

Ministerial Brief

Unclogging Chiang Mai's Traffic Congestion



Photo credit: www.stickmanbangkok.com

Master in Public Administration 2017/2018

PP5804 Governance Study Project

Urban Possibilities: Reimagining Chiang Mai

Submitted by:

Fu Yaqin

Saw Chun Kiat

Tan Lu Hsia

Xu Kuang

Unclogging Chiang Mai's Traffic Congestion

Executive Summary

As one of the fastest growing secondary cities in Southeast Asia, Chiang Mai is undergoing rapid urbanisation. Due to the absence of effective transport demand management policies, public transport investment, and a lack of integrated transport and land use planning over many years, the city is facing pressing serious urban transport challenges such as growing traffic congestion, high accident rates, and worsening air pollution. These problems not only compromise Chiang Mai's livability and environmental sustainability but also pose a direct threat to the tourism industry, one of the city's main economic drivers. While it is hardly possible to eradicate congestion in a growing and economically vibrant city like Chiang Mai, sound policies should be deployed as soon as possible to mitigate traffic problems to ensure the city's sustainable development.

This project sets out to analyse the factors that have contributed to Chiang Mai's traffic congestion and to come up with policy alternatives that could mitigate the problem. Developing an effective transport management system requires broad and holistic changes involving long time horizons and high costs. Working within the allocated budget of US\$17,000, the project team proposes small-scale policy alternatives which could have an effect on road users' behaviour to reduce road congestions and the use of private motor vehicles. Specifically, this project examines the use of parking management, with a view towards designing a pilot experiment using the allocated budget.

Background

Chiang Mai has been the most important economic and cultural center of Northern Thailand. Over the past 20 years, its Gross Provincial Product (GPP) has almost tripled, from 62,826 million baht in 1995 to 217,951 million baht in 2015 (NESDB 2015). Chiang Mai's vision is to be a 'tourist hub in Asia' and 'gateway of trade and investment which link to the world community' (Chiang Mai Governor Office 2015). Tourism is thus one of its most important economic activities; the province attracted 8.67 million tourists in 2014 which is more than five times that of the total provincial population, bringing in annual revenues of around 73,757 million baht (Chiang Mai Governor Office 2015). While development has brought about some wealth and

prosperity to the city and its people, it has also resulted in negative consequences that would compromise Chiang Mai's sustainable development in the long run, not least in the area of urban transport.

Sustainable transport development is highlighted in United Nations (UN) 2030 Sustainable Development Goals (SDGs) Target 11.2 that member countries to “provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons” (UN 2017). Although sustainable transport is not represented by a standalone SDG, it is mainstreamed across several SDGs and targets, especially those related to food security, health, energy, infrastructure and cities and human settlements (UN 2017). A city with a well-developed transportation system will see smoother goods and people movement, less environmental pollution and higher overall efficiency. A healthy transport system is hence essential to a city's economic growth and livability.

Problem Identification and Analysis

The project team conducted literature reviews and in-person interviews with Mr. Paisarn Surathamvit, Assistant to the Mayor of Chiang Mai Municipality (CMM) and Dr. Nopadon Kronprasert, lecturer at the Department of Civil Engineering of the Chiang Mai University (CMU), to understand Chiang Mai's urban transport landscape and identify the causal factors for its transport problems.

Chiang Mai's Urban Transport Landscape

Chiang Mai presently has the highest per capita ownership of private vehicles as compared to other regional cities (Jittrapirom 2015) (Table 1). While its car ownership is in the same range with other cities (Bangkok and Taipei), its motorcycle ownership rate is much higher (33% higher than Hanoi) (Jittrapirom 2015). The 2012 Chiang Mai Mobility Travel Survey (CM-MTS) showed that 97% of households own at least one motorised vehicle; motorcycles account for approximately 70% of total vehicles registered in the city and are the most popular transport mode within the municipality area due to their manoeuvrability, compactness, affordability (Jittrapirom 2015).

Table 1. Comparison of vehicle ownership between Chiang Mai and other cities

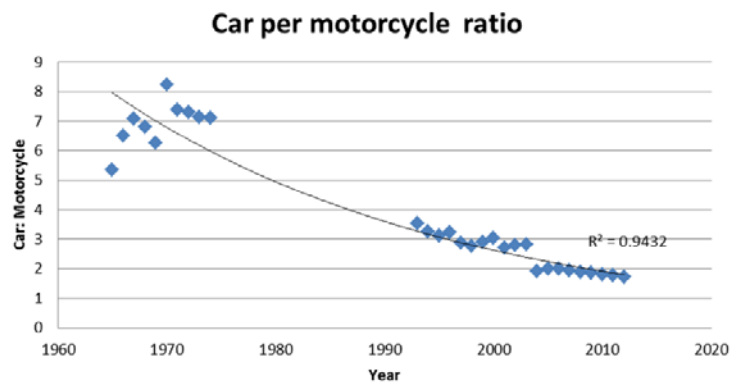
Source: Jittrapirom 2015

City	Population (year)	Vehicle ownership per 1000 capita		
		Car	Motorcycle	Car and motorcycle
Hanoi	6,500,000 (2009)	12	400	412
Ho Chi Minh	7,990,000 (2013)	12	371	383
Delhi	22,000,000 (2012)	82	174	256
Jakarta	10,200,000 (2011)	125	165	290
Taipei	2,700,000 (2012)	257	379	636
Bangkok	8,300,000 (2010)	316	316	632
Chiang Mai	602,000 (2011)	304	535	839

That said, Chiang Mai is experiencing a transition away from the dominance of the motorcycle and moving more towards the car as the preferred means of personal transport (Jittrapirom 2015) (Figure 1). The negative trend of the car to motorcycle ratio indicates that the number of motorcycles registered per car has reduced significantly; from between 5 to 7 motorcycles per one car in 1960s to 1.7 per one car in 2012 (Jittrapirom 2015).

Figure 1. Chiang Mai's Car Per Motorcycle Ratio

Source: Jittrapirom 2015



The city's rapid motorisation and car growth in recent decades have resulted in a number of unsustainable negative impacts:

Chronic congestion that slows down goods and people movement, especially during the peak hours when the commuters from the suburban areas pour into and out of the city center in

private vehicles. Gridlocks are often observed around the areas where the schools, businesses and government offices are located. From 2002 to 2012, the average travel speed in the municipality has decreased from 23.9 km/hour to 21.7 km/hour, indicating worsening congestion levels (Jittrapirom 2015).

Worsening air pollution. Chiang Mai has been ranked as one of the top polluted cities in the world (The Nation 2018). Along with the haze caused by the slash-and-burn farming in the mountainous areas, black and toxic fumes expelled from the vehicles' exhausts constitute a major cause of the city's ever-declining air quality (CityNews 2016).

Increasing traffic-related casualty. Last year there were 31,445 reported traffic accidents in Chiang Mai and 253 people lost their lives (Thai RSC 2017). Motorcycles are often involved in these accidents especially during Songkran Festival (The Nation 2018).

Shrinking public space. Vehicles are frequently seen parked on the sidewalks, forcing the pedestrians to share the road with the traffic. Because of weak parking management and inefficient law enforcement, illegal and obstructive parking in the city center is rampant.

These problems will worsen if vehicle growth continues unchecked. The traffic volume is expected to double in the next 20 years (Figure 2) based on status quo. Such unrestrained private transport growth will inevitably overwhelm the municipality's high-density urban infrastructure and transport network capacity, and further degrade its environment and quality of life.

Figure 2. Predicted Traffic Volume of Chiang Mai's Road Network in 20 Years

Source: Excellence Centre of Infrastructure Technology and Transportation (ExCITE)
Chiang Mai University 2017



Causal Factors

1. Misguided Urban Transport Policies

Chiang Mai's current transportation woes can be traced to its misguided urban transport planning which focused on improving the flow of traffic primarily through road capacity expansion, and on policies which promoted the affordability of private vehicles. Thailand's paved roads increased from 200 km in 1935 to 40,000 km by 1990 (Jittrapirom 2015). In 2012, in addition to the Chiang Mai-Bangkok high speed rail project, the Thai cabinet approved the budget for the development of ten highway projects around Chiang Mai, signalling its continued emphasis on accommodating higher motorisation levels. The Thai government has also actively supported growth of the automobile industry by passing various bills and measures, such as exempting import tax on vehicle parts when the industry needed a boost (Jittrapirom 2015). In addition, the government's First Car policy from 2011 to 2013, subsidised first-time car buyers with a tax rebate of up to 100,000 Baht or about 16% of a car's price (Jittrapirom 2015). The twin desires for congestion-free and affordable driving were politically seductive and played to motorists' desires and the interests of car industries (Barter 2015). However, both policies resulted in increasing motorisation. The number of registered personal cars in Chiang Mai almost doubled between 2006 and 2013, standing at 265,890 for a city with 75,878 registered households (CMM 2014).

The absence of traffic restraint measures, coupled with rapid economic growth, also contributed to Chiang Mai's rapid motorisation and car growth. In 20 years, GDP increased by more than 100% between 1991 and 2011, while the average income per Chiang Mai resident rose by about 300% from 32,761 baht to 94,060 baht between 1991 and 2011 (Jittrapirom 2015; NESDB 2015). The rise in wealth provides the population with increased purchasing power to acquire cars, which are also seen as a status symbol (Jittrapirom 2015).

2. Limited Non-Private Vehicle Alternatives

Public transport and non-motorised transport were also neglected, which diminished their viability as an alternative for the emerging middle-class (Barter 2000). In the absence of a reliable and quality public transportation system, the red cap taxi (*song teaw*) emerged as the primary paratransit mode in Chiang Mai over the past thirty years, providing on-demand service with fare negotiated between commuters and drivers. However, its inefficiency and unreliability as well as

the *song teaw* co-operative groups' mafia-style behaviour have been heavily criticized by the public, especially those who advocate a thorough change of the city's public transportation system (Kemasingki 2015).

The municipality began its public bus service only in 2004. The public transport today continues to be unattractive due to low speeds, low frequency and poor service levels, contributing to the decline of patronage as public buses came to be the "mode of last resort" for residents. Based on our interviews, the 18 mini-buses plying only three routes and with very low frequency (of more than 30 minutes) did not manage to change commuters' preference for private transport.

3. *Fragmented Governance and Planning*

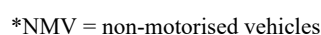
Chiang Mai, being an ancient city that has been existing for nearly 700 years, was first designed as a walking city with compact layouts and narrow roads, i.e., primarily for walking, with some animal-drawn vehicles and water transport (Barter 2000). Despite the rapid growth of motorisation, population size, and tourism numbers in recent years, the city has not been able to substantially alter its urban form and network capacity to keep up with today's traffic intensity for two key reasons:

The centralisation of land use and transport planning to the Ministry of Interior (MOI) and Ministry of Transport (MOT) means that local authorities are dependent on the Central Government (CG) for funding especially on infrastructure projects (Jittrapirom 2015) (from our interviews, any project above 100 million baht or about US\$3 million has to be approved by the CG and be aligned with CG's goals). A lack of attention from CG and insufficient funding meant that the local government not only had little control over city expansion and land use planning, it also had limited resources to provide quality public transport (Jittrapirom 2015) (a detailed stakeholders analysis is given in Annex 1).

The "fragmented centralisation" of the city's transport sector poses a major obstacle to its development (Jittrapirom 2015). For example, there are 11 local administrative bodies within the central Aumpor Muang district alone, which fragment and weaken integrated planning of transportation and land use within the area (Jittrapirom 2015). The transfer of authority for major land use and transport infrastructure matters to separate CG ministries (MOI and MOT) also meant that while responsibility for land use and transport planning was centralised, planning became disconnected and uncoordinated (Jittrapirom 2015).

For Chiang Mai to switch to a more sustainable transport development path, we first need to locate its current stage of transport system development and the future trajectory of existing policies, in order to determine the alternative pathways and changes necessary to achieve sustainability. The city typology and transport development paths developed by transport policy specialist Paul Barter (Figure 3) is useful for this purpose.

Source: Barter 2000



Based on Barter's typology, Chiang Mai is currently at the stage of a traffic-saturated motorcycle city with signs of becoming increasingly car-dependent. There are three envisaged outcomes and actions for Chiang Mai based on its current stage of transport development (Barter 2000):

1. Become an automobile city provided road capacity and suburbanisation can continue to keep up;
2. Traffic disaster with worsening traffic congestion based on status quo with unrestrained motorisation; or
3. Switch to a transit-oriented city with policy interventions that discourage the ownership and use of private vehicles, promote investments in public transport and non-motorised transport (NMT) like the use of bicycles, and adopt transit-oriented land-use planning to improve residents' proximity to a variety of services, thereby reducing the need for motorised transport.

Outcomes 1 and 2 are not desirable. The municipality's high urban density restricts further expansion of road capacity, and with no funding support from the CG for urban redevelopment, the city is unable to accommodate a predominantly car-oriented transport system. In addition, with Chiang Mai's vision of being a tourist hub and gateway for trade and investment, the city cannot adopt a 'do nothing' approach either and allow the traffic situation to degenerate into a 'traffic disaster'. Hence, outcome 3 remains the only viable and sustainable path for Chiang Mai, i.e., to adopt proactive and vigorous interventions to alter its course from a traffic-saturated motorcycle city to a transit-oriented city.

Policy Options

While it would be ideal for Chiang Mai to adopt a comprehensive transit-oriented solution that comprises traffic restraint measures, enhancement of non-private vehicle alternatives, and transit-oriented urban planning to reduce the need to travel, the local government is not likely able to implement all concurrently, given various structural constraints. Taking the lens of the Chiang Mai Provincial Land Transport Office (LTO), the project team rationalised the various policy interventions to determine suitable one(s) which LTO could realistically administer (Table 2).

Table 2. Rationalisation of policy options that LTO can consider.

Policy Options	Impact timeline	Feasibility for CMM to plan and implement	Reasons
1. Traffic restraint/ Transport Demand Management (TDM)	Immediate Term (effects on reducing congestion can be seen immediately)	Partial. Some usage-based measures may be more feasible than restraining ownership.	Restraining private vehicle ownership may run against national level support for the automotive industries in Thailand and may have to be a CG decision. In addition, restricting ownership could be politically challenging, seen to be impinging on civil liberties and favouring rich. Usage-based tools may face the same issues as well, although a more narrowly-scoped option like parking management could be met with less resistance from CG and motorists alike.
2. Investments in public transport and NMT	Medium Term (takes time to establish a quality public transport system. A safe, viable NMT network is also first dependent on traffic reduction)	Limited but on-going.	High investment cost and dependent on CG's approval and budget support. However, it is also observed that a Chiang Mai Public Transport Master Plan developed by the national-level Office of Transport and Traffic Policy and planning (OTP) and Chiang Mai University (CMU) for the growth of a city public transit network is already in the works; the proposal for a Light Rail Transit system connecting major traffic attractors like the airport, CMU, and convention centre is also projected to be finalised by 2019 (CityNews 2017).
3. Transit-oriented land-use development	Longer Term (takes time for building leases to expire for redevelopment to happen)	Limited.	Land-use planning and budget resides with CG.

The above analysis suggests traffic restraint/TDM to be the most urgent measure that Chiang Mai, at its current stage of development, must adopt to slow the rate of motorisation and ease congestion. In fact, private vehicle ownership and usage restraint was the critical first step

that many successful transit cities like Seoul, Hong Kong and Singapore undertook in their evolution towards transit-oriented development so as to slow motorisation despite rapid increase in incomes and ‘buy time’ for them to build up quality public transport systems without ridership being prematurely undermined by rising private vehicle ownership (Barter 2000). Unfortunately, as discussed earlier, the Chiang Mai local government lacks autonomy in agenda-setting and is unlikely able to unilaterally impose vehicle ownership restraint policies, e.g., taxes on vehicle purchase or ownership quotas, without CG’s blessings. Some usage restraint measures such as fuel taxes, congestion charging, or licence-plate based driving restrictions may also be highly unpopular and politically challenging. In addition, they are costly to implement, e.g., installation of charging gantries and in-vehicle metres to facilitate congestion charging, which is beholden to funding from CG. This leaves parking management – which targets a narrower group of motorists – as the most practicable option for LTO to undertake at least in the short term (being the least likely to be met with resistance from CG and motorists alike). Notwithstanding this, the local government should continue to stress the importance of traffic restraint to CG and appeal for its support for this critical, immediate-term measure, while pursuing public transport investment and transit-oriented urban development as medium- and longer-term measures.

Key Policy Recommendation - Parking Management

Parking management (PM) may be the most practicable TDM option for LTO to administer but is by no means the least useful. Its advantages include relatively low implementation costs, highly targeted, and rapid results of visibly improved street parking conditions with the reduction of obstructive and chaotic parking to secure public acceptance and support (GIZ-SUTP 2016). Cities like Taipei, Shenzhen, and Makati have all made dramatic progress with their on-street parking situations in short periods of time (GIZ-SUTP 2016). The scalability of parking management also means that proof-of-concept pilots can be realised at fairly low costs within the project allocated US\$17,000. Hence, the project team recommends that LTO consider parking management as a tool for easing congestion and managing private vehicle usage.

On-street parking is a prime example of a common-pool resource, and if left unmanaged, there is a high risk that open-access on-street parking in busy parts of the city will be over-used, harming safety and liveability and causes congestion and public transport delays (GIZ-SUTP 2016).

A significant contributor to Chiang Mai's traffic woes are on-street parking problems as a consequence of weak on-street PM. Common scenes include rampant illegal and obstructive parking in streets overrun with parked cars and motorcycles at the roadside, straddling kerbs, and even on walkways (Figure 4); people on foot or NMT users are forced to traverse in the dangerous space between parked vehicles and the traffic flow (GIZ-SUTP 2016).

Figure 4. Photos showing parking even on walkways in Chiang Mai that obstructs both pedestrians and road users

Source : <http://www.chiangmaicitylife.com/news/the-art-of-walking-in-chiangmai/>



Access thus needs to be rationed and managed, and on-street PM is usually the best first response before rushing into parking supply expansion (GIZ-SUTP 2016). On-street PM influences the manner, location, timing and duration of parking along streets to ensure that such parking is safe, orderly, and used efficiently consistent with wider goals for streets and the transport system (GIZ-SUTP 2016). Improved on-street PM can ease congestion in two main ways: (i) directly by reducing obstructive parking and traffic friction (created by parking manoeuvres in adjacent lanes) through better design of spaces and via better enforcement, or (ii) indirectly by reducing on-street parking saturation which causes many problems like search traffic, waiting, illegal parking and double parking (GIZ-SUTP 2016).

Proposed Pilot Experiment

The project team proposes for one to two heavily congested street(s) where obstructive and chaotic parking is rampant during peak hours to be selected, e.g., Changpuak road, Huay Kaew

road, Kaew Nawarat road and Charoenprathet road, for a pilot to be conducted with two-month timeframe. Key components of the pilot experiment include:

1. Data collection. Casual observations of parking problems often lead to mistaken assumptions about the nature of the problem and its underlying causes. Simple, low-cost surveys can be conducted to collect and analyse routine but important parking data to guide PM decisions and actions, e.g., surveys on parking supply/inventories, parking duration, purpose of parking (work, shopping, etc), and parking occupancy (the proportion of legal parking spaces occupied by vehicles) (GIZ-SUTP 2016).

2. Stakeholder engagement. Even though PM makes parking a less painful experience for motorists, they are generally not happy about the enforcement, the regulations and the pricing that enable such improvements (GIZ-SUTP 2016). Strong involvement by local key stakeholders like residents/premise owners/employees, public consultation at the initial stages, and winning over key stakeholder groups is key for gaining public acceptance. Successful PM needs to ensure that PM provides enough benefits to local stakeholders, e.g., offering special off-street arrangements for key local stakeholders to moderate the pain of PM for them, or by distributing part of any parking revenue surplus locally, e.g. via a local property tax rebate or to local charities (GIZ-SUTP 2016).

3. Pricing on-street parking. Among the approaches to ration on-street parking, pricing is the most efficient, flexible and powerful tool (GIZ-SUTP 2016). Parking pricing can nudge motorists to modify their choices and exercise flexibility, e.g., choosing a different on-street parking location that is free or at a lower price or beyond a time limit, switching from on-street to off-street parking, adjusting their time of the visit to park at a cheaper time, modifying the duration of parking to make a visit shorter, or even switching to another transport mode such as public transport (GIZ-SUTP 2016). Even a modest price per hour can nudge most long-duration parking to more appropriate options, such as under-used off-street parking, and help keep street spaces open (GIZ-SUTP 2016). On-street parking fees (together with fines) may even yield a revenue surplus, which could help cover the costs of managing the PM system or invested in improving the public transport system to secure acceptance for necessary but

unpopular PM policies; this contrasts with non-pricing approaches to managing parking, such as time limits, which impose net costs (GIZ-SUTP 2016). Pricing can also introduce market-responsiveness by making the parking system more attuned to variations in local conditions, with parking prices adjusting to changing parking supply-and-demand conditions (GIZ-SUTP 2016). When it comes to setting on-street parking prices, a growing consensus in parking policy literature advocates the use of occupancy targeting as the best approach to reduce the incidence of on-street saturation, i.e., prices to be adjusted based on an occupancy criterion to bring occupancies within the desired, efficient range that is neither too full nor too empty of around 85% (GIZ-SUTP 2016).

4. Fee collection mechanism. Mechanisms for collecting parking fees include having parking attendants, in-street parking meters, pre-paid coupons, mobile phones or in-vehicle parking meters (GIZ-SUTP 2016). It is recommended that digital mechanisms be adopted for the pilot, primarily through the pay-by-app method with options for pay-by-phone or pay-by-sms methods for the less tech-savvy, so as to maximise PM effectiveness without extensive parking meter cost investments. The advantages of digital methods include relatively low capital costs, high convenience for users, easy price adjustment, low-cost integration with enforcement, low transaction costs, and the ability to integrate with permits and special discounts (Reinventing Parking 2016).

5. Enforcement. Effective enforcement is necessary to achieve an acceptable level of compliance and to strongly deter blatant illegal parking (GIZ-SUTP 2016). The intent of enforcement must be clear from the onset, that is, to serve PM goals; revenues through fines should be seen as merely incidental, and not have it influence enforcement policy choices, which may cause public indignation and bad publicity undermining public support (GIZ-SUTP 2016). Enforcement should also focus more on fostering good behaviour and less on penalties, e.g., issuing only warnings for first-offence parking violations; affixing tips for how to avoid the same mistake if fines and warnings are to be issued; and encouraging enforcement officers to see their role as helping people to do the right thing, rather than just about punishing offenders (GIZ-SUTP 2016). Parking enforcement is also best carried out by a dedicated force

of parking wardens, rather than the traffic police which has other priorities, and enforcement intensity should be allocated to places and times that cause the most problems (GIZ-SUTP 2016).

6. Budgeting. A broad breakdown of the US\$17,000 budget is as such:

- US\$10,000 on parking app development and onsite parking design;
- US\$2,900 for parking enforcement;
- US\$3,600 for data collection;
- US\$500 for stakeholder engagements

The pilot trial could be undertaken by CMU under ambit of the Memorandum of Understanding signed between OTP and five universities in Thailand. CMU would design and conduct pre-and post-pilot studies and evaluation efforts to objectively assess the fulfilment of the pilot's objectives, development efficiency, effectiveness, impact, and sustainability and the above budget is reimbursable by CMU. The proposed implementation plan and budget breakdown is in Annex 2.

Conclusion

A sustainable transport system is at the core of any city's sustainable urban development. To achieve Chiang Mai City's vision of being a tourist hub and gateway for trade and investment, Chiang Mai needs to focus in resolving its traffic congestion issues. Policy interventions on restraining motorisation and integrated land-use planning development to facilitate a transit-oriented development require coherent national and local policies and coordination. While the municipality hands are full as it undertakes public transport master-planning, it would be feasible for the municipality to administer parking management, while appealing vigorously for CG's support for traffic restraint measures as an urgent, critical need. The scalability of the parking management planning and policy can be validated after conducting a pilot trial.

###

(4,063 words excluding citations and references)

References

1. Barter P.A 2015, Think Piece Achieving Sustainable Mobility, in The State of Asian and Pacific Cities 2015. Available at: <http://unhabitat.org/books/the-state-of-asian-and-pacific-cities-2015/>.
2. Barter P.A 2000, Urban Transport in Asia: Problems and Prospects for High-Density Cities, Asia-Pacific Development Monitor, 2, 1, 33-66.
3. Chiang Mai Governor Office 2015, Information, <http://www.chiangmai.go.th/english/index.php/welcome/information>, viewed on 18 May 2018.
4. Chiang Mai Municipality (CMM) 2014, Chiang Mai Sustainable Urban Transport Project, Chiang Mai Municipality Incorporation with the Office of Transport and Policy Planning, Global Environment Facility and the World Bank, Page 12 and 22.
5. CityNews 2016, New Checkpoint Checking Toxic Exhaust Fumes and Black Exhaust Fumes, <http://www.chiangmaicitylife.com/news/new-checkpoint-checking-toxic-exhaust-fumes-black-exhaust-fumes/>, Chiang Mai Citylife CityNews, 15 February 2016, viewed on 30 May 2018.
6. CityNews 2017, Green Light for Chiang Mai Light Railway Transit System, <http://www.chiangmaicitylife.com/news/green-light-for-chiang-mai-light-railway-transit-system/>, Chiang Mai Citylife CityNews, 24 August 2017, viewed 26 May 2018.
7. CityNews 2018, Smart Bus Trial a Success, Full Operations Commence April 5th, <http://www.chiangmaicitylife.com/news/smart-bus-trial-success-full-operations-commence-april-5th/>, Chiang Mai Citylife CityNews, 4 April 2018, viewed 26 May 2018.
8. GIZ-SUTP 2016. *On-Street Parking Management: An International Toolkit*, Sustainable Urban Transport Technical Document #14, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Germany. Available at: http://www.sutp.org/files/contents/documents/resources/B_Technical-Documents/GIZ_SUTP_TD14_On_Street_Parking_Management_en.pdf.
9. Nicolas Gantois 2014, Traffic Troubles, <http://www.chiangmaicitylife.com/citylife-articles/traffic-troubles/>, Chiang Mai Citylife 2014 Issue 4, 28 March 2014, viewed on 18 May 2018.
10. Office of the National Economic and Social Development Board (NESDB) 2015, Info/Statistics, http://www.nesdb.go.th/nestdb_en/more_news.php?cid=156&filename=index, viewed on 18 May 2018.
11. Office of the National Economic and Social Development Board (NESDB) 2015, Gross Regional and Provincial Product CVMs 2015 Edition, http://www.nesdb.go.th/nestdb_en/ewt_dl_link.php?nid=4317&filename=national_account, viewed on 31 May 2018.

12. Peraphan Jittrapirom 2015, An analysis of Chiang Mai city's transport system and its path towards sustainability, with a focus on the role of the motorcycle and the shared-taxi, Doctoral Thesis, Doctor of Science in Civil Engineering of the Vienna University of Technology, Faculty of Civil Engineering, April 2015.
13. Pim Kemasingki 2015, Mess Transit- Why Chiang Mai doesn't have Public Transportation, Chiang Mai Citylife 2015 Issue 11, <http://www.chiangmaicitylife.com/citylife-articles/mess-transit-why-chiang-mai-doesnt-have-public-transportation/>, 1 November 2015, viewed on 18 May 2018.
14. Reinventing Parking 2016, How to collect on-street parking fees (and why it matters), <https://www.reinventingparking.org/2016/11/how-to-collect-on-street-parking-fees.html>, 30 November, 2016, viewed on 31 May 2018.
15. Thai RSC 2017, Number of Reported Traffic Crashes year 2017 by Province, Thai RSC Statistical Report, <http://rvpreport.rvpservice.com/viewrsc.aspx?report=0685&session=16>, updated 31 May 2018, viewed on 31 May 2018.
16. The Nation 2018, Chiang Mai ranked sixth worst for air pollution globally, The Nation Thailand Portal, http://www.nationmultimedia.com/detail/around_thailand/30341186, 18 March 2018, viewed on 30 May 2018.
17. The Nation 2018, Road accidents much higher than in 2017, The Nation Thailand Portal, <http://www.nationmultimedia.com/detail/national/30343230>, 16 April 2018, viewed on 30 May 2018.
18. United Nations (UN) 2017, Sustainable Transport, UN Sustainable Development Knowledge Platform, <https://sustainabledevelopment.un.org/topics/sustainabletransport>, viewed on 26 May 2018.

Annex 1

Stakeholders Analysis

Stakeholders	Interest		Power (influence policy on restricting privatized vehicles / public transport)	
	Low/High	Elaboration	Low/High	Elaboration
Central Government (CG) - Ministry of Interior (MOI)	Low	(For transport-related) Road safety and public works; promote Chiang Mai as aviation hub and to/fro Royal Flora exhibition	High	Budgetary power and land use planning
Central Government (CG) - Office of Transport and Traffic Policy and Planning (OTP) & Ministry of Transport (MOT)	High	Make public transportation more effective and to encourage higher public transit ridership	High	Coordinating infrastructure delivery in sectoral areas
Local Government- Chiang Mai municipality (CMM);	High	Provide infrastructures that support sustainable prosperity, derived four specific goals: 1. Development of land use in accordance with the principal plan 2. Development of road infrastructure to ensure good accessibility 3. Development of traffic system and public transport system	Medium	Make city development policy but dependent on central government budget and policy

		4. Improvement of cityscape, tidiness and beautification		
Local Government- Chiang Mai Provincial Land Transport Office (LTO)	High	Improve the effectiveness of the public transport market	Low	Impose routing regulations; responsible for all administration related to land transport, traffic regulation enforcement and planning of road transportation
<i>Song Teaw</i> drivers and cooperatives/unions	High	Strongly resist any changes that appear to threaten the livelihood of its members	High	The unions are highly complex with a closely knit organizational structure that has enabled them to remain independent of local government's control and sustain its status quo operation for decades.
Public (Road users)	High	Road safety and cheap and convenient public transport system	Low	Little power
Business (e.g. malls operators)	Low	Easy access to their business	High	Ability to create parking space and provide shuttle bus services to their premises
Motor vehicle owners	High	Less congested road and availability of parking spaces	Low	Little power and reliance on their private transport

Annex 2

Proposed Implementation Timeframe and Budget Requirement for Parking Management Pilot Trial

Activity Description	Week Number (Estimated Duration for Activity)	Budget
1. Engagement of Institution to plan and operationalize pilot trial (e.g. CMU)	Week 0 (2 weeks)	Not applicable <i>(Assuming to leverage under MOU with OTP signed in 2013)</i>
2. Identification of targeted stretch of road with rampant illegal parking	Week 1 (2 weeks)	Not applicable (Under Item 1)
3. Inter-government stakeholders' consultation and clarifications of pilot trial	Week 3 (1 day)	Not applicable <i>(Assuming inter-government consultation is held on government premises)</i>
4. Data collection on local traffic situation to determine the extent of problems and identify reasons for parking issues	Week 3 (1 week)	US\$672 <i>(Assuming @ US\$6/hour x 8 hours/person x 2 persons x 7 days)</i>
5. Design survey questionnaire and conduct face-face survey with vehicle owners, residents/premise owners/employees and pedestrians	Week 4 (2 weeks)	Not applicable (Under Item 1)
6. Design pilot trial with clear objectives and projected targets; time of implementation (e.g 8am to 6pm), fees collection and mode and enforcement information	Week 6 (4 weeks)	
7. Local Key Stakeholders consultation and feedback (townhall style)	Week 10 (1-2 days)	US\$500 <i>(Assuming refreshments @ US\$5/half-day/person x 50 persons x 2 half-days)</i>

		<i>Venue charges not applicable if townhall is held on government premises, e.g., community halls or government office)</i>
8. Adjust pilot trial details, prepare frequently asked questions and information on how feedback by local stakeholders were incorporated.	Week 11 (2 weeks)	Not applicable (Under Item 1)
9. Development of mobile Parking app; demarcation of parking lots, erecting signages of parking charges	Week 13 (4 weeks)	US\$10,000 <i>(Assuming US\$9,000 for app development; US\$1000 for on-street parking demarcation, e.g., painting of lanes, signages)</i>
10. Public/Media announcement of pilot	Week 17	NIL
11. Pilot trial involving data collection, face-face-survey 12. Deployment of traffic wardens	Week 18 commence and end at Week 22 (4 weeks)	US\$2880 for data collection <i>(Assuming @US\$6/hour x 8 hours/person x 2 persons x 30 days)</i> US\$2880 for parking wardens <i>@US\$6/hour x 8 hours/person x 2 persons x 30 days)</i>
13. Data analysis and Reporting	Week 23 -Week 27 (4 weeks)	Not applicable (Under Item 1)
Total		US\$16,932

Note:

- 1 Wage for people collecting data and parking enforcement in this pilot trial is based on average wage of equivalent jobs in Singapore at about SGD\$8 per hour.
- 2 Cost of app development is based on the average cost of a basic app at between SGD\$10,000 and SGD\$15,000. Reference <http://www.skylark.com.sg/blog/cost-mobile-app-development-singapore/>.