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# HighDro: An Intelligent Asset and Pressure Management Application for Local Water Utilities using GIS

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**Abstract.** The study aimed to create a secure application for a local water utility, addressing asset management and pressure monitoring in the district meter area. The Intelligent Asset and Pressure Management Application, developed through Agile Model Phases, served as a tool for employees to monitor assets, report leaks, and make informed decisions. Quality assessment and acceptability determination employed ISO/IEC 25010 criteria, using questionnaire and interview techniques with IT experts and utility employees as respondents, chosen through purposive sampling. Results indicated alignment with ISO 25010 Software Product Quality Standards, covering functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. The application proved highly effective in the water utility, excelling in asset and leak management, pressure monitoring, and decision-support modules, according to study respondents.

*Keywords:* Asset Management; Decision-Support; Georaphic Information Systems; Local Water Utility; Pressure Monitoring

## 1. Introduction

Local Water Utilities (LWUs) are local corporate entities that operate and maintain a water supply system in one or more cities or municipalities throughout the country.

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LWUs are established by the Local Water Utilities Administration (LWUA) due to the water crisis experienced by the Philippines in the early times. LWUA is a government-owned and controlled corporation (GOCC) created by the proclamation of Presidential Decree No. 198, known as "The Provincial Water Utilities Act of 1973". Its main function is to promote and oversee the development of water supply systems in provincial cities and municipalities outside of Metropolitan Manila.

Their main function is to ensure that their service area gains access to clean and potable water. They process ground and surface water like rivers to ensure that they are safe for human consumption. They are also in-charge in the installation of main lines and water meters to determine the consumption of their concessionaires. With these, they are also tasked with reading water meters and providing accurate bills to their customers. They also entertain calls that are related to leak repairs and other maintenance activities. Aside from this, personnel of water utilities are tasked to detect leaks from the main line which causes Non-Revenue Water (NRW) or water that was just going to waste because it is not consumed by the concessionaires.

With the emergence of different technologies, LWUs adapt different methods to make their work easier and more efficient. Some of these include, the creation of electronic billing and collection systems, the use of SMS technology to message customers for their bills and announcements, the use of mobile meter reading applications and the use of geographic information systems to map their assets' locations.

However, there are still some problems that LWUs encounter in their current scenario. First, having GIS applications to map their asset's locations are expensive. Some GIS in the Philippines cost at around 2 million pesos annually with functions limited to only seeing the location of an LWU's assets. In smaller LWUs, it will hugely affect their total Capital Expenditures (CAPEX). It will be difficult to release this amount of money because this amount can be used on their operations and other projects that they can work on. These GIS applications also require high specifications and fast internet speed connections thus making it impossible for field employees who only have smartphones to use it. To know the asset's location, they have to call someone from the office to map it for them which could take longer.

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Another problem is that LWUs who are now partnered with private organizations via joint ventures are frequently changing personnel. Most of them are just on contractual basis and are not renewed after the contracts end. This means that the previous personnel who were familiar with the service area will be replaced by new personnel who will be trained to get familiarized with the locations of each asset to be monitored. This will also cost a lot of time and effort since there are more than 20,000 assets that need to be monitored even for smaller LWUs.

Another problem is the extraction of data from different pressure points for processing. Most LWUs gather and analyse data manually. This means they need to visit all pump houses and gather information from pressure loggers installed in each area.

With these problems at hand, the researchers felt that there is a need to develop an application that will provide solutions to the problems stated and help LWUs to continue providing quality service to their concessionaires. In line with this, the researcher proposed and developed a web-based application that provides efficient asset and pressure management for local water utilities using geographic information systems.

## 2. Methodology

The proponents used the sequential exploratory mixed method of research for the study. Sequential exploratory design is a mixed methods study design where a qualitative data collection and analysis will be conducted first before proceeding to a quantitative phase of data collection and analysis.

The data collected from the interview served as the qualitative data that analysed and used to develop the system as well as to check their willingness to support the development of an application, and the data collected from the survey questionnaire served as the quantitative data that is used to measure the quality of the developed system and its level of effectiveness in the operations done by the end-users.

### *2.1. Sampling Procedure*

Purposive sampling was used in selecting the respondents of this study. Purposive sampling is a non-probability sampling method in which the items of the sample are picked based on the researcher's judgment. Researchers frequently feel that by applying competent judgment, they may produce a

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representative sample and save time and money (Black, 2010). For this study, the purposive sampling technique allows the researcher to choose the respondents for the study based on their personal judgments that he thought give the appropriate evaluation for the study.

### *2.2. Respondents*

The respondents of the study were divided into two groups. The first group is the IT experts and the second group is the end-users. The IT experts are those individuals whose expertise is in line with software and application development, specifically those inclined in geospatial technology and those with expertise in mobile applications development. The end-users are the personnel of the local water utility who used the application upon its deployment. They are the maintenance crew who were on the field and received notifications for repairs and other maintenance activities, the engineering personnel who mapped newly installed meters and newly installed main lines in the service area, and last are the customer service associates who lagged leaks and new service connections to the application. In addition, the Branch Manager and Contract Monitoring Unit (CMU) Manager was also noted as end-users so they can gain access to the valuable information and reports that can be generated by the application.

#### 2.2.1 Research Site

The study took place in Cabanatuan City Water District – PrimeWater Cabanatuan City (CCWD-PWCC), the local water utility situated in Cabanatuan City, Nueva Ecija. At present, it caters to more than 53,000 households, providing safe water of the highest quality to the people of Cabanatuan. Through a Public-Private Partnership under the Joint Venture Agreement with PrimeWater Infrastructure Incorporated last January 2017, CCWD-PWCC was able to expand its services to 76 barangays within the city. CCWD-PWCC has a total of 149 employees serving different functions ranging from office clerks to field personnel doing repairs and installations.

## 3. Results and Discussion

### *3.1. Description of the Current Scenario in Asset Management and Pressure Monitoring*

Based on the responses provided during the interview, an application can be developed and implemented to minimize the problems that are encountered

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within the different processes involved in the local water utilities activities with regards to Asset Management and Pressure Monitoring.

### *3.2. Development of the Application Based on the Agile Model Phases*

Based on the discussion provided, the Intelligent Asset Management and Pressure Monitoring Application was successfully developed and implemented following the Agile Model Phases namely conception, inception, iteration, release, and maintenance.

### *3.3. IT Expert's Evaluation of the Developed Application Based on the ISO 25010 Software Product Quality Standards Criteria*

The evaluations given by the IT experts indicated that the developed application highly exceeds the ISO 25010 Software Product Quality Standards on technical quality assurance. The IT experts had given an average rating of 3.93, which means that the developed application is highly functional, highly efficient, highly compatible, highly usable, highly reliable, highly secured, highly maintainable, and highly portable.

### *3.4. End-Users' Evaluation of the Developed Application Based on the Selected ISO 25010 Software Product Quality Standards Criteria*

The evaluations specified by the different end-users of the application indicated that the application highly exceeded the ISO 25010 Software Product Quality Standards on the technical quality assurance. The end-users unanimously rated the system as highly functional, highly efficient, and highly usable. They also had an average rating of 3.96 with high ratings for each category. The results show that the end-users all agreed that the developed application is functionally suitable, performance efficient and usable.

### *3.5. Evaluation of the Level of Effectiveness of the Implementation of the Developed Application*

The IT experts and end-users all agreed that the system was Highly Effective in terms of Asset Management, Leak Management, Pressure Monitoring and Decision Support. Assets can now be traced anytime and anywhere which led to faster and more effective management of assets. Reports of leaks are also created and transferred to maintenance orders for repair crew real-time, meaning they can respond to the soonest possible time and lessen the instance of having non-revenue water due to service and mainline leaks. The leak

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monitoring team were also delighted as they can monitor the pressure in just a few taps on their devices. The results showed strongly that the system was highly effective in all functions and features that it has, which was also supported by the exemplary results of the survey using the ISO 25010 Software Product Quality Standards.

In addition, due to its outstanding features, the management also plans to endorse the use of the application with other neighboring water utilities so that they can also experience the benefits of the system in their day-to-day operations.

## 4. Conclusions

Based on the findings, the following conclusions were drawn:

1. The implementation of the Intelligent Asset Management and Pressure Monitoring Application helped in solving the problems stated during interviews with the expected end-users of the application.
2. The Intelligent Asset Management and Pressure Monitoring Application was successfully developed following the Agile Development Phases.
3. The developed application complied with the requirements specified in the ISO 25010 Software Product Quality Standards as evident by the ratings given by the IT experts.
4. The developed application complied with the requirements specified in the selected ISO 25010 Software Product Quality Standards as evident by the ratings given by the end-users which include the maintenance crew, engineering personnel, customer service associates, branch manager and the CMU manager.
5. The level of effectiveness of the implementation of the developed application was Highly Effective as specified by the ratings given by the IT experts and the end-users of the application.

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