Enhancing Energy Efficiency in a Luxury Hotel Property

Case Study

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Introduction

This case study explores the transformation of a luxury hotel property with over 180 rooms through the implementation of advanced HVAC optimization techniques. This property with a centralised chiller plant, 2 water cooled chillers, 13+ hydronics systems and 20 AHU's , faced significant operational challenges due to complex and an aged HVAC system

Problem Statement

The hotel property was grappling with several critical issues related to its HVAC system, including:

1. High Energy Consumption

- Excessive energy usage due to the lack of automation in the HVAC system.
- Manual control of HVAC operations leading to inconsistent and inefficient energy use.

2. Lack of Real-Time Monitoring and Visibility:

- No system in place for real-time monitoring of HVAC operations.
- Difficulty in identifying areas of high energy wastage or inefficiency.

3. Operational Inefficiencies:

- Manual operations and reporting processes led to operational inefficiencies.
- Engineering staff faced challenges in maintaining consistent HVAC performance.

4. Guest Comfort Issues:

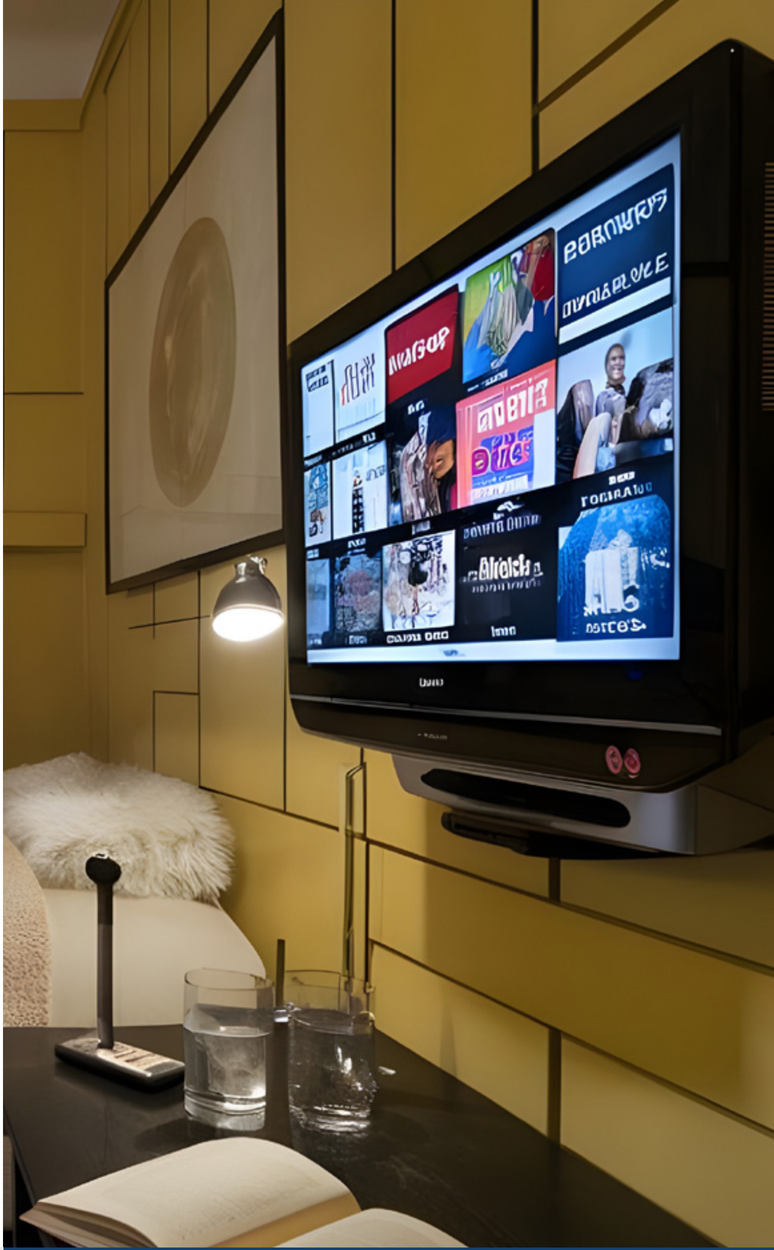
- Inconsistent indoor climate control resulted in hot and cold pockets, affecting guest comfort and satisfaction.

Pain Points

- High operational costs due to inefficient use of the HVAC system.
- Absence of real-time data to monitor and optimize HVAC performance.
- Manual operations and lack of automated reporting.
- Unclear asset health status, leading to frequent equipment breakdowns.

Implications

- Financial impact: Increased operational expenses due to higher electricity bills and frequent HVAC equipment breakdowns.
- Guest comfort issues impacting customer satisfaction and property reputation.



Goals

- Reduce electricity bills by 15% as part of their ESG (Environmental, Social, and Governance) goals.
- Improve the lifespan of critical HVAC equipment by 15-20%.
- Enhance the operational efficiency of the engineering staff by 30%.

Analysis & Solutions

A comprehensive analysis of the HVAC system revealed significant inefficiencies and areas for improvement. The i-SIDDHI Framework was identified as the optimal solution to address these challenges. This framework is designed to optimize HVAC operations through a systematic and phased approach

HEAL Phase

- **System Audit and Assessment:** Conduct a thorough review of existing equipment, processes, and performance to evaluate the current state of the HVAC system.
- **Retrofit Sensors, Controllers, and Gateway:** Upgrade the infrastructure with new sensors and controllers on equipment like chillers, AHUs, secondary pumps, and cooling towers to gather real-time data.
- **Custom Automation Logic:** Develop and deploy tailored automation scripts or algorithms that control chiller systems, AHUs, pumps, and cooling towers based on the collected data. This helps in optimizing performance by adjusting operations in real-time.

OPTIMIZE Phase

- **Condition-Based Maintenance:** Transition from scheduled maintenance to maintenance driven by actual equipment conditions, using data from sensors to predict and address potential issues before they cause failures.
- **Reduction in Capital Expenses:** Continuous monitoring and better asset management leading to more informed decisions on equipment upgrades or replacements, reducing unnecessary capital expenses. .
- **Foundation for Future Enhancements:** Implement a scalable system that supports future enhancements such as Indoor Environment Quality (IEQ) improvements and access control systems.

BALANCE Phase

- **Measure, Validate, and Fine-Tune Performance:** Regularly assess and improve system performance by measuring performance metrics, validating them against expected outcomes, and making adjustments as necessary.
- **Monitor and Correlate 600+ KPIs/Minute:** Track a large number of key performance indicators (KPIs) in real-time, analyzing data to correlate different performance factors.
- **Alerts/Notifications:** Provide real-time alerts for performance issues based on performance data at micro and sub-system levels, ensuring that any anomalies or potential issues are detected and addressed promptly.

Competitors Shortcomings

The competitive analysis highlighted that other solutions lacked the comprehensive, integrated approach of the i-SIDDHI Framework, which combines real-time data acquisition, AI-based analytics, and continuous commissioning for optimal performance..

Implementation

The implementation of the i-SIDDHI Framework involved several critical steps:

Installation of Sensors, Valves, and DDCs:

- Over 50 sensors were installed to measure parameters such as temperature, pressure, flow rate, and humidity, strategically placed throughout the system for comprehensive data collection.
- Valves were integrated into the piping and equipment to manage fluid dynamics effectively.
- Direct Digital Controllers (DDCs) served as the local brain of the system, processing data from the sensors and controlling the valves and other equipment based on pre-programmed logic to automate control processes and optimize overall system performance.

Creation of a Specialized Network:

- A robust network of wired and wireless protocols was created to ensure efficient data transmission and control, enabling real-time data sharing and coordinated operations. This optimized overall system performance and reliability.

Data Acquisition and Dashboarding:

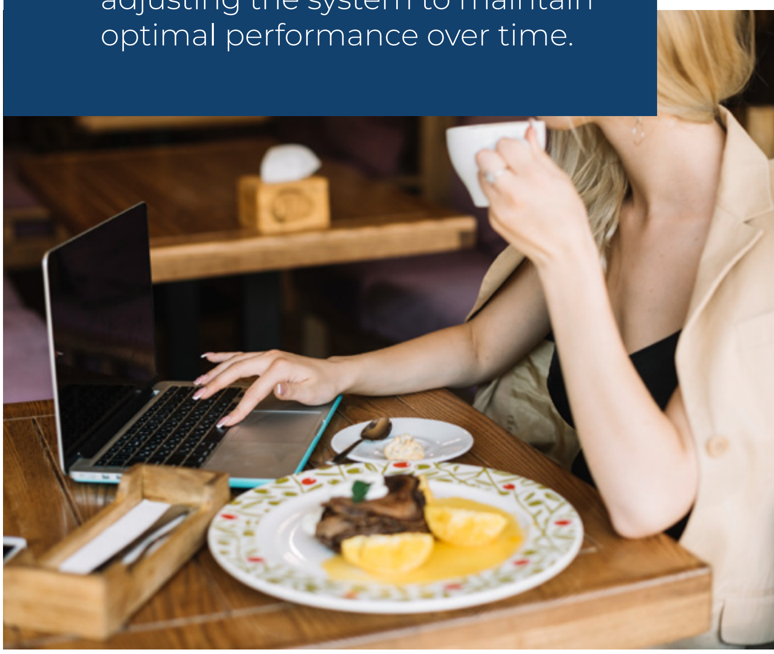
- Over 600 KPIs were monitored and analyzed every 15 minutes. The system's performance was tracked through various metrics, including energy consumption, temperature differentials, and equipment efficiency.
- The analyzed data was visually represented on dashboards, (updated every 15 minutes), allowing operators to monitor system performance closely and make informed decisions.

Commissioning of Edge Gateway and Controller

- Customized algorithms were designed to optimize the performance of the specific chiller plant. These algorithms took into account real-time data and adjusted system operations accordingly, ensuring that the chiller plant operated at peak efficiency.

AI-Based Data Analysis, Correlation, and Continuous Commissioning:

- AI algorithms analyzed the collected data, identifying patterns, predicting failures, and suggesting optimizations. By linking different data points, AI helped understand the relationships between various parameters and their impact on system performance.
- Continuous commissioning involved an ongoing process of monitoring, analyzing, and adjusting the system to maintain optimal performance over time.



Challenges and Overcoming Them

- **Aged Equipment:** Support from OEMs for aged equipment was difficult to obtain. Meticulous planning and seamless execution with the help of highly experienced project planning expertise was required.
- **24/7 Operations:** The property operated round the clock, necessitating careful planning of installation, testing, and commissioning to avoid disruptions in guest comfort and operations.

Results

Outcomes:

- **Energy Savings:** Achieved a 17-21% reduction in electricity bills
- **Digital Twin:** The entire chiller plant and AHU parameters were mapped, allowing remote operation of the system from anywhere in the world via an app or web browser.
- **Asset Health Improvement:** The thorough data analysis and revamp of the chiller plant improved asset life by 3-5 years.
- **AI/ML Optimization:** The complete HVAC system was optimally operated as per psychometric principles using advanced AI/ML logic and policy engines. This helped the customer make informed decisions through alerts and predictions.

Measurable Impact:

- **Electricity Consumption Reduction:** Significant reduction in kWh usage and costs
- **Operational Efficiency:** Enhanced efficiency and productivity of the engineering staff by 30%.

Key Takeaways:

- Real-time data and automation can significantly reduce operational costs and improve system efficiency.
- Continuous monitoring and AI-based analytics are crucial for maintaining optimal performance and extending the life of critical equipment.
- The i-SIDDHI Framework provides a comprehensive, integrated approach that outperforms competitors by combining real-time data acquisition, AI-based analytics, and continuous commissioning for optimal HVAC system performance.

Conclusion

This case study demonstrates the significant impact of the i-SIDDHI Framework on optimizing HVAC operations, reducing energy consumption, and enhancing guest comfort in a luxury hospitality setting. The successful implementation highlights the importance of adopting advanced technological solutions to achieve operational excellence and sustainability goals in the hospitality industry.

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