INFRASTRUCTURE MAINTENANCE EQUITY
A STUDY ASSESSING THE MAINTENANCE ORDER PLAN FOR LED STREETLIGHTS

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1. INTRODUCTION

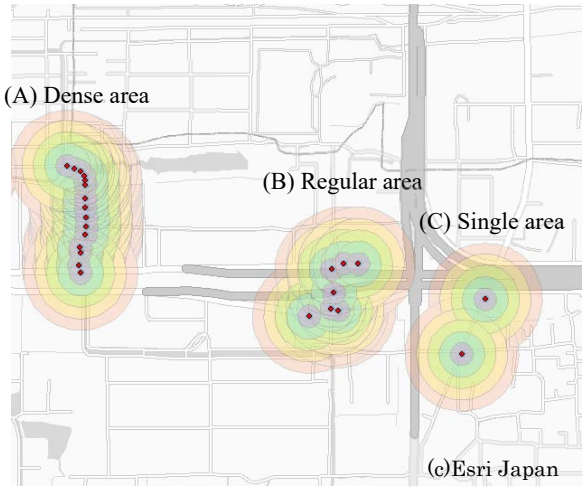
In recent years, Light-Emitting Diode (hereafter referred to as LED) conversion has been required, instead of continuing to use sodium lamps, from the viewpoint of economic efficiency. The public's interest in the issue of maintenance priority has been growing. Although social infrastructure projects have been developed on the basis of a request in accordance with the times and installed lack of unified purpose, the existing maintenance method has not been established and dealt with appropriately as needed. It is necessary to find common ground on the sprawl of infrastructure and manage it in an equity and unified way. Efficiency and equity are a trade-off, and the majority of historical maintenance of infrastructure has tended to lean towards efficiency. This study aims to provide priorities for equitable maintenance of infrastructure installed for different purposes focusing on the distance between adjacent streetlights in a city. The analytical model this study will use is a satellite city with a population of around 120,000 and is a standard municipality. The number of streetlights under the maintenance of the city is 399.

2. METHODOLOGY

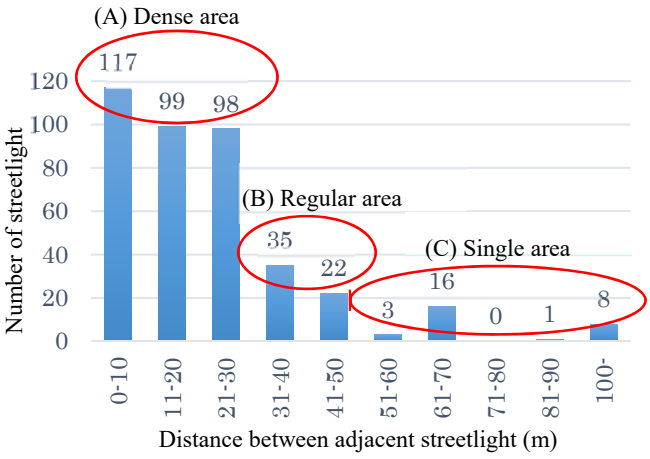
This study presents a method focusing on the distance between adjacent streetlights for considering efficiency and equity in four steps: (1) extract the distance of adjacent streetlights by using the buffer tool in Arc GIS, (2) graph the data in distances of 10 meters (m), (3) classify into three groups, (4) understand the characteristics and define a new concept for each group.

Firstly, the map on the right shows the location of streetlights and the extracted distance of adjacent streetlights by using the buffer tool in Arc GIS. Secondly, it is graphed in distances of 10m as shown via the bar graph on the right. It illustrates the relationship between the number of streetlights and the distance between adjacent streetlights. The "Number of Streetlights" shows there are around 100 within a distance of less than 30m, with around 30 streetlights in the distance between 31m and 50m. However, the streetlights with a distance of 51m or more account for a far lower number. Thirdly, as mentioned above, the data can be clearly classified into three groups to categorize the features of groups of adjacent streetlights.

(A) Dense area (30m or less): a district containing commercial facilities, such as stations, schools and shopping streets.
(B) Regular area (31-50m): a district containing main roads of residential areas and facilities, such as sports grounds.
(C) Single area (51m or over): a residential area with or without underpasses.



{Figure 1} The location of streetlights



{Figure 2} The correlation between distances of 10m and the number of streetlights

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Streetlight Groups and Feature

Group	Distance of adjacent streetlights	Location of streetlights	Concept of group
(A) Dense area	30m or less	Stations, schools, shopping streets etc.	Economic effects and education
(B) Regular area	31-50m	Main roads of residential area and facilities	Improving the quality of life
(C) Single area	51m or over	Residential area, underpasses	Safety and security

Finally, in the table above, we can understand these characteristics and define a concept to each group:
(A) Economic effects, (B) Improving the quality of life, (C) Safety and security.

3. A WAY OF THINKING ABOUT THE EQUITY AND EFFICIENCY OF MAINTENANCE

There has been an issue due to the “efficiency” and “equity” of social capital pertaining to facilities generally regarded as public property. These concepts are caught in a trade-off restricting the effects of both. However, in the location of the streetlights from {Figure 1}, it seems that the citizens are comfortable with the “equity” of their streetlights, due to a lack of complaints until now if it is to be assumed that a certain level of understanding has been obtained.

The benefits and characteristics of LED conversion can be arranged in three groups.

(A) Economic effects: brighter
(B) Improving the quality of life: more accurate
(C) Safety and security: safer

Based on this, the maintenance order is decided by the municipal administration depending on the term and situation. When it is focused on safety and security, the first priority is group (C). The way of deciding priority based on a majority vote and a strategy which seems equitable at first glance. The former is not equitable for the minority. However, the latter follows the municipal administration and is not judged by a majority vote or minority opinion. The strategy shows how to solve the citizen’s problem and it changes each term and depending on the situation. Thus, it seems that the strategy mostly satisfies the concept of equity.

According to these results, it is considered that the rules of equity for deciding the maintenance order can assist in building consensus among stakeholders according to the city’s maintenance strategy.

4. CONCLUSIONS

Social infrastructure has been installed each with an individual maintenance plan over a long term period. An entire maintenance plan is required at the point in time when they were installed. In other words, in the first stage of being installed, equity is heavily considered. In the second stage of being maintained, efficiency is the primary focus. Efficiency and equity are a trade-off. However, it is considered that these concepts are compatible with each other if stages one and two - mentioned earlier - are followed.

This study looked at LED conversions to streetlights as a case study, assessed one of the methods to extract the distance of adjacent streetlights that are installed individually, and group them to define a new concept to prevent the overlooking of maintenance. This work reported the process for determining a maintenance order according to the maintenance strategy. Thus, this process gives priority to maintenance on the basis that the municipal policy is objective and equity. Factors can be grouped appropriately, so long as they can be comprehended by citizens, such as the distance and the characteristics. Moreover, maintenance which best reflects civilian life is required by citizens and considered efficient. Therefore, we believe that this method is one of the most appropriate ways of maintaining social infrastructure.

Lastly, this study reported on the importance of retaining lists on the three fundamentals of asset management:
(1) retaining lists (2) grasping the situation (3) calculating maintenance costs (Onishi, 2002). It is applicable not only to the LED plan but also a way of obtaining data, administrating data and management data that can be used in the future for other infrastructure.

5. REFERENCES

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