Classification of Data Center Operations Technology (OT) Management Tools

White Paper 104

Revision 1

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> Executive summary

Data centers today lack a formal system for classifying software management tools. As a result, confusion exists regarding which management systems are necessary and which are optional for secure and efficient data center operation. This paper divides the realm of data center "Operations Technology" into four distinct subsets and compares the primary and secondary functions of key subsystems within these subsets. With a classification system in place, data center professionals can begin to determine which physical infrastructure management tools they need – and don't need – to operate their data centers.

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Introduction

The total data center universe that most data center professionals are familiar with consists of two principal "realms". The first realm, information technology (IT), refers to all systems that address the information processing aspects of the data center. The second realm, operations technology (OT)[1], revolves around the physical infrastructure and controls that allow the devices within the information processing realm to function. **The classification system described in this paper is limited in scope to the data center Operations Technology (OT) realm.**

Both realms are interrelated (IT cannot operate without OT and OT supports both the data center and the larger building that houses the data center), but the subsystems within each are procured, managed, and maintained by separate users. Typically, facilities and engineering departments "own" and operate OT equipment. IT department personnel "own" the IT equipment. In some larger data centers both IT and OT devices share a common communications backbone. As the total data center evolves, these departments will become more intertwined as will the management systems that support them. **Table 1** provides definitions of terms utilized in this paper to describe and contrast the OT classification system.

Table 1

Terminology definitions and examples

Term	Definition	Data Center Examples
Operations Technology (OT)	OT represents the totality of the material systems and foundational physical equipment necessary to facilitate operations of a reliable, controlled and secured IT environment.	•Power systems •Cooling systems •Security systems
Information Technology (IT)	The entire spectrum of technologies for information processing, including software, hardware, communications technologies and related services.	• Servers • Storage systems • Network systems
Environment	The total physical surroundings within a building or facility that house the various pockets of data center related hardware and software.	• IT room • Electrical room • Mechanical room
Subset	A logical grouping of physical subsystems with similar primary functions (four of these).	•Monitoring & Automation •Planning & Implementation •Dashboard •Data Collection
Subsystem	A purpose-built software package that addresses a specific need (potentially hundreds of these).	•Facility power device monitoring subsystem •IT room security monitoring subsystem
Primary function	A software function that is first in order of development and first in rank or importance when compared to other software functions available within that particular subsystem.	• The PowerLogic ION Enterprise software package's electrical room power analytics function
Secondary function	A software function that is second in rank of importance or later in order of development coming after the primary function.	• The PowerLogic ION Enterprise software package's facility HVAC cooling device monitoring function

[1] The term "Operations Technology" is derived from the Gartner research publication G00174016 "The Management Implications of IT/OT Convergence", March 4, 2010

> A note regarding energy management

The data center management software context map as presented in **Figure 1** does not specifically call out energy management in any of its subsets. In fact energy management is involved throughout all layers of the management software construct and is not concentrated in any one subset or subsystem.

In an ideal world, data center managers should be able to run one management software package that addresses all of their basic needs. However, the concept of "one system" does not exist in any practical sense. While numerous vendors promise a vision of the ultimate "unified" management system, this is an elusive dream that will be difficult to realize. The following points illustrate why "one system" is an unattainable goal in the foreseeable future:

- **A need for simple tools that fulfill specific requirements** – IT and facilities employees have different priorities and no one package will meet all of their needs. These employees prefer simple tools that focus on addressing their specific need.
- **Investments in pre-existing systems** - Most data center professionals already have software in place that performs part of the management function. In many cases, it is neither feasible nor cost effective to replace existing software.
- **Open protocols enable integration of disparate software** –Operations Technology (OT) management software is highly specialized. It is more cost effective to leverage new standards and protocols, such as web services, and to integrate existing software, than it is to recreate the functionality of the software by building a new "unified" system. (Note: In some cases there are benefits to keeping some automation and control software secured and segregated from the general user and external access)

Classification system context

Figure 1 illustrates a context map of the four subsets within the OT portion of the data center. Depending upon the size of a given data center, the total data center (both IT and OT) could consist of hundreds of management software subsystems. The first step when classifying these subsystems is to group them into general OT subsets. Although the focus of this paper is OT software, the subsets can also be used to classify IT management software.

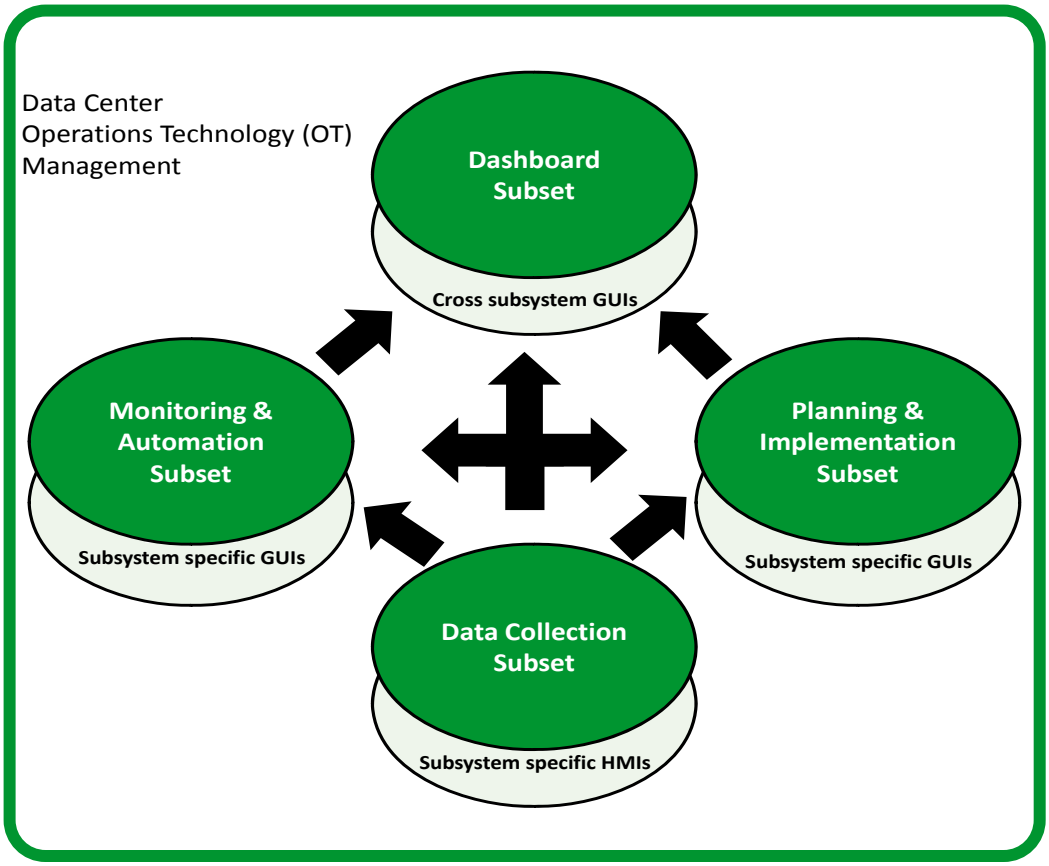


Figure 1

This data center OT software context map demonstrates how the various subsets interact

Note that the subsets in **Figure 1** have either graphical user interfaces (GUI) or human machine interfaces (HMI) associated with them. Also note that the Dashboard subset is the

primary area within the context map that allows for the visualization of *cross subset* information.

The first step for data center operators who are evaluating their management software is to examine key data center elements such as the power distribution system, building mechanical and cooling facilities, IT room, and security. This will help to determine which subsystems are already in place and, looking forward, which subsystems are actually needed. A colocation data center, for example, may not require a subsystem that manages at the IT room level. However, HVAC control and power management subsystems may be essential for that same colocation facility. A small or medium-sized data center with an IT room housing 100 racks might forgo a facility control and power subsystem, leaving that to the facilities staff. However, the IT staff may wish to directly monitor performance data by investing in an IT room management subsystem.

Monitoring & automation

Subsystems grouped within the Monitoring & Automation subset ensure that 1) the data center functions as designed, and 2), activities are automated to maintain / maximize the availability and efficiency of the data center. Monitoring & Automation software acts upon user-set thresholds by alarming, logging, or even controlling physical devices. The Monitoring & Automation subset of subsystems includes facility power, facility environmental control, facility security subsystems, and IT room management (see **Figure 2**). **Table 2** helps to differentiate the mainstream Monitoring & Automation subsystems in terms of their primary and secondary functions (see side bar “Not all monitoring solutions are created equal”).

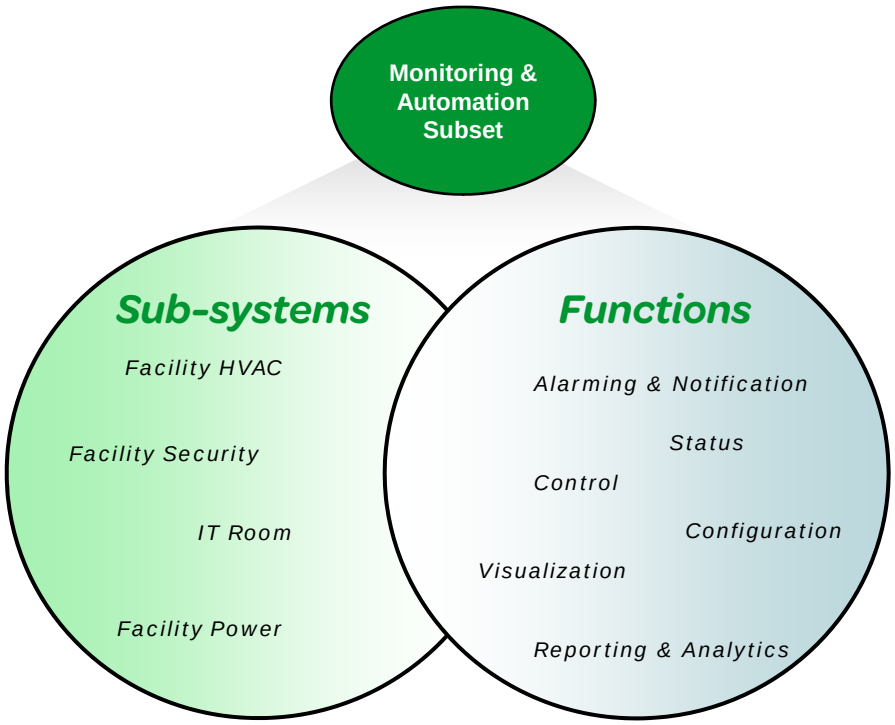


Figure 2

Subsystem groupings within the monitoring & automation OT subset subsystems

Facility power

The facility power management subsystem provides detailed insight into the status and operation of the entire electrical distribution network (from utility feeds, to transformers, to PDUs, to racks) within a building, often including the data center. Electrical engineering staff and consultants utilize this subsystem to manage the electrical distribution network. The key functions provided by this type of subsystem include power monitoring of current conditions (critical and non-critical load), power alarming, and “power analytics”. These functions

support critical activities such as notification of and response to electrical network problems, maintenance (planned and unplanned), capacity planning, facility expansion / retro-fit projects, energy efficiency projects, power quality analysis, and power reliability analysis.

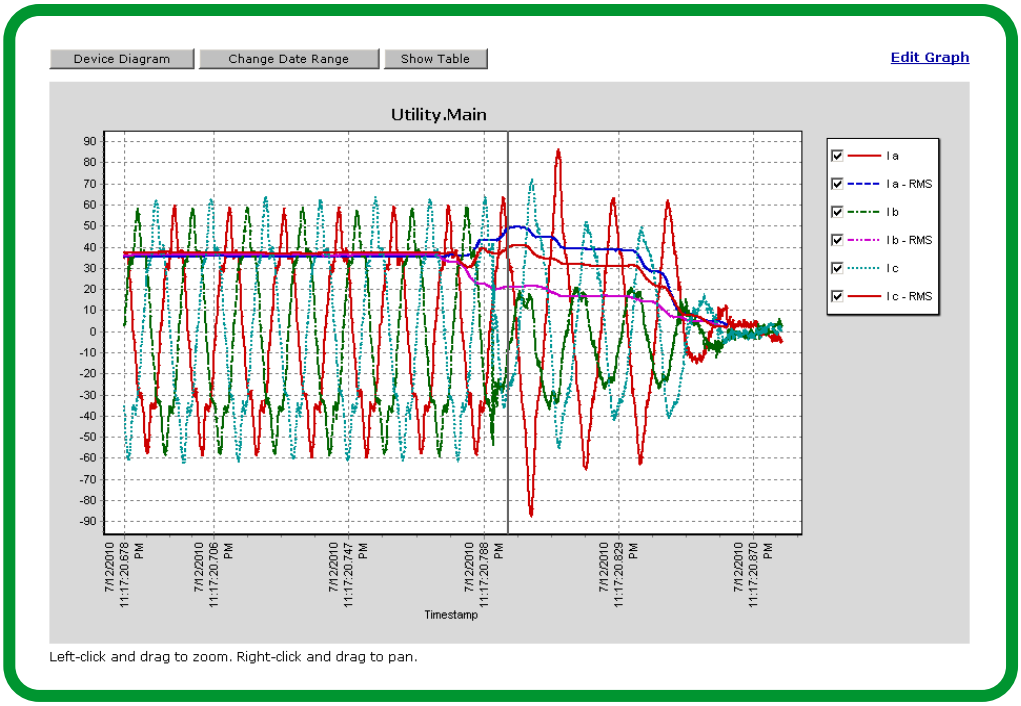


Figure 3

Monitoring of facility power utilizing the PowerLogic ION Enterprise GUI

> Not all monitoring software solutions are created equal

Monitoring subsystems are built with a **primary function** in mind. The InfraStruxure Central IT room monitoring system, for example, has as its primary function the ability to monitor power and cooling in the IT room. However, many monitoring systems expand their capabilities over time.

These **secondary functions** are typically less robust than those found in a purpose-built system. APC's InfraStruxure Central, for example, has a secondary ability to monitor Modbus devices outside the IT room. While not its primary function, that ability may be enough for data center operators with simple Modbus device monitoring requirements. **Table 2** shows examples of the primary and secondary functions of physical infrastructure monitoring systems.

The facility power management subsystem provides synthesized and actionable information based on detailed electrical data such as power, energy, power factor, amperage, voltage, frequency, harmonics, and waveforms. The subsystem's output includes 3-D graphical views of the facility, electrical one-lines, and equipment detail. The facility power management subsystem also provides visual alarm indicators and alarm notification, data analysis tools, and the ability to schedule and distribute reports.

Facility power management subsystems can either provide a fairly simple, primary electrical monitoring function for smaller data centers, or can provide extremely high speed and high performance feedback for large sites. Schneider Electric's PowerLogic ION Enterprise and PowerLogic SCADA are examples of facility power monitoring subsystems (see **Figure 3**).

Facility environmental control

Facility environmental control subsystems traditionally support the requirements of corporate facilities departments. In addition to facility heat, ventilation and air conditioning (HVAC) control, facility environmental subsystems can also encompass fire systems, water, steam, and gas systems. The preferred communication protocols for facility environmental control systems include BACnet, LONworks, and Modbus.

Everyday functions of facility environmental control systems include the opening and closing of valves and dampers, the spinning up fans and initialization of pumps, and the controlled cooling and heating of targeted spaces within the facility.

Schneider Electric Continuum is an example of a mainstream facility environmental control subsystem. Environmental control subsystems are also differentiated from power management subsystems in that facility environmental control handles the coordination, control and reporting for all energies, not just electrical power.

Table 2

*Comparison of **Monitoring & Automation** primary and secondary functions*

● Primary function
◐ Secondary Function
○ No Function

FUNCTIONS	InfraStruxure Central*	PowerLogic ION Enterprise**	Continuum (BMS)	Pelco Digital Sentry
Facility Power				
Power device monitoring	◐	●	◐	○
Power analytics	○	●	○	○
PUE monitoring	◐	◐	●	○
Facility Environmental				
Automation and control	○	○	●	○
Cooling device monitoring	◐	◐	●	○
Facility Security				
Surveillance	◐	○	◐	●
Access control	○	○	◐	○
IT Room				
Power device monitoring	●	●	◐	○
Cooling device monitoring	●	○	◐	○
Environmental monitoring	●	○	◐	○
Security monitoring	●	○	◐	◐
Partial PUE monitoring	◐	◐	◐	○

Facility power devices include: breakers, trip units, medium voltage and low voltage metering (i.e., transformers, switches), programmable logic controllers (PLCs), remote terminal units (RTUs), automatic transfer switches (ATS), generator controls, UPS controls.

IT power devices include: UPS controls, power distribution units (PDUs) and branch circuit metering, rack power strip metering

* Includes security add- ons such as NetBotz, and PUE monitoring tools such as InfraStruxure Energy Efficiency

** Works in coordination with installed meters for data collection

> Note regarding tables 2 and 3

Many physical infrastructure software products from multiple manufacturers exist in the marketplace today. Most offer a wide variety of functions. **Tables 2 and 3** compare the functions of only a partial sampling of the Schneider Electric products that fit within the Operations Technology (OT) universe.

Tables 2 and 3 are not meant to be a comprehensive representation of what is available in the marketplace. In fact, it is not Schneider Electric's role to represent other manufacturer's products in these tables. The functions of other manufacturer's products are often in a state of flux and could easily be misrepresented. Therefore these tables are restricted to a portion of the Schneider Electric current suite of products.

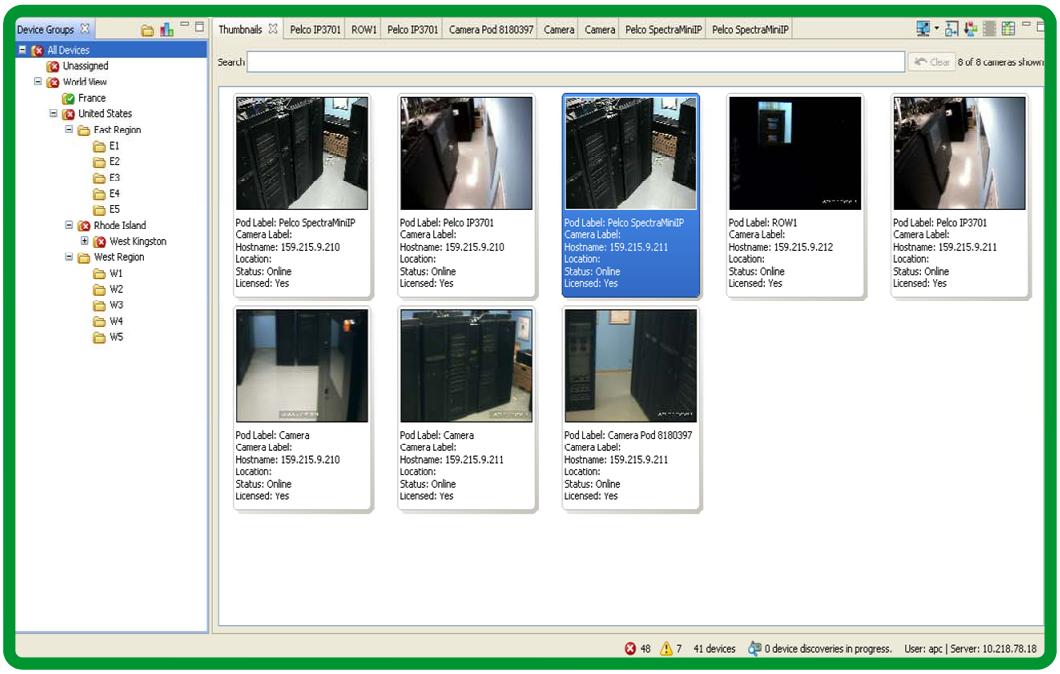
Generic tables are located in the **Appendix** which allow for data center operators to enter their own personal suite of management software products for comparison purposes.

Facility security

As new technologies such as advanced optical video management systems and biometric identification and remote management systems become more widely available, traditional card-and-guard security is being supplanted by facility security subsystems that can provide positive identification and tracking of human activity in and around the data center. Identification technology is changing as fast as the facilities, information, and communication it protects. Schneider Electric Pelco is an example of a facility security subsystem capable of providing both indoor and outdoor video security support.

Figure 4

Typical data center IT room security interface



> A note regarding subsystem users

Subsystems throughout the data center are managed by individuals with differing job responsibilities. On the IT side, operators tend to focus on a series of individual subsystem GUIs whereas management focuses on the consolidated information reported on the dashboard.

On the facilities side, a similar situation occurs. Engineers monitor individual building HVAC systems, for example, and the facilities management tends to interact with the dashboards that display cross facility information.

IT room

IT room management subsystems monitor the power and cooling systems on the IT room floor so that uptime of servers, communication equipment, and storage equipment can be maintained. Data center IT room management subsystems are developed around the needs and requirements of the computer room operators (a need for faster speed and real-time information). The IT environment is characterized by frequent changes, intelligent devices, and a management philosophy based on exception. These subsystems can also integrate with security cameras within rows of racks. APC by Schneider Electric NetBotz cameras are an example of such a subsystem.

IT room management subsystems are designed to accommodate simultaneous firmware upgrades to multiple systems, and to monitor battery health by identifying exceptions that indicate behavioral characteristics beyond pre-programmed thresholds. IT room management subsystems are built around the expectation that power and cooling monitoring operates in a manner similar to other IT applications. That is, the software can be self installed, and the software performs auto discovery of linked components. In essence, everything just “works” out of the box, with the ability to change the configuration. These subsystems generally utilize an IP network communication protocol. APC by Schneider Electric’s InfraStruxure Central is an example of an IT room management subsystem.

Planning & implementation

Planning & Implementation, the second subset of subsystems (see **Figure 1**), ensures 1) efficient deployment of new equipment, 2) execution of planning in order to facilitate changes in the data center, 3) tracking of assets within the data center, and 4) simulation of potential changes in order to analyze the future impact on the data center. Functions within Planning & Implementation involve prediction and modeling ("What happens if I do this?"), change tracking ("At what point does my system get obsolete?"), inventory tracking ("How do I track the history and movements of this piece of equipment?"), and dependency analysis ("If I change the contents of this rack, how will it impact my cooling?").

Five subsystem groupings exist within the Planning & Implementation subset:

Facility asset management – This subsystem allows for management of asset deployment, generation of facility-relation parts specifications, calibration, costing and tracking of building equipment assets.

Facility capacity management – This subsystem aids facilities staff to plan both moves and changes within the mechanical and electrical rooms, by providing realtime measurements of energy consumption and water flows in addition to the project impact of changes to the power and cooling infrastructure.

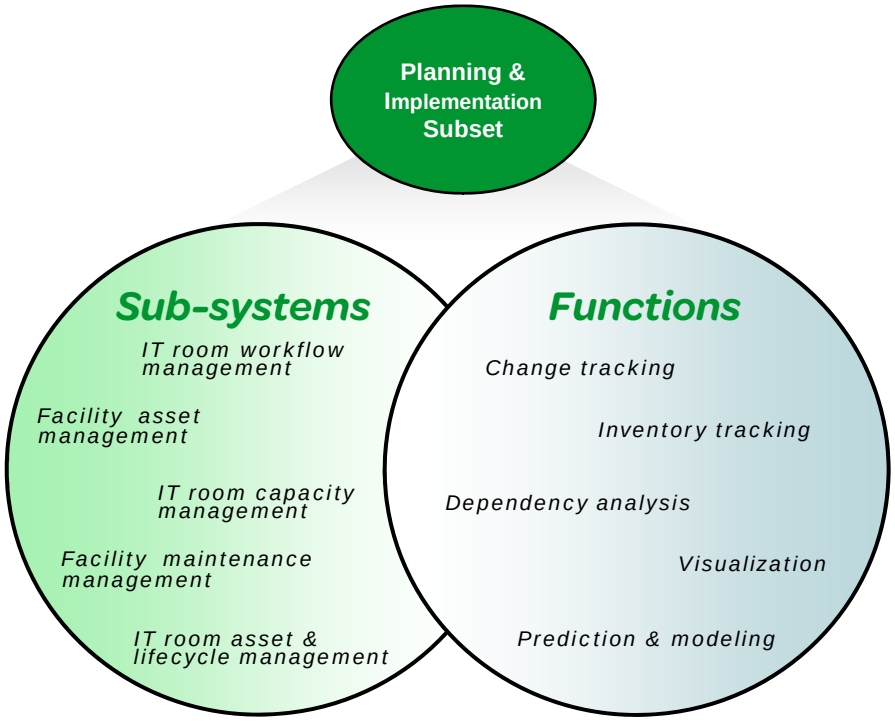


Figure 5

Subsystem groupings within the planning & implementation OT subset subsystems

IT room workflow management – This subsystem facilitates the execution of equipment additions, moves, and changes by presenting a hierarchical overview of data center locations, including global and local views and from groups to single assets.

IT room capacity management – From a power consumption efficiency perspective, the system identifies the optimal physical location for power, cooling, and rack-based IT equipment. User defined requirements such as redundancy, network use and line of business groupings are also factored in. Live data is utilized to create simulations which analyze the impact of changes before they occur. This level of planning allows for reductions in stranded cooling and power capacity. For more information on the subject of stranded

Link to resource
White Paper 150
Power and Cooling Capacity Management for Data Centers

capacity, please see White Paper 150, *Power and Cooling Capacity Management for Data Centers*.

IT room asset & lifecycle management – This subsystem allows for the management of IT room inventory. Visual models of the data center layout enable tracking of IT assets and available space. The rendering of the data center physical layout also allows for visualization of power consumption per rack as well as identification and location of power failures.

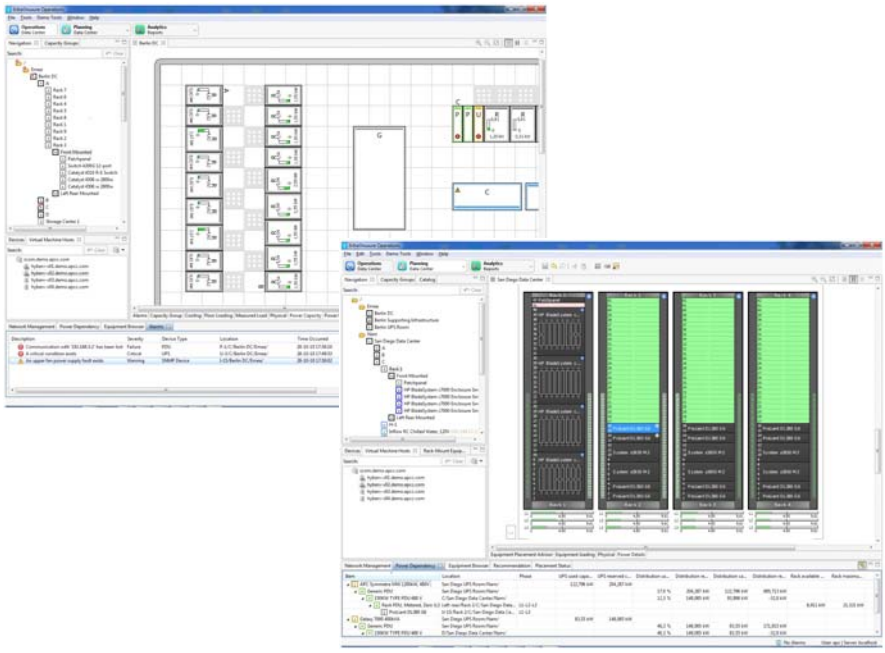


Figure 6

Planning and implementation for the IT room environment utilizing the InfraStruxure Capacity GUI

Table 3 helps to differentiate some of the mainstream planning and implementation subsystems in terms of their primary and secondary functions.

Table 3

Comparison of ***Planning & Implementation*** *primary and secondary functions*

● Primary function
◐ Secondary Function
○ No Function

FUNCTIONS	PowerLogic ION Enterprise	Continuum (BMS)	InfraStruxure Operations	InfraStruxure Capacity	InfraStruxure Change
FACILITY ASSET MANAGEMENT					
Inventory tracking	○	○	◐	○	○
Maintenance tracking	◐	◐	○	○	○
FACILITY CAPACITY MANAGEMENT					
Impact and dependency analysis - Power	◐	○	◐	◐	○
Impact and dependency analysis - Cooling	○	◐	◐	◐	○
IT ROOM WORKFLOW MANAGEMENT					
Prediction and modeling	○	○	○	●	○
Workflow tracking	○	○	○	○	●
IT ROOM CAPACITY MANAGEMENT					
Impact and dependency analysis - Power	○	○	○	●	○
Impact and dependency analysis - Cooling	○	○	○	●	○
Impact and dependency analysis - Network ports	○	○	○	●	○
IT ROOM ASSET & LIFECYCLE MANAGEMENT					
Inventory tracking	○	○	●	○	○
Change tracking	○	○	○	○	●

Dashboard

Data center managers all require some means for consolidating critical information about the performance of their data center. Not only does the critical information need to be aggregated, but the user needs to visualize the data in a manner that is meaningful and actionable. In fact, this **visualization** of the data via a dashboard is a key function that allows a view across the four main subsystem subsets.

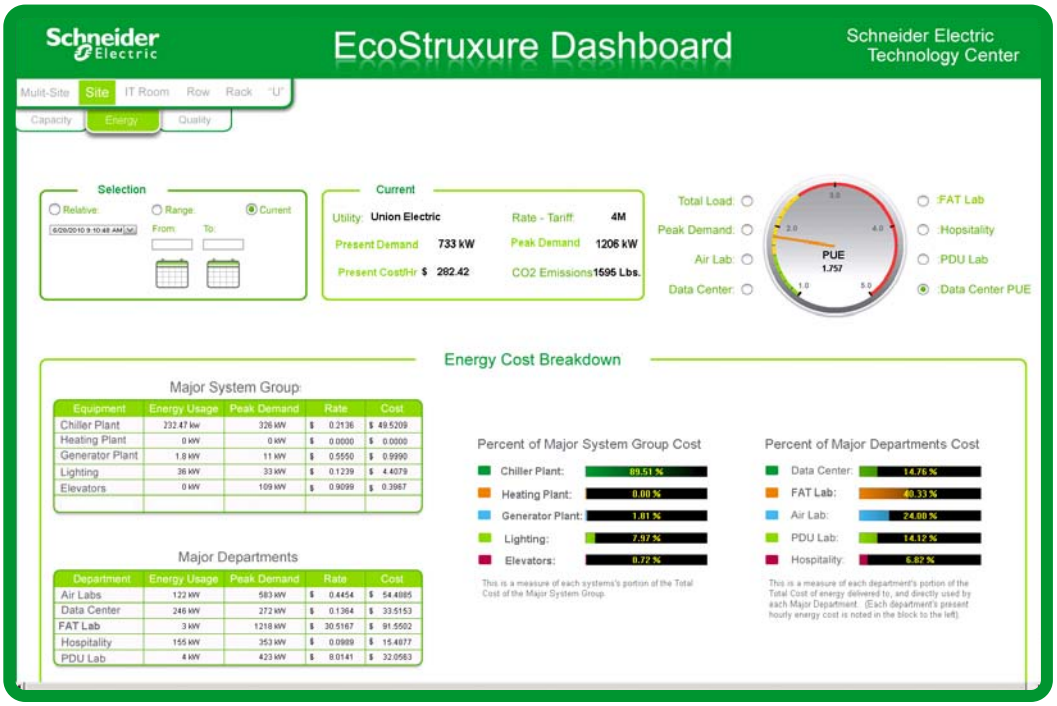


Figure 7

Sample dashboard collects data across OT subsets and centralizes information in one or more GUIs

Some data center operators may choose to access data in its raw form without the benefit of a dashboard. For example, queries from SQL tables may be generated and transferred to an Excel file so that a report can be produced that meets the immediate requirement for performance information. Various monitoring subsystems can also highlight urgent issues. But as data centers become more complex, the information required needs to be easily formatted and presented into a formal dashboard. A dashboard represents a third subset which captures data from the three other subsets and then updates to a management package, providing KPIs and data summaries, over the existing network.

Some dashboards are more focused on the performance of the IT equipment while others provide summary views into the physical infrastructure (cooling, power, security). Dashboards draw their information from monitoring & automation and planning & implementation, and data collection subsets. Some dashboards are custom built or are purchased from third parties (see **Figure 7** for sample dashboard).

Visualization software

Although the dashboard is the key centerpiece for aggregation of actionable data, various levels of human machine interface (HMI) and graphical user interface (GUI) exist and enable meaningful data to be visualized by specific users via the various subsystems across the data center (see GUI and HMI in **Figure 1**). Although the HMI used by the facilities engineer may not resemble the GUI utilized by the IT operator, both extract information from the system based upon the individual user's preferences and priorities.

Data collection

The data collection subset represents devices such as meters, power protection devices, embedded cards, programmable logic controllers (PLCs), sensors and other such devices. These devices perform the fundamental function of gathering data and forwarding it to management software for processing.

Figure 8

Human machine interface (HMI) provides configuration and operation information for individual UPS device

Conclusion

By sharing key data points, alarm notifications, historical data, and asset tracking information, data center Operations Technology (OT) management software allows users to make informed decisions based upon real-time power and cooling capacity and redundancy data.

The classification system presented in this paper takes the first step in laying the groundwork for a logical approach which can be summarized as follows:

A **Whole Data Center**, from which is selected the

Operations Technology (OT) portion, which is divided into

Subsets, each of which consists of multiple

Subsystems, which are compared and contrasted by illustrating

Primary and Secondary functions, which enable

Efficient investment in management software

…with key steps supported by **visualization** software

Today multiple management applications across the principle domains of IT room management, building control, security, and power address various parts of the enterprise suite, but no one application does it all. The segmented approach will continue for the foreseeable future. However, innovative dashboards are being developed that will facilitate prudent, informed operational decisions that consolidate information from these sources and enhance uptime and reduce energy costs.

About the author

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Appendix

Table A1

Monitoring & Automation
product comparison worksheet

● Primary function
◐ Secondary Function
○ No Function

FUNCTIONS	InfraStruxure Central*	PowerLogic ION Enterprise**	Continuum (BMS)	Pelco Digital Sentry	Name of product	Name of product	Name of product	Name of product	Name of product
FACILITY POWER									
Power device monitoring	◐	●	◐	○					
Power analytics	○	●	○	○					
Efficiency monitoring	◐	◐	●	○					
FACILITY ENVIRONMENTAL									
Cooling device monitoring	◐	◐	●	○					
Automation and control	○	○	●	○					
FACILITY SECURITY									
Surveillance	◐	○	◐	●					
Access control	○	○	◐	○					
IT ROOM									
Power device monitoring	●	●	◐	○					
Cooling device monitoring	●	○	◐	○					
Environmental monitoring	●	○	◐	○					
Security monitoring	●	○	◐	◐					
Partial PUE monitoring	◐	◐	○	○					

* Includes security add- ons such as NetBotz, and PUE monitoring tools such as InfraStruxure Energy Efficiency

** Works in coordination with installed meters for data collection

Table A2

Planning & Implementation
product comparison worksheet

● Primary function
◐ Secondary Function
○ No Function

FUNCTIONS	PowerLogic ION Enterprise	Continuum (BMS)	InfraStruxure Operations	InfraStruxure Capacity	InfraStruxure Change	Name of product	Name of product	Name of product	Name of product
FACILITY ASSET MANAGEMENT									
Inventory tracking	○	○	◐	○	○				
Maintenance tracking	◐	◐	○	○	○				
FACILITY CAPACITY MANAGEMENT									
Impact and dependency analysis - Power	◐	○	◐	◐	○				
Impact dependency analysis - Cooling	○	◐	◐	◐	○				
IT ROOM WORKFLOW MANAGEMENT									
Prediction and modeling	○	○	○	●	○				
Workflow tracking	○	○	○	○	●				
IT ROOM CAPACITY MANAGEMENT									
Impact and dependency analysis - Power	○	○	○	●	○				
Impact and dependency analysis - Cooling	○	○	○	●	○				
Impact and dependency analysis - Network ports	○	○	○	●	○				
IT ROOM ASSET & LIFECYCLE MANAGEMENT									
Inventory tracking	○	○	●	○	○				
Change tracking	○	○	○	○	●				