ANALYZING THE COST-EFFECTIVENESS OF ENHANCEMENT APPROACHES FOR REHABILITATING WATER DISTRIBUTION NETWORK

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We hereby declare that We have checked this thesis and in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science

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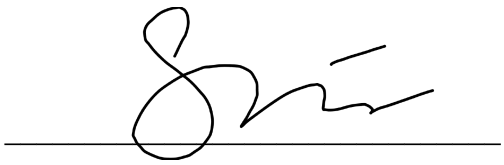

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Pengurusan air lestari telah menjadi matlamat yang popular di dunia. Air bukan hasil (NRW) adalah salah satu bentuk kehilangan air. Terdapat sejumlah besar NRW, terutama di negara-negara membangun. Kerugian sebenar mewakili bahagian NRW yang lebih penting. Kerugian ini memberi kesan negatif kepada ekonomi dan membentuk halangan untuk mencapai kelestarian air. Oleh itu, tujuan kajian ini adalah untuk mengurangkan NRW. Kajian sistematik pertama kali dilakukan untuk mencari teknik dan kaedah yang relevan untuk memulihkan rangkaian pengedaran air (WDN), yang merupakan salah satu kaedah untuk mengurangkan NRW dan untuk mencapai tujuan penyelidikan yang mengurangkan NRW, setelah mengenal pasti pendekatan pemulihan WDN, tinjauan soal selidik di Malaysia dan Mesir dilakukan selama lima bulan dari bulan Jun 2020 hingga Oktober 2020. Tujuan utama tinjauan soal selidik adalah untuk mengenal pasti pendekatan peningkatan kos efektif. Sebanyak 109 responden dari Malaysia dan 67 responden dari Mesir, yang bermaksud sejumlah 176 responden dikumpulkan dan dianalisis. Ukuran sampel sesuai kerana sebahagian besar populasi yang disasarkan adalah di antara pengurus dan pengurus projek yang mempunyai pengalaman sekurang-kurangnya tiga tahun dalam bidang WDN. Penduduk ditentukan berdasarkan syarikat teratas dan pihak berkuasa air kerana penyelidikan ini memfokuskan pada pendekatan peningkatan pemulihan WDN yang maju. Kemudian, peringkat skor alpha, skor min, nilai normalisasi, dan analisis perjanjian Cronbach dilakukan dalam fasa analisis data. Hasil kajian menunjukkan bahawa pendekatan peningkatan kos efektif adalah pengaturcaraan, model, kawalan penyeliaan dan pemerolehan data (SCADA), dan digital berkembar. Selain itu, data dari Malaysia mencadangkan dua pendekatan peningkatan kos efektif: rangkaian zonasi dan algoritma genetik. Kedua teknik ini mungkin memiliki potensi besar untuk negara-negara membangun lain, seperti Mesir. Kemudian akhirnya, setelah mengenal pasti pendekatan kos efektif perbandingan antara pendekatan kos efektif antara Malaysia dan Mesir dilakukan. Memilih teknik yang betul dapat membantu pengamal industri memaksimumkan manfaat pemulihan WDN. Perbandingan akan membantu para penyelidik dan peserta industri untuk mengadopsi dan mengembangkan lagi pendekatan yang disarankan, Perbincangan pendekatan pemulihan peningkatan WDN dapat membantu menyesuaikannya dari negara lain di masa depan. Pemulihan WDN yang betul menyokong pengurangan NRW, yang terutama membantu menuju ke arah pengurusan air lestari di negara-negara membangun

Kata kunci: Pembangunan lestari, kehilangan air, Air bukan hasil, Rangkaian pengagihan air, Pemulihan WDN.

ABSTRACT

Sustainable water management has been a trending goal in the world. Non-revenue water (NRW) is one of the forms of water loss. There is a tremendous amount of NRW, especially in developing countries. The real losses represent the more significant portion of the NRW. These losses negatively affect the economy and formulate a barrier towards reaching water sustainability. Therefore, the aim of the study was to that reduce NRW. A systematic review was first conducted to find the relevant techniques and methods for rehabilitating water distribution networks (WDN), which is one of the methods to reduce NRW and to achieve the research aim which is reducing the NRW, after identifying the WDN rehabilitation approaches, a questionnaire survey in Malaysia and Egypt was carried through five months period from June 2020 to October 2020. The main aim of the questionnaire survey was to identify cost-effective enhancement approaches. A total of 109 respondents from Malaysia and 67 respondents from Egypt, which means a total of 176 respondents were collected and analyzed. The sample size is suitable as most of the targeted population are among the managers and project managers with at least three years of experience in the WDN field. The population was determined based on the top companies and water authorities as the research focuses on advanced WDN rehabilitation enhancement approaches. Then, Cronbach's alpha, mean score ranking, normalization value, and agreement analysis were carried in the data analysis phase. The results show that cost-effective enhancement approaches are programming, models, supervisory control and data acquisition (SCADA), and twin digital. Additionally, the data from Malaysia suggest two more cost-effective enhancement approaches: zoning network and genetic algorithm. These two techniques might possess great potential for other developing countries, such as Egypt. Then finally, after identifying the cost-effective approaches, a comparison between the cost-effective approaches between Malaysia and Egypt was done. Choosing the right technique can help industry practitioners maximize the benefits of WDN rehabilitation. The comparison would help the researchers and industry participants to adopt and further develop the suggested approaches. The discussion of the WDN enhancement rehabilitation approaches can help in adapting them from other countries in the future. Proper WDN rehabilitation supports NRW reduction, which mainly helps move towards sustainable water management in developing countries.

Keywords: Sustainable development, water losses, Non-revenue water (NRW), Water distribution network (WDN), Rehabilitation of WDN.

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