MSIWF 2016 Traffic Safety Research Grant

Report of Research Results

Title: **Creating a safer urban environment for tourist cyclists-** a design study in Chiang Mai, Thailand.

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Summary: This study conducted 404 surveys with tourist cyclist in Chiang Mai in order to gain a better insight into their riding characteristics and behaviour. The results found 25-34 years old travellers are most likely to use the bicycle (*37.1%*); with more than half (*55%*) of the respondents to be female riders, whilst the main reason for riding is to save money; the results found that most of the cycling journey spans between 1-10 km with a duration that lasts between 16-30 minutes; The survey found 5.7% of the respondents have had some type of accident whilst cycling in Chiang Mai and out of that, 4.8% of them required hospital treatment. The accident locations were pin-pointed to 6 locations across the city, 45.5% of these accidents occurred in the evening between 5-8pm, and they most often took place at traffic junctions (*41%*) and that motorbikes are the most common tourist cyclists have had collision with (*38.1%*). The finding also revealed that 28% of respondents have never cycled before riding in Chiang Mai. Upon conducting spatial analysis of each accident site, the findings revealed a serious lack of traffic calming measures in place to protect cyclists, and a vast majority of them have no bicycle orientated infrastructure to support tourist cyclists. Furthermore, it made several key observations that include road-side parking, traffic marking, traffic signalling that are clearly producing hazards and obstacles for tourist cyclists, at the same time, the lack of secure bicycle parking facilities is forcing tourists cyclists at times to park their bikes on traffic lanes, which could pose potential hazards for other road users.

In order to raise the awareness of traffic safety for tourist cyclists, the study in stage 2 produced two design outputs; firstly a new cycle-map was created to help tourist cyclists navigate around the city on bikes, at the same time the additional illustration on safety guidelines such as signalling, approaching and emerging at junctions contributes towards increasing the awareness and knowledge for tourist cyclists in Chiang Mai. Lastly, utilizing the accident site analysis, the study developed a 5 points strategy that suggests how these 6 locations can be redesigned in order to make the spaces more bicycle friendly and help to improve the overall experience of cycling in Chiang Mai, the 5 points include developing: striking and impactful traffic markings; segregated cycle lanes; advanced stop lines; bicycle friendly traffic signals and secure bicycle parking facilities.

Aim of research: This study aims to achieve 1) explore the dynamic relationship between tourist cyclists and the urban context of Chiang Mai by a) analysing tourist cyclists' riding behaviour and patterns of movements around the city of Chiang Mai. The main research questions for phase one include, A) Which are the popular routes tourists like to take in Chiang Mai, and where they visit on the bicycle? B) What are the obstacles facing tourist cyclists and their accident statistics? What are the spatial characteristics of those accident locations? Objective 2 is to develop two design studies that aim to: increase the safety awareness of tourist cyclists when they are using the bicycle for sight-seeing, and to reduce the risks they pose to other road users. The first design study is to create a cycle-map for tourist cyclists; whilst the second design study is to reimagine the bicycle accident sites with more bicycle friendly infrastructural designs that intend to protect and make cycling a safer experience for tourists riders.

Research methodology and progression: In stage 1, the study conducted in total 404 surveys with tourist cyclists over a period of 8 weeks between April to June of 2017. The survey team consisted of 4 assistant researchers that employed a random sampling method to conduct the surveys. 36 bicycle rental shops in the city centre were identified, which the team visited in order to recruit the sampling groups. For the survey itself, a questionnaire consist of 18 questions were used to gather the data, these are divided into 2 categories; with the former designed to highlight the characteristics of tourist cyclists; while the latter focused on understanding their behaviour and identifying safety concerns such as accident locations, time, injury and collision details. In order to analyse the accident locations, the study utilized the "International Cycling Infrastructure Best Practice Study" (**Dales. J, Jones. P, 2014**) as a guideline for assessing the infrastructural design of the accident sites. A table was developed to summarize the findings (*see table 1*) that separated the results into 2 categories: infrastructural; which examine the existing infrastructure surrounding the accident sites; these include location of the crash sites, either mid-block or junction; type of road, either major or minor; flow of traffic, one way or 2 ways; presence of pavements; presence of road-side parking; presence of traffic lights; the number of traffic lanes; and the number of approaches to traffic junctions. The second category is related to presence of bicycle orientated infrastructure and traffic calming measures such as cycle lanes; speed bumps; advanced bicycle stops and central reservations for cyclists road crossings.

In stage 2, the study organised a design competition named '*Chiang Mai Cycle Map Contest*'. In total 13 students from 3 faculties (Faculty of Architecture, Faculty of Engineering and Faculty of Mass Communications) participated. Each team of students were given a brief, a base map in PDF and JPEG format and a selection of the initial findings from stage 1, such as accident locations, behaviours and main attraction locations in order for them to illustrate in their designs. Each team submitted a written report outlining the design concept, and a copy of the cycle map itself. 2 experts from the Faculty of Engineering, Chiang Mai University who are involved with the design and implementation of the Mass-Transit System for Chiang Mai was invited to be the judging panel, and together the study chosen 3 winning teams. The evaluation criteria include: problem analysis; problem solving; safety; practicality; design and innovation. For the final design exercise, which was to develop 6 design guidelines that suggest improvement of the 6 accident locations, the study worked together with the experts from the Faculty of Engineering, CMU to create a conceptual guideline of site specific infrastructural

design improvements, these design guideline is then correlated and reviewed against the "*International Cycling Infrastructure Best Practice Study*" (**Dales. J, Jones. P, 2014**).

Results of Research: Stage 1 results provides a clearer understanding of tourist cyclists characteristics, these include their age group, which the results show that 25-34 years old travellers are most likely to use bicycle as a sight-seeing transport mode (*37%*); with more than half (*55%*) of the respondents to be female riders; it also found that tourists like to use bicycle mostly in order to save money. Moreover, the results also allowed a better insight into the behaviour of tourist cyclists, such as finding that most of the tourist cycle journey spans between 1-10 km with a duration that lasts between 16-30 minutes; most interestingly, the result found 28% of the respondents have never ridden a bicycle before (*see figure 1*). The survey attempted to capture some of the common routes tourist cyclists have taken, however, this became evident that it could not be done as most respondents could not pin-point the route they cycled when we interviewed them. Instead the study captured the most popular attractions respondents visited (*see figure 2*).

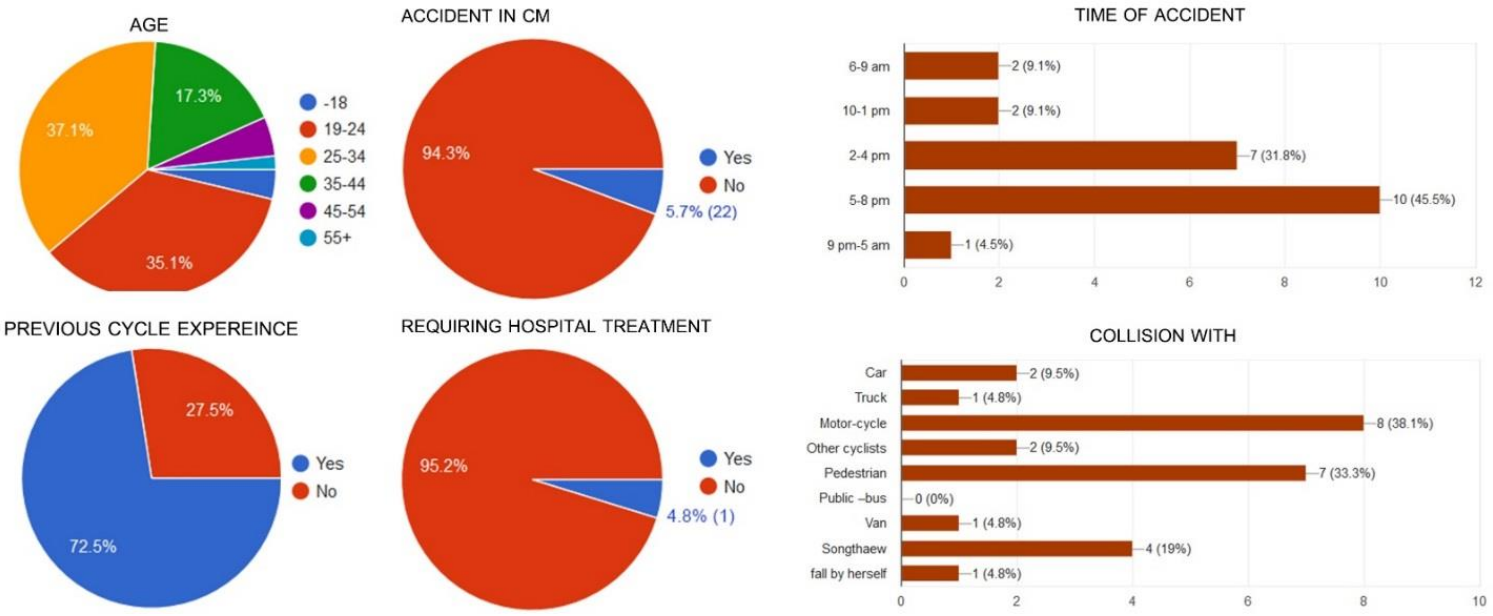
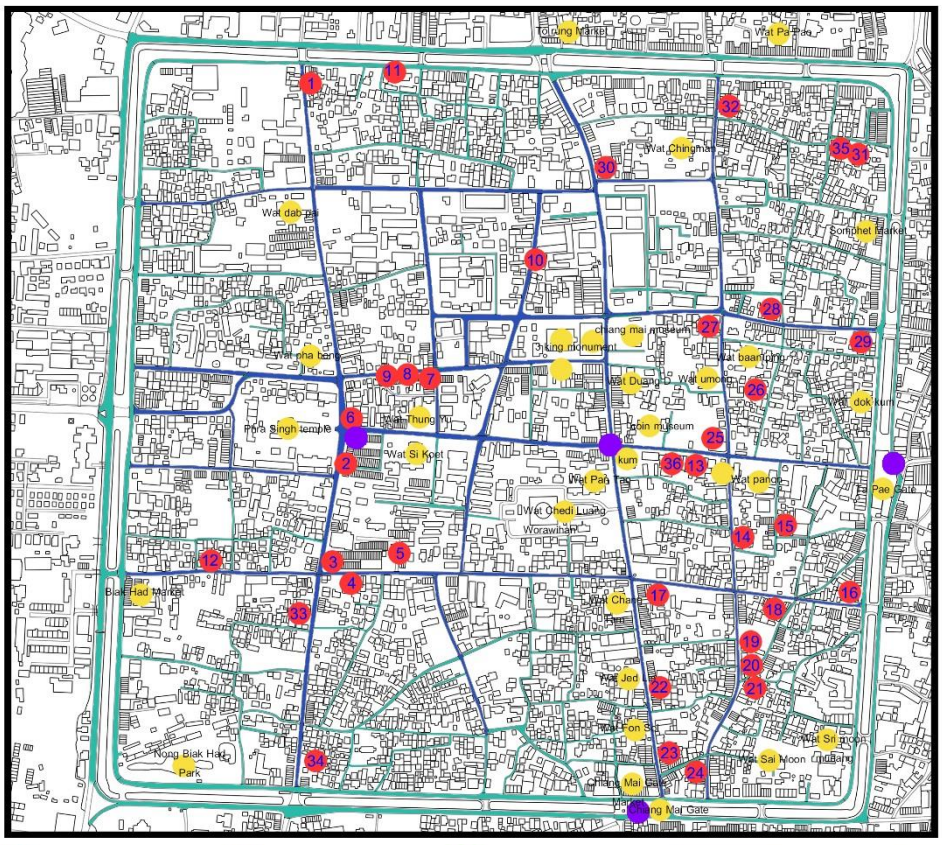


Figure 1: Characteristics of tourist cyclists and the bicycle accident details.

Crucially, the study is able to identify a range of safety statistics regarding tourist cyclists. These include 5.7% of the respondents was found to have had some type of accident, with 4.8% of them required hospital treatment (*see figure 1)*. It also found that 45.5% of the accidents occurred in the evening between 5-8pm, and accidents were more likely to take place at traffic junctions (*41%*) and that motorbikes are the most common type of vehicle tourist cyclists have had collision with (*38.1%*). Moreover, the results identified 6 locations across the city where these bicycle accidents have taken place.



	GPS Cordinates		GPS Cordinates
bike shops		tourist hotspots	
1	18,47'43,22 N 98,58'54,60 E	1	18,47'18,76 N 98,58'54,93 E
2	18,47'15,55 N 98,58'56,96 E	2	18,47'22,74 N 98,58'55,37 E
3	18,47'09,11 N 98,58'55,97 E	3	18,47'18,86 N 98,59'02,75 E
4	18,47'08,05 N 98,58'47,59 E	4	18,47'17,34 N 98,59'02,19 E
5	18,47'09,10 N 98,59'01,61 E	5	18,47'34,34 N 98,58'53,25 E
6	18,47'18,83 N 98,58'57,84 E	6	18,47'07,28 N 98,58'41,66 E
7	18,47'22,35 N 98,59'03,28 E	7	18,47'13,09 N 98,59'11,84 E
8	18,47'21,98 N 98,59'01,64 E	8	18,47'15,84 N 98,59'15,92 E
9	18,47'21,90 N 98,58'59,72 E	9	18,47'06,57 N 98,59'17,11 E
10	18,47'29,16 N 98,59'11,34 E	10	18,47'01,89 N 98,59'17,84 E
11	18,47'43,29 N 98,58'57,27 E	11	18,46'57,40 N 98,59'18,68 E
12	18,47'09,28 N 98,58'48,12 E	12	18,46'53,79 N 98,59'18,53 E
13	18,47'16,53 N 98,59'21,95 E	13	18,46'52,76 N 98,59'20,36 E
14	18,47'10,90 N 98,59'25,66 E	14	18,47'16,38 N 98,59'17,93 E
15	18,47'11,38 N 98,59'28,43 E	15	18,47'22,13 N 98,59'18,62 E
16	18,47'06,72 N 98,59'34,25 E	16	18,47'24,82 N 98,59'18,28 E
17	18,47'07,38 N 98,59'19,32 E	17	18,47'25,08 N 98,59'12,82 E
18	18,47'06,38 N 98,59'28,94 E	18	18,47'37,62 N 98,59'21,84 E
19	18,47'04,15 N 98,59'26,11 E	19	18,47'22,03 N 98,59'23,56 E
20	18,47'02,38 N 98,59'26,03 E	20	18,47'15,75 N 98,59'27,45 E
21	18,47'01,23 N 98,59'27,10 E	21	18,45'55,66 N 98,59'38,47 E
22	18,47'00,94 N 98,59'19,65 E	22	18,46'57,52 N 98,59'32,77 E
23	18,46'55,92 N 98,59'20,37 E	23	18,47'15,97 N 98,59'35,55 E
24	18,46'55,42 N 98,59'22,25 E	24	18,47'21,08 N 98,59'35,00 E
25	18,47'08,41 N 98,59'24,99 E	25	18,47'32,75 N 98,59'34,89 E
26	18,47'11,20 N 98,59'28,11 E	26	18,46'55,52 N 98,58'45,49 E
27	18,47'26,15 N 98,59'24,29 E	27	18,47'23,07 N 98,59'13,16 E
28	18,47'26,40 N 98,59'28,11 E	28	18,47'17,40 N 98,59'16,47 E
29	18,47'25,17 N 98,59'55,57 E	29	18,47'18,30 N 98,59'19,00 E
30	18,47'36,07 N 98,59'19,79 E	30	18,47'24,83 N 98,59'15,12 E
31	18,47'38,14 N 98,59'34,08 E	31	18,47'15,19 N 98,59'24,18 E
32	18,47'40,81 N 98,59'24,78 E		
33	18,47'04,53 N 98,58'54,36 E		
34	18,46'54,84 N 98,58'54,19 E		
35	18,47'38,19 N 98,59'32,61 E		
36	18,47'16,49 N 98,59'20,97 E		

Figure 2, left: map illustrating the 31 locations (yellow) where tourist cyclists have most visited from the 404 respondents, and also the numbers and locations of 36 bicycle rental stores (red) where the sampling group were recruited. The study also mapped the different types of road-ways in the Old Town, and documented whether the road-way was a dual way traffic or one way traffic, and also identified routes in the old city that incorporated cycle lanes. Right, GPS locations of bicycle rental stores and popular tourist destinations.

Results from the accident site analysis produced 2 main observations; firstly concerning the existing infrastructure, which it found that all of the accidents took place at junctions, with the exception of site 5 which was at mid-block; all of the accidents occurred on main roads, with 3 on one-way roads and 3 on two-way roads; 4 out of 6 of the accident sites had street-side parking; and 4 out of the 6 accident site have inadequate traffic light crossings. The second observation, which examined existing cycling orientated infrastructure, the results found that none of the accident site contained traffic calming measures; and site 2 is the only location that had a cycle-lane and speed bump in place; all of the accident sites do not have either advanced bicycle stops or central reservation for cyclists crossing in place. The findings from accident site analysis suggest there are inadequate cyclists orientated infrastructure in place in these locations to protect cyclists and observations such as road-side parking, poor traffic marking, and lack of traffic signalling is creating potential hazards and obstacles for tourist cyclists, at the same time, the lack of secure bicycle parking facilities is forcing tourists cyclists at times to park their bikes on traffic lanes, which could pose potential hazards for other road users.

		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	B1	B2	B3	B4
SITE 1	18,47'15,97 N 98,59'35,55 E	N	Y	Y	N	Y	N	Y	N	N	Y (1)	3	2	N	N	N	Y
SITE 2	18,47'17,40 N 98,59'16,47 E	N	Y	Y	N	N	Y	Y	N	Y	Y (1)	2	0	Y	Y	N	N
SITE 3	18,47'09,11 N 98,58'55,97 E	N	Y	Y	N	N	Y	Y	N	Y	Y (1)	3	3	N	N	N	N
SITE 4	18,46'52,76 N 98,59'20,36 E	N	Y	Y	N	Y	N	Y	N	Y	Y (1)	3	3	N	N	N	N
SITE 5	18,46'57,38 N 99,00'00,18 E	Y	N	Y	N	Y	N	Y	N	Y	N	2	0	N	N	N	N
SITE 6	18,46'51,90 N 98,69'59,07 E	N	Y	Y	N	N	Y	Y	N	N	Y	2	4	N	N	N	N

*Table 1: Accident site analysis table. A1-A12: existing infrastructure of the site; B1-B5: cyclist orientated infrastructure; A1- Mid-block (yes/no), A2- Junction (yes/no), A3- Major road (yes/no), A4- Minor road (yes/no), A5- One way (yes/no), A6- 2 way (yes/no), A7- Pavement/pedestrian walkway (yes/no), A8- Bus stop (yes, before, after), A9- Road-side parking (yes/no), A10-Traffic lights (yes/no), A11-Number of traffic lanes (#), A12-Number of approaches into junction (#), B1-Cycle lanes (yes/no), B2- Speed bumps (yes/no), B3- Advanced bicycle stops (yes/no), B4- Central reservation (yes/no)(1)= traffic light is present but not at every approach in the junction**

In stage 2, the study produced 2 design outputs; firstly, working together with students from Chiang Mai University, a new tourist cycle-map was developed. The main objective of this map is to highlight locations of the main touristic destinations across the city, at the same time illustrating cycling routes connecting them. Moreover, the map also serve to raise awareness of cycling safety for tourist riders, not only the risks that they face, but also the risk they can potentially pose to other road users. To achieve this, the outcome incorporated a range of additional cycling safety information, these include a reminder to wear safety equipment; how to signal for turning when riding; and how to emerge and approach into and from traffic junctions, since it's the most likely place for bicycle accidents to occur. It also contain additional information such as the different types of bicycles and their intended uses, in order to assist tourist riders to select the most appropriate bicycle for their intended purpose (*see figure 3*). Besides graphic illustrations, particular attention was also paid to how potential cyclist would use the map. The study found conventional pocket maps to be difficult to use because the way they are often folded, and also to fold and unfold them, therefore the outcome created a map with a roll-fold system that allow it to be read even when it's folded.

Working with the experts and referring to the "*International Cycling Infrastructure Best Practice Study*" (**Dales. J, Jones. P, 2014**), the second design output developed a 5 points strategy guideline that suggest how the 6 bicycle accidents can be redesigned so that they could become more bicycle friendly and help to improve the overall experience of cycling in Chiang Mai. As the accident site analysis have shown, the existing infrastructure is poorly designed and have little to no bicycle friendly infrastructure in place to support cyclists, therefore the design guideline focused on redesigning and improving these aspects, in particular, it suggests to develop:

1) **Striking and impactful traffic markings that clearly divide different users:**
The accident site analysis observed that a majority of the sites had poorly marked road surfaces. The priority task would be to re-establish all the road surface markings, with a clear and easy to read graphic and logo system, any textual signage should be displayed in both Thai and English, to ensure not only locals but also visitors can understand the signage meaning.

2) **Segregated cycle lanes:**
The study had found only 1 of the accident site to have cycle lanes in place. As a response it suggest cycle lanes should be implemented to other locations, particularly on busy main roads and intersections such as site 1, 3, 4 and 6. Moreover, the cycle lanes should have a different colour painted and clearly segregated from the main traffic to make it more visible, unlike the existing marking which is already fading and hard to see. Furthermore, some locations such as site 2, road side bollards should be in place in order to protect cyclists and also act as a prevention for street side parking.

3) **Advanced Stop Lines (ASL) for cyclists:**
Advanced Stop Lines (ASL) are reserved areas for cyclists to stop at traffic lights that protrudes in front of motor-vehicular traffic (**Dales. J, Jones. P, 2014**). They allow cyclists to be more visible to other road users, therefore increasing the safety awareness of all road users, at the same time they allow cyclists a head start at the traffic lights, which will help to minimize the risks cyclists face at traffic junctions during change of traffic lights.

4) **Bicycle friendly traffic signals:**
Working in conjunction with ASL, bicycle friendly traffic signals enable cyclist a head start when the traffic lights change, and separate them with motor vehicular traffic (**Dales. J, Jones. P, 2014).**

5)**Secure Bicycle Parking Facilities:**
The study also found at a number of tourist destinations where bicycle are often left without secure parking facilities, sometimes the bicycles are parked on the main traffic lanes, which potentially posing as hazards and obstacles for other road users. Therefore the study suggest to put in place adequate and secure bicycle parking facilities so that tourist cyclists can park their bicycles without affecting the safety of other road users.

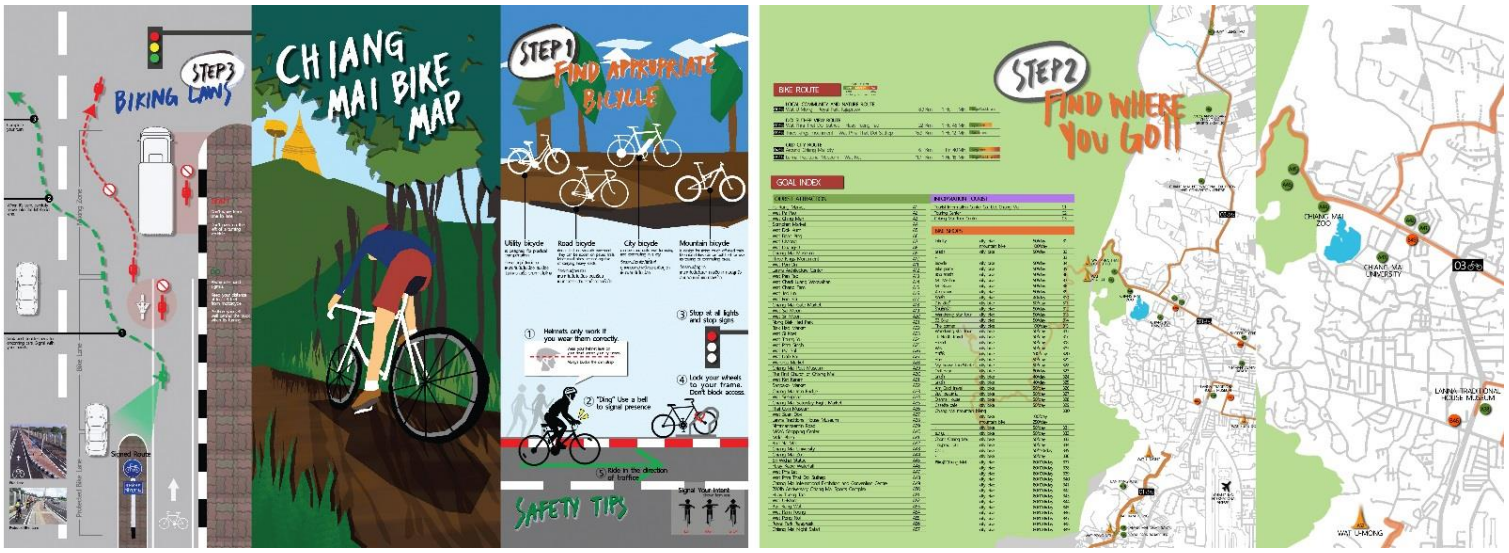


Figure 3, a new cycle map created to help tourist cyclist riding around Chiang Mai, it not only contain touristic destinations and routes, but it also incorporates additional safety information on how to ride a bicycle safely.

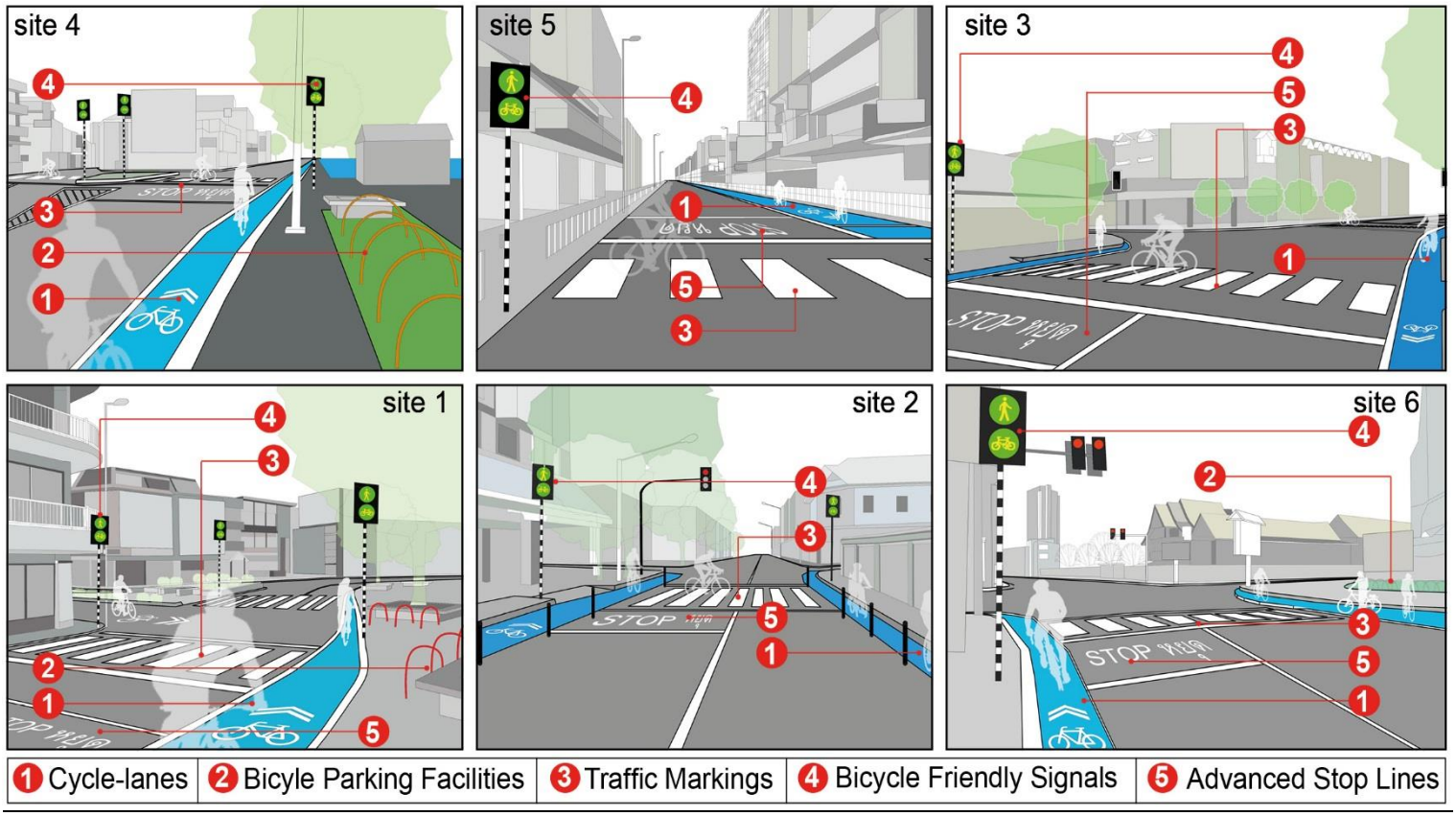


Figure 4: 6 design guidelines that suggests a 5 points strategy to improve the safety and overall cycling experience for tourist cyclists in Chiang Mai, as imagined to be implemented to the 6 accident sites across the city. The 5 points include striking and impactful traffic markings; segregated cycle lanes; advanced stop lines; bicycle friendly traffic signals and secure bicycle parking facilities.

Future study: The outcome of the research have contributed towards a better understanding on the behaviour of tourist cyclists, however, there are multiple challenges regarding sampling tourist for data collection, the study will benefit greatly from a more rigorous sampling and population selection method, together with a more complex observation technique that can better capture their riding characteristic and behaviour, not only through questionnaire but in real life situations.

Means of official announcement of research results: The content of this study will be used to develop a full research paper, and the finished paper will be send to **The Journal of Transport and Land Use** for publication in 2018.

References: **Dales. J, Jones. P,** *International Cycling Infrastructure Best Practice Study,* Report for Transport for London. 2014. (*downloaded from* content.tfl.gov.uk, on 20th, October, 2017*)*