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Taichung City's Management Strategy for Leisure Cycleway Maintenance: A Case Study of Gaomei Cycleway

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Abstract. In an era marked by global warming, energy conservation and carbon reduction are increasingly prioritized by national and local governments, companies and individuals. The bicycle is emerging as an important tool for reducing the overall volume of traffic, protecting the environment and conserving energy, as well as improving individuals' health and relieving their stress. Therefore, environmental demand for cycleway is garnering increased attention. The cycleway built by Taichung City's government include the Gaomei Cycleway, a coastal route famous for its seascapes and sunsets, and surrounded by rich ecological resources. This study uses Gaomei as a case for exploring the city's maintenance and management strategies for its cycleway. Specifically, it looks at the varying demands placed on Gaomei and the system in general by leisure users and commuters. Importance-Performance Analysis (IPA) was used to review bikers' strategy recommendations generated from a questionnaire covering four facets: safety, continuity, service facilities, and environment. The results of IPA indicate that bike commuters give more weight of the safety and continuity facets due to the high frequency with which they use the system, whereas leisure are more attuned to the other two facets.

1. Introduction

The Intergovernmental Panel on Climate Change's (IPCC) fifth Climate Assessment Report [1] estimated that, by the end of this century, global mean temperature will rise by 4.8 °C. As greenhouse-gas emissions are closely related to energy consumption and transportation, energy conservation and carbon reduction are increasingly prominent parts of national energy policies. The bicycle is emerging as an important tool for reducing the overall volume of traffic, protecting the environment and conserving energy, as well as improving individuals' health and relieving their stress. As a result, environmental demand for bicycle-related land, including cycleways and storage facilities, has also increased. In Taiwan, Taichung City's government has placed the creation of recreational cycleway at the center of its efforts to provide its citizens, and especially children, with easy access to high-quality outdoor leisure activities.

Surrounded by rich ecological resources, the Gaomei Cycleway is a famous 3.4 km coastal route, passing through Gaomei Wetland. Famed for its coastal scenery and magnificent sunsets, it has become a major tourist attraction within Taichung City, promoted by its Tourism Office and deemed a top-five bicycle route by Daily View Internet Thermometer. Because prior research has found that the quality of cycleway maintenance management is directly correlated with user satisfaction, this study (1)



explores differences in how bike commuters and general users perceive the importance and performance of the cycleway's environment and facilities; (2) uses Importance-Performance Analysis (IPA) to assess these two groups' recommendations for the maintenance and management of its environment and facilities.

2. Literature review

2.1 Bikeway design and assessment principles

2.1.1 Taiwan institute of transportation

In 2017, the Taiwan Institute of Transportation [2] published its Study of Integration and Evaluation of the Bicycle Lane Network System: a set of design reference principles for the planning of various system facilities associated with cycleways, including road-network infrastructure and ancillary facilities. The manual also contains management and maintenance mechanism for cycleway evaluation.

2.1.2 Research, development and evaluation commission, taichung city

Taichung City's 2017 Bicycle General Inspection Report [3], based on expert consultation and spot-checks of consumer opinions, aimed to understand the actual situation and facilitate further improvements to cycle safety and cycle-route quality at a strategic level. Based on its findings, the present study divides cycleway evaluation into four facets – safety, continuity, service facilities and environment – each comprising four factors, meaning that a total of 16 factors will be considered.

2.2 Performance

User performance is defined as the difference between the consumer's expectation regarding a product or service, and his or her perceptions of it after purchasing/using it.

2.3 Importance-performance analysis

IPA assesses individuals' perceptions of specific projects in terms of those projects' importance and performance, as an aid to efforts to improve user satisfaction and loyalty [4]. Its graphic depiction of users' comment content uses the overall average values of importance and performance as its separation point, with the X and Y axes cutting the space into four quadrants, as follows.

2.3.1 First Quadrant (Keep up the Good Work)

High clustering in this area indicates a highly competitive service, the quality of which should simply be maintained.

2.3.2 Second quadrant (possible overkill)

The service's quality or quantity may be excessive. Resources can be cut back somewhat without the overall experience being diluted.

2.3.3 Third quadrant (low priority)

Problems with the quality of the service are relatively unimportant, insofar as the service itself is not an especially vital one for its users.

2.3.4 Fourth quadrant (concentrate here)

This quadrant reveals the main source(s) of the service's disadvantages and drawbacks. Therefore, its content should be treated as a decisive factor for future development and improvement prioritization.

2.4 Hypotheses

Based on the foregoing literature review, this study was guided by the following two hypotheses (figure 1) :

(H1) The (a) importance and (b) performance perceptions regarding environmental quality will be correlated both with each other, and with the parallel perceptions regarding facilities.

(H2) General/leisure users and commuters will have different perceptions of the importance and performance of the cycleway's environmental quality and facilities.

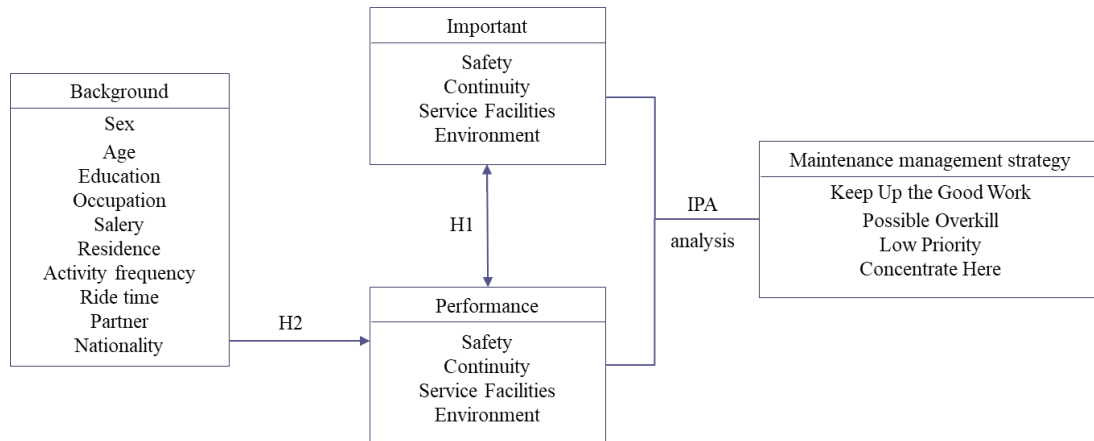


Figure 1. System Architecture

3. Research methods

Based on this study's purpose and the relevant prior literature, the researchers devised a questionnaire to explore the IPA facets of the Gaomei Cycleway. This instrument consisted of three parts, covering the respondent's socio-economic background; his/her perception for importance and performance of the cycleway environmental and facilities' quality. For purposes of analysis, socio-economic background factors were treated as independent variables, and environmental importance and performance as the dependent variables. All items were answered via the same five-point Likert scale, with 1 = "poor" and 5 = "excellent". SPSS Statistics 25 software was used to analyze the results.

Table 1. Reliability Analysis

Facets	Factors	Important Cronbach's α	Reliability	Performance Cronbach's α	Reliability
Safety	4	.784	high	.827	high
Continuity	4	.735	high	.839	high
Service Facilities	4	.761	high	.802	high
Environment	4	.642	high	.757	high
Overall	16	.847	high	.919	high

4. Results and discussion

A total of 201 questionnaires was issued via face-to-face interaction with bikeway users' between 13 and 28 October 2018. The reliability analysis overall are high(table 1).

4.1 Reliability analysis of importance and performance ratings

Reliability analysis yielded overall Cronbach's alpha coefficients of 0.847 for importance and 0.919 for performance, indicating that both parts of the questionnaire were highly reliable.

4.2 Analysis of users' background data

Male users in the sample outnumbered female ones by 12.4%. Most of the respondents were between 19 and 35 years old and highly educated, with students accounting for the single largest occupational category. It is possible that the sample was skewed in favor of individuals such as middle schoolers who felt they had ample time to answer it. Most (88.6%) of the respondents lived in the local area, and

the proportion living in the central part of Taichung was high, 46.3%. Only 77 respondents were willing to reveal their monthly income, with many of the others citing privacy concerns. In terms of their frequency of cycling, 74.1% stated they did so once per week or less, and 74.7% said they cycled on the Gaomei Cycleway was less than one hour. The majority of users and friends together accounted for 53.2% of partners.

4.3 Gaomei cycleway users' rankings of its importance and performance

The average value the respondents assigned to the Gaomei Bikeway's importance and performance were 4.199/5 and 3.754/5, respectively (figure 2). Under the general rubric of *importance*, the highest scoring factors were safety and the clarity with which the route was marked, while higher-than-average scores were assigned to the cycleway's width, the smoothness of the pavement, route indicators, the continuity of the bicycle route, route signs/markings, route network information, supply facilities, environmental cleanliness and absence of unauthorized vehicle types all scored higher than average. Under *performance*, higher-than-average scores were assigned to included most of the same factors (i.e., all except smoothness of the pavement and supply facilities), plus recreation facilities, bicycle parking space, bike rental sites, and landscape.

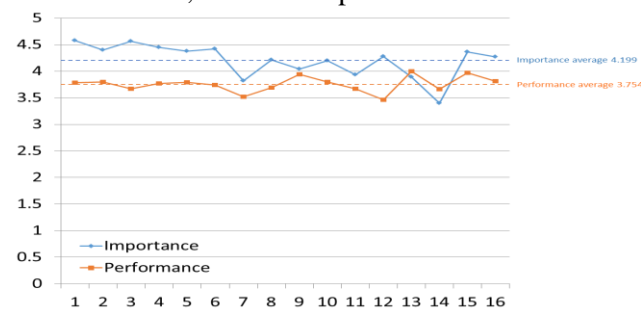


Figure 2. Gaomei Cycleway Users' Rankings of Its Importance and Performance

4.4 Importance-performance analysis: general users vs. commuters

IPA showed that the responses of general users (figure 3) and commuters (figure 4) were roughly similar in both the importance and performance categories. However, the former group tended to rate Gaomei Bikeway's security and clarity, route, route instructions, and bicycle parking spaces as "keep up the good work", whereas commuters saw all of these areas as needing improvement. Additionally, general/leisure users tended to think that bike parking spaces needs to be improved as a first priority, while commuters did not rate this concern as highly. Both groups agreed that the width of the cycleway, the continuity of its route, the cleanliness of the environment, and the exclusion of certain vehicle types were all as expected and should be kept as they were. Likewise, both groups agreed that pavement evenness, route-network information and supply facilities should be improved as a matter of priority, and that route-mileage representations, bike rental sites and local specialties were in need of only minor improvement (table 2).



Figure 3. IPA results, general users

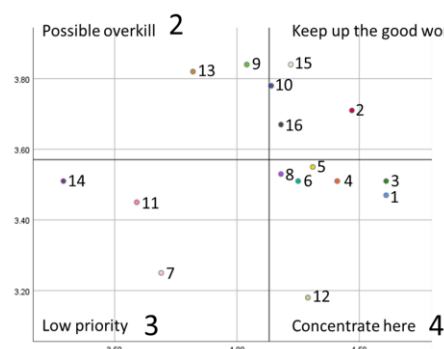


Figure 4. IPA results, commuters

Note: Factor numbers are as given in Table 2.

Table 2. Comparison of IPA strategy for general users and professional riders

Facet	Factor	General users			Bike commuters		
		Importance	Performance	Quadrant	Importance	Performance	Quadrant
Safety	1. Safety and clarity of cycleway	4.57	3.88	1	4.61	3.47	4
	2. Width of cycleway	4.37	3.83	1	4.47	3.71	1
	3. Pavement evenness	4.55	3.73	4	4.61	3.51	4
	4. Route indicators (direction indicators, warning signs, milestones, trails)	4.47	3.85	1	4.41	3.51	4
Continuity	5. Continuity of the route	4.41	3.87	1	4.31	3.55	4
	6. Bicycle route indicators/markings	4.47	3.82	1	4.25	3.51	4
	7. Mileage representations	3.86	3.61	3	3.69	3.25	3
	8. Route-network information	4.23	3.74	4	4.18	3.53	4
Service facilities	9. Recreational facilities (seats, bowers, etc.)	4.04	3.97	2	4.04	3.84	2
	10. Bicycle parking space	4.23	3.81	4	4.14	3.78	1
	11. Bicycle rental points	4.05	3.74	3	3.59	3.45	3
	12. Supply facilities (toilets, first aid equipment, etc.)	4.28	3.55	4	4.29	3.18	4
Environment	13. Landscaping	3.91	4.05	2	3.82	3.82	2
	14. Local specialties (snacks)	3.44	3.71	3	3.29	3.51	3
	15. Environmental cleanliness	4.41	4.01	1	4.22	3.84	1
	16. Exclusion of certain vehicle types	4.30	3.86	1	4.18	3.67	1

5. Conclusion

The results indicate that bike commuters had relatively greater concern about the facets “safety” and “continuity”, due to the high frequency with which they used the bikeway[5,6]. Other users paid more attention to “service facilities” and “environment”. Both groups agreed that the Gaomei Cycleway’s width, the continuity of its route, the cleanliness of the environment, and its rules regarding what vehicles were allowed were all appropriate and should be maintained in the future. In terms of pavement evenness, route-network information, and supply facilities, on the other hand, both user groups felt that the Gaomei Cycleway had insufficient facilities and/or that its management unit should actively seek to improve user satisfaction. The fact that more attention was paid to bike rental points by general/leisure users than by commuters was probably due to the latter group mostly owning their own bikes.

6. References

- [1] Intergovernmental Panel on Climate Change’s (IPCC) fifth Climate Assessment Report.
- [2] Institute of Transportation, Taiwan (2017). A Study of Integration and Evaluation of the Bicycle Lane Network System.
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