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Water Consumption Monitoring & Tracking System as a Tool to Measure the Efficiency of Water Conservation and Service Water Optimization Initiatives

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ABSTRACT

- **Background**

Water is a critical resource that should be managed carefully in order to assure its sustainability and the proper use while taking all measures to avoid any potential misuse or undesirable waste. The conservation of water is extremely important in order to preserve wildlife habitats.

From another hand, drilling activities are consuming large volumes of water particularly in remote areas. Accurate and continuous monitoring of water consumption on rig site is a major requirement for proper management of that critical resource to define the real needs and optimize the consumption.

- **Aims & Objectives**

Making informed decisions regarding to water conservation initiatives requires:

- Ensuring efficient water consumption data reporting (maintain accuracy, usability, consistency, and timely reporting)
- Communicating / reporting all water consumption data electronically and from one authenticated source
- Maintaining a secured water consumption database that can ensure confidentiality of water data when sharing or reporting
- Supporting decision making while developing water conservation strategy by providing more insight via data analytics

- **Solution Description and Development**

In line with the requirements of the corporate Water Conservation Policy, D&WO Water Conservation Road Map, and the mandate by the Water Sustainability Committee for water sustainability reporting, all D&WO departments are reporting water consumption and conservation data (usage and reuse/recycle) periodically and for development of a corporate water conservation KPI.

Therefore, D&WO has developed an efficient water consumption tracking system in order to streamline the water consumption and conservation data collection and reporting process to ensure that data are collected, compiled, and reported in a consistent and timely manner.

The developed system allows operation people to reporting their daily water consumption volumes, water sources, water reuse, etc.

The system can produce a set of static periodical reports to highlight all water consumption and preservation activities, it is also equipped with an interactive analytics tools that allows

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environmental specialists to investigate specific cases and analyze records to monitor the efficiency of the conservation plans and measures.

- **Business Impact and Benefits**

The major benefits of the Automated Water Consumption & Conservation Monitoring System are:

- Accurate and consistent water consumption and preservation reporting
- Centralized and secured database for water consumption and preservation
- Determination of the base water amount required for the given use
- Identification of water reuse possibilities
- Continuous monitoring of the effectiveness of water preservation measures
- Conclusion

The system has helped to reduce unnecessary water usage, assess the effectiveness of policies, strategies and activities to sustainably manage the natural resource in an objective manner, a conservative estimate of water consumption savings is around 6% over the past three years which is helpful to meet the current and future human demand.

The specific add values are:

- Improved water data quality
- Availability of all water data in one source
- Ability for development and better tracking of water conservation initiatives and KPIs
- Support informed decisions making; e.g. minimization of use of good quality water with high monetary value, selection/implementation of appropriate water conservation technologies, etc.
- Ensure compliance with the corporate water conservation policy

EXTENDED ABSTRACT

Background

Water is a critical resource that should be managed carefully in order to assure its sustainability and the proper use while taking all measures to avoid any potential misuse or generation of undesirable waste. The conservation of water is also important to preserve wildlife habitats.

From another hand, drilling activities are consuming large volumes of water particularly in remote areas. Accurate and continuous monitoring of water consumption on rig site is a major requirement for proper management of that critical resource to define the real needs and optimize the consumption and to make informed decisions regarding water conservation initiatives which requires:

- Ensuring efficient water consumption data reporting (maintain accuracy, usability, consistency, and timely reporting)
- Communicating / reporting all water consumption data electronically and from one authenticated source
- Maintaining a secured water consumption database that can ensure confidentiality of water data when sharing or reporting
- Supporting decision making while developing water conservation strategies by providing more insight via data analytics

Solution Description and Development

In line with the requirements of the corporate Water Conservation Policy, Water Conservation Road Map, and the mandate by the Water Sustainability Committee for water sustainability reporting, all departments are reporting water consumption and conservation data (usage and reuse/recycle) periodically and for development of a corporate water conservation KPI.

Therefore, an efficient water consumption tracking system was developed in order to streamline the water consumption and conservation data collection and reporting process to ensure that data are collected, compiled, and reported in a consistent and timely manner.

The developed system allows operations teams to report their daily water consumption volumes, water sources, water reuse, etc.

The system can produce a set of static periodical reports to highlight all water consumption and preservation activities, it is also equipped with an interactive analytics tools that allows environmental specialists to investigate specific cases and analyze records to monitor the efficiency of the conservation plans and measures.

In the next section, we throw some light on system design and features and the system architecture.

• *System Design & Features*

Data Entry Forms

In order to digitalize water consumption tracking, the first step was data capturing at rig site. The data capturing application was broken into three different sub modules based on water sources. Three key sources for water were identified:

- Water consumption from water wells connected to waterlines
- Water consumption from water wells using trucks
- Water consumption from other sources e.g. desalinated sea water

Simplified data entry form was introduced for each one of these sources.

The forms are utilized on daily basis by end users, usually Rig Foreman, to capture water consumption details.

Using this form, water well name as a source is defined, water flowmeter serial number, flow rate, flowmeter readings (initial and final) are captured, and consumption volumes are calculated automatically. Fig. 1.

In case flowmeter is not installed or malfunctioning; water flow rate and flow durations are captured and the consumption volumes are automatically calculated.

Fig. 1 Data Entry Form for Water Consumption from Water Wells Connected to Waterlines

In the case water well is not connected to a waterline, trucks can be utilized to provide water to rig sites, so number of truck loads and average truck volumes are captured, and consumption volumes are calculated automatically. Fig. 2.

Other sources include desalinated sea water, purchased water, reuse water from other aramco facility, untreated sea water, etc. that can also be reported with full details including sources, quantities, etc. Fig. 3.

Interactive Analytics & Reports

The system can produce a set of static periodical reports to highlight all water consumption and preservation activities. It is also equipped with an interactive analytics tools that allows

environmental specialists to investigate specific cases and analyze records to monitor the efficiency of the conservation plans and measures. Fig. 4.

Fig. 2 Data Entry Form for Water Consumption from Water Wells Using Trucks

Fig. 3 Data Entry Form for Water Consumption from Other Sources

• System Architecture

The architecture of the solution, follows an industry standard n-tier architecture. An N-tier architecture divides an application into logical layers and physical layers. Each layer has specific responsibility. This architecture is highly flexible in terms of modularity, extendibility & scalability and resiliency. It is easy to modify and maintained with rapid development options.

The major components and frameworks used by solution are Oracle's Jersey framework which is an implementation of model view controllers (MVC) for back end services, Google's Angular as front technology which is famous for modern single page applications, Oracle and PLSQL database and query language. Team decided to use TIBCO Spotfire commercial tool for interactive reports. The good thing about Spotfire is that it allows developers to combine data in a single analysis and get a holistic view of the same with an interactive visualization. It makes businesses smart, delivers AI-driven analytics, and makes it easier to plot interactive data on maps. Furthermore, the team also follows Microsoft Azure Devops tool to follow DevOps practices and implement continuous integration and continuous deployment to ensure quality and delivery of software.



Fig. 4 Interactive Analytics and Reports Sample

Business Impact and Benefits

Drilling is a process in which massive amounts of water, both onshore and offshore, can be consumed. Due to the mobile / temporary nature of rigs and the amount of water data rigs, water conservation for drilling operations can be very challenging. The first step to overcome the challenges is to understand the scale of water usage. This cannot be achieved without a reliable data monitoring system such as our new and automated Water Consumption & Conservation Monitoring System which is a valuable resource that can provide useful and complete insight of water usage patterns and can help to make informed decisions to implement appropriate actions and to ensure sustenance of water resources.

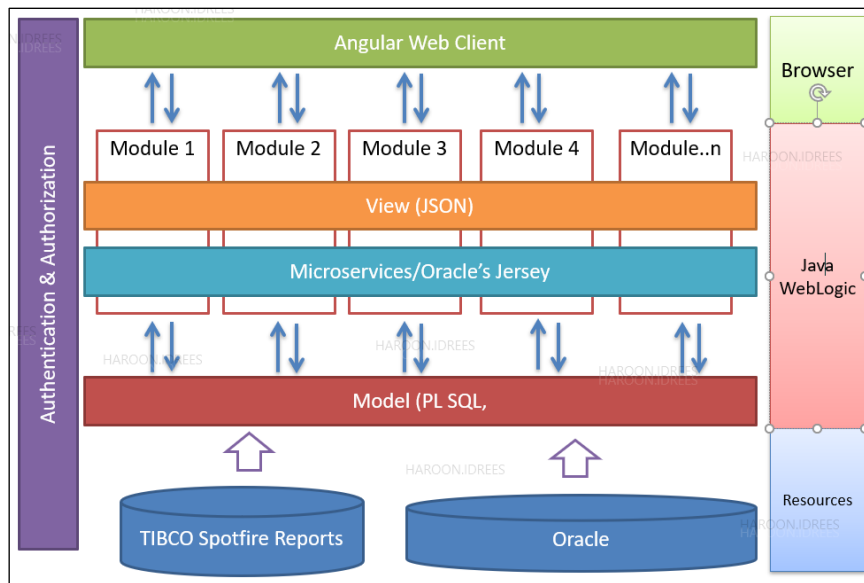


Fig. 5 System High Level Architecture

Introducing the reporting and monitoring tools equip our teams with interactive analytics to help the organization realize many benefits; that includes:

- Accurate, consistent, and reliable water consumption data reporting
- Completeness of water data – all departments and all rigs are able to report all sources of water including groundwater and desalinated seawater. Rigs are able to report data under all scenarios (normal operations and when the water meter is not available or not working). This will help to establish a comprehensive baseline water data for forecasting water usage and benchmarking
- Ability for allocation water resources, making informed decisions (e.g. minimization of use of good quality water with high monetary value)
- Identification and implementation of appropriate water conservation technologies
- Ability to ensure compliance with kingdom and corporate water conservation requirements
- Development, implementation, and monitoring of measurable water conservation initiatives and KPIs using the reliable data from the system Automated water data analysis including tabulation and charting – not just by quantity but also by quality (know where, how, how much, and what type of water is consumed)
- Water Usage optimization – ability to optimize and control water usage by quantity as well as by quality
- Assignment of economic value (\$ value) to groundwater based on water quality

- Water reuse possibilities – ability to identify water/wastewater reuse and savings
- Ability to identify alternate water resources (e.g. seawater, desalinated seawater) for use
- Achieve improvements in water cycle and water balance
- Centralized and secured database for water consumption and preservation
- Potential for integration of the water data system with other data system(s)

Improvements are ongoing and additional features (e.g. monitoring of down hole water losses, wastewater generation, etc.) are planned to be developed in the system that will help D&WO in its water conservation efforts and to achieve the water conservation targets.

Conclusion

The system has helped to reduce unnecessary water usage, assess the effectiveness of policies, strategies and activities to sustainably manage the natural resource in an objective manner, a conservative estimate of water consumption savings is around 6% over the past three years which is helpful to meet the current and future human demand.

The specific add values are:

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