Performance Evaluation of Smart Street Lighting Systems Applying the PFI Model

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Abstract:

   Private Finance Initiative (PFI) involves long-term contracts where private entities invest in the construction and maintenance of street lighting facilities. The current implementation of PFI Smart Street Lighting Systems faces challenges in the fulfillment process, including discrepancies in quantities, coordination of power variations, delays in the deployment of smart systems, and issues with performance indicator scoring. These challenges disrupt the smooth execution of contractual obligations. Nevertheless, the adoption of intelligent systems in street lighting presents significant advantages in reducing energy consumption, extending the lifespan of fixtures, and enhancing maintenance efficiency. This study aims to analyze an ongoing project, applying the Fuzzy Analytic Hierarchy Process (FAHP) to identify crucial PFI indicators and their weights. The study explores areas of improvement in the project compared to traditional street lighting, aiming to provide solutions to the mentioned challenges. The results indicate that indicators such as PS3 (Lighting Service Continuity) with a weight of 0.384% and PS4 (Smooth Operation of the Smart Street Lightings Management System) with a weight of 0.274% have the highest impact on service performance. Additionally, the project involves replacing 162,000 streetlights, resulting in a yearly energy consumption reduction of approximately 70%, a decrease in monthly maintenance time from an average of 48 hours to 15 hours, and an expected reduction of 900,000 tons in carbon emissions during the project period. Value for Money (VfM) analysis suggests an annual reduction in government expenditures of NTD 66 million. This reveals that implementing PFI model is more advantageous than traditional street lighting procurement, as it allows the government to leverage contractor financing and alleviate the initial high costs of streetlight replacement, thereby reducing the overall costs of streetlight establishment and maintenance.

Key words: Infrastructure, Smart Street lightings System, Private Finance Initiative (PFI), Street lightings Information, Fuzzy Analytic Hierarchy Process (FAHP)