Centralized Operational Analytics Dashboard

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Abstract

This study proposes the creation of a centralized reporting solution to consolidate global distributed operational data into a unified analytical dashboard. The dashboard focuses on integrating metrics like equipment maintenance, diesel, electricity and water consumption to improve visibility, trend analysis and data-driven decision making. It emphasizes scalability, data accuracy, historical analysis and anomaly detection in specific sites or global data to support the business operational efficiency, optimization and initiatives for stakeholders.

Introduction

Organizations with operations across multiple sites face challenges when consolidating and analyzing data from multiple sources. Each system may have different data collection methods which creates inconsistent reporting formats and data availability issues. This creates problems for stakeholders to evaluate operational performance. The proposed solution uses Business Intelligence and visualization platform to combine raw data into a single solution that supports monitoring, analysis and decision-making across global site operations [1].

Background

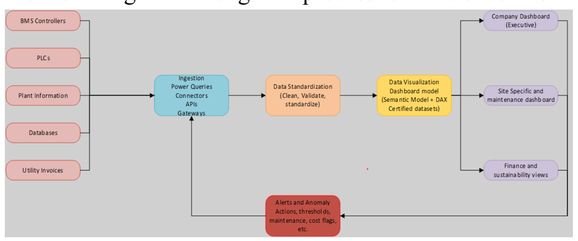
Business Intelligence solutions support organizations to transform raw data into actionable insights, supporting decision making tasks, and operational efficiency. The solution is important as it will support the integration of information from multiple data sources into a single reporting environment [2]. The data integration supports consistency and reliability, while ETL Model (Extract, Transform and Load) supports the preparation of raw data by extracting information from source systems, transforming them into standardized formats and loading it to repositories optimized for analytics and visualization.
There is a growing importance for real time analytics, organizations benefit from being able to access operational information faster to allow early detection of anomalies, quicker response to operational issues and have more efficient strategic planning. Dashboard is an essential tool used as it simplifies complex data sets on charts or indicators that support trends analysis [3].

Problem

Organization face difficulty managing operational information from multiple sites across the world, this can complicate as they have different data sources, systems and reporting formats. This proposed solution addresses these challenges by using a single reporting environment where all operational information can be standardized, validated and visualized consistently.

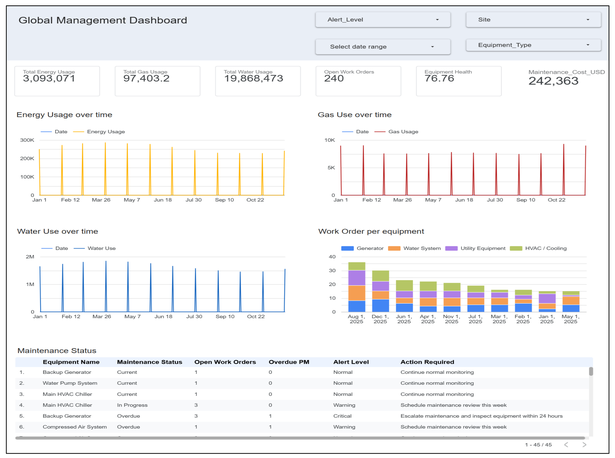
Methodology

This study outlines the structured process and implementation of a centralized Business Intelligence visual reporting tool capable of integrating multiple data sources into a unified platform. This will support the improvement of data accuracy, scalability, automation, and usability and provide real-time data monitoring and promote data-driven decision making.
This process was divided into phases for this centralized dashboard. Requirement Analysis: involves identifying business requirements, stakeholder needs and Key Performance Indicators. Critical components identified were diesel, electricity and water consumption, maintenance schedule and status, operational alerts and cost tracking. Data Acquisition focuses on connecting the multiple data sources required, some of these include Plant Information systems, building management systems, etc. The integration phase consolidates the extracted data into staging layers and separating raw and curated data for validation and troubleshooting activities. Then the data quality supports the identity of missing records, duplicate entries, invalid values and inconsistent timestamps before moving to a reporting environment. The transformation phase standardizes common data, timestamps, site identifiers, and resource categories to support the generation of metrics as required. Data modeling and visualization are the last steps to determine to prepare the dashboard with the data that has already validated, transformed and complete.
This is all implemented using a Dimensional data model to optimize reporting performance and analytical flexibility. Fact tables were implemented to store measurable operational data such as resource consumption (gas, water and electricity), equipment maintenance, utility invoices and equipment thresholds. Dashboard was developed to provide executive summaries for global or site-specific monitoring, trend analysis, KPI tracking and operational alerts.
The deployment of these analytical dashboards require a workspace environment where a process of system testing, user validation, training, continuous improvements to support future enhancements, such as adding additional data sources and long-term scalability. The diagram provides a simple diagram of the process from sending data through the process to the dashboards.



Results and Discussion

The implementation of the centralized operational analytics dashboard can demonstrate that the integration of multiple data sources into a single reporting environment improves visibility, consistency and the analytical capabilities across specific or global sites. This dashboards consolidates critical KPIs such as electricity, diesel/gas and water consumption, equipment maintenance status and operational costs into a standardized analytical platform.
The dashboard enables stakeholders (from executives to standard users) the ability to evaluate global or site-specific operational performance data. Maintaining an Identical dashboard logic across sites improves comparability and reduces inconsistencies, before hand this was not possible as each site maintained different data sources and data collection applications that did not share a common structure creating a significant issues when translating data causing fragmented reporting methods. This dashboard allows the users to identify operational anomalies, compare resource consumption across sites and monitor alerts conditions for equipment in all locations simultaneously.
It also provides historical trends visualization to evaluate abnormalities such as spikes in gas, electricity or water usage, and overdue maintenance activities, providing improvements to investigating operational issues more efficiently.
From a performance perspective, the use of staged transformations, semantic modeling, and incremental refresh strategies supported efficient handling of large historical datasets while maintaining near real-time visibility for operational metrics. The architecture validated that separating source systems from the analytical layer improves scalability and simplifies future integration efforts for across sites and operational resources.



Conclusions

This research concludes that the centralized reporting solution can help improve global and specific site operational monitoring process, by integrating multiple KPIs such as gas, electricity, water consumption, costs data, and equipment maintenance governed under semantic model and interactive dashboard environment. This dashboards solution combines data acquisition, validation, transformation, data modeling, refresh automation and visualization to improve operational visibility and support data-drive decision making. This solution supports the evaluation of costs by allowing the stakeholders to monitor consumption, detect anomalies, compare data across sites and track performance over a period.

Future Work

There are multiple activities to be performed such as expanding the muti-site dashboard to more sites and incorporate more automated data sources. The dashboard can continue to improve by adding new KPIs and creating additional views. It can also implement the use of generative data using AI tools to be able to predict or estimate problems such as equipment maintenance issues, costs increases, gas, electricity or water usage spikes, this can be performed as more data is available. This can help the organization perform preventive actions to avoid or mitigate operational issues.

Acknowledgements

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References

[1]Thomas Davenport and Jean G. Harris, Competing on Analytics: The New Science of Winning, 1st edition, 2007.

[2]Ralph Kimball and Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, 3rd edition, 2013.

[3]Stephen Few, Information Dashboard Design: Displaying Data for At-a-Glance Monitoring, 2nd edition, 2013.