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Leveraging Enterprise Architectural Framework for Energy Optimization in an Enterprise

Krishna Somayajula[a*], GVB Subrahmanyam[b*]

[a]Associate Consultant, Mahindra Satyam,DLF Gachobowli, Hyderabad 500081, India
[b]Enterprise Architect,Mahindra Satyam,DLF Gachobowli, Hyderabad 500081, India

Abstract. 'IT for Green/Sustainability' is gaining prominence as organizations begin to tread the path of sustainability. Since energy efficiency is one of the major focus areas under the sustainability umbrella, organizations are looking to improve their energy metrics as enterprises spend a great chunk of their overhead costs on energy. This article proposes a framework for energy saving/energy optimization that captures data from enterprise applications and various sensors through a presentation layer and integrates it with a simulation tool to arrive at various energy optimization/energy efficiency strategies. The article also proposes a few used cases to support the proposed methodology.

Keywords*:* Architecture for Energy Optimization, Energy Efficiency, Green Architecture

1. Introduction

With Energy Efficiency becoming the talking point from board rooms to boiler rooms, a number of new and unique approaches to improving energy efficiency of facilities have emerged over the last few years(1-2). In this publication, we will discuss one such energy efficiency/optimization Enterprise Architectural framework that is considered by many industry experts to be the next generation energy optimization technique that will come in to play as a result of collaboration between building controls giants and information technology powerhouses. This framework is built on the basis of simulation tools (based on static data), real time sensor data and the data coming from various Enterprise Applications (3-6). Several interconnected systems are monitored and this information helps in regulating several enterprise applications so that overall energy of the Enterprise can be controlled within the limits. This type of enterprise Green Architecture is both tactical and strategic and considers multiple area of an Enterprise like people, Processes, and Systems and is different from the traditional operational approach. The architectural approach defined in this publication facilitates for enterprise level sustainability/energy optimization by correlation of data from various applications and leveraging the data to arrive at actionable efficiency/optimization strategies.

2. Simulation Tools

Building/energy simulation tools are used extensively by energy efficiency experts and other engineers involved in design, planning and implementation of energy efficiency projects in facilities that include both commercial as well as manufacturing. The primary purpose of an energy simulation tool is to replicate the performance of a facility and various energy centers (HVAC, Lighting, Manufacturing Process, etc) within the facility and enables energy professionals to optimize the building design and performance to use less

a*. Tel.: +91-8978187272
E-mail address: krishna_somayajula@mahindrasatyam.com

* b*. Tel.: +91-9989124941
E-mail address: gvb_subrahmanyam@mahindrasatyam.com

energy. It is important to note here that simulation tools are essentially stand alone applications that require a number of static data points such as building floor plans, mechanical schedules, occupancy schedules etc to simulate the facility under consideration. In other words, simulation tools provide performance and optimization strategies based on the static data of the facility instead of real time performance/operating conditions data such as sensor data, historical equipment performance data, etc.

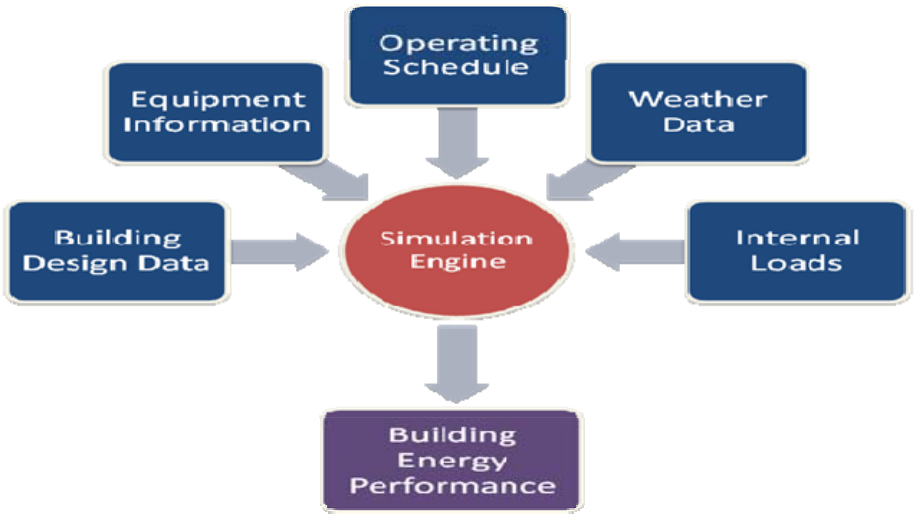

Fig. 1. Schematic of a Typical Energy Simulation Tool

3. Sensors and Enterprise Applications

Over the past decade, the sensor and control systems market has evolved rapidly with the advent of highly sophisticated sensors and smart meters that can sense, record and interpret data such as relative humidity, power consumption, light levels (lumen), occupancy, temperature, pressure etc.

Similarly, the enterprise applications market has grown rapidly to cater to the complex business needs of organizations. Enterprise applications such as ERP, MRP and SCM systems help organizations plan, schedule, and track various activities ranging from employee travel, employee attendance to planned production schedule (in a manufacturing facility),order management etc.

With these two systems, organizations now possess enormous data and information that can be leveraged to provide new ways of improving energy efficiency. Essentially, the strategy being proposed is to leverage the data sets generated by sensors and enterprise applications to understand the interactive effect of each of them on a facilities' energy use and assist in the more efficient operation by predictive control – a comparison of different control strategies by testing them on the building model and ultimately forecasting the optimum control strategy.

4. Approach to Enterprise Energy Optimization Framework

Following activities will provide the approach for proposed architectural framework for achieving the energy optimization

- Identification of enterprise systems whose data can be used to understand the state of energy usage within the enterprise and which can have an impact on energy consumption of the enterprise.
- Identification of sensors and other smart meters within the enterprise which can provide real time data that can be used to identify optimization strategies.

- Based on the data coming from enterprise applications and sensor controls, simulated data for similar environment from the static data and Meta data, Green management team will operate the controls to efficiently reduce the energy consumption

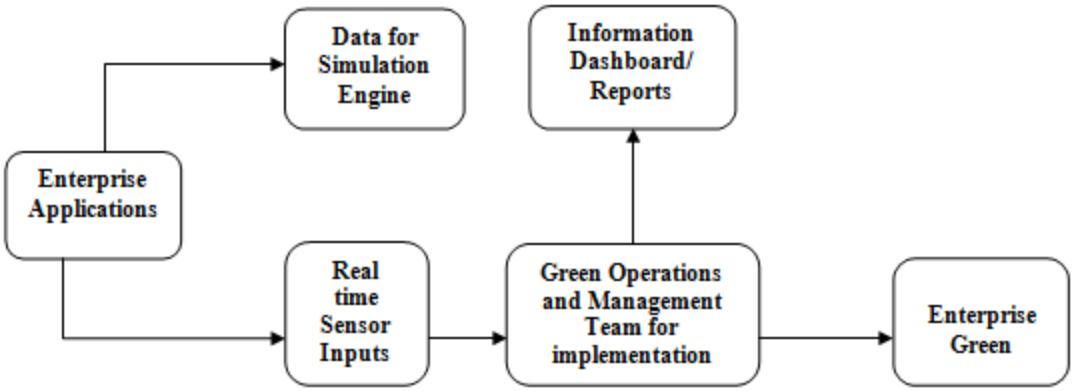

Fig. 2. Schematic of the Framework

The below diagram represents the layered framework for creating an Enterprise Energy Optimization framework in an organization with enterprise systems providing real time data.

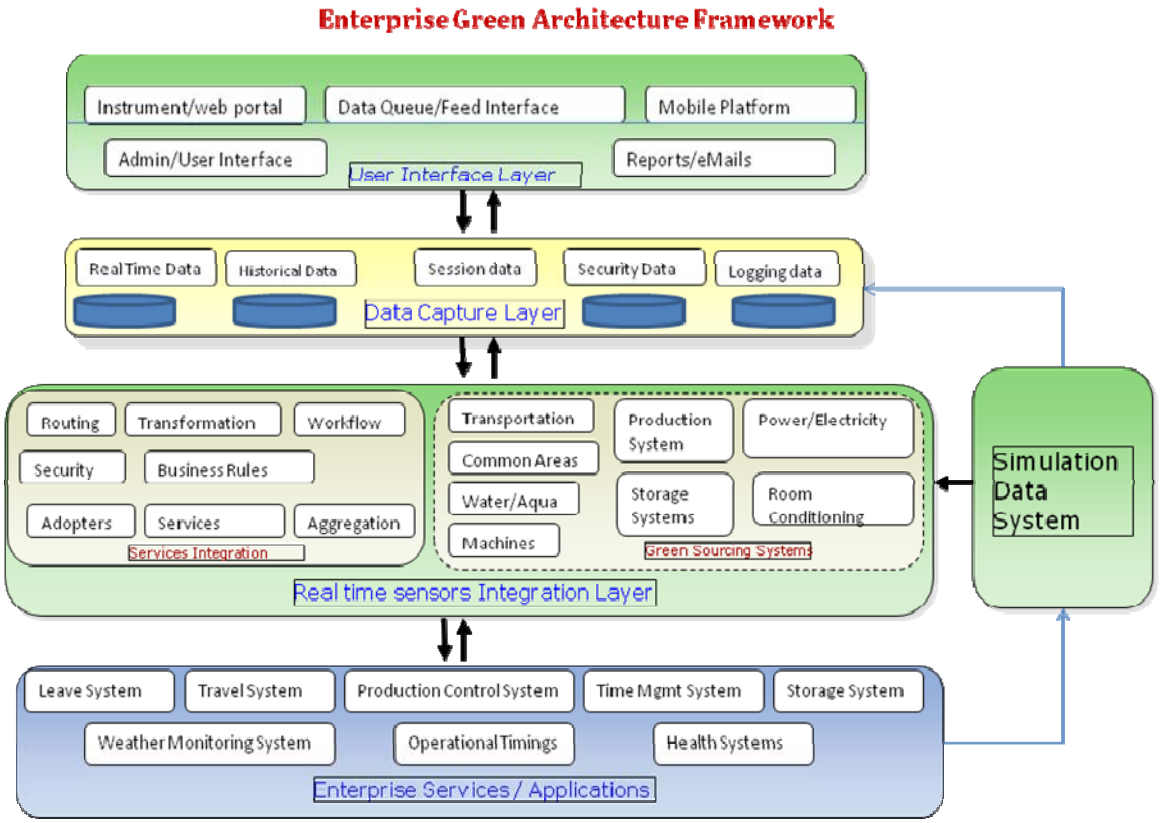

Fig. 3. Enterprise Green Architecture Framework

In the above framework, there are four layers described. Each layer has significance on providing the information and to control the information for Green computing.

Enterprise application layer has the systems of an enterprise like Leave System, Travel System, Production planning and Control, Time Management System, Storage System, Weather Monitoring System, Operational Timing System, Health Systems etc. These systems are used by both human resources and

operational resources within the Enterprise and provide valuable data both for real time sensors and also to the Simulation Data system on energy consumption and /or utilization. Real time data from these systems is captured in real time integration layer. At the same time, some of the data available from these systems is captured in simulation system.

Simulation Data System is used for collecting data and simulates the enterprise systems for energy optimization. Real time Sensor Integration layer will play a significant role. It collects the data from Enterprise Systems and sends it to Data capture layer. User interface layer will have access to Admin/Operations team on controlling various energy systems within the Enterprise based on the information obtained in Data Capture layer and also input from Simulation Systems. Integration layer also has common service components like work flows, business rules, reporting functionalities etc. User interface layer has both input of information through screens and also reporting dashboards for information on energy Optimization.

5. Use Cases

To implement the above described framework, we have proposed the following three use cases as samples:

Use case 1: Leveraging Production Planning System (PP) for Optimization – In this scenario, the PP system provides the scheduled production data for a given day which is used by the simulation engine in turn to forecast/estimate the building load/energy requirements under the current conditions and calculates the internal load (HVAC, Lighting, etc) of the facility and accordingly makes necessary optimization decisions. Similarly, if a certain production line within in the manufacturing plant is down on a particular day, the simulation will use this data and signal the building management system to turn off the HVAC, Lighting, etc in that region of the facility.

Use case 2: Leveraging Inventory Management System (IMS) - In this scenario, the IM system will provide the current level of inventory within the warehouse. This data will be used by the simulation engine to calculate the internal load (a function of inventory level) and accordingly signals the building management system (can be done by manual intervention as well) to alter the set points.

Use case 3: Leveraging Conference Rooms (CR) Booking Systems: In this scenario, the CR booking system provides input to the building management system, which automatically turns off/on the HVAC, Lighting system depending on booking schedule of the CR.

6. Conclusion

Energy Optimization is taking a significant role as Sustainability is increasingly becoming relevant to Enterprises. With the increase in real estate foot print of Enterprises and also with the diverse and extensive use of enterprise applications, Enterprises need to come up with new and innovative ideas on how they can leverage some of the information available on hand for energy optimization. The framework provided in this publication is one such innovative and practical way of implementing Energy optimization Technique.

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