s victory. Even if the rumors about the connection between the Matra’s victory and the military deals were true, the deals only reinforced the VAL256’s superiority rather than changed the game. Moreover, almost all committee members voted the VAL256 as their best choice. Hence, even if all of them received an order or pressure to let Matra win,

[401] The interview with TP03.

we cannot conclude that the political factor was the most critical reason for Matra's victory. However, I cannot exclude the possibility that the Taiwanese government struck a deal with Matra and French government because the DORTS has not opened the record of the bid at the specific request of Commissioner Chi and the committee members. This suggests that the decision was extremely sensitive politically.[402] In any event the technical choice and the DORTS' ambition to be autonomous had dramatic consequences for Matra, the DORTS, and Taipei City.

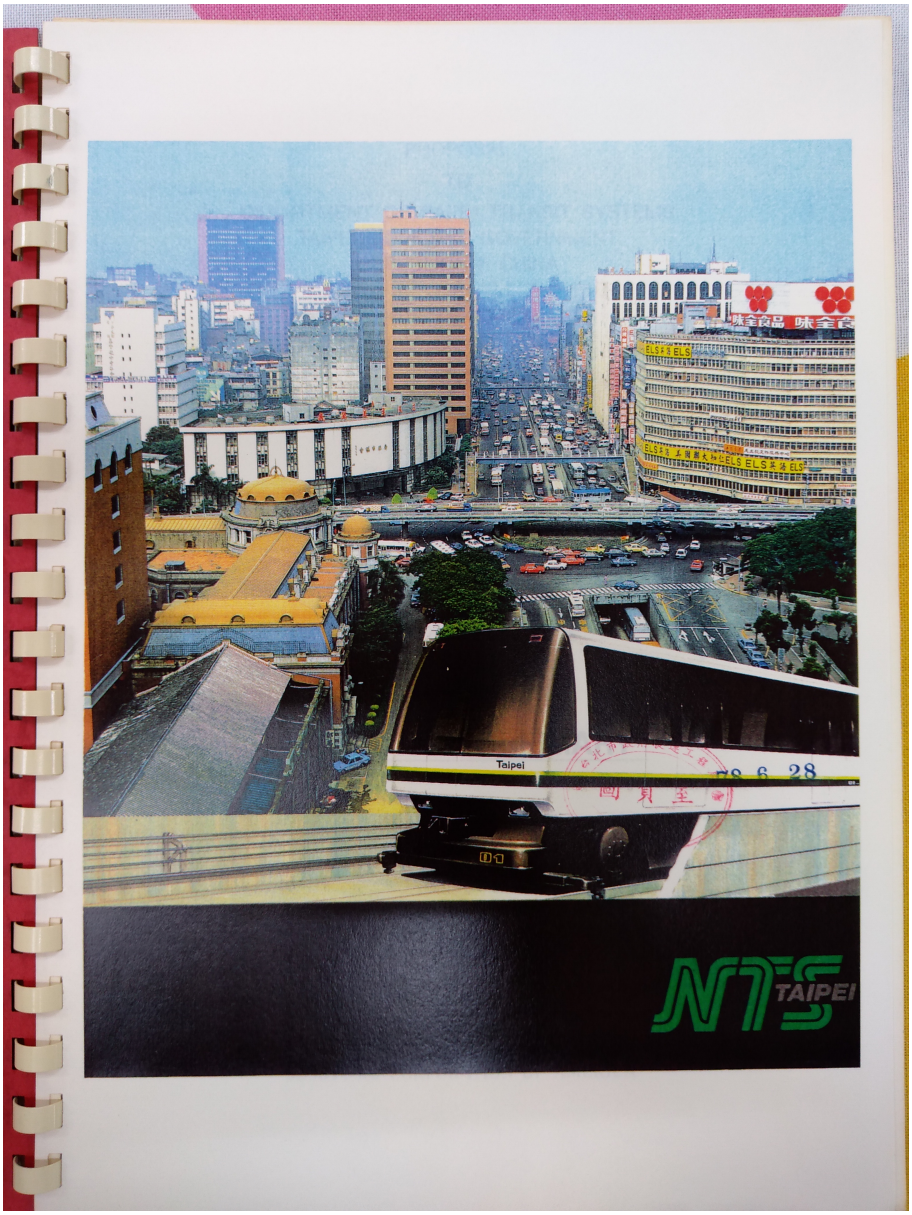

Figure 7.1: Sumitomo's technical proposal of the NTS.

[402] Wang, "Lost in Arbitration!" December 3, 2000.

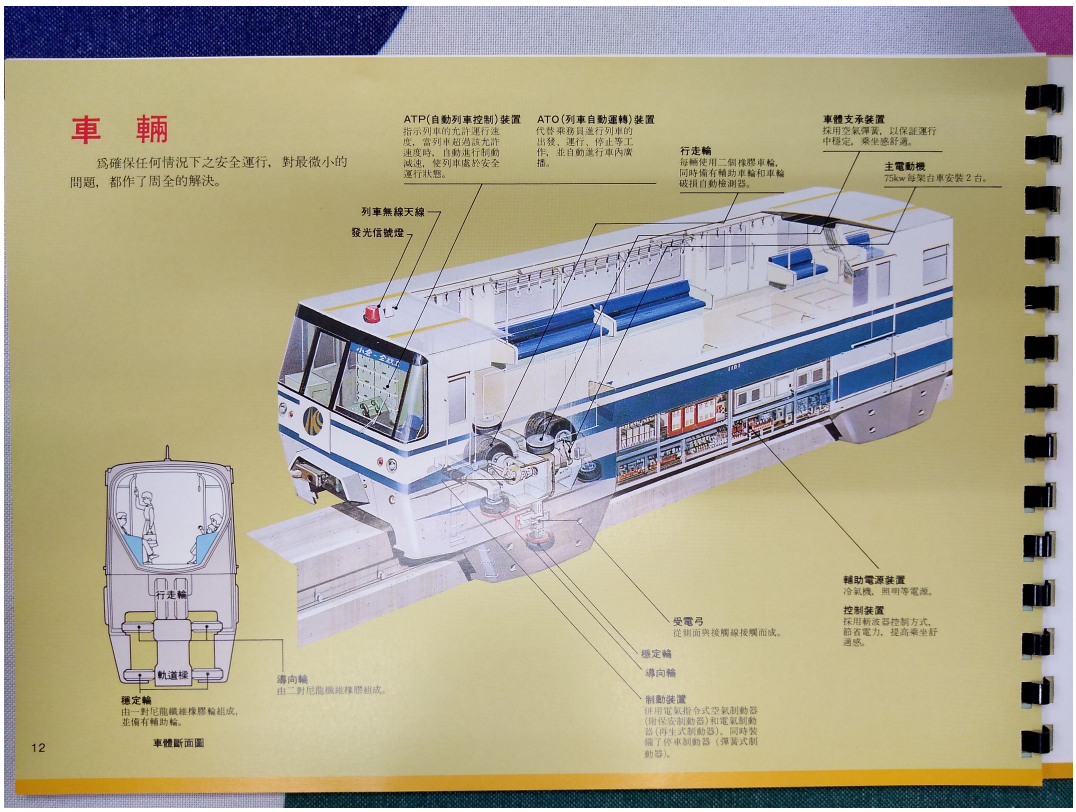

Figure 7.2: Mitsui's booklet in Chinese within its technical proposal of the Monorail

Figure 7.3: The UTDC's technical proposal of the Skytrain.

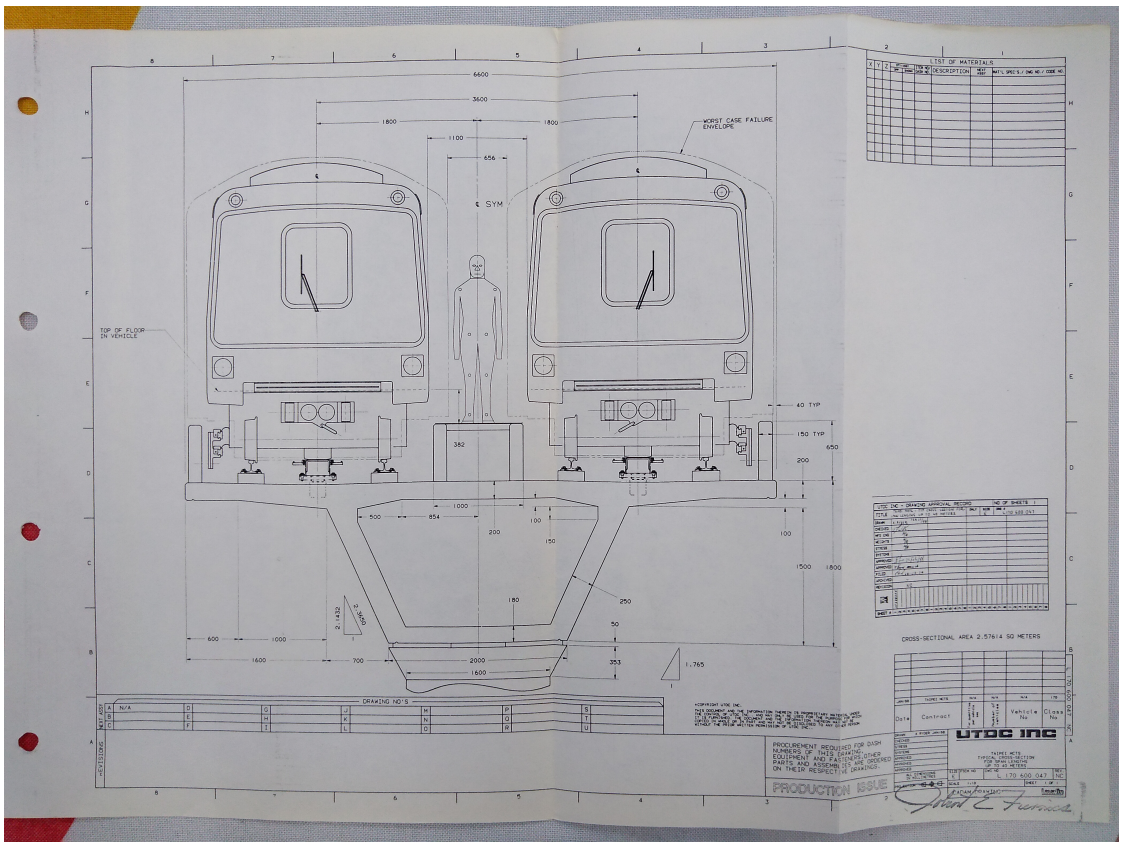

Figure 7.4: The GEC's technical proposal

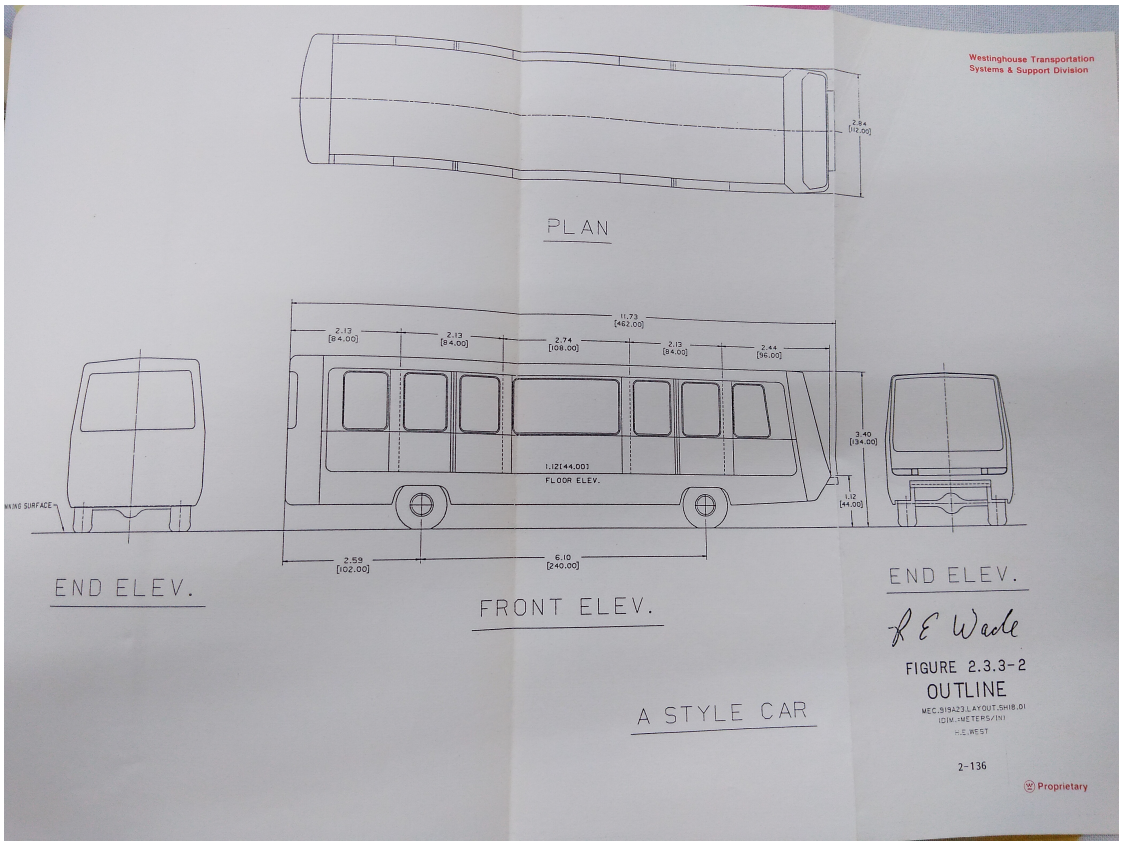

Figure 7.5: Westinghouse' technical proposal

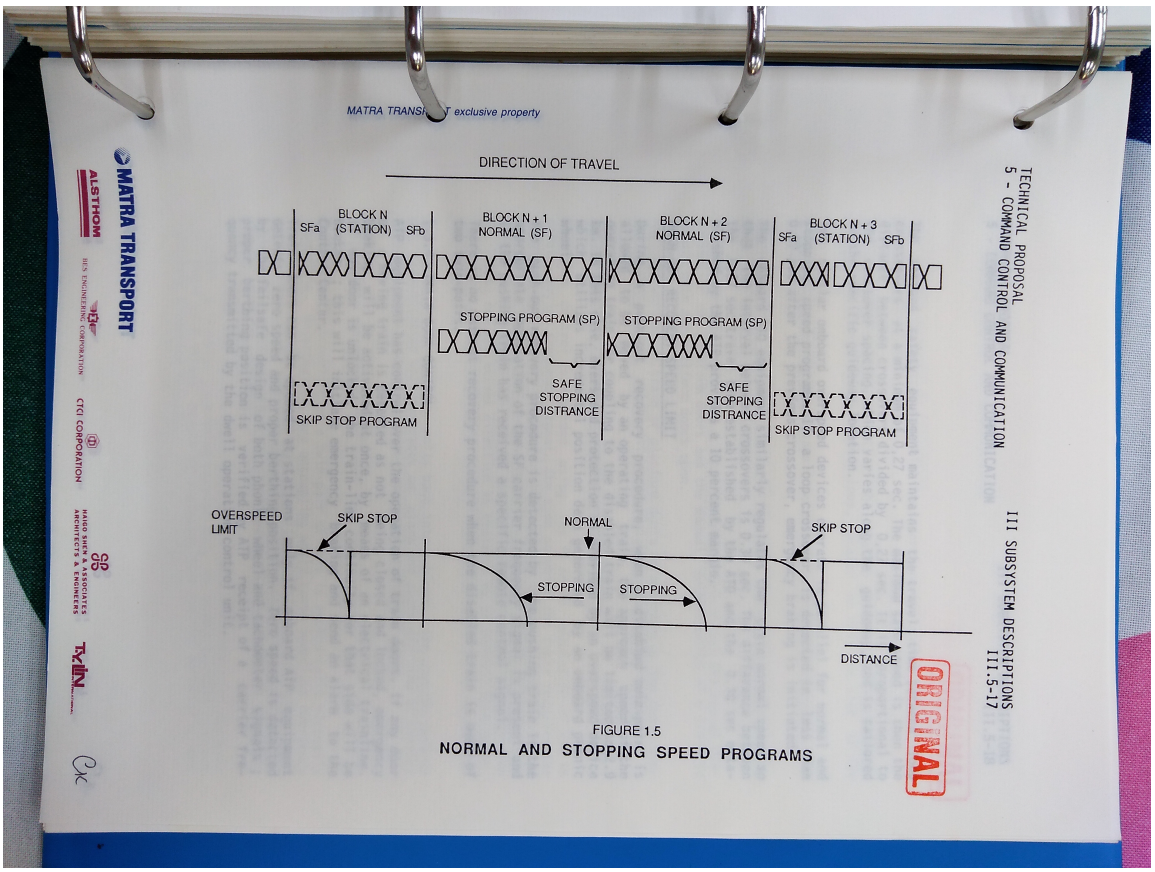

Figure 7.6: Matra's technical proposal. Note how the program controls a train.

Fire on the Tracks

May 5th, 1993. The DORTS and Matra's engineers were testing the VAL256 hoping that the Brown Line could be open to the citizens soon. Construction had begun five years earlier with the promise that the Line would be completed in three years as Matra had done in Lille. As a train drew into the Xinhai Station (辛亥站), one of the darkest moments in DORTS history occurred. The train's second married pairs' tires exploded, and the train caught fire. No one got hurt in the accident since no passenger was in the trains at the time. The DORTS was testing the system, and the system was driverless. Matra's engineers thought the brake system caused the accident tried to fix it during the test phase.[403] However, on September 24, 1993, a tire explosion and fire accident happened again, leading to the suspension of the test. To pray for safety for the nearly-completed Brown Line, the DORTS asked a famous Taoist temple which is close to the Brown Line to hold a ceremony asking the gods to bless the metro line on September 13,

[403] Wang, I-chung. "Matra Submitted the First Report of the Fire Accident「馬特拉」送出第一次火燒車報告" *The United News*, October 2, 1993.

1994[404]. But, on September 24, 1995 there was another tire explosion a year to the day from the previous accident, though there was no fire this time.

The fire accidents and tire explosions were only the most severe problems on the Brown Line. The quality of the product and the cost of the construction also raised severe doubts and criticisms. The subsequent delay of the opening of this metro line, which was supposed to be the first line of the Taipei Metro, led to a crisis of trust in the DORTS and the whole metro system. In the election for mayor in 1994, the Brown Line's problems naturally became a hot spot. This was the first election of the mayor of Taipei City since Taipei became a special municipality in 1967, and it was also the first election of both of the special municipality (Taipei and Kaohsiung) and Taiwan Province in Taiwan. As the capital of this country, Taipei's election received most attention in the press, and the crisis of the Brown Line made headlines nationwide. The candidates from the opposition parties, Chen Shui-bian from the Democratic Progressive Party (DDP) and Jaw Shaw-kong (趙少康) from the New Party, sharply criticized the KMT's Mayor Huang Ta-chou (黃大洲) for the Brown Line. Facing rivals' attacks, Mayor Huang and the DORTS delivered a white book to explain the process of the construction of the Brown Line[405]. However, the two rivals even claimed that they would not open the Brown Line or would even demolish it. Finally, Huang and Jaw lost to Chen, and the Brown Line seemed to be in danger.

Before we start to discuss how the DORTS and the Brown Line overcame the crisis, why the fire accidents happened needs explaining. In the bid for the system for the Brown Line, Matra promised that the VAL256 could run 4-car trains, and it could run 6-car trains in the future if necessary so that it won the bid for the system's capacity. This promise had two outcomes. First, every station's platform on the Brown Line had additional length for the future expansion to 6-car trains. Second, Matra modified the train control program. Matra did not develop a new program for the 4-car trains. It slightly modified its VAL208 to meet the promise. In the VAL256, a 2-car train as a married pair was still defined as a unit, and the Matra connected two married pairs as one train. Ideally, once the married pair ahead received an order from the control center, it would

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[404] Shiao, Yuan-chung 蕭元鍾. "Praying for Safety Not Escaping from Adversity 大拜拜 祈消災 劫運到 也難逃." *The United Evening News*, September 24, 1994.

[405] Yu, Hong-chen 游鴻程. "DORTS' White Book Whitewashed Huang 捷運局白皮書 為黃大洲漂白" *The United Evening News*, October 21, 1994.

send the same order to the one behind so that the train would operate smoothly like the trains in the VAL208 in Lille and O'Hare Airport[406].

However, if the connection between the first married pair and the second one malfunctioned, a tire explosion and even a fire accident could occur. Although the cars of the VAL256 were like a huge bus due to its rubber tires and disc brakes, the operation of the brake system was different to that of automobiles. In the case of an automobile, the brake is off unless the driver steps on the brake peddle or pulls the hand brake. The logic is reversed in the VAL system. The car's brake is always on unless the car receives an order to move. Also, the second married pair could not send a message of its situation to the first one, so the system could not stop the train if there was a malfunction in the second married pair[407]. What happened in the fire accidents and tire explosions was this. When the connection between the two married pairs was out of order, and the system ordered the trains to move, the first married pair would release its brakes and move forward while the second married pair would still hold its brake on, and was dragged by the first married-pair because it did not receive an order to move. Thus, the second married pair's rubber tires would cause friction directly with the concrete tracks without rolling, generating heat that exploded the tires and caused a fire[408]. Matra erred in checking the brake system instead of the connection system after the first fire accident happened, and whole scenario soon repeated itself.

Taoist gods could not solve this problem, but Matra and the DORTS could. They did three things to overcome the problem. First, they installed a temperature sensor on each tire's brake disc; the system would be shut down if the sensor detected the temperature as being too high, preventing the first married pair from keeping dragging the second pair. Second, they refined the connection between the two married pairs. Third, they set a coasting mode for the trains. When trains were leaving a station, the motors would drive the trains and then stop immediately, so, when the brake was off, the trains would slide for a few seconds. In these moments, the system would check if the brake was on or not, and the trains would move forward again if brakes were off; if the system found that brakes were on, it would stop the trains, and the operator would send technicians to check the trains[409]. Moreover, a member of the faculty of National Tsing

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[406] The interviews with TP01, TP02, and TP07.

[407] The interview with TP07.

[408] The interviews with TP01, TP03, and TP07.

[409] The interview with TP07.

Hua University (NTHU, 國立清華大學) found a different design of the rubber tire provided by Michelin, and persuaded Matra and Michelin to change to a more muscular tire for the VAL256[410].

Even though the braking problem was solved, the future of the Brown Line was still unknown because the DPP had won the election and because citizens no longer trusted Matra. . The technical problem was solved, but the technopolitical problem was newborn causing even more headaches for the DORTS.

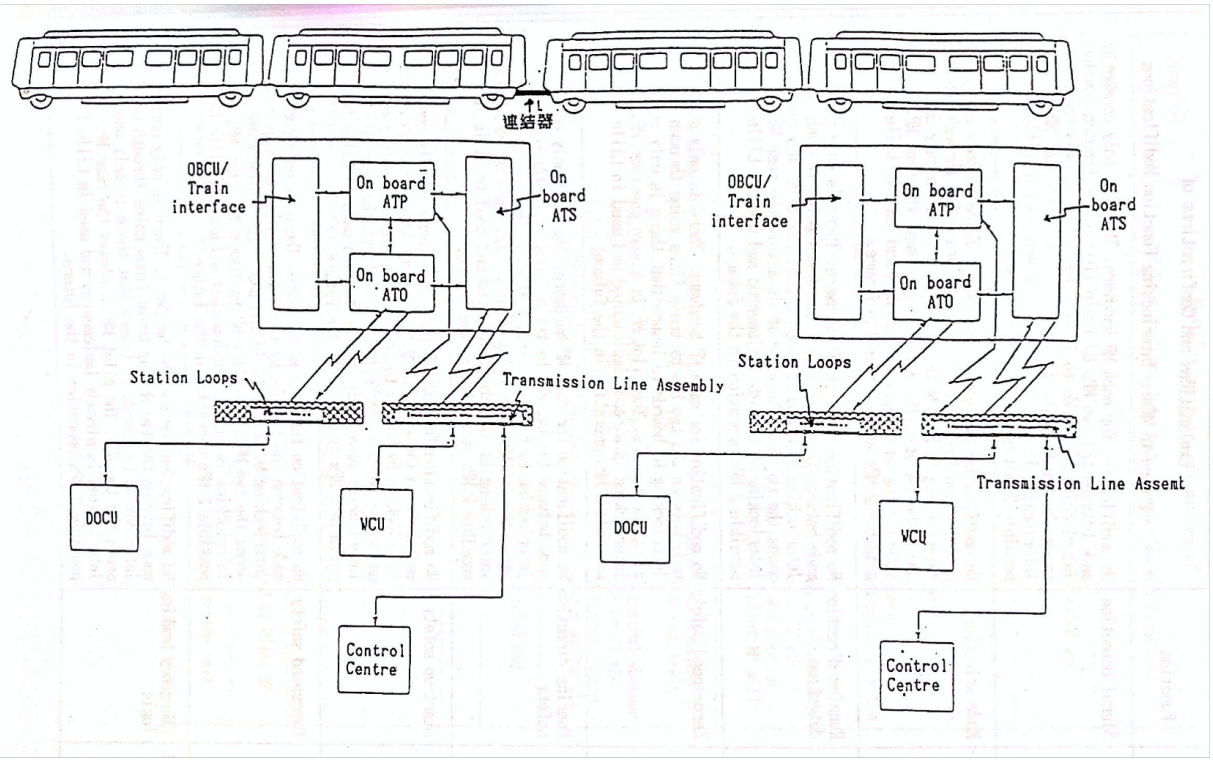

Figure 7.7: The communication design of two married-pairs in the VAL256[411]

We Pull it!

December 25, 1994. Chen Chui-bian took office as mayor of Taipei. How he would deal with the Brown Line became one of the focuses of his decision making, especially as he once mentioned that he would not let the Brown Line open during the election campaign . However, Taipei City Government set up an ad hoc committee, the Brown

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[410] Li, Yen-fu 李彥甫, " The Brown Line Works! Research Institute Took the Lead! 木柵線成行 研究單位居首功" *The United News*, September 27, 1997.

[411] The Brown Line Interrogation Committee 臺北捷運系統木柵線體檢委員會, *The Taipei Metro Redbook: the Interrogation Report of the Brown Line* 《捷運紅皮書:台北捷運系統木柵線體檢報告》. (Taipei: The Brown Line Interrogation Committee 臺北捷運系統木柵線體檢委員會,1995), Pp.181.

Line Investigation Committee (臺北捷運系統木柵線體檢委員會), to investigate the Brown Line instead of tearing it down directly or suspending the plans for its future operation. The committee had 20 members divided into four technical groups, including civil engineering, electromechanical, operation, and system integration. The members included faculty from Taiwan's universities, high-level engineers employed by international consultants, and experts from an automation technology corporation. One of the committee members was the general manager of Lille Metro, which was the first metro system using the VAL[412]. The committee specially focused on the quality of the architecture, noise problem, and the most critical problem, the causes of the tire explosions and subsequent fires. With the metro line almost ready, the Brown Line committee spent two months reviewing all the problems mentioned during the construction and test and concluded that the Brown Line was ready to open to the public if the problems they listed in the report could be solved although the committee did not think much of the Brown Line's planning and design[413].

Although the Brown Line Investigation Committee's endorsement saved the Brown Line from being demolished, its report revealed the strong tension between the DORTS, Matra, and the newly established Taipei Rapid Transit Corporation (TRTC). The system integration group of the committee pointed out that the TRTC blamed the DORTS for signing a contract made it difficult to buy spare parts and maintenance manuals from Matra. On the other hand, the DORTS argued that the TRTC refused to take over the system without even trying to make the system better, since all it did was to rely on Matra. The report showed that the committee members often needed to be peacemakers in the meeting with the DORTS, Matra, and the TRTC, failing the meetings were suspended to stop dramatic arguing between the stakeholders[414]. Matra condemned the TRTC for not training its technicians did not follow the system maintainers rules[415]. The report also showed that local Taiwanese contractors were one factor causing the delay. The committee members admitted that the construction quality was as good as that used in the VAL system[416]. For example, the pavement of concrete track was not smooth, and some of the gaps between tracks were too wide so that the cars' rubber tires could be

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[412] The Brown Line Interrogation Committee, *The Taipei Metro Redbook*.

[413] The Brown Line Interrogation Committee, *The Taipei Metro Redbook*, Pp. IX.

[414] The Brown Line Interrogation Committee, *The Taipei Metro Redbook,* Pp. 137.

[415] The Brown Line Interrogation Committee, *The Taipei Metro Redbook,* Pp. 139.

[416] The Brown Line Interrogation Committee, *The Taipei Metro Redbook,* Pp. 97.

damaged, contributing tire explosions[417]. Last but not least, the Taipei City Council kept asking the DORTS to request Matra for compensation for the fire accidents, though DORTS held back the reimbursement payment due to the general delay and under political pressure[418]. The system seemed to be ready to go, but this highly automated transit system needed all partners needed to bury their differences in the name of for safety and efficiency so that the tension among them, especially the relationship between Matra and its Taiwanese clients, would not put successful future operation at risk.

In this situation, the Taipei City Government decided to open the Brown Line to the public on February 27, 1996, for a free test ride, and, after refining the disadvantages that emerged during the test drive, the TRTC began to operate the first metro line in Taiwan's history. On March 28, the Brown Line officially opened for operation, and Taiwan finally owned its metro system after three-decade-long discussion and planning.

On April 17 and 18, the president of Matra's Taiwan branch visited the Mayor Chen Shui-bian and the Deputy Mayor Chen Shih-meng (陳師孟) who was in charge of the Brown Line's problems, He warned the Taipei City Government that the firm might withdraw all its technicians from Taipei if the Taipei City Government insisted in holding back NTD 1 billion down payment. The DORTS and Matra were ready to sign the contract for maintenance and parts supply for the Brown Line. However, the Taipei City Government hoped that Matra to treat the down-payment and the maintenance contract independently from the main contract It mentioned that the Brown Line still had problems of noise, brakes, and lack of software so that it could not pay the down-payment to Matra[419].

On May 30, 1996, Matra abruptly withdrew all of its technicians from Taipei without signing the maintenance contract. The VAL system contained many parts and software which were protected by patents so that Matra was the only source. It was also difficult to imagine that Taipei could run the Brown Line without Matra since Taipei was a novice in running a metro system. Even before Matra left Taipei, outages occurred twice on the Brown Line, showing that the VAL256 was still unstable[420]. Moreover, the Brown Line was

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417 The Brown Line Interrogation Committee, *The Taipei Metro Redbook*, Pp. 106-107.

418 The interviews with TP01 and TP07; Fan, Chih-ming 范植明, "Matra Shows its Hand! The Brown Line may Stop 馬特拉攤牌 捷運木柵線可能停擺" *The United Evening News*, April 18, 1996.

419 Fan, "Matra Shows its Hand!" April 18, 1986.

420 Yu, Hong-chen 游鴻程. " Metro Malfunctioned, Again Partially Stopped 捷運又故障 局部停擺" *The United Evening News*, May 23, 1996.

in operation, so there would be a political storm if the Brown Line were shut down due to Matra's leaving. Matra seemed to hold all the bards in its negotiation with the Taipei City Government, and Taiwan, as a catching-up country in the field of metro technology, had no weapons to fight back. Even the Chairman of the TRTC said that the Brown Line's service might last for only half of a year without Matra, and the Brown Line had malfunctioned four times from December 1996 to January 1997[421]. The shutdown of the Brown Line and Taipei's surrender was imminent.

Nonetheless, in 1998, the Brown Line received the ISO9002 quality certification showing that the Brown Line survived and provided stable service after Matra's departure[422]. What did the DORTS and the TRTC do to make this happen? In historian of technology Thomas Hughes' words, the VAL256 was a system with hard technological momentum because it was protected by the interweaving of knowledge, artifacts, and a legal system. Matra was supposed to have power over Taipei City, pressuring the City Government to pay the down-payment. Instead the DORTS and the TRTC got control of the system and made it work smoothly, making Matra redundant. How?

First, when the tension between Taipei City Government and Matra emerged, the DORTS and the TRTC anticipated that Matra might withdraw its technicians as a strategy to threaten Taipei City to pay the down-payment, So the TRTC's engineers stealthily copied Matra's latest version of the control program whenever the Matra sent a new version from France to the Brown Line's control center. Thus, when Matra's technicians suddenly left the control center, the TRTC simultaneously installed the copied program into the sections running the system, so the Brown Line was not shut down despite Matra's action[423].

Second, the TRTC invited a local computer manufacturer, MiTAC (神通電腦) to study the functions of the VAL256's motherboards and chips controlling the system and then rewrote the program into the parts manufactured by the MiTAC or purchased from other suppliers so that they could replicate the system's parts without breaking Matra's patents[424]. The TRTC found that many parts in the VAL256 were to standard specifications, and it believed that Taiwan, as the primary manufacturer of electronic

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[421] Yu, Hong-chen 游鴻程. " No Outage in Lille Metro for 13 years 法國里耳捷運13年來零故障" *The United Evening News*, January 3, 1997.

[422] Dong, Zhi-sen 董智森, "International Affirmation of the Brown Line 木柵線品質佳 國際肯定" *The United News*, August 9, 1998.

[423] The interviews with TP01 and TP07.

[424] The interviews with TP01, TP02, and TP07

products worldwide, could manufacture these parts. Therefore, it sent its engineers to Taiwan's biggest computer electronic parts market, Guang Hua Digital Plaza (光華商場)[425], to collect necessary parts for the system. Sometimes the engineers could not directly find the parts they needed, but the dealers in Guang Hua Digital Plaza could use their international connections to get the parts from other countries[426].

Finally, because the copied program was not the best version, so that the system might crash due to bugs inside the program, the TRTC would shut down the system at midnight once a year and reinstall the program since it found the system would crash after 13-months of operation[427].

The digital clock in the control center was fixed at the date and the time when Matra's engineers and technicians left[428], but the trains on the Brown Line kept running, and passengers kept riding and leaving the metro line. In a seminar on the future of the Brown Line held after Matra withdrew its technical assistance, the vice president of Matra's Taiwan branch claimed that the security of the Brown Line was problematic and that Matra would not take any responsibility if any accident happened[429]. However, no accident happened after the Taiwanese modified the system making the VAL256 a Franco-Taiwanese metro system.

In October 1998, Siemens acquired Matra Transportation, but did not recognize the legal conflict between Taipei City Government and Matra. Nonetheless, the merger brought a change to the Brown Line. In April 1999, Siemens agreed to sell the VAL256's parts to the TRTC, and it signed a maintenance contract for the electronic parts in the system. The contract value was NTD11,000,000(about USD3.3 million) while Matra asked NTD300,000,000(about USD30 million) for the same contract when it withdrew its technicians three years earlier[430]. Taipei had reversed the power relationship with Matra thanks to Taiwanese engineers and technical officials' strategies and actions, creating a metro system which was built by the French but reborn by the Taiwanese. The mayor of

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[425] It used to be the preowned book market before the 1980s. In the 1980s, it became a market for personal computers, electronic parts, software, comic books, porn videos, and video games. Many products there, no matter hardware or software, were pirate versions. There were also many preowned products.

[426] The interview with TP07.

[427] The interview with TP01.

[428] The interview with TP07.

[429] Chu Ke, Chun 諸葛俊, "Where should the Brown Line go? 木柵線何去何從?" *The United Evening News*, August 26, 1996.

[430] Chu Ke, "Where should the Brown Line go?" August 26, 1996

Taipei City from 1994 to 1998 and the future president of Taiwan, Chen Shui-bian, left a sentence memorized by many Taiwanese precisely depicting the story: “ If Matra doesn’t pull, we pull! (馬特拉不拉，我們自己拉)”

The Resolution: CBTC

Siemens’ supply of parts did not solve the Brown Line’s problems thoroughly. First, the TRTC was still using the train control program with bugs even though the Brown Line was temporarily stable. Second, the core parts of the system were protected by Matra’s patents meaning the TRTC could not gain any upgrades since the Taipei City Government and Matra were still in a lawsuit. Finally, the Brown Line had an extension plan to connect the Taipei Song Shan Airport, Neihu District, and downtown Taipei City. If the DORTS directly used the VAL256 to build an extension line, Siemens would be the only supplier so that the price of the system would be extremely high. If the DORTS decided to change the system, the Brown Line needed to be shut down for a long time, causing congestion on the route. Furthermore, after the conflicts and controversies with Matra, Matra already had a terrible reputation among Taiwanese, so there would be a political storm if the DORTS chose the same system to build an extension line even though Siemens merged with Matra Transportation.

However, the City Government and Council had once considered planning a different line in Neihu District in 1993 when the fire accidents happened, although the DORTS planned to extend the Brown Line into Neihu gaining the City Council’s approval in 1989[431]. In 1999, after years-long discussion, the DORTS founded an ad hoc team to study the possible options for the metro line in Neihu listing five alternative options, four were an extension of other regular railway metro lines, and one was an independent automated transit line. But, the DORTS found that the alternative options would increase the cost of construction too much and that the regular railway transit system was not suitable for Neihu due to Neihu’s narrow streets. Furthermore, an independent driverless metro line was unrealistic and expensive[432]. Finally, after the DORTS released a poll showing that over 70% of the residents of Neihu agreed with the original plan, the

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[431] The Department of Rapid Transit System, Taipei City Government 臺北市政府捷運工程局. *The General Report of the Brown Line of the Taipei Metro* 《臺北都會區捷運捷運系統文湖線工程總報告書》. (Taipei: The Department of Rapid Transit System, Taipei City Government 臺北市政府捷運工程局, 2014), Pp.5-6.

[432] The Department of Rapid Transit System, Taipei City Government, *General Report of the Brown Line*, Pp. 8.

extension of the Brown Line, the City Government and City Council decided to extend the Brown Line into Neihu in 2001. Moreover, Taipei City Government modified the plan for the extension of the Brown Line, adding one station in Taipei Song Shan Airport, ensuring the final plan of the extension metro line in 2001[433].

The cost and environment of Neihu were only two of the reasons to keep the extension plan; the Brown Line's system was also a reason for supporting this plan. The Neihu extension plan was both a problem and an opportunity for the DORTS. If the DORTS continued to use the VAL256 on the Neihu extension section, Siemens would ask a high price thanks to its monopoly status. The high price obviously would create a severe political storm for the DORTS and Taipei City Government. But, building an extension line could also be an opportunity to replace the VAL256 with a newer system. If the replacement was successful, the DORTS could not only upgrade the Brown Line's system but also escape from the problematic VAL system. The problem was that changing the system should not lead to the suspension of the Brown Line's ongoing service because the Brown Line was serving too many passengers to be stopped. To fulfill the demands required by changing the system while retaining an ongoing service, the DORTS found a new train control technology: communication-based train control (CBTC)[434].

CBTC means the central control center sends orders to trains through communication channels like optical fibers instead of using analogical signals. In other words, CBTC is the application of internet technology in rail mass transportation. At the time of the advent of the VAL or other driverless systems, the computing power and communication speed were not powerful enough to control trains automatically so that these systems needed to use analogical signals for sending orders, and their programs needed to work with equipment like TLA, or the control center could not control its trains. This imposed limitations on the systems. For example, the VAL's trains' speed was fixed, meaning the control center could not order them to speed up during running because it was a given that a train would pass one TLA for a particular time. Thus, only the size of TLA loops could determine its speed, and the TLA was fixed on tracks. Moreover, the systems using analogical signals could control trains with fixed block, so how many trains could run on the line was also determined. On the other hand, CBTC could use moving blocks allowing more trains on the line at the same time. Moreover, CBTC's wayside

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[433] The Department of Rapid Transit System, Taipei City Government, *General Report of the Brown Line*, Pp. 8-9.

[434] The interviews with TP01, TP02, and TP07.

equipment would not conflict with those belonging to analogical systems. Although only a few systems were using CBTC technology in the 2000s, the DORTS decided to introduce CBTC to thoroughly solve the Brown Line's problem[435].

The DORTS took the following strategies for determining which system would win the business of the extension of the metro line. First, it combined the civil engineering bid and system bid into one rather than two separate bids. Taiwanese engineering companies needed to find an international system provider on their own so that the DORTS could avoid judging the systems directly. Thus, if Siemens did not get the business, it could not blame the DORTS. Moreover, the court finally determined that the Taipei City Government needed to give the down-payment with interest (NTD 1 billion in total) to Matra because the court thought the local constructors delayed Matra instead of Matra itself. To avoid a similar situation, asking constructors to manage their system providers would be the right choice. Second, the DORTS did not exclude the VAL or similar systems, but it also includes CBTC as an acceptable option. Therefore, if the Siemens wanted to win the bid, it needed to lower its cost. Third, the DORTS asked the system providers to integrate the existing VAL256 system and the new system without shutting down the whole Brown Line. The DORTS anticipated that Siemens would seek a higher price for providing the VAL to the extension line so that the local constructor winning the bid would not choose it[436]. As the DORTS expected, the Bombardier became the system provider, and it planned to install its automated transit system with CBTC technology, CITYFLO650, on the Brown Line.

Building the extension line in Neihu and installing CITYFLO650 on the existing line was not a big challenge, while the Brown Line continued to serve its passengers. Testing was. Since the existing section would be integrated into the new system, the TRTC needed to shut down the VAL256 letting the Bombardier's trains, the Bombardier INNOVIA APM 256, run on the existing tracks when the DORTS and the Bombardier tested the new system. Therefore, they could only use off hours to test the system and trains. When the construction entered the testing stage, the Bombardier and the DORTS designed a switch system. In the service hours, the Brown Line still used the existing VAL256 to provide service; after service ended, the DORTS would send its engineers to all the stations switching the system from the VAL256 to the CITYFLO650 starting the test. When the service hours approached, they switched the system back again. The

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[435] The interviews with TP01, TP02, and TP07.

[436] The interviews with TP01 and TP02.

DORTS and the Bombardier even refined the switch, making it change system automatically[437]. Therefore, when the DORTS and Bombardier tested the new system, the Brown Line had two systems, though passengers did not know it.

In the final stage, the TRTC shut down the whole Brown Line at weekends to verify the functions and the trains of the CITYFLO650 for two months, and the TRTC also shut down the Brown Line during the Chinese New Year for testing in February 2009. After the test, Taipei City Government decided to open the Neihu extension section and the new CITYFLO650 to the public in May 2009. However, compared to the VAL256, the test of the CITYFLO650 was not that thorough before it opened. In the case of the VAL256, the DORTS and Matra ran the trains 24 hours per day continually for 14 days at once, verifying the system's functions and liability[438] while the DORTS only tested CITYFLO650 over 24 hours on several weekends before it started to provide service. Furthermore, the VAL256 for the first phase of the Brown Line was simply a system installed on the metro line, while the CITYFLO650 was integrated with the existing system so that the complexity and difficulty of installing the later on the Brown Line in the 2000s were higher than the former in 1990s.

Taipei City Government paid the price for the decision to open the extension line just after the opening of the new system. On July 4, the opening day of the extension line and the new system, the Brown Line was stopped for 9 minutes because of an alarm triggered by an obstacle on the track. The next day, the same thing happened again, leading to a service suspension for 8 minutes. On July 10, the Brown Line experienced a power outage for more than 8 hours due to the malfunction of the uninterruptible power system (UPS) and the following cyber storm. This time passengers got out of the trains and walked on the tracks to leave the metro system. In the following months, the Brown Line experienced outages and dysfunctions ten times, leading to the resignation of the commissioner of the DORTS and to the public's distrust of to the system. The Brown Line seemed to face another failure, and a technopolitical disaster before the problem of the VAL256 was solved, though this hybrid metro Line finally reached over 99% liability in 2010, confirming the success of the system replacement.

The most critical outage of the system on July 10 was caused by the malfunction of the UPS and a cyber storm of the communication system. The latter was caused by

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[437] The interview with TP07.

[438] Huang, Ling-Ming 黃令名. "The Awkward Rail toward 'Modern' 通往「現代」的曲折軌道" (Master's thesis, National Tsing Hua University, 2011), Pp. 133.

the former. In the beginning, the Brown Line's power system for one zone[439] of the line experienced an outage. Ideally, the UPS should take it over, introducing power from the city's power supply system. But the UPS provider did not use this design, directly providing power from its battery. When the battery was out of power, this zone was shut down. At this time, one train was on the edge of the zone without power and in another zone, so the system found that it could not receive a signal from the train leading to an abnormal situation in the system. The system kept asking for signals through different communication channels, trying to find the train and exhausting its computing power, creating a cyber storm. The consequence of the cyber storm was that the control center could not find any train on its monitor, so the manager of the control center pushed the emergency button turning off the whole system[440].

Besides the design of the UPS, the harsh construction environment also contributed to the showdown and cyber storm. Too much dust caused short-circuits in the electronic components[441]. The DORTS, the TRTC, and the Bombardier refined the system to reach the goal of a stable system. First, for the outage caused by the malfunction of the UPS, the DORTS took two actions. It added one more UPS for the system and separated the power supply system into two, one for the train controlling system and another one for other usages like escalators, lights, and the ticket system. The DORTS also asked the UPS provider to modify its design. Second, the DORTS found that it would be impossible to solve the problem of dust on electronic components, so it asked the Bombardier to upgrade the communication system. After the upgrading, if electronic components crashed due to dust, the cyber storm would not happen because the communication system had higher computing power and broader bandwidth so that signals could be sent smoothly[442].

The DORTS and Bombardier knew that they could build a stable system on the Brown Line if they had enough time to test the system finding problems and solving them so that passengers would not face the inconvenience of persistent technical problems[443]. However, the mayor of Taipei City at the time, Hau Lung-pin (郝龍斌), decided to open the extension line in May 2009 rather than later. Why did Mayor Hau decide to do so? The

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[439] The Brown Line was divided into 6 zones.

[440] The interviews with TP01, TP02, and TP07.

[441] The interview with TP07.

[442] The interviews with TP01 and TP07.

[443] The interviews with TP01, TP02, and TP07.

municipal election in December 2010 might be the reason. In 2010, Mayor Hau was campaigning for reelection, and, if there was any problem in the newly opened extension line and the system, he would face harsh criticism from his opponents . Problems on a new system could be expected, especially the CITYFLO650 that was a system integrating an old one, and citizens would once be frustrated by the metro's problems. Thus, opening the system earlier became a reasonable strategy. Although the passengers would experience the outage and shutdown of the system, the citizens would find that the reborn Brown Line finally became stable by the time the election came around so that the mayor could claim that he had solved the problem of the Brown Line. We do not have evidence to establish how Mayor Hau made the decision, so the argument above is deduced from a technopolitical analysis. Indeed, Mayor Hau won the election.

Changing Brains

One more problem remained unsolved of the hybrid metro despite the opening of the extension line and the CITYFLO650: the 51 married pairs of the VAL256. When the Neihu extension line was opened to public, only the Bombardier's INNOVA APM 256 (101 married-pairs) provided service. Because the Brown Line had been suffering from congestion since it opened in 1996, the trains of VAL256 left by Matra were needed for transportation on the Brown Line. However, these trains were specially designed and manufactured for the VAL system. Moreover, these trains were made in the 1980s when train control and communication were using analog signals rather than digital signals. Therefore, how to integrate them with the CITYFLO650 became a critical challenge.

First, the TRTC transferred one married pair to the DORTS, and the DORTS and Bombardier's engineers installed a machine on the married pair, letting the machine record the functions of every wire on the car on the testing track with the VAL256 system on the bottom of the train on the Brown Line. Then, according to the information recorded by the machine, the Bombardier manufactured the prototype of the control and communication system for the trains that was compatible with the CITYFLO650 and installed it on the married pair, testing it on the track with the CITYFLO650 system. During the test, the DORTS and Bombardier's engineers modified the system on the married pair piece by piece[444]. If the test of this married pair was successful, Bombardier would go on manufacturing the "new brains" for the other 50 married pairs. However, after three long years of work, the DORTS and Bombardier still could not precisely replicate the acceleration and brake curves of the VAL256's married pair, which showed

[444] The interviews with TP02 and TP07.

how to speed up and slow down the cars. Without exact acceleration and brake curves, the engineers could not write a control program making the married pair stop at the precise point so that the car's doors could match the platform's automatic doors. In 2009, the Bombardier almost abandoned the plan of modifying Matra's train[445].

Finally, Bombardier found engineers who had once worked for Matra and Alstom and hired them to modify of the cars. Because of these engineers' familiarity with the cars, the DORTS and Bombardier quickly solved the problem of the acceleration and brake curve, making Matra's train precisely speed up and stop under the Bombardier's control system[446]. Then, the DORTS and Bombardier removed the VAL256 system from the VAL256's trains, installing "new brains" on them. After a six-month-long test, these cars were returned to duty in December 2010. It was the birth of the only "hybrid Metro" in the world. Among all the automated transit systems in the world, the Brown Line of the Taipei Metro was the only one running two types of cars that were manufactured by two different companies in two different countries. Today, we can see both the VAL256 and the Bombardier INNOVA APM 256 running on the Brown Line's track automatically and precisely at the same time. It was a happy end to a process marked by a series of accidents, political storms, transnational conflicts, and stealthy technological innovations. Be it intentionally or not, the DORTS, the TRTC, the Bombardier, and, in some sense, even Matra and Siemens were involved in this decades-long formation of technological hybridity.

[445] The interview with TP07.

[446] The interviews with TP01, TP02, and TP07.

Figure 7.8: the Matra's train (right) and Bombardier's train (left)[447]

The technological Hybridity of Systems

December 15, 1996, about 9 months after the Brown Line opened to the public, the Jacksonville Transportation Authority (JTA) shut down its VAL system on the Skyway automated metro because it failed to negotiate with Matra for the extension project. Bombardier Transportation won the contract to replace the VAL system and the extension project in 1994, and the Skyway was transformed into an automated monorail system. The JTA sold the VAL's cars to Chicago O'Hare International Airport. The VAL's first urban metro system out of France ended. The Brown Line faced not only the challenge of extension but also experienced accidents on the tracks and legal conflicts with tMatra. However, the DORTS and the TRTS did not shut down the system or pay the Matra to solve the problems of the Brown Line. Instead, they built and ran a "hybrid metro." Coincidently, Bombardier's systems were the alternatives for the two cities' VAL systems, but Taipei's story shows how a catching-up country used hybrid strategies to change the power relationship with the technologically advanced country. Furthermore, we should not forget that the birth of the Brown Line was a product of Taiwan's international politico-economic context in the 1980s.

Thomas Hughes' idea of technological system and technological momentum can help us to understand how the Taiwanese used hybrid strategies to change its power

[447] https://cosmic.pixnet.net/blog/post/27971669. Accessed on January 20, 2020.

relationship with the Matra. Hughes states that technological systems solve problems or fulfill goals using whatever means are available and appropriate; the problems have to do mostly with reordering the physical world in ways considered useful or desirable, at least by those designing or employing a technological system[448]. Moreover, Hughes does not regard the technological system as a static object. Instead, he notices that the interaction of technological systems and society is not symmetrical over time. Evolving technological systems are time-dependent. As the technological system became larger and more complex, thereby gathering momentum, the system became less shaped by, and more the shaper of, its environment[449]. Hughes also reminds his readers that technological systems both have the technical core and social core[450]. The VAL, or any other metro system, is a technological system, but the VAL was a system with hard momentum in the late 1980s when Matra introduced it to Taipei. First, the VAL became mature after it successfully proved its efficiency as a reliable automated people moving system in many airports and as an urban metro system in Lille. Moreover, the system was legally protected by the patent system so that no one could easily replicate the components of the system. Finally, Matra, which was a huge technology corporation, sought to reap the rewards of any success of this system. In Hughes' word, the VAL was a "seamless web." What the DORTS could do for Taiwan's development of the metro system was to upgrade its constructors' ability with the help of the VAL's technological momentum[451].

However, as Chang's case study of the Brown Line shows, when the VAL traveled to Taiwan, it faced the integration with Taiwan's material and social context leading to a reverse salient of the technological system[452]. That is to say, the VAL's momentum was weakened in the process of its transplantation into Taipei. The fire accidents and tire explosions were evidence of this fact. The accidents triggered the conflicts between the DORTS and Matra, and Matra tried to use the VAL's momentum to leverage its power pressuring the DORTS to compensate it for its loss in the accidents and their conflicts. But, the DORTS and the TRTC chose to make the Brown Line hybrid instead of turning to Matra to overcome the reverse salient of the VAL256 system. In the first phase, the DORTS and the TRTC mobilized local resources to break through the bottleneck of the

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[448] Hughes, "Evolution," Pp. 47.

[449] Hughes, "Technological Momentum," Pp. 108.

[450] Hughes, "Technological Momentum," Pp. 106.

[451] Chang, "Constructing the Taipei Metro Muzha Line," Pp. 163-164.

[452] Chang, "Constructing the Taipei Metro Muzha Line," Pp. 178-179.

operation of the VAL256 making the Brown Line a Franco-Taiwanese metro system. Then, when facing the extension issue of the Neihu section as Jacksonville once experienced, the DORTS introduced Bombardier Transportation and its CBTC technology, finishing the second phase of the making of the hybrid metro. Therefore, although the DORTS and Taiwanese did not mean to do so at the very beginning, they exploited the weakened technological momentum to reverse or at least to change the power relationship between them and Matra by making the Brown Line a Taiwanese-Franco-Canadian hybrid metro. The hybrid metro and the making of it are at once a strategy and an outcome. Although the Taiwanese were facing a French company instead of the American hegemony, they chose similar strategies to deal with both, from which technological hybridity emerged.

The accomplishment of the Brown Line is also a story of innovation, but the innovation was not driven by ambitious goals of changing a city, or a country's environment, even though this was the goal the Taiwanese wanted to reach by introducing the automated transit system into Taipei. Instead, it was Taiwan's catching-up status and lack of ability on metro technology that forced the DORTS, the TRTC, other Taiwanese engineers, and even the Bombardier to embark on innovation. Thus although the DORTS successfully solved the Brown Line's problems left by Matra, the DORTS and other metro authorities set up processes and institutions to prevent the problems happening again on the Brown Line. For example, the Taiwanese government set up an institution to directly contract with the system provider of a metro line for a possible extension so that it did not need to face the system integration issues like those in the Brown Line. The Yellow Line of the Taipei Metro[453] and the light rail system in New Taipei City will be the first results of establishing institution[454]. The DORTS might be proud of its achievement, but it does not want to relive the experience of the Brown Line!

[453] The Yellow Line was open to the public in January 2020. It is also a metro line with an automated transit system. According to the DORTS' plan, the Yellow Line will become a circle line connecting outskirt of Taipei Metropolitan so that the extension will be vital issue. If its extension plan is approved, the DORTS could directly contract the system provider, Hitachi Italy, under particular limitation rather than open a bid to all possible system providers.

[454] The interview with TP01.

Chapter 8: The People

The Metro as a Source of National Pride

1996-Present

"This the first light rail train made in Taiwan, '!(Cruising Warrior) Shingwuje'[……] The road of 'national trains made by the nations' will continue! (這就是台灣第一輛國產的輕軌捷運車輛，「行武者號」！[.....]「國車國造」的路，還要走下去！)—"Eric Chu Li-lun (朱立倫), the Mayor of New Taipei City (2010-2018).

"The MRT space for the performance of this new citizenry has created an 'MRT tribe' (jieyunzu) of everyday riders who embody well-disciplined and prideful behavior—they are smart, efficient, and considerate participants in the running of the city.[455]" Joseph R. Allen, 2012.

In May 2012, a Democratic Progressive Party (DPP) legislator suggested amending the Mass Rapid Transit Act to allow passengers to drink water in metro systems because drinking water was essential for human wellbeing and it would not cause any pollution in the trains and the station. He emphasized that drinking water and eating food in metros systems was allowed in advanced countries like the U.S., Canada, European countries, and Japan so that Taiwan should not insist on the rule. In Taiwan drinking water and eating in metro systems was against the law, and people who did so so were fined. The suggestion was severely criticized and many concerns were expressed. "Then, there would be people asking to eat meals in the metro system!" "It is too hard to tell the difference between water and liquor!" Interestingly, earlier in January, the Kaohsiung Metro (this legislator was elected in Kaohsiung) released propaganda urging people not to drink water, to sell goods, or to eat food in the metro system[456]. Finally, as with many such initiatives in the past, and in the future, the law remains the same. Taiwanese still do not want people to drink water in their metro systems. Taiwanese are enthusiastic about

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[455] Allen, R. Joseph. *Taipei: City of Displacements.* (Seattle: University of Washington Press, 2012), Pp. 88.

[456] https://www.ettoday.net/news/20120506/44276.htm. Accessed on January 22, 2020.

keeping the metro's environment clean. They also spend much time and effort to define orders and etiquette in metro systems.

In this chapter, we discuss how the Taiwanese have shaped the Taipei Metro and other metro systems into a clean, highly ordered, and respectful environment. I argue that the phenomenon was derived from the Department of Rapid Transit System, Taipei City Government (DORTS), and the Taipei Rapid Transit Corporation's (TRTC)'s ambition to build a "progressive" and "advanced" metro system to change Taipei and Taiwan. Moreover, the making of the environment of the metro and the metro system itself generated the standards of what metro space should be and were made an issue national pride about the metro in Taiwan. Furthermore, when other cities were building their metro systems, they also followed wanted to create beautiful architectures for their metro systems and to build neat spaces within the systems. The rail transportation systems like the TRA (Taiwan Railways Administration) and the Taiwan High Speed Rail (THSR) also aim to follow the Taipei Metro's experience to improve management and the customer's experience of the ride. However, Taiwanese do not entirely like the construction of the metro systems in Taiwan despite their admiration for the systems. This chapter tells the story from the opening of the Taipei Metro and describes how people have participated in interpreting and shaping the metro system.

Safe, Clean, and On Time

In 1987, the Deputy Commissioner of the DORTS at the time, Wu Meng-kuei (吳夢桂), his colleagues in the DORTS, and a few of Taipei City councilors started visited Korea, Japan, Singapore, and Hong Kong to study options for the metro systems for the future Taipei Metro. The trip lasted for two weeks, and the metro study group carefully recorded how these metro systems were built, and how these cities managed their metro systems. Except for the metro systems in Seoul and Tokyo, the systems they visited including Osaka's New Tram, Kitakyushu's Monorail, Singapore's MRT (Mass Rapid Transit), and Hong Kong's MTR (Mass Transit Railway), had been recently built. In his report on this trip, the Deputy Commissioner Wu wrote, "take 'new' as the initial point with pioneer's determination to build 'the culture of the metro' to stimulate the construction of the Taipei Metro glorifying the first chapter of the history of the Taipei Metro.[457]" He went on to say,

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[457] Wu, Meng-kuei 吳夢桂, Liu, Te-li 劉德黎, and Tieh, Tai-chih 帖台之. *The Trip of Metro in Northeast and Southeast Aisa: the Investigation Report of the metro in Korea, Japan, Singapore, and Hong Kong* 《東北南亞捷運行》. (Taipei: The Department of Rapid Transit System, Taipei City Government 臺北市政府捷運工程局,1987), Pp. 124.

“Anyway, be new, be progressive, be thoughtful, be ambitious. We can emphasize our national feature and our specialty, but we did not invent the metro system, so we should, in the principle of choosing the best and the latest, collect all the advantages of others catching up but not left behind. The only advantage of catching up is not to repeat other’s painful steps in their experiences and failures. We must especially not only think about the metro as such but also its added value That is to say, the metro is the basis, but what will the metro bring about? That is what we should care about![458]”

As we discussed in chapter 4, this kind of ambition illustrated in Deputy Commissioner Wu’s words perfectly matched the American consultants’ experience and ideology of building a metro system that led to the monumental architecture of the stations of the Taipei Metro. Initially, the technical officials tended to build something new in the capital, and they aimed at changing the city and even the country through building an advanced and inspiring metro system. The previous chapters also show that Taiwanese technical officials and scholars preferred the Automated Guideway Transit (AGT) system as a means of solving the congestion problem in Taipei because it was the latest metro technology at that time. The DORTS also mentioned that building the Taipei Metro could show the country’s technological ability and economic growth[459]. This idea was conveyed to the operator of the Taipei Metro, the TRTC, since many members of the newly founded metro company came from the DORTS.

The company set “safe,” “clean,” and “on time” as its goals[460]. As a metro company, safety must be the highest goal, but cleanliness seems to be unique in this case. To reach the goal of cleanliness, the TRTC set a criterion that allowed only one piece of paper per a number of square metes: this was to be used as a guide by the contractors who kept the stations and trains clean[461]. Moreover, the TRTC also uses a surveillance system to monitor the cleanliness of the station to help the cleaning contractors and passengers to maintain the stations’ and the trains’ cleanliness.

In addition to the TRTC’s effort to keep the metro’s space clean, the most crucial factor contributing to keeping the Taipei Metro and other metro systems in Taiwan clean was the Mass Rapid Transit Act (MRT Act). The MRT Act was passed in June 1988 when the construction of the Taipei Metro had just begun. It has been amended six times. The

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[458] Wu, Liu, and Tieh, *Trip of Metro in Northeast and Southeast Aisa*, Pp. 132-133.

[459] The Department of Rapid Transit, *The Q&A,* Pp. 16.

[460] Huang, “The Awkward Rail,” Pp. 31.

[461] Huang, “The Awkward Rail,” Pp. 31.

main changes in the amendments define light rail as a kind of mass rapid transit, modify fines for misbehavior, and enforce the rights of the 'physically challenged' in metro systems. One feature of the act, the rules aiming at keeping the stations and trains clean, was added in an amendment in 1997 when the Brown Line and the Red Line had just opened to the public. According to this amendment, Article 50, paragraph 8, of the MRT Act stipulated that those who smoke, eat, drink, spit, spit out betel nut and waste, and throw waste paper, cigarette butts, gum, fruits' waste, and other general trash would face a penalty of NTD1,500 to 7,500 (about USD50 to USD250). However, not all lawmakers supported this amendment. Tsai Huang-liang (蔡煌瑯) from the DPP argued that betel nuts were part of Taiwan's national spirit so that the penalty for chewing betel nuts should not be written into the law, or the law would be a form of discrimination[462]. Stella Chou (周筌) from the New Party and Chen Chi-Mai (陳其邁) also worried that listing eating and drinking in metro systems as illegal behavior in the MRT Act might be against the constitutional right of personal freedom[463]. The official of the Ministry of Transportation and Communication (MOTC) admitted that banning eating and drinking in metro systems was intended to keep metro systems clean and neat. The vice president of the TRTC, Fan Liang-shiow (范良銹), tried to connect the cleanliness issue with a security issue, arguing that the waste of food might lead to outages of metro systems[464]. Finally, the committee of transportation listed only spitting out betel nut and its waste in metro systems as illegal; chewing the nut was not.

The driving force of this amendment was the opening of the Red Line and the Brown Line. First of all, the TRTC established the administrative rules to ban eating and drinking in the Taipei Metro. It even once banned the selling beverage and food in the business facilities within its stations but canceled this policy because it found it challenging to recruit stores into its facilities. However, not all passengers were willing to follow the TRTC's rules. Many passengers still ate food, drunk beverages, smoked, and chewed betel nuts or gum in the metro stations. The employees of the TRTC could only ask them not to do so, and even that sometimes led to severe arguments with the passengers[465]. To contain the disorder in the stations and trains, officials even suggested

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[462] *The Gazette of Legislative Yuan* 《立法院公報》, Vol. 85 No.39 2861, at Pp. 212-213.

[463] *The Gazette of Legislative Yuan*, Pp. 214-215.

[464] *The Gazette of Legislative Yuan*, Pp. 215.

[465]m Yu, Hong-chen 游鴻程. "Free Riders…a Little 'Highhanded' 免費乘客 有些'鴨霸'" *The United Evening News*, March 15, 1996.

taking pictures of those who breached the company's rules and publishing them in stations[466]. Before the amendment of the MRT Act in 1997, the TRTC sent 150 people on the Brown Line to advise passengers not to eat and to drink in the metro system. After the amendment, on June 15, the TRTC warned 45 passengers not to eat and to drink in the Taipei Metro on the Red Line and emphasized that the metro police would start to fine those who ate and drunk in the metro system[467]. Compared to the thousands of riders, the cases of disorder seemed to be rare. In 2007, the number of penalties for eating or drinking in the Taipei Metro was just 231 for the whole year[468].

However, chewing gum and betel nuts became problematic since article 50, Paragraph 8, of the MRT Act only stipulated that those who spat out betel nuts and chewing gum would be fined, not those who merely chewed them. But, the TRTC still insisted on fining passengers who chewed gum or betel nuts. Faced with this situation, Taipei City Government reminded passengers who were fined for chewing gum or betel nuts to appeal and asked the MOTC to explain the law[469]. In 2004, the Legislative Yuan amended the previous MRT Act, and chewing gum and betel nuts in metro systems became illegal. According to the discussion between an official and a DPP lawmaker, the DPP lawmaker, unlike his colleague fighting for betel nuts, even complained that the fine for chewing gum was not high enough because gum may increase the risk of outages of the metro's equipment leading to a security issue[470]. Chewing the "national spirit" in VAL256 would be fined.

The people in Taipei appreciate this rule. In 2000, the Department of Transportation, Taipei City Government (DOT), decided to promote the policy of no food and drink on buses. It mentioned that many citizens told its officials that they appreciated the clean environment in the Taipei Metro and that many foreigners also admired it. It was the law forbidding eating and drinking in the metro that contributed to the clean space in the Taipei Metro. The DOT hoped to promote the same policy on buses. After consulting

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[466] Yu, Hong-chen. "Plan to Publish Photos of Eating and Drinking in Trains 車廂內飲食 擬公布照片" *The United Evening News*, April 26, 1996.

[467] Chou, Wei-hsin 周維新. "Warning Disorder in Metro Eating. Snack and Smoking is the Most 捷運違規勸導 吃零食抽菸最多," *The United News*, June 16, 1997.

[468] Chiang, Ying 姜穎. "No Food for a Clean Space Metro Rider: Proud! 禁食換乾淨空間 捷運族：很驕傲" *The United Evening News*, June 1, 2008.

[469] Yu, Hong-chen. "Controversy! Fined for Chewing Gum in Metro 嚼口香糖搭捷運受罰 有爭議" *The United Evening News*, July 10, 1997.

[470]s *The Gazette of Legislative Yuan*, Vol. 93 No.7 3341, at Pp. 102.

bus drivers, the DOT found that most bus drivers appreciated this policy. Although passengers would not be fined if they ate or drunk on buses because it was not against the law, the DOT and bus companies believed that a clean bus would make passengers obey the rule[471]. A poll in 2001 showed that 86% of citizens supported the policy[472].

Comparing the Taipei Metro's clean environment with those in American or European cities became more and more common among Taiwanese. A young woman who traveled in London shared what she saw and felt in London's Tube in a newspaper. She appreciated the Tube's convenience though this system was old, narrow, and lacked fresh air. She complained about how dirty Tube stations were and how she almost sat on gum on a bench. She wrote, "When a train enters the station, you will see trash flying in the air. At that moment, the image that foreigners are more respectful of the public vanished." She concluded that the citizens in Taipei were lucky since they had the Taipei Metro, that was clean, and in which the price of a ticket was low. "The grass is not always greener on the other side," she said[473]. Taiwan's media are also enthusiastic to report how foreigners appreciate the cleanliness of the Taipei Metro. For example, the *Global Views Monthly* (遠見雜誌) translated an article by Martha Sorren. It praised the cleanliness and consideration of people in the Taipei Metro, especially compared with New York, where she had lived for seven years. She emphasized how clean the bathrooms in the stations are, "Someone was even cleaning the bathroom I was in when I used it, proving that it's actually a priority for the metro system to keep its facilities in good condition. Who knew the Taipei metro could turn me into the kind of person who goes to the bathroom in a subway?[474]."

Stand on the Right Side!

Besides cleanliness, order is another target that the TRTC and many Taiwanese are happy to cooperate in and to maintain. The MRT Act has also played an essential role in this respect. Article 50 of the MRT Act listed the following behaviors in metro systems as being subject to a penalty (unless needed to maintain cleanliness and safety in metro

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[471] The United News. "The Month of Clean Bus. Promote not to Eat or Drink on Bus Next Month 公車環保月 下月起宣導禁食" *The United News*, June 21, 2000.

[472] Chou, Wei-hsin. "86% Support the Policy of No Food on Bus 公車禁飲食86% 贊成" *The United News*, May 12, 2001.

[473] Sophie 蘇菲. "The Taipei People's Luck 台北人的福氣" *The United News*, September 20, 2000.

[474] https://www.gvm.com.tw/article/55774. Accessed on January 23, 2020. Martha Sorren's article: https://www.insider.com/taipei-metro-vs-america-2019-1. Accessed on January 23, 2020.

systems). People can be fined for staying on trains out of service ignoring staff's advice, unauthorized fundraising, unauthorized posting or disseminating propaganda materials, unauthorized selling of goods or other business activities, bringing animals without permission, blocking entrances, exits, ticket machines, escalators, elevators, or other paths that impede passengers, setting up stands without permission, lying on benches and chairs, wandering around on platforms, trains, halls, playing on platforms, walking on escalators, and running on escalators. Like the issue of no food and drinking in metro systems, listing these behaviors in the metro as illegal once again produced some opposition. Critics thought this law might be against constitutional rights of personal freedom. For example, one lawmaker questioned the official definition of wandering, worrying that the vague definition would make it easy for passengers to break the law[475]. Parliament passed the paragraphs about appropriate behavior all the same. Subsequent amendments of the MRT Act did not include these paragraphs.

The MRT Act alone cannot build a highly ordered environment of the metro system, without its terms being implemented by the TRTC. One of the most critical policies was advising users of escalators to stand on the right side, letting those in a hurry walk past on the left side. This escalator etiquette did not originate in Taiwan. Countries including the U.K., Canada, and Japan[476] had promoted it. Many other countries like China and Korea also followed the examples of the U.K. and Japan, reminding the metro passengers to do so, not always with much success Taiwan's cities, however, successfully implemented this rule. In 1999, the TRTC started to advise passengers to stand on the right of escalators, but it did not merely put stickers on escalators or make an announcement. It chose three escalators in the Taipei Main Station, sending people to demonstrate how to behave properly[477]. The TRTC's advocacy produced some controversies and even conflicts in and out of the Taipei Metro. There were many arguments on the Internet. Furthermore, people who agreed with the etiquette fought with those who did not in the stations causing the staff some embarrassment since this was a matter of etiquette, not one of law. Faced with the controversies, the TRTC insisted on

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[475] *The Gazette of Legislative Yuan,* at Pp. 212-213.

[476] People using escalators in Japan mostly stand on the left and walk on the right, but people stand on the right side of escalators in cities in the Kansai area like Osaka.

[477] Liu, Kai-yuan 劉開元. "Please Stand on the Right of Escalators 搭捷運電扶梯 請靠右站" *The United Evening News*, July 13, 1999.

persuading its passengers to follow the etiquette if only for others' convenience, although no law obliged it[478].

In May 2000, the TRTC decided to strengthen its advocacy of escalator etiquette. Besides the approaches it had already taken, such as posting stickers on escalators and setting up stands, the TRTC used the station's broadcasting system repeatedly to remind passengers. Moreover, it sent staff to the stations on the Blue Line, which was the metro line with the most ridership to "direct" passengers to follow the etiquette. The staff not only advised those who did not stand on the right side of escalators but also used speakers to loudly remind passengers to stand on the right on escalators. The TRTC told one journalist, " most of the passengers accept this etiquette, but some passengers think that no law asks them to do so; sometimes conflicts occurred because of the disagreement." Thus, "the TRTC believes that generating group pressure by strong promotion can reduce conflicts.[479]" After the big promotion for a whole day, most passengers followed the staffs' direction standing on the right; the Zhongxiao Fuxing Station's (忠孝復興) staffs said the situation remained the same, many passengers did not follow the instruction. However, the Zhongxiao Fuxing Station's biggest escalators connecting the underground station of the Blue Line and the elevated station of the Brown Line did not have any staff to promote the escalator etiquette because the TRTC thought walking on the four long escalators may cause danger[480].

On New Year Eve in 2004, thousands of passengers rushed into the Taipei Metro to attend a party next to the City Hall Station, and, at about 10:30 pm, an accident happened in Taipei Main Station. Several passengers fell on a moving escalator causing five females to be injured. Two of them had their hair caught in the moving escalator leading to critical head injuries. After this serious accident, the TRTC changed its promotion of the escalator etiquette focusing more on safety on escalators rather than the etiquette of standing on the right. However, the TRTC invited the famous Taiwanese opera (歌仔戲) actress, Sun Tsui-feng (孫翠鳳), to be a spokesperson for escalator safety, demonstrating the escalator etiquette in public. Sun and the TRTC suggested standing on the right of escalators while also emphasizing how to stand on escalators safely by

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[478] Wang, I-chung 王一中. "Standing on the Right Fights on the Internet 搭電扶梯靠右站 網路開戰." *The United Daily News*, March 13, 2000.

[479] Wang, I-chung. "Standing on the Right! Strong Persuasion 捷運電扶梯請靠右站左側通行 強力宣導" *The United Daily News*, May 16, 2000.

[480] Wang, I-chung. "Standing on the Right Most Cooperate 捷運電扶梯靠右站 多能配合" *The United Daily News*, May 17, 2000.

standing inside of a yellow frame and holding on to the moving handrail[481]. TRTC finally removed the propaganda for escalator etiquette; rather, it urges its passengers to use escalators safely using stickers, display stands, and broadcast systems.

Figure 8.1: the Taiwanese opera star, Sun Tsui-feng (right), demonstrated how to take escalators.[482]

Just as it invited the Taiwanese opera star to promote escalator etiquette and safety, the TRTC also invited other celebrities to promote etiquette in the metro systems. The etiquette was not limited to the escalator use, and it included not eating or drinking, leaving priority seats for those who were in need, letting passengers on trains get off first, waiting for trains in line, keeping quiet in trains, and not blocking trains' doors. The celebrities would demonstrate the appropriate behavior in the metro system, film video

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[481] Feng, Fu-hua 馮復華. "How to Use Escalator Sun Demonstrates 搭捷運電扶梯 孫翠鳳示範" *The United Daily News*, February 3, 2005.

[482] 國立臺灣大學數位人文研究中心。「新版國家文化資料庫 。」2010。http://doi.org/10.6681/NTURCDH.DB_NRCH/Collection

clipsfor promotion, and receive interviews to promote metro etiquettes. For example, in 2002, the TRTC cooperated with radio stations to release “Metro News,” “Metro Stories,” and “Metro Music Festival,” and invited singers like Jay Chou (周杰倫), A-Mei (張惠妹) and Leehom Wang (王力宏) to make videos to promote metro etiquettes[483]. In 2013, the TRTC set March 28, which was the date when the Brown Line opened in 1996, as Metro Culture Festival. In the Festival, the TRTC holds a series of cultural actives like small size concerts in the stations and art competitions, and these activities aim at promoting metro etiquette and safety. One of the features of the Metro Culture Festival is releasing videos promoting metro etiquette. These videos do not appeal to etiquette directly but tell a story to show how to follow the etiquette and how good it was to do so.

We need to note one of the videos released in the first Metro Culture Festival. In this video, a white female named Sara visited her Taiwanese male friend Bill in Taipei (the video does not show where Sara came from and if they were lovers or not). At the beginning of the video, Bill welcomes Sara at Song Shan International Airport, which is the international airport located on the Brown Line. They used contactless smart cards to enter the station, starting their trip in Taipei. They visited many famous sights in Taipei, including Beitou Hot Spring, Taipei 101, Tamsui Old Town, and the National Palace Museum using the Taipei Metro. In the metro system, Sara saw “the most beautiful scenes in the Taipei Metro” including safety (the TRTC’s staff held passengers behind the yellow line on the platform when a train was coming), order (passengers got on the train in line), warmth (a volunteer showed a way to a passenger), and consideration (the TRTC’s staff helped an old man to enter a train). In Sara’s eyes, there were many things “making riding on the Taipei Metro a ‘cultural’ thing” including leaving seats to those who need it, being active (young people dancing in the designated open space of the metro system with mirrors), and following the order (passengers standing on the right side of the escalator while Sara and Bill walked by them on the left side). At the end of the video, the mayor of Taipei City at that time Mayor Hau appeared saying “ those who are supporting warmth and caring and creating happiness and a convenient life together are the ‘Metroers’ (捷客).’”

Three things in the video are worthy of discussion. First, in the section showing what Sara was looking at in the Taipei Metro, order in the metro system appeared twice emphasizing its importance. Furthermore, although this video was released in 2013 when

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[483] Wang, I-chung. “A-Mei and Jay Chou’s Voice for Metro 阿妹、周杰倫為捷運發聲.” *The United Daily News*, December 24, 2002.

the TRTC had already stopped promote the etiquette of standing on the right of the escalators, standing on the right was still seen as obeying order in the metro system. Second, all the “good” behaviors in the Taipei Metro were defined as constituting a metro culture. The TRTC shows how it tries to create an ideal environment in the metro system to exhibit Taiwan’s goodness. The TRTC’s efforts echo the DORTS’ ambition to change the city and the country by building an outstanding metro system. What is good is not limited to how efficient the metro system was and how beautiful the architecture of the metro space and its pubic artworks was. How people act in the system and even the quality of the people, the Taiwanese, also matters. Third, the most notably feature of the video, the main character, was an English-speaking white female. Compared with the other character in the video, Bill, Sara was the critical eye witnessing the goodness in the Taipei Metro. Why does a video promoting the metro etiquette to Taiwanese need to use a foreigner’s perceptions to see assess the etiquette and the people’s quality? In Taiwan, the metro is not only about a city but about the whole country.

Figure 8.2: the screenshot of the video for the Metro Culture Festival in 2013.[484]

484 https://taipeino1.taipei/Video/Detail/4d41c8b6-6efa-4602-81cd-abb30e6346e9. Accessed on January 27, 2020. The word showing on the screenshot is “following orders” in Chinese.

National Pride

Using foreigners' viewpoints to verify how good Taiwan's metro systems are is not limited to the TRTC. As the previous section shows, Taiwanese media often introduce the news or articles in other country's media to the advantages of the Taipei Metro, and comparing the Taipei Metro with the metro systems in European and American cities is a common approach. For example, the Buzzorange (報橘), a newly rising online media in Taiwan, made special reports for the 20th anniversary of the Taipei Metro at the end of 2015. Among six articles about the Taipei Metro that Buzzorange introduced or translated into the special reports, four described how to make the Taipei Metro better or mentioned its disadvantages, and two described the advantages of the Taipei Metro. Interestingly, the two that had a positive attitude toward the metro system were derived from foreigner's articles. The first one was the Buzzorange's introduction and translation of an article written by a Japanese designer, Akase Tatsuzo (赤瀬　達三), who highly values the space deigns of the Taipei Metro. The second one was the introduction and translation of an article written by a Taiwanese American journalist, Benjamin Dunn, comparing the Taipei Metro and the LA Metro finding that the Taipei Metro was far better than the LA Metro[485]. At the same time, traditional media like newspapers also took a similar approach to report the 20th anniversary of the Taipei Metro. One report mentioned three specialties of the metro culture: standing on the right on escalators, no food and drinks in the metro, and leaving seats for those who needed them. This report went on to emphasize how Japanese who were regarded extremely disciplined were surprised by how clean and ordered the Taipei Metro was and how well Taiwanese maintained it.[486]

After scrutinizing the media contents, the metro systems, including the Taipei Metro, Kaohsiung Rapid Transit System (KRTS), and the Taoyuan Metro, were sources of national pride. In my view there were three reasons for this: the metro culture, its operation, and its architecture. As we discussed above, the metro culture shaped by the TRTC, the MRT Act, and the passengers is the feature mentioned the most to show Taiwan's goodness. Moreover, the operation of the metro systems, notably the Taipei Metro, is another feature to be regarded as a source of national pride. First of all, cleanliness is not only an achievement of the quality of the Taiwanese people but also of TRTC's management. In 2017, Singapore's MTR experienced a flood and a car accident,

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[485] https://buzzorange.com/category/feature/taipei-mrt/. Accessed on January 27. 2020.

[486] Kao, Shih-chin 高詩琴. "Let the Citizen Last the Pride! 讓市民延續這分驕傲" *The United Daily News*, May 24, 2014.

and it asked the Taipei Metro to assist it in improving its operation. Taiwanese media widely reported this news[487]. Furthermore, many of the contents also focus on the efficiency and reliability of the Taipei Metro. The TRTC also stresses this aspect. For instance, the TRTC has released press releases claiming that the Taipei Metro is more reliable than other members in the Nova (Nova Urban Railway Benchmarking Group) and CoMET (Community of Metros). (These are international metro communities that set the benchmark for metro systems[488].) On the TRTC's website, the TRTC takes a page to introduce the CoMET to Chinese-speaking visitors.

Finally, the architecture and the public artwork of the metro systems in Taiwan can be regarded as sources of national pride, though the KRTS (Kaohsiung Rapid Transit System) should be mentioned rather than the Taipei Metro. In 2012, the KRTS' Formosa Boulevard Station (美麗島站) was listed in second place in the rank of the most beautiful metro stations in the world by a traveler website, BoostnAll. Two years later, CNN and the PolicyMic, which is an online media, also listed the Formosa Boulevard Station as one of the most beautiful stations in the world. Moreover, the Central Park Station of the KRTS, as the Formosa Boulevard Station, was also listed by the PolicyMic as one of the "8 Elegant Global Subway Stations New Yorkers Could Only Dream Of.[489]" These rankings were widely reported by Taiwanese media. Although the rankings sometimes come from new online media instead of well-known media like CNN, Taiwanese media still found them and widely reported them. For the Taipei Metro, the EBC News (東森新聞) reported a video made by an American. Besides the metro culture and the efficiency of the Taipei Metro, the video emphasized that the music which was played when a train enters a station as a part of the "best metro.[490]"

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[487] For example, the reports from the Liberty Times Net (自由新聞網) https://news.ltn.com.tw/news/life/breakingnews/2247390, the NowNews (今日新聞) https://www.nownews.com/news/20171119/2647059/, and the Business Today (今周刊) https://www.businesstoday.com.tw/article/category/80392/post/201803290014/北捷成功經驗紅到海外%20星媒列五大關鍵. Accessed on January 27, 2020.

[488] The Nova and the CoMET are the systems of rail transportation run by the Transport Strategy Centre at Imperial College London. The metro systems with annual ridership below 500 million can join the Nova while the systems have ridership higher than 500 million can join the CoMET. The Taipei Metro joined the Nova in 2002 and then became a member of the CoMET in 2011.

[489] https://www.mic.com/articles/78745/8-elegant-global-subway-stations-new-yorkers-could-only-dream-of. Accessed on January 27, 2020.

[490] https://www.youtube.com/watch?v=WEPn5kJMtdI. Accessed on January 27, 2020.

“Metroalization”

The three features of the Taipei Metro, the metro culture, well-run operation, and architecture and public artworks were replicated in other metro systems in Taiwan because the technical officials from the DORTS and TRTC worked in projects of these metro systems. Moreover, the Taipei Metro set the benchmark for metros in Taiwan so that other cities would follow Taipei’s model. Finally, Taipei is the capital city of the country, so people in other areas would tend to follow how people behave in the Taipei Metro, all the more so since the Taipei Metro was the only metro system in Taiwan for twelve years. Nonetheless, the expansion of these features is not limited to the metro systems, but to other two important rail transportation systems, the Taiwan Railways Administration (TRA) and the Taiwan High Speed Rail (THSR), through the same approach. Hence, I argue that the imitation of the space, culture, and operation of metro systems in Taiwan in other mass rail transportation can be called “Metrolization.”

The word “Metrolization” is derived from the Mandarin Chinese Jieyunhua (捷運化), meaning to make things like the metro. The Railway Reconstruction Bureau, Ministry of Transportation and Communication (RRB) first use this word. As we discussed in chapter 3, the TRUPO (Taipei Railway Underground Project Office) was reformed as the RRB once it had turned the section from Banciao Station to Songshan Station on the West Coast Line into an underground system in 2002. Since then, the RRB extended its working area outside of Taipei Metropolitan. First, the RRB focused on refining the East Coast Line. Second, it initiated the massive project of “ the Metrolization of the TRA (台鐵捷運化)” in other metropolitans. The projects to build or to rebuild the TRA’s line in urban areas aimed to make the intercity railways like metro systems. To make the intercity railways metro-like, the TRA rebuilt the West Coast Line in Taichung and Kaohsiung as elevated (Taichung) and subterranean (Kaohsiung), and in the projects, it built new commute stations to shorten the distance between stations. Besides reconstructing urban parts of the West Coast Line, the RRB also built new elevated branch lines as “metro lines which are not metro.” Moreover, the projects also purchased commuter electrified trains to serve the new elevated/subterranean railways and new stations. The DEC’s (Deutsche Eisenbahn Consulting) idea of rebuilding railways in downtown Taipei into the Taiwanese version of an S-Bahn was finally realized in Hsinchu, Taichung, Yuanlin, Kaohsiung, and some areas of New Taipei City.

The Metrolization of the railways did not only involve transforming intercity railways into commuter railways. The RRB copied the ways the DORTS made the stations’ space.

First, it tried to build monumental architectures for stations. Second, it built new regional central control centers to upgrade the efficiency of its operation. Third, it introduced public artworks as the Taipei Metro did. Finally, the TRA, the operator of the railways, also promoted escalator etiquette and priority seats in its stations no matter whether they were newly built or not. Without strong promotion, the passengers who had been trained by the Taipei Metro naturally transplanted their behavior in the metro into the TRA's stations. In some cases in the TRA's intercity express trains, conflicts arose over whether young passengers with seat reservations should leave the seats to the elderly, children, or pregnant women. For example, the TVBS News reported that a young woman complained that one older man asked her to leave the seat for him because he was old while she was young, even though the woman had reserved the seat[491]. In 2015, one pregnant woman complained that another young woman with a seat reservation of a limited express train refused to leave her the seat, and she took the photo of the young lady posting it online. However, this action led to much criticism, and the young woman who was accused also posted an article showing that she was pregnant[492].

The TRA cannot wholly replicate the metro's operation and the metro culture because of the TRA's problems with efficiency and lack of resources, the different functions of the railway and the metro, and the differences between the Railway Act and the MRT Act (for example, the Railway Act allows passengers to eat food and drink on trains and in stations). However, the TRA's stations and trains and the passengers' behaviors how that the builder (the RRB), the operator (the TRA), and the passengers work together to make the stations and the trains more like the Taipei Metro.

The THSR (Taiwan High Speed Rail) was a slightly different story. Unlike the TRA and the RRB, the THSR was a brand new company run and owned by the private section, state-owned companies, professional mangers, and mass investors. Therefore, the THSR could decide how to build the space of the high speed railway system. Tong and Li already point out that the THSR built a neat, highly ordered, and organized environment for its passengers and system by initiating the Taipei Metro under the same context of modernization and globalization. In this sense, they further regard the THSR as a "big-size

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491 https://news.tvbs.com.tw/life/1158504. Accessed on January 28, 2020.

492 https://news.ltn.com.tw/news/life/breakingnews/1273898. Accessed on January 28, 2020.

metro.[493]" In the THSR's stations, we can see the monumental architectures as if all rail transportation should have them. Moreover, the THSR used the same standard to maintain the cleanliness of its stations and trains. It also heavily focuses on the etiquette of riding on a high speed rail train. On the 10th anniversary of the THSR, the United Daily News released a report about how the high speed railway had incubated a high standard of civilization into its passengers. The right behavior listed by the report, including waiting for trains in line, cleanliness in trains and stations, and consideration of others, all echo the metro culture, which was built by the TRTC and the Taipei Metro's passengers[494].

Figure 8.3: the rebuilt elevated TRA Taichung Station[495]

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[493] Tung, Chien-Hung 董建宏, and Lee, An-Ru 李安如. "The Progressive Transportation Construction and the Change of Taiwan' Urban Culture: the Taipei Metro and the THSR 進步性交通建設與台灣都市文化轉變：以台北捷運與台灣高鐵為例" in *ECONOMIC OUTLOOK Bimonthly* 《經濟前瞻》No. 124, (2009): 43-47.

[494] Tseng, Chi-sung 曾吉松. "The Considering THSR Incubates Civilized Passengers 貼心高鐵 養出一批文明客" *The United Daily News*, January 5, 2017.

[495] Photoed by the author.

Figure 8.4: THSR's propaganda of etiquettes on the train.[496]"

The Exception of National Pride

Taiwanese see Taiwan's metro systems as a source of national pride because of the cultural habits it promote, its operation, and its space. Mattes are different when it comes to the manufacturing of metro artifacts. On November 7, 2017, Taoyuan City Government announced that only those rolling stock companies which had had experience in building entire electromechanical systems for metro systems were qualified to compete for the business of trains and controlling system in the planned Green Line of Taoyuan Metro. This means that the Taiwan Rolling Stock Company (TRSC), the half state-owned train manufacturer in which huge Japanese rolling stock manufacturer

[496] The translation of the Chinese sentence on it is, "the easiest way to a comfortable trip is to lower your volume, not letting others know what happens in your home. The THSR's website: https://m.thsrc.com.tw/tw/News/Detail/2b71cfd0-7d17-4d94-a6c1-be480f3cad26/1. Accessed on January 28, 2020.

Nippon Sharyo (日本車輛製造株式会社) and the Japanese group Sumitomo (住友グループ) owns about 40% of its stock, lost this business in advance because it only had experience in assembling trains. Moreover, Japanese or German companies provided the orders and design diagrams to the TRSC to assemble the trains. In January, 2018, there was more bad news for the TRSC. The Mayor of Taipei City announced the same policy as Taoyuan City for the planned Light Green Line of the Taipei Metro. Tsai Huang-liang, the lawmaker who had stressed that betel nut was the "national spirit" of Taiwan to stop the prohibition of chewing betel nuts in metro systems when the parliament reviewed the amendment of the MRT Act, became the focus of metro issues again. As the president of the TRSC, he argued that Taipei City and Taoyuan City should take a "National trains made by Nationals (國車國造)" policy to incubate the growing rolling stock industries in Taiwan. He insisted that TRSC did have the ability to provide total solutions of electromechanical system for the two cities. If the government did not provide opportunities to Taiwanese companies, they would never gain experience in manufacturing rolling stock and train control systems. So, Tsai hoped Taipei City would allow the TRSC to join the bid by cooperating with international partners with experience[497].

[497] Posted on Tsai's Facebook on January 19 and 20, 2018: https://www.facebook.com/373362590787/posts/10159917098905788/?d=n and https://www.facebook.com/373362590787/posts/10159922286165788/?d=n. Accessed on January 29, 2020.

Figure 8.5: the president of the TRSC. The calligraphy says "National trains made by nationals.[498]"

The TRSC and Tsai reanimated severe controversies, and the two cities refused TRSC's requirement. The mayor of Taipei City, Ko Wen-je (柯文哲), even emphasized that the TRSC could not provide a total solution for the electromechanical part of a metro line, and that it was impossible for TRSC and president Tsai to "reach the heaven with only one step.[499]" The legislator Tuan Yi-kang (段宜康) also condemned the TRSC's "National trains made by Nationals" as being merely a slogan. He stated that the Shingwuje light rail train for the Danhai Light Rail in Tamsui, New Taipei City manufactured by TRSC, was merely a product of assembling a German company's diagrams, and the TRSC could not make a whole metro train[500]. The most embarrassing thing was that Tsai and Tuan both were members of the ruling party, the DPP. Although Tsai had an interview with the media to explain his idea, the two cities did not change the bidding requirements, and no

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[498] Tsai's Facebook profile photo posted on August 20, 2019: https://www.facebook.com/373362590787/photos/a.10150396830190788/10162242440590788/?type=3. Accessed on January 29, 2020.

[499] https://www.chinatimes.com/realtimenews/20180120001888-260407?chdtv Accessed on January 29, 2020.

[500] https://www.ettoday.net/news/20180120/1097056.htm. Accessed on January 29, 2020.

indisputable evidence shows that strong opinions were pressuring Taipei and Taoyuan to change their mind.

The TRSC's lack of experience can explain why its president's advocacy did not receive strong support in Taiwan. This conflict also shows that Taiwanese do not support their rolling stock manufacturer merely due to nationalist reasons. Taiwanese do not value the manufacturing quality of the TRSC, and they do not value the fact that the TRSC assembles trains designed by international companies and buys diagrams to manufacture them. Moreover, China had dedicated its own resources to its metro systems, high speed rail, and indigenous railway industries. As the main rival for Taiwan's national identity the growing Chinese railway industries seem to be overwhelmingly superior to Taiwan's TRSC. One of my informants also criticized the TRSC's design ability. The informant argued that the quality of the Shingwuje LRT train was not as good as the Taipei Metro 's train assembled by the TRSC because it did not provide the specs of materials with sufficient precision. Moreover, Taiwan also lacked the market and industrial supply chains for national railway industries, so he was not optimistic about the future of railway industries in Taiwan[501]. By contrast another informant who has worked in the project of the Taipei Metro as a contractor rather than as a technical official thinks the Taiwanese government should give a chance to Taiwanese manufacturers although they do not have enough experience, or they would never have chance to accumulate their experience and ability. National pride in a metro system is limited to its culture, management, and space. The DPP government might have a nationalist ambitions for the railway industries, but not all Taiwanese are enthusiastic about it.

When the shutdown of the Brown Line after the integrated system was over in 2009, many media and councilors insisted that the hybrid system caused the problems[502]. The same situation also happened to THSR. The THSR is the high speed railway system using a signal control system from Europe and trains from Japan. Before it opened, it was severe criticized for its hybridity of European and Japanese systems. Because the THSR changed its trains from a European one to Japan's Shinkansen after it became the builder and the operator of the railway system, some believed this change was the "payment" for Japan who welcomed ex-president Lee Teng-hui to have heart surgery there. The THSR

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[501] The interview with TP08.

[502] Lin, Pei-i 林佩怡. "The Hybrid Brown Line Wrong with Integration? 內湖線拼裝貨 系統整合凸槌？" *The China Times,* July 11, 2009; The Apple Daily, "The Brown Line Stopped for 8.5 Hours 木柵內湖 捷運停擺8.5小時" *The Apple Daily*, July 11, 2009.

denied this allegation[503]. Lin's case study of assembly cars in rural Taiwan shows that the idea of assembly or hybridity would be regarded as dangerous and unstable even though the assembly cars fully satisfied users' needs and could adapt to different kinds of environment[504]. Although the Brown Line and the THSR have run smoothly for over ten years, the technological hybridity of rail transportation is still seen as a problem rather than an advantage or an achievement.

Formosa Technological Sublime

In June, 1995, the president of Taiwan at that time, Lee Teng-hui, visited his alma mater, Cornell University, and gave a speech. To make the trip happen, the KMT government hired Cassidy & Associate, a well known public relations firm with a strong tie to the Democratic Party after Cornell's president visited Taipei initiating the process of inviting President Lee to visit the U.S in 1993[505]. In May 1995, the House voted 396-0 for a nonbinding resolution favoring Lee's trip; in the Senate, despite administration pressure, similar measure carried 97-1[506]. With the pressure from the Congress, Bill Clinton authorized Lee's trip to the U.S. On June 9 President Lee gave the speech at Cornell University. He introduced two new points in his speech. First, Lee emphasized that popular elections imbued the R.O.C. with sovereignty, not just its status as the successor state to the Qing Dynasty. Second, he asserted that Taiwan's democracy should be a model for China and the world. Lee's success in securing a visa and becoming the first Taiwanese president to travel in the U.S. infuriated the Chinese[507]. In 1996, China launched missiles when Taiwan held its first presidential popular election, causing the Third Taiwan Strait Crisis. The resulting military confrontation with China in Taiwan Strait involving two U.S. aircraft carrier battle groups saw the Clinton administration eventually move to a much more coherent engagement policy toward China[508]. Taiwanese elected

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[503] Li, Wen-i 李文儀, Liu, Li-jen 劉力仁, and Wen, Chun-hua 溫春華 "Nita Ing: No Political Exchange for choosing Japan rather than Europe 殷琪：棄歐就日 無政治交換" *The Liberty Times*, January 18, 2005.

[504] Lin, Chung-Hsi 林崇熙, "Technology in Silence: Self-Assembled Vehicles on Jianan Plain 沈默的技術--嘉南平原上的拼裝車." *Taiwanese Journal for Studies of Science, Technology and Medicine*, No.1 (2001): Pp. 1-42.

[505] Tucker, Nancy Bernkopf, *Strait Talk: United States-Taiwan Relations and the Crisis with China* (Cambridge, MA: Harvard University Press, 2011), Pp. 206.

[506] Tucker, *Strait Talk,* Pp. 211.

[507] Tucker, *Strait Talk*, Pp. 214.

[508] Sutter, *US-China Relations,* Pp. 103.

Lee in response to China's military threats, and the Taiwanese national identity was strengthened even though Taiwanese business investment in China kept increasing.

However, Taiwan's special status and constitutional situation remain the same, and this fact drove the Taiwanese to seek the meaning of being Taiwanese rather than Chinese. Furthermore, China's strong economic growth and closer relations with the U.S. and other countries in the world created pressure to build a new national national identity. Taiwan, known as the Republic of China, is not recognized by most of the countries in the world; on the other hand, faced by the increase of China's economic, technological and military power, Taiwan seems to be powerless and devoid of a coherent identity. Taiwanese have thus been seeking reasons for being Taiwanese in many fields. For example, they named Wang Chien-ming (王建民), a major player for the New York Yankees during 2005 and 2008, the "lighting of Taiwan", connecting his dominant performance in baseball, the "national sport" of Taiwan, to Taiwan's greatness in a domain that China cannot reach. At the same time, the Taipei Metro, a brand new transportation system with the ambition to change the city and the country, was opened for the Taiwanese.

In *American Technological Sublime*, David Nye argues that the American sublime embraced technology. Where Kant had reasoned that the awe inspired by a sublime object made men aware of their moral worth, the American sublime transformed the individual's experience of immensity and awe into a belief in national greatness[509]. Nye states, "the rededication of the Statue of Liberty, like the launch of Apollo XI, was nearly empty of the contents of political life required by republicanism. Neither made any reference to a virtuous citizenry, and neither made the once-common claim that a new technology was a moral machine that would elevate the people. Instead, each was a massive display of organizational and technical power. Each encouraged the belief that democracy and state control of advanced technology was compatible. Each event presented a technical achievement as a sign of national greatness, encouraging the citizen to introject this vision of power and make it a fundamental part of personal identity. In this way, each enhanced the technological sublime as a category of American political experience.[510]" Nye's view can help us to understand the metro systems as a source of national pride in Taiwan, although Taiwan's political experiences and the content of national identity are different from the U.S.

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[509] Nye, *American Technological Sublime,* Pp. 43.

[510] Nye, *American Technological Sublime,* Pp. 279-280.

I call the combination of the metro systems' space, operation, and culture a "Formosa technological sublime." In the field of metro systems, although the Taiwanese know that many core parts of their metro systems were not invented, designed, and manufactured in Taiwan, they know that the metro systems' space was planned and managed by the Taiwanese. Indeed, Taiwanese do not even value the technological hybrid strategies used in the construction of the metro and Taiwan's manufacturing ability of metro equipment. Moreover, the mobilization of transnational knowledge and technology is simply the consequence of the tight connection between the global economy and politics. The systems providers and the consultants were not necessarily Taiwanese, but the outcome was coordinated and organized by the Taiwanese. Like the Jiantan Station of the Taipei Metro and the Formosa Boulevard Station of the KRTS, the architects and the artist of the breathtaking artworks could be a foreigner, but it is the the Taiwanese that made it happen on a grandiose scale. Notably, the Formosa Boulevard Station is the place where the democratic movement started in 1979, and the glass ceiling artwork talks about the myth of the birth of the city, Kaohsiung, from the ocean. This fact is just like the metaphor of Taiwan's status in the global industrial chain, "we may not create something innovative, but we make things from all around the world great," a capacity that lies at the root of Taiwan's decades-long prosperity. Interestingly, the idea of creating an outstanding metro space was derived from American consultants!

Figure 8.6: the Formosa Boulevard Station[511]

The operation followed a similar logic; the cities operate the metro. Originally, the DORTS just wanted to build the best metro system in the world[512]. The TRTC which was composed of former DROTS' members when it was founded set the same goal focusing their performance on impressing the world Additionally, it and other metro operators in Taiwan were always aware of how to make international visitors feel at home and comfortable.

Taiwanese passengers can also compare their experience in other countries' metros and imagine how foreigners feel when they enjoy the efficiency of the metro systems. So, although Taiwanese passengers do not get involved in the operation of the metros, they still can feel that they share in the reliability and comfort of the metro systems. The success of the metro systems is the success of Taiwan.

Finally, the passengers respond to the call of the DORTS and the TRTC's ambition of making the best metro in the world, building and maintaining the metro culture,

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[511] https://zh.wikipedia.org/wiki/美麗島站#/media/File:Glassart_in_Formosa_Boulevard_Station.JPG. 攵

[512] The interview with TP05.

although it was initiated by the TRTC and bolstered by the MRT Act. They even further expanded the culture to other rail transportation systems in Taiwan. Taiwanese do not show how powerful they; instead they promote their order and cleanliness; they do not stress how they innovated the technological systems and how they crafted the monumental architecture of the stations but emphasize their care and consideration for others. Passengers' respectful behavior and etiquette paints a picture of Taiwanese collective cultural values on the canvas composed of the breathtaking architecture of stations. The ordered lines on the escalators and the platforms are the landscape of a highly efficient technological system showing that Taiwanese can mobilize international resources to build the metro successfully and maintain it successfully. Being a part of it, they perform no matter whether they have heard it or not, the dictum of the Taiwanese nationalist activist, Cheng Nan-jung (鄭南榕)[513], “we are humble people in a small nation; but, we are kind people in a good nation (我們是小國小民，但是我們是好國好民).”

[513] Cheng Nan-jung, a democratic and Taiwanese nationalist activist. He had struggled with the authoritarian KMT government for “100% freedom of speech” and “New Taiwanese Nation Movement.” In 1989, when the police tried to arrest him for treason, he jailed himself in his office of the magazine run by him for months. Finally, on April 7, 1989, he burned himself to death at the age of 41 due to the police’s raid into his office.

Chapter 9: Conclusion

America, Hybridity, and Nation-Building

"A metro system can bring multiple benefits to society, and, in general, the benefits are the following. First, national and social benefits: promoting international economic status; upgrading transportation and technology; a showcase exhibiting the technical level and economic growth of our nation (捷運系統能為社會創造多方面的效益，大體而言，捷運系統的效益為：一、國家與社會效益：1. 提高國際經濟地位。2. 提升交通運輸與科技。3. 為我國技術水準及經濟成展之展示櫥窗。)"[514]. The Department of Rapid Transit System, Taipei City Government (DORTS), 1988 (my translation).

"The word 'republic' is derived from the Latin term *res publica*, literally, a 'public thing.' Metro is a public thing. It is public transportation, public works, public policy, public investment, and, since its opening, public space. It is a monument to confidence in the public realm.[515]" Zachary M. Schrag, 2006.

This dissertation answers the questions of how the Taipei Metro and the rail mass transportation systems were built, of what factors caused the technological hybridity of Taiwan's rail mass transportation technology, of how technology was transferred in the field of metro related knowledge and technology, and of how a catching-up country like Taiwan dealt with technologically advanced countries. American hegemony over Taiwan provided resources, and facilitated the transnational circulation of knowledge and technology. It also helped establish institutions for the Taiwanese to build the profession of transportation studies and planning. American hegemony was also the driving force that shaped the environment for the technological hybridity of metro technology. The most solid product of the decades-long process of building the metro system is the Taipei Metro — a nationalist technology composed of hybrid technology, efficient operation, and a unique metro culture. It has been built and shaped by all actors including technical

514 The Department of Rapid Transit, Taipei City Government, *The Q&A,* Pp.16.

515 Schrag, *Great Society Subway*, Pp.282-283.

officials, international consultants, political leaders, engineers, system operators, and the passengers of the metro system.

American Hegemony in Taiwan

The two civil wars in East Asia in the mid-20th century changed Taiwan's trajectory. Although Chiang Kai-shek's KMT government had already acquired Taiwan as the representative of the Allies under MacArthur's General Order No. 1[516], the Chinese Civil War sent the whole KMT government to Taiwan, making Taipei the capital city of the regime. But, the KMT government could be overthrown at any time if communist troops crossed the Taiwan strait: the U.S. decided not to intervene in the bloody Chinese civil war from 1945 to 1950. The outbreak of the Korean War changed the KMT government again. Taiwan, along with Chiang Kai-shek's government, became the Asian front of the Free World, facing communist China. With the neutralization of the Taiwan Strait and the subsequent Sino-American Mutual Defense Treaty in 1954, and the professed U.S. commitment, the KMT government's territorial base was undoubtedly made more secure against Communist encroachment. Yet, an inevitable corollary of the treaty and resolution was that Taipei's military capability would henceforth be purely defensive, and would be substantially restricted in scope by its American ally, with little possibility of reaching beyond the island territories the Nationalists now claimed as the Republic of China[517]. Taiwan became the "accidental island state."

Besides the security of the island state, the Korean War also brought "U.S. Aid" into Taiwan. U.S. Aid did not only pour military and economic assistance into Taiwan. It also facilitated the transnational circulation of knowledge, technology, and people between the U.S. and Taiwan, in cooperation with the Taiwanese, producing consensual American hegemony over science and technology in Taiwan. Taiwan thus faced a double American hegemonic power: military and technological. U.S. Aid started the construction of American hegemony, but it extended beyond that. After 1965, when Washington terminated U.S. Aid, military protection and technological assistance projects continued. With the U.N.'s technological assistance projects, the KMT government began to build the profession of transportation studies and planning, and international consultants, most of whom were American, came to Taiwan. They helped Taiwanese technical officials to

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[516] According to General Order No. 1, the Empire of Japan should order its armed forces to disarmed and surrender to the Allies. In China, except for Manchuria, Taiwan, and French Indochina north of 16 degrees north latitude, Japanese armed forces were required to surrender to Chiang Kai-shek, the Supreme Leader of the China Front.

[517] Lin, *Accidental State*, Pp. 237.

found their institute for the profession, the Transportation Planning Board (TPB). In the TPB, knowledge moved into Taiwan via written documents like manuals, journal articles, technical reports, and people with experience and know-how from the U.S. thus Americanizing the fields of transportation studies and planning in Taiwan

The change in U.S.-Taiwan relations since 1972 triggered the decline of American hegemony over transportation technology and hybrid knowledge. The Taiwanese began to seek alternative sources of knowledge and technology for the development of rail mass transportation. They turned first to Germany and then to Japan and to Britain. The disruption of diplomatic relations with the U.S. created the space for Taiwanese technical officials to introduce different types of knowledge and ideas as regards technology from advanced countries other than the U.S. All the same, the change in the U.S.-Taiwan relations could keep American at a distance, but it could stimulate a new closer relationship. The trade deficit between the U.S. and Taiwan led to America's intervention in the Taipei Metro project, bringing American consultants and technology into Taipei since Washington still had military and political hegemony over the island state.

This brief historical account shows that Taiwan's diplomacy and its relationship with the U.S. was one key factor explaining technological development on the island. The Taipei Metro and other railway systems in Taiwan show how the transnational circulation of knowledge and technology between the U.S. and Taiwan along with American hegemonic power shaped them with designs and artifacts embedding American models and experience. The mixture with which the designs and artifacts coming from other countries were deployed also reveals traces of the interaction between the U.S. and Taiwan.

Further questions for research hence emerge. Despite this study of rail transportation technology, we can also include the diplomatic factors and U.S.-Taiwan relations as a key viewpoint to explain other technological systems and their hybridity. Moreover, another member of Taiwan's rail transportation system, the Taiwan High Speed Rail (THSR) which was planned, designed, and built after the 1990s may also be discussed within the same analytical frame, a vast technological system that still needs to be studied in greater depth than was possible in this dissertation.

Creating Hybridity

The technological hybridity of rail mass transportation technology is both the strategy and the outcome of the process of building technological systems, including the Taipei Metro and the subterranean railways in Taipei. Consensual American hegemony in

technology and the development of U.S.-Taiwan relations created a suitable environment for producing hybrid knowledge and technology. Indeed the determination to maintain autonomy drove Taiwanese to take hybrid strategies while they were building technological systems and their capabilities for future development. This was a decades-long process from the making of knowledge to building a successful metro system. The mixture and integration of different knowledge, ideas, designs, and artifacts led to the material deployment of hybridity. As this dissertation reveals, we can classify technological hybridity into three types: the hybridity of knowledge, the hybridity of styles and functions, and the hybridity of systems.

The technological hybridity of knowledge was based on the Americanization of Taiwan's transportation studies and planning and created by Taiwanese technical officials' strategies and efforts for autonomy for the island state. In the case of the metro system in Taiwan, the acquisition of knowledge played an essential role in building the system and the formation of other types of hybridity. First, planners and engineers needed to generate the knowledge of the city, including the ways how people move, its economic development, the geography of the city, and other many kinds of urban activities, or they would have had no idea how to design and build the system. Second, the knowledge embedded a technological and political ideology defining the ideal of order and its material embodiment in the system and the city. And once the ideas and designs were realized, the technological hybridity of styles and functions emerged.

The technological hybridity of styles and functions reveals how ideas, designs, and artifacts were integrated into Taiwan's local context ant political agenda after their transnational travels. The transnational history of the metro system in Taiwan is not the history of the replication of technological systems from technologically advanced countries, with minor modifications to adapt it to the local context; instead, it is the history of how transnational technology provided the materials for the catching-up countries to build their systems. However, catching-up countries cannot build systems arbitrarily; instead, they build their systems within the limitation of their resources and their power relationships with technologically-advanced countries. So, as the subterranean railways in Taipei and the Taipei Metro show, technological systems are the outcomes of the negotiations, conflicts, compromises, and cooperation of multiple actors representing their nation-states. Some designs and material deployments can tell a story of how technologically advanced countries overpowered catching-up countries, while others show how catching-up countries changed the power relations with partners.

Technological hybridity exhibits the possibility that multiple technological systems can be integrated into one to pursue different goals and techno-social orders. Transnational movement of technological systems might weaken their technological momentum since technological systems need to customize themselves to the local context. Systems' momentum generates system builders' (mostly from technologically advanced countries) power over system receivers (catching-up countries). Hence, the weakening of technological systems means the chance for catching-up countries to change the power relations with technologically advanced countries. The hybrid system also must generate the technological hybridity of styles and functions since every technological system aims at a particular goal by its designs, modification of the material world, and deployment of artifacts.

These three types of hybridity are rooted in the case studies of this dissertation on the history of Taiwan's rail mass transportation technology, but I do not argue these types of hybridity exhaust all possible forms of hybridity. The technological hybridity derived from this dissertation may inspire future researches on hybrid knowledge and technology, and I expect future research can explore different types of hybridity or even modify my classification. Moreover, readers may wonder whether there are other conditions that make technological hybridity meaningful. This dissertation shows that the concept of technological hybridity can contribute to the transnational history of technological systems, but what if the boundary of different technological systems is not nations? Historians of technology may explore the possibilities of of this concept in different situations, though always bearing in mind that the exploitation of this concept has its limits.

The "American Dream" in Taiwan

The Taipei Metro is an "American dream" come true in Taiwan, but the content of this dream is far different from the stereotype of the American dream. It was an alternative version of the American dream about moving in cities. In fact, in some American cities, this dream of metro systems has failed or at least disappointed. In the 1960s and 1970s, American metro engineers tried to build metro systems in American cities, including San Francisco, Atlanta, and Washington, D.C., hoping to change the automobile-centric urban environment. In these cities, we can find that the Metro is a public thing. It is public transportation, public works, public policy, public investment, and, since its opening, public space. It is a monument to confidence in the public realm[518]. For example, the

[518] Schrag, *Great Society Subway*, Pp. 282-283.

Washington Metro, its creation, took place in an era when Americans passionately embraced the automobile[519]. These dreamers needed to compete with automobiles, the ideology of an automobile-centric society, and a major transport system already gaining momentum.

As chapter 4 shows, these metro systems in American cities were not only built and run by public authorities but also took a series of approaches to compete with automobiles. For example, they all had monumental architectures and artworks to attract people to use them. Their builders spent much effort to make the space of the systems comfortable, and they tried to build the systems serving all classes and all races. However, the metros were built, but the dream was not. For instance, at the very beginning, the builders of Atlanta's MARTA (Metropolitan Atlanta Rapid Transit Authority) hoped that six counties would join the project, but only two counties were engaged by 2015. The MARTA even has the nickname of "Moving African Americans Rapidly Through Atlanta," revealing the disproportion of racial distribution of its riders. Not even to mention its temporary shutdown every Sunday due to the financial crisis in 2008.

However, these system builders and their successors traveled transnationally to Taipei in the mid-1980s along with American intervention of the project of the Taipei Metro. Their knowledge, experience, and ideology also entered Taipei finding the perfect match with Taiwanese technical officials' ambition to build a metro system that could be a source of pride and change the city and the island country. By integrating with the designs coming from other countries, Taiwanese and their American consultants built a metro system which is a crucial component of the metropolitan area inhabited by at least 6 million people. In 2019, the Taipei Metro's average ridership per day was 2,163,285, making of it a sustainable metro system. The Taipei Rapid Transit Corporation (TRTC), which is a 100% public corporation, generated about 18.9 billion NTD (about USD3.3 billion) revenue-earning and about 1.4 billion NTD (about USD470 million) profit after tax in 2017. Last but not least, the price of each ticket is from 20 NTD to 65 NTD (about USD0.6 to 2.1), making it one of the most affordable metro systems in the world. The American planners and engineers made their dream come true, not in any American city but in Taiwan's capital city.

This dissertation suggests that maintenance, management, and operation defines the difference between metro systems in Taiwan and those in American cities, but a more comprehensive comparison between the metro systems is necessary to fully explain the

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[519] Schrag, *Great Society Subway*, Pp.1.

differences. Although Taiwan's cities have many different characteristics from American cities, we still have enough elements to compare the systems on two sides of the Pacific. First, the same group of planners and engineers were involved in building the systems meaning these systems shared many designs and ideas. Second, all American and Taiwanese cities were automobile-centric when they started the projects of metro systems. In the 1980s, Taiwan had never ever had a metro system in its history. That is to say, these cities all needed to change and transform an urban environment designed for automobiles. Finally, both America and Taiwan do not have strong railway manufacturing industries, so both countries need to rely on international suppliers for core systems of metro systems like signal control and rolling stocks highly.

Building Systems, Building a Nation

From the very beginning, the history of Taiwan's rail mass transportation technology after WWII is not merely the history of building a metro system; instead, the story started from the time when Taiwan suddenly became an accidental island state during the 1950s. As a former colony facing the possible military threat from China under the U.S.' protection, Taiwan and the KMT government's goal was to survive and gain economic and technological power to confront China in the context of geopolitics in the Cold War. Therefore, in the case of transportation systems, Taiwan did not only want a railway or any particular transportation system but the ability to generate necessary knowledge for developing its transportation systems in the future. In the 1970s and 1980s, the transportation projects like the subterranean railways in Taipei and the Taipei Metro were being planned and designed, Taiwanese technical officials and political leaders still held the same motivation of gaining technological power leading to technology transfer in these projects.

Hence, the Taiwanese technical officials did not merely try to build a metro system and a subterranean railway for Taipei; their efforts were a part of nation-building. Besides the technical officials' motivation and approach to building the profession and ability to generate knowledge, three facts show that building mass transportation systems can be regarded as part of the nation-building of Taiwan. Firstly, from the TPB to the Taipei Metro, all projects were initiated from the central government, although the Taipei Metro was completed and operated by the hand of the Taipei City Government. Secondly, the Taiwanese technical officials and political leaders vehemently maintained the Taiwanese government's autonomy, although they were involved in the coproduction of American hegemony in the early stage, and they compromised due to political pressure many times.

Finally, after the Taipei Metro was open to the public, the TRTC and its passengers have meticulously shaped the space and culture of the Taipei Metro regarding it and other metro systems in Taiwan as a national pride to show Taiwan's unique goodness.

As the introduction of this dissertation argues, the Taipei Metro and the project of subterranean railways in Taipei were national projects instead of municipal projects. All the projects were initiated by the central government in the scope of national development rather than merely solving one city's problems. Moreover, many critical decisions were made by the top level of the KMT government like Chiang Kai-shek, Chiang Ching-kuo, and Yu Kuo-hwa which shows that building mass transportation systems in Taiwan was a national affair. Also, Taipei is the main stage of this history, and because it is the capital city of the island state it involves many Taiwanese out of Taipei. The Taipei metropolitan already engages a third of the population in Taiwan, and Taiwanese living in other areas have a high possibility to visit Taipei because it is the capital. Hence, the transportation system projects are inherently national.

The technical officials, engineers, and political leaders' actions of maintaining Taiwan's autonomy toward technologically advanced countries, including the U.S., Germany, Britain, and France, also generated the sovereignty of Taiwan. Chang's dissertation about the construction of the THSR shows how engineering practice formed a national and engineering identity and subjectivity[520]. This dissertation further reveals that identity and autonomy were generated and maintained in an earlier stage of building rail transportation system: knowledge-making. Furthermore, the history of the Taipei Metro just shows how vague the boundary is between political or technical decisions. Although one of the most important political issues for Taiwanese is to describe the differences between them and Chinese, the history of rail transportation technology in Taiwan shows that Taiwanese officials also generated Taiwan's autonomy by distinguishing themselves from the U.S. and other technologically advanced countries. Indeed, one of the nation-state's characteristics is to show the differences from all countries except itself. Frankly, this dissertation is not to argue that all Taiwanese technical officials or Chiang Ching-kuo were Taiwanese nationalists. In fact, many technical officials even held strong Chinese national identity (do not forget the meaning of the KMT is "Chinese Nationalist Party) or had little interest in national identity. Nonetheless, their positions, decisions, and actions of building the systems involved the

[520] Chang, "Technological Construction."

making of the nation-state named Taiwan or the Republic of China no matter what kinds of national identity they held.

In this sense, this dissertation may inspire a different approach to the studies of nationalism. What role do material and institutional factors play in the formation of a nation-state? Besides technological nationalists, we can find an alternative viewpoint when we try to understand the relationship between technology and nationalism though this dissertation only touches a little on this issue.

Finally, after the mid-1990s, the growing Taiwanese national identity has been eager to show the island nation's uniqueness even though Taiwan has been excluded from mainstream international society for decades. Hence, the stunning metro systems became the technological sublime to exhibit Taiwan's exceptional quality as a nation-state in the world. This dissertation points out that operation, maintenance, and passengers' behaviors and understandings are also critical parts of the building and shaping of technological systems. Taiwanese built the profession to generate knowledge about their city and people. With international consultants' assistance, they integrated technological and political ideas about rail transportation designing their railways and stations and making them stunning. Finally, they shape the metro culture and space by disciplining their bodies and equipping considerateness as a part of Formosa's technological sublime so that they can declare they have as much national pride as any other country in the world. By building the systems, the Taiwanese are building the island nation.

Appendix A

People and Places

This dissertation mentions many Taiwanese, Chinese, and Japanese, and Taiwanese cities, administrative districts, and sites are also points for the discussion. However, the formation of the English spelling of the names of the people and places in Taiwan is quite complicated because of Taiwan's political and historical development. Therefore, this article explains how the English spelling of the names of people and places come in this dissertation.

People

In this dissertation, when I mention a Taiwanese, Chinese, or Japanese, I follow the order that surname comes first, and the first name follows. This order is how East Asian countries call their people. Moreover, some Taiwanese and Chinese are customarily called with this order, such as Chiang Kai-shek, but some others were not. I think it might confuse. To avoid confusion, I use the name order with East Asian customs when I mention the names of Taiwanese, Chinese, and Japanese. For example, Chiang Chin-kuo (蔣經國) and Shima Hideo (島 秀雄).

Furthermore, when this dissertation mentions these people's surnames, I add their title in front of the surnames because different Chinese or Japanese surnames may use the same English spelling. For example, Chiang Kai-shek (蔣中正) and Dr. Chiang Yu-sheng's (姜渝生) English spelling of their surnames are the same, but they have different surnames "蔣" and "姜." In order to avoid confusion, the dissertation uses Dr. Chiang when it only mentions Dr. Chiang Yu-sheng's surname. Other examples are Professor Yeh, General Tung, commissioner Chi, and counselor Fu.

Some technical officials have specific English names or like to use the acronyms of their first name as an English name since many of them had a tight connection with foreigners, and people customarily use these names to call them. For the former, Paul Lai (賴世聲) and David Poo (濮大威) are the examples; for the later, K.T. Li (李國鼎) and C. C. Wang (王章清) are the cases.

Taiwanese use multiple spelling systems to compose the English spelling of their names, and some of them would even use two systems at the same time due to their identity. All of the people mentioned in this dissertation were born before the 1970s, and

before the 1990s, most Taiwanese would use the Wade–Giles system to compose the English spelling of their name. Therefore, most of the names of Taiwanese mentioned in this dissertation would follow the Wade-Giles system. Nonetheless, there are many exceptions. Some people's names already have their conventional spelling, like Chiang Kai-shek. Some people use the spelling from multiple systems, such as Lee Teng-hui (李登輝) and Chen Shui-bian (陳水扁). There are also cases that they have exact English names, like David Poo, Paul Lai, and Morris Chang (張忠謀). Lim Giong (林強) is a special case since he uses his name's Taiwanese pronunciation instead of Chinese one to form his English name. Moreover, Taiwanese's names all have a hyphen between the two words of their first name if they have two words in their first names, while Chinese does not have it.

Places

Like people's names, the English spelling of Taiwanese places' names can come from multiple spelling systems, but no rule can determine which places use the Wade-Giles system, the Hanyu Pinyin system, or the Tongyong Pinyin system. Therefore, I take the following policies to determine to use which version of English spelling of the name of places.

For cities and administrative districts, this dissertation follows the local government's decisions. Some of these places have unique ways to compose their English names. Tamsui (淡水) is a typical case. This romanization name was used customarily for centuries. Therefore, when the dissertation mentions the railway or metro lines, river, and station named after this old town, it would use "Tamsui." For instance, the Tamsui River, the Tamsui Station, and the TRA Tamsui Line. New Taipei City (新北市) is another particular case. According to the Hanyu Pinyin system, this city was supposed to be "Xinbei City" when it was reformed from Taipei County as the special municipality in 2010, but, after a toll, the citizens prefer to translate the city's name by meaning rather than the pronunciation.

For the stations and lines in the railway and metro systems, this dissertation follows the TRA (Taiwan Railway Administration), Taipei Metro, and KRTS' (Kaohsiung Rapid Transit System) English websites even though some of the lines' English names have different meanings from its Chinese names. For instance, the West Coast Line (縱貫線). The names of the lines in the Taipei Metro need to be explained. Although Taiwanese are used to use names of places to refer the metro lines, such as Tamsui-Xinyi Line (Red

Line; 淡水信義線), this way would be wordy and hard to read for English readers. Especially in the case of the Blue Line and the Brown Line, Taiwanese would call them “Bannan Line (板南線)” and "Wenhu Line" meaning from Banqiao (板橋) to Nangang (南港), and from Wenshen District (文山區) to Neihu District (內湖區), easily causing misunderstanding. Hence, this dissertation uses representative colors to refer to the metro lines.

Finally, Taiwan has had many times of reformations of administrative districts in the half of a century, so many administrative districts would thus have different names from time to time. For example, Tamsui was once “Tamsui Township” but now “Tamsui District.” Hence, except for those cities which have never changed their names, such as Taipei City, Taichung City, and Kaohsiung City, this dissertation would drop the administrative districts after the names of places to avoid confusion. For instance, this dissertation would only mention “Tamsui” instead of “Tamsui Township” or “Tamsui District.” New Taipei City/Taipei County would be a special case. New Taipei City/Taipei County and Taipei City refer to two different areas. To avoid misunderstanding with Taipei City, when the dissertation mentions New Taipei City/Taipei County, it would always come with its full name.

For reference, the following chart is the translation of the classification of the administrative districts in Taiwan.

Districts	Chinese	Example
City	市（直轄市、省轄市、縣轄市）	Taipei City
County	縣	Taipei County
Township	鄉、鎮、市	Tamsui Township
District	區	Neihu District

Appendix B

Interviews

I held ten interviews with the retired technical officials, metro engineers, operators of the metro system, suppliers of the Taipei Metro, and international consultants. The interviews were held during March and July 2019, and all of them have audio records. Because this research is under IRB's protocol, all interviewees are anonymous, and the records of the interviews are well protected. The following chart is the information about the interviews.

Code of interviewee	Related institutes	Time	Place
TP01	**DORTS, TRTC**	March 31, 2019 14:20-16:20	The Daan Park Station, Taipei Metro, Taipei City, Taiwan.
TP02	**DORTS**	April 17, 2019 14:30-18:00	The Taipei Main Station, Taipei City, Taiwan.
TP03	**DORTS**	April 18, 2019 14:00-16:00	A Coffee shop in Taipei City, Taiwan.
TP04	**International Consultants**	April 26, 2019 16:00-18:00	The interviewee's office in Taipei City, Taiwan.
TP05	**TPB, DORTS**	April 30, 2019 14:00-17:00	The interviewees's apartment in New Taipei City, Taiwan.
TP06	**DORTS**	May 30, 2019 15:30-17:30	The interviewees's apartment in Taipei City, Taiwan.
TP07	**DORTS**	June 20, 2019 10:00-12:00	The interviewee's office in Taipei City, Taiwan.
TP08	**TPB, DORTS, RRB**	July 3, 2019 09:30-12:00	The Taipei Main Station, Taipei City, Taiwan.
TP09	**Contractors**	July 11, 2019 11:00-15:00	The interviewees's apartment in New Taipei City, Taiwan.
TP10	**DORTS**	July 16 , 2019 10:00-12:00	The Taipei Main Station, Taipei City, Taiwan.

Appendix C

Archives

The historical works in this dissertation rely on the archives in the National Archives in Xinzhuang District, New Taipei City, and the archives of the Institute of Modern History, Academia Sinica. The following chart lists the archives and their information that I exploit in this dissertation.

Title	Chinese Title	Number	Source
Metro System	捷運系統	A329000000G/0067/G-1.6.1.1(F)-2/01	National Archives 國家檔案閱覽中心
Subterranean Railway	地下鐵	A329000000G/0067/G-1.6.1.1(F)-1/01	National Archives 國家檔案閱覽中心
The Contract between the CUSA and the Engineering Consultants	美援會與美援工程顧問組合約	A303000000B/0051/473.2/15	National Archives 國家檔案閱覽中心
The Subterranean Railway in Taipei City Feasibility Study	為台北市地下鐵路初步可行性研究事希知照洽辦由	A315180000M/0060/023/016/1/002	National Archives 國家檔案閱覽中心
Sending the P&B's Study of the Subterranean Railway in Taipei City	檢送「美派森斯公司研究台北市區鐵路地下化報告」一份	0064/210/002/1/010	National Archives 國家檔案閱覽中心
The Agreement of the SAFED and the Management Committee	中美基金協定及管理委員會	0067/A-1.1.2/01	National Archives 國家檔案閱覽中心
The Plan for Improving Transportation in Taipei Metropolitan, Building Subterranean Railway or Elevated Railway in Taipei City, and Mass Transportation Systems Planning.	改善大台北地區交通運輸計畫、台北市鐵路地下化或為高架鐵路規劃、大眾運輸系統規劃等	36-10-001-070	Academia Sinica Archive, CIECD Central File 中央研究院近代史研究所檔案，國際經濟發展合作委員會檔案
The Plan for Improving Transportation in Taipei Metropolitan, Building Subterranean Railway or Elevated Railway in Taipei City, and Mass Transportation Systems Planning.	改善大台北地區交通運輸計畫、台北市鐵路地下化或為高架鐵路規劃、大眾運輸系統規劃等	36-10-001-071	Academia Sinica Archive, CIECD Central File 中央研究院近代史研究所檔案，國際經濟發展合作委員會檔案

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