

EFFICIENCY ASSESSMENT OF RENEWING AGING WATER SUPPLY PIPELINES
FROM THE VIEWPOINT OF DEMOGRAPHIC CHANGES: A CASE STUDY OF
WATER SUPPLY SERVICE IN KASHIWA CITY

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ABSTRACT

Aging society has been raised as a social issue at nationwide in Japan, which not only the population is shrinking but also refers to public social infrastructure. The peak of social infrastructure investment was 1950s, and until today many of them are still being on active service in which be found have been in place far beyond their life. At the same time, Japan has experienced population decline since 2010 and the situation is expected to become more severe after 2030 with forecasts indicating an expected 30% decline from 2005 to 2055. These demographic changes are expected to affect society at many levels such as labour markets decline, increased tax burden, and economic stagnation. How to balance the population decline with a larger and larger need of maintenance and renew fund posts challenges to the whole society.

Previous studies have been focusing mainly on the above mentioned challenges especially from the stance of establishing model to predict the deterioration situation of water supply pipelines by fitting with the history data of pipelines breakages. However,

little is known about the impacts of population decline on physical infrastructure, especially water supply pipelines buried underground. The impacts includes but not limited to possible deterioration of current infrastructure and increased financial burden of sustaining it thus if there is necessary to downsize the pipelines or adjusting the renew priority to adapt the population change should be discussed.

In light of the increasing replacement cost of water supply systems and decreasing population in Japan, this study aims to conduct an integrated analysis of the impact of different population fluctuation on water supply pipeline development and management with the consideration of pipelines physical properties, thus providing policy implications for sustaining water supply systems in Japan.

To achieve these objectives, this thesis presents a new assessment study on the impacts of population decline on water supply pipelines in Japan. Data collection methods and analysis methods include interviews and model establishment. Kashiwa City, located in northwestern Chiba Prefecture of Japan has been chosen as a case study for this study. Methodologies includes literature review, interviews and secondary data analysis for collecting data. For analytical methods, we give the definition two parameters aging rate and efficiency rate to develop the efficiency assessment of aging pipelines in Kashiwa City

The main findings of this study indicate that based on the calculation of pipelines' aging rate, the peak of pipelines in need of renew will come around 2050s, especially in the ten years from 2056 to 2066, the aging rate of pipelines increases sharply to 21% (15,955 in the total of 75,943 pipelines), which represents that tremendous pipelines around 2050s are in need of renewal intensively. To shift the peak, three scenarios are built to find a proper schedule for per year's renew plan. Moreover, efficiency rate of pipelines are calculated to testify how population change will give influence on the priority of renewing. The results suggest that although the whole Kashiwa City is predicted to depopulate in the future, population in each community in Kashiwa City shows various characters, which should be taken into different consideration of schedule planning. To explain and testify the results more specifically, we take two areas A and B in Kashiwa City as example to show how the priority should be adjusted in one area where population keeps increasing and another area where population is decreasing.

From the comparison, we suggest situation similar to B area, where population will decrease sharply, should adopt the plan which requires renewing pipelines earlier even pipelines in those areas are not the most aging ones. Conversely, situation similar to A area, where population is expected to increase, we should delay the renew plan if pipelines in those areas are aging but still works functional. By taking this sort of

priority, we could achieve the target that ensure the most efficient use of resource and higher quality of public service can be supplies to more citizens.

As the main conclusion of this study, we point out that since demographic changes have significant impacts on water supply systems and infrastructure, with the background of depopulation in Japan, increasing attention should be paid on how to make the most efficient use of resource for new built pipelines and face the inevitable issue of spatial disparity.

The demographic trends in Kashiwa City indicate complex interactions between population changes and future plan of water supply system. Meeting these challenges and balance the complex relationships require water supply department to examine pipelines' aging rate and combining it with population changes to ensure long-term efficiency and more population can enjoy high water quality. In this sense, comprehensive strategy including forecasting and scenario building are extremely important.

Key words: Aging water supply pipelines, Demographic changes, Efficiency assessment