VIEW POINT

BUILDING MANAGEMENT SYSTEM(BMS): HOW DIGITALIZATION ADDRESSES ENVIRONMENT, HEALTH AND SAFETY (EHS) CHALLENGES

Abstract

Building Management System (BMS) or Building Automation System (BAS) is installed in buildings to control and monitor building services such as heating, ventilation, air-conditioning, electrical system, fire detection, and suppression.

Modern enterprises integrate digital technologies into Environment, Health and Safety (EHS) operations to mitigate risks. According to industry research, digitization can reduce fatalities by ~10% and workplace injuries by ~20%. The key levers of digitalization for EHS are business intelligence and analytics, mobile apps, sensor network, and the cloud.

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Executive Summary

A Building Management System delivers value across several dimensions, including IT and architecture. Controllers installed in a building at the time of construction allows BMS to control building equipment. The control ranges from a simple control such as switch on/off electrical equipment to complex control systems such as HVAC chillers.

An enterprise needs to look beyond today's configuration while making an investment in BMS. Decision makers should cast a wide net and realize the advantages of merging the BAS with the IT infrastructure and EHS. Several companies have established a Resource Engineering Center of Excellence (CoE) to enhance EHS performance. Consistent EHS performance demands an open mindset for evaluating EHS parameters to predict unforeseen events.

In this point of view, Infosys deconstructs BMS and explores emerging digital technologies that can be implemented across industries. Technology innovations based on mobility, Industrial Internet of Things (IIoT) and big data analytics provide capabilities to systematically improve safety and environmental performance.

Problem Statement

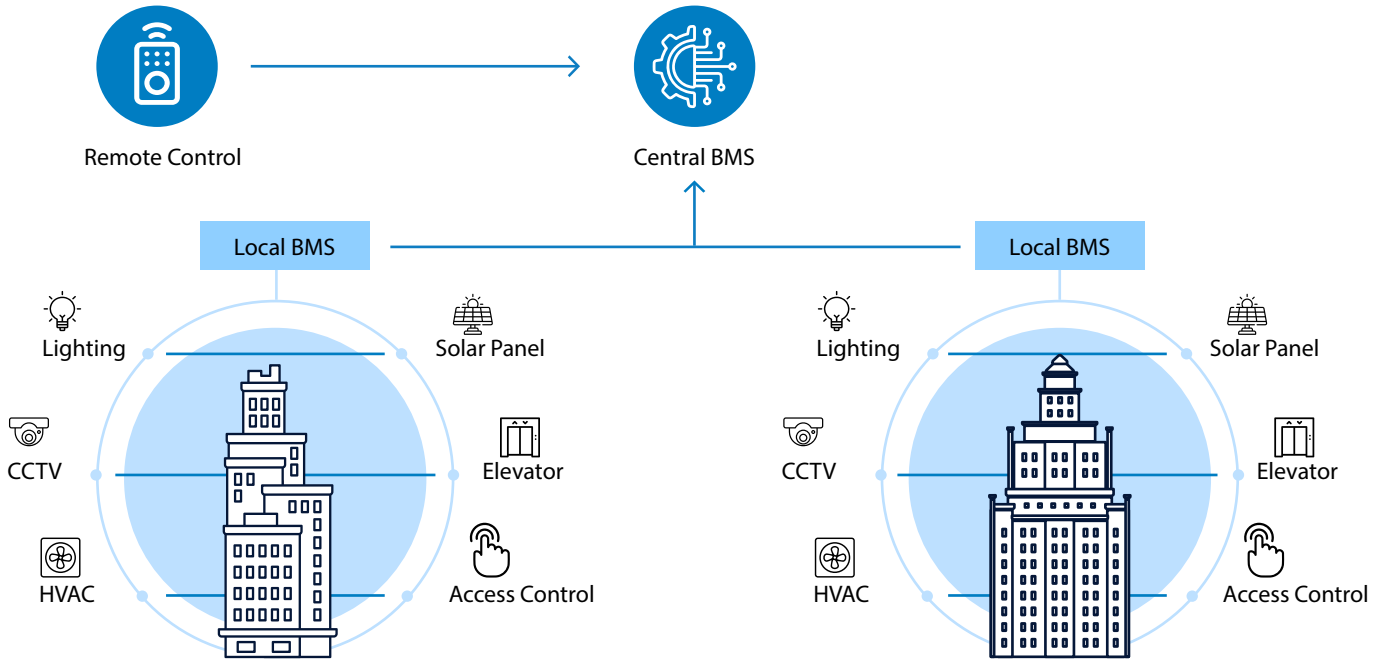
Industries face EHS challenges in BMS such as maintaining energy efficiency by controlling the electricity efficiently, auto switching off elevators when not in use, water management by controlling the motor, etc. Significant research is underway to address these challenges and improve the efficiency of BMS solutions.

Overview of BMS

BMS is an intelligent microprocessor-based controller network installed to continuously monitor and control a building's services such as air-conditioning, ventilation, and lighting. It integrates the functionalities of all building equipment to operate as an integrated system. BMS controls multiple building services such as lighting system, HVAC, elevators, fire suppression and detection. Leading BMS software products include WebCTRL, Optergy, Elipse, Entelec, DEOS-AG, and Desigo.

Purpose of BMS

- Allows users to schedule operations of building equipment and lighting systems leading to energy savings.
- Allows users to monitor energy usage of equipment through graphical dashboards.
- Provides the ability to send notifications and alert stakeholders in the event of system failures.
- Enables scheduling of equipment activation and deactivation leading to energy efficiency.
- Access control systems management controls access to restricted areas of the building.
- Allows comparison of various parameters such as internal air condition, outside air temperature and humidity, to provide optimal energy supply for HVAC equipment.
- Compatibility of BMS system with automation controls network and other open source communication protocols as well as integration with other BAS and TCP/IP.
- Management of power backup to provide uninterrupted power supply.



Systems used in a smart building

Components of BMS

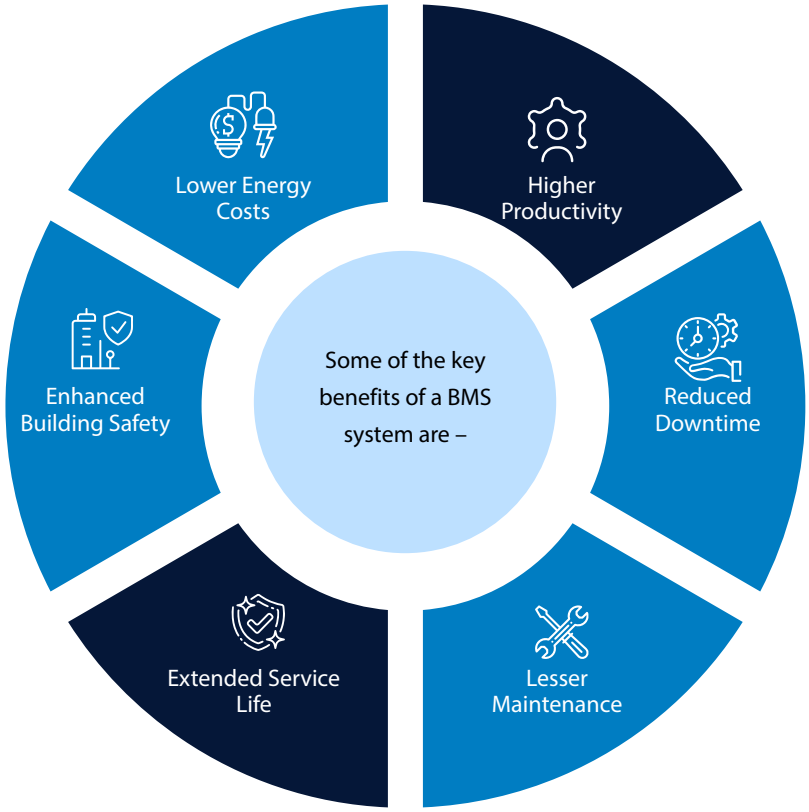
A typical BMS incorporates hardware such as a direct digital controller, sensors, actuators, cables, servers, software tools, and networking protocols.

Challenges in existing BMS

- Buildings account for ~70% of energy consumption and 30% of greenhouse gas emissions. The imperative: sophisticated emission and energy monitor and control systems.
- Hazard monitoring and reflection are implemented in BMS via sensors and actuators, but the system lacks software solutions to record hazards automatically and identify the root cause for preventive actions.
- Conventional BMS uses separate controls and networks that are vulnerable to security threats.
- Conventional BMS is challenged and unable to adapt to the latest technological advancements.
- The needs of small, medium and large building owners differ for managing building services. Cost savings, regulatory compliance and energy efficiency are primary needs of any building owner. Conventional BMS does not cater to the diverse needs of building owners.

Benefits of BMS

BMS or BAS provides multiple benefits to the building owners and makes the entire building more efficient by ensuring optimum utilization of resources.



> For a few years, the awareness that integrated BMS are the integrated digital hub of the building, instead of the IT system has grown. The days that IT defined building design criteria are over.
>
> **- BMS EcoXpert Martin Feder**

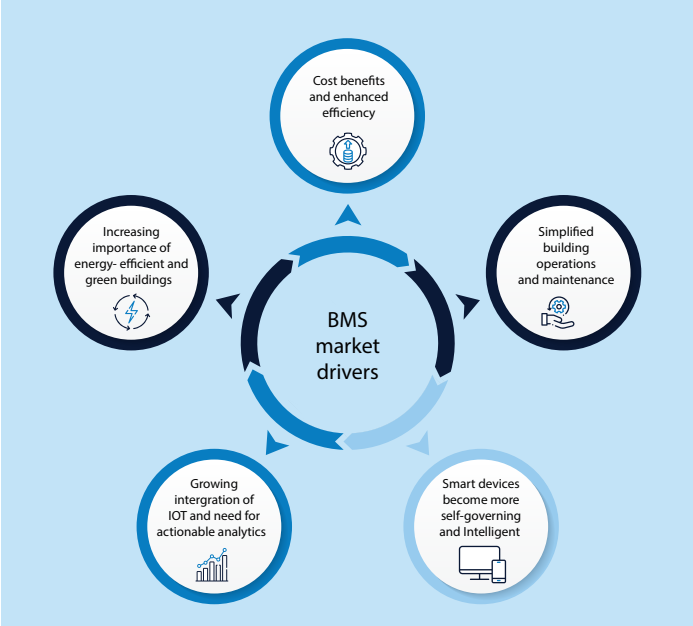
Current trends in BMS

- **Shifting field controllers to the IP level**
  Field controllers are actual control devices, and moving them to IP level ensures faster connectivity of BMS. It provides more information, leading to better autonomous decision-making at the field level, whereby only critical information is moved to the BMS system.

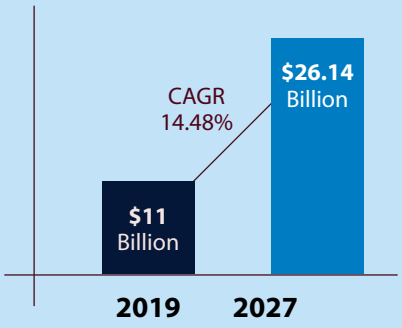
- **Lesser installation time and wireless networking**
  Connected systems and IoT technology have evolved to deliver benefits such as minimal and integrated wiring for communication. Plugging into IP networks and power transmission over Ethernet leads to faster installation.

- **Reducing energy usage by HVAC system through sensor technology**
  According to the American Council for an Energy-Efficient Economy (ACEEE report, 'Smart Buildings: A Deeper Dive into Market Segments'), an average 18% of annual building energy consumption can be saved by installing smart sensor technology in buildings.

IOT, intelligent devices, actionable analytics, and connectivity driving the future of the BMS and sercing evolving BMS needs



Global building Management System Market was valued at USD 11 billion in 2019, and is projected to reach USD 26.14 billion by 2027, growing at a CAGR of 14.48% from 2020 to 2027.



"The growing integration of IOT with building automation systems (BASs) is driving the growth of the building management market based on software. The smart devices that are integrated for the purpose of building automation and managementare expected to be more self-governing and intelligent in terms of sharing data with BASs and with the cloud".

Future forecast of IoT in BMS

- **Internet Protocol (IP)-based systems**
  With serial devices, there is only one way to connect the device to the host that communicates to the end-user. On the other hand, for an IP-based building management system, every device on the network has its own IP address, in the same manner as networked computers.

- **Radiant cooling system**
  In radiant cooling technology for air conditioning systems, a network of pipes is laid within the ceiling, floor, and walls of a building. Chilled water is circulated through this network of pipes to cool surfaces by absorbing heat evenly.

A forced air system installed in a sealed building makes the radiant cooling system more efficient by providing fresh air to the building interiors.

Building Management System and Sustainable Built Environment

The construction industry faces multiple challenges, including sustainability in the built environment. A BMS is a catalyst in ensuring sustainability in the built environment.

A successful BMS implementation leads to energy efficiency, lesser maintenance and operating costs, better quality of indoor air, and superior occupant comfort leading to higher productivity.

A BMS facilitates complete control of building equipment such as lighting, control of water pumps, and monitoring of water tank status. It also monitors the health of sub-systems that require continuous vigil such as generators, STP plants, and elevators. One of the key features of BMS is energy consumption monitoring, especially for energy consumption devices without using sub-metering. It makes the building more resource efficient.

A facility controlled by a BMS system operates more efficiently, experiences less wear and tear, requires fewer repairs, and results in lesser maintenance costs.

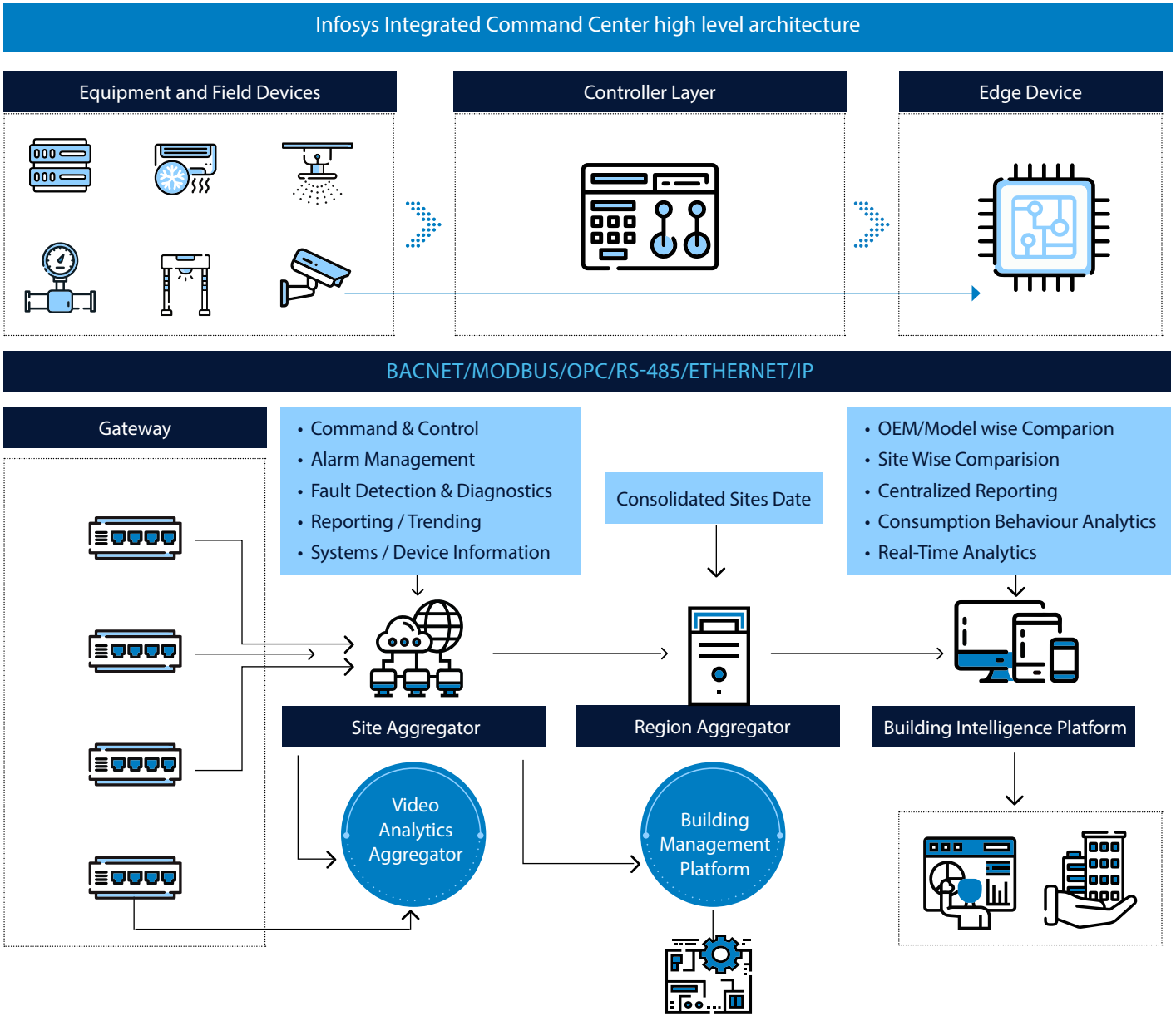
A BMS is capable of automatically adjusting temperature and lighting to maintain optimal comfort level, thereby boosting productivity.

A BMS uses multiple sensors to measure the levels of various agents in a building such as indoor air quality, carbon dioxide levels, VOCs, temperature, humidity, light, occupancy, and sound.

Smart Spaces - Infosys Integrated Central Command Center

Infosys Integrated Central Command Center for energy optimization enables:

- Centralized operations across buildings and systems to enhance visibility into energy usage and consumption. This holistic approach provides a consolidated platform for managing resource efficiency, enables continuous measurement and verification of operations, and provides data to optimize future designs adhering to Leadership in Energy and Environmental Design (LEED)/global standards.
- Smart sensors onboarding and adherence to sustainability metrics, including energy consumption monitoring by various subsystems in the building, energy and water consumption and optimization, occupant comfort, Indoor Air Quality (IAQ), renewable energy, critical operations and central utilities, alerts, and diagnostics.

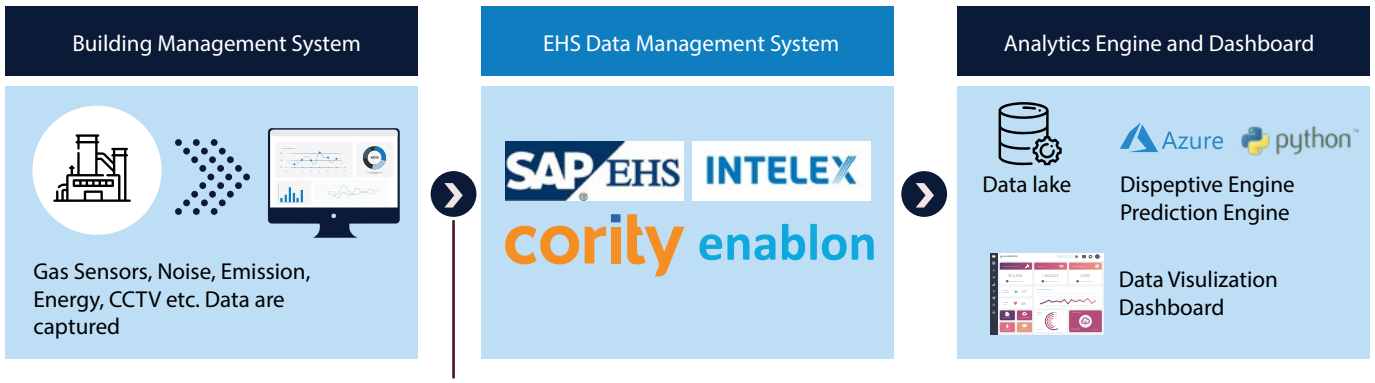


Benefits of Integrated Command Center

- End-to-end real-time visibility by integrating data from disparate systems, including legacy devices to provide a common platform for managing resource efficiency
- Pre-defined and flexible KPIs and data models in a converged network to ensure a single source of truth
- Leverages real-time sensor and process data to improve Overall Equipment Effectiveness (OEE) and minimize equipment failure implementing advanced data-driven diagnostics
- Acts as control center for holistic building management through continuous measurement and verification by subject matter experts
- Improves service delivery through proactive surveillance, and ensures accurate and prompt response to faults and failures of equipment on sites
- Provides data to optimize future building designs, facilitates comparison between different buildings and sharing of best practices
- Provides system performance reports and organizational resource utilization goals tracking report to the management team

Use Cases

Use Case 1:
EHS COTS Integration with BMS for Automated Incident Recording and Incorporation of Analytics



Proposed solution architecture

What

- Lack of real-time incident recording.
- CCD and sensor data may be lost in the event of hazards.
- Lack of incident forecasting.
- Buildings contribute a major part of green house gas emissions and energy consumption.

How

- COTS solution can be integrated with the BMS. When an event occurs, it will automatically record immediately.
- Integration will attach relevant witness records from devices in the BMS such as CCTV, mic sensors, and emission sensors for further investigation.
- Integration of COTs products with analytics engine enables incident data analysis. Prescriptive, descriptive and predictive analytics solution can be showcased using a dashboard.
- Predictive analytics solution and ML algorithms can forecast energy consumption and emissions across building parameters.

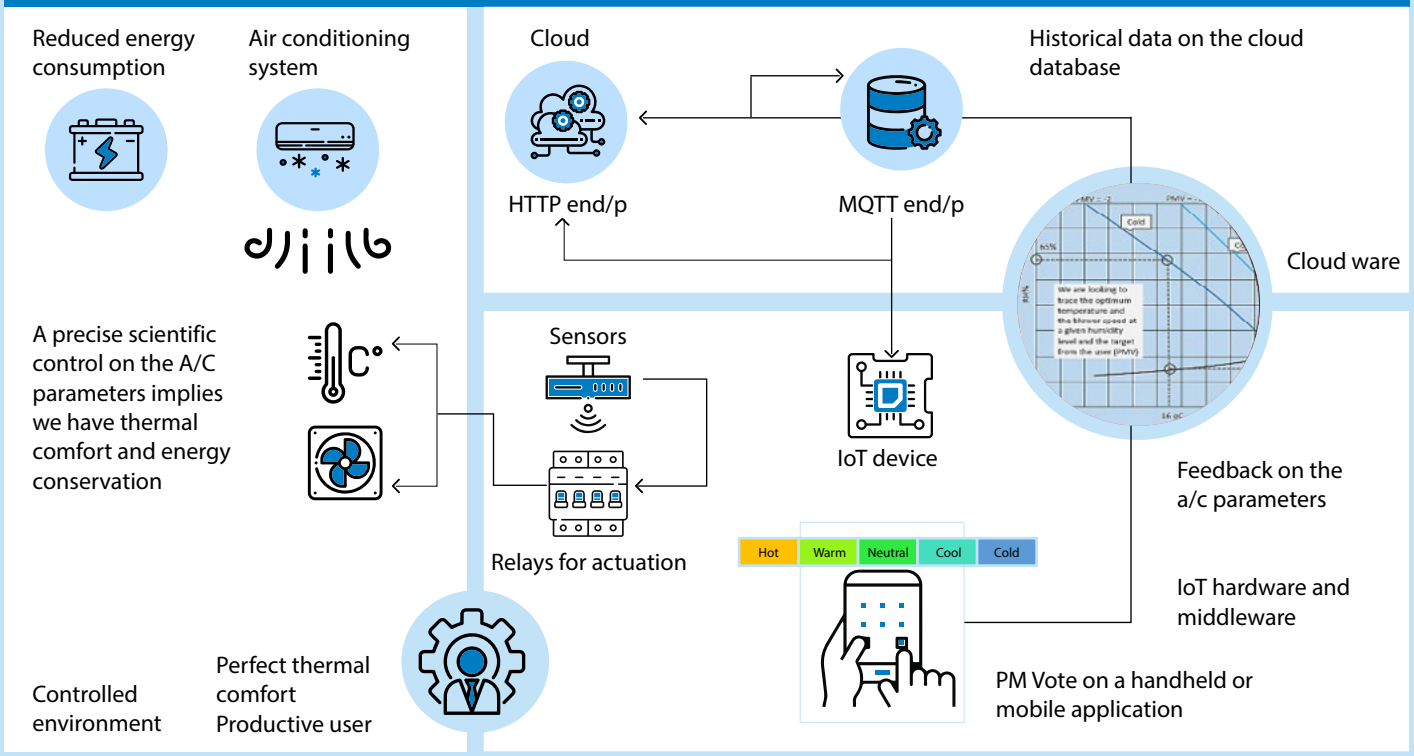
Benefits

- Witness records are retained when systems are damaged after the incident.
- Team analyzes the incident and takes necessary preventive actions.
- CCTV recordings can be analyzed to capture near misses, safety observations, and log incidents.
- Forecasting of incidents enables timely preventive maintenance and minimizes chances of BMS systems breaking down.
- Drill down representation on dashboard can be created for reporting and strategy planning.

Use Case 2:
IoT-based Smart HVAC System for Thermal Comfort

HVAC is an integral part of BMS systems. In modern HVAC systems, a user can set the temperature and fan speed, which contributes to a lack of thermal comfort, increase in energy consumption, lower productivity and adverse effects of over cooling such as chills and headaches. IoT-driven air-conditioning system provides thermal comfort based on empirical data. It takes into account user preferences and prevalent conditions to optimize the configuration of the A/C for minimal energy consumption and maximum comfort.

Solution Architecture



What

- Manual setting of temperature and air speed on demand causes health issues.
- Manual selection ensures prompt comfort, but it causes high energy consumption and adverse health effects.
- Exposure to improper HVAC causes illness and reduces productivity.
- Humidity factor needs to be considered to determine optimal temperature and air flow.

How

- The smart HVAC system monitors relative humidity using IoT sensors.
- User can enter how (s)he wants to feel (PMV), which is a sentimental input of the user.
- The logarithmic relation between relative humidity and air temperature and the respective air speed to achieve thermal comfort.
- Inputs in the cloud can ensure optimal air temperature and air speed from the polynomial equation derived from the logarithmic relation.

Benefits

- User enjoys thermal comfort without health issues.
- IoT-based smart HVAC provides optimal temperature and air speed based on the user's sentimental input.
- Optimal temperature and air speed optimizes energy consumption.
- Productivity gets a boost since there is no downside.

Conclusion

A Building Management System (BMS) allows efficient monitoring and control of building services. BMS generates data and presents reports in a graphical format. This data helps users calculate various parameters of the health and energy consumption of building equipment.

Data analysis also enables preventive maintenance of the building equipment. It reduces energy consumption and overall operational costs, thereby boosting efficiency. BMS layered with analytics, IoT, and integration of COTS systems makes buildings more smart and efficient.

From being a controller of subsystems, BMS has evolved to better maintain, alert, analyze and forecast instances of building systems. Smart buildings enable early detection of preventive maintenance, enhanced security, health and well-being; optimal resource performance, reduced environmental impact, and superior productivity.

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