



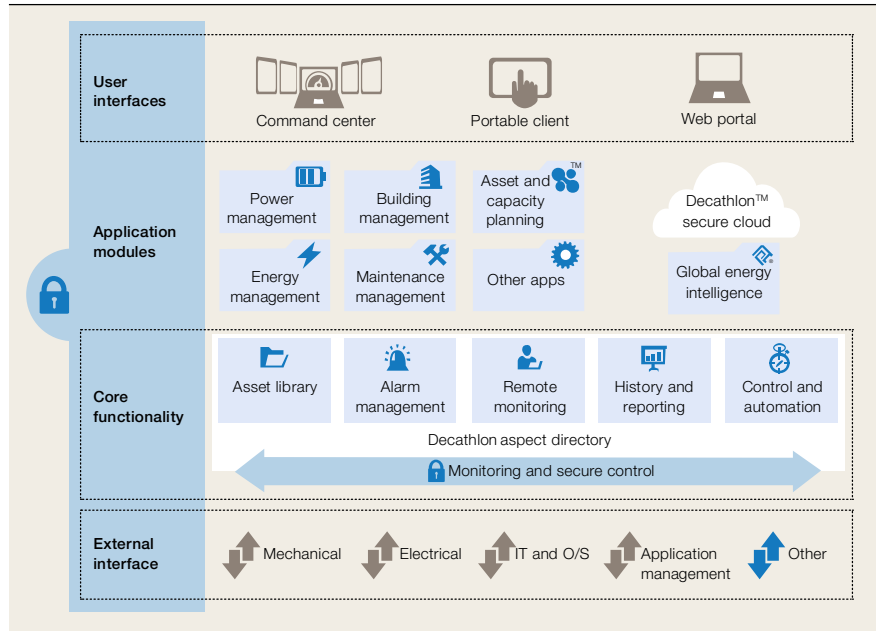
Automated excellence

New concepts in the management of data center infrastructure

JIM SHANAHAN – As data centers grew out of server closets to become the computing titans that now consume over 2 percent of grid power in many countries, they brought with them a legacy of automation systems that they had outgrown but to which they continued to cling. The industry has finally realized that modern data center infrastructure management (DCIM) tools need to provide scalable solutions that bring advanced technologies into play, enabling those who best leverage them to leapfrog their competitors. ABB is helping those customers differentiate themselves in a very fast-moving industry.

Title picture

Sophisticated tools that allow all aspects of a data center to be managed in an integrated way are essential if an operator is to differentiate and survive in the very competitive data center world.



Data centers usually operate along lines that mirror their makeup. As a consequence, facility operations (mechanical and electrical systems) tend to run in isolation from IT and server operations. This silo approach makes it difficult to get an overview of what is happening in the

- DCIM analyzes this data and provides actionable information about data center management.
- DCIM is not a standalone solution, but a component of a comprehensive data center management strategy.

To the IT engineer, DCIM can be a tool to manage server location, configuration and application load; for the facilities manager, it can be a system to control and monitor electrical and mechanical equipment; to a senior manager, it can be a way to compare data centers and leverage business intelligence. ABB's DCIM product, Decathlon™, is one of the most advanced DCIM solutions

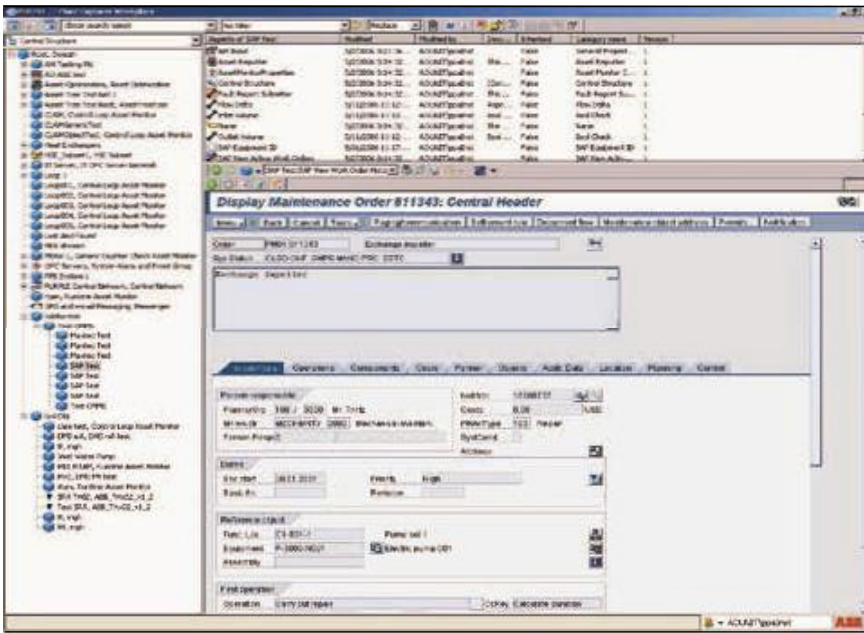
ABB has brought its best practice solutions from other industries and merged them with new data-center-specific libraries and applications to form Decathlon.

data center as a whole, even though most critical decisions need to take account of the entire picture.

Initially, DCIM may seem confusing because the term is used so broadly. However, the definitions of DCIM published by leading industry research firms concur that:

- DCIM requires instrumentation in order to gather and normalize data center metrics.

on the market today. Delivered via hardware and software, the Decathlon system provides the tools to manage a flexible network of power, cooling and IT equipment. The information is presented in a single operational environment and via a single data source, which helps overcome information barriers. Both IT and facility personnel can work together more effectively - sharing a "single truth" from which they can index and report their data center improvements.



Decathlon takes automation lessons learned from process industries and applies them to data centers.

Decathlon also offers advanced control, maintenance management, strategic energy procurement and the ability to shift computing loads between data centers based on the cost or availability of energy.

More recently, fully featured converged DCIM solutions have emerged that offer end-to-end visibility. Whoever pays the power bill can now measure data center efficiency in terms of workload-per-kWh – for example, the number of SAP transactions per MW or the number of e-mails processed per dollar. This visibility provides new leverage for data center owners and operators, and drives efficiency in the data center organization. ABB has brought its best practice solutions from other industries and merged them with new data-center-specific libraries and applications to form Decathlon → 1. As well as “normal” DCIM functions, Decathlon also offers advanced control, maintenance management, strategic energy procurement and, through a concept known as software defined power, the ability to shift computing loads between data centers based on the cost or availability of energy.

involved, some newer ideas around how they can be managed and the value of a converged DCIM solution.

Keeping cool

The starting point for a DCIM project is often a need to control or monitor the physical environment around the servers. In recent years, it has become popular to raise server inlet temperatures to achieve higher efficiency because less cooling is then required. It is not uncommon now to find “cold aisle” temperatures at server inlets in excess of 27 °C. This means the “hot aisle” at the server outlet can exceed 40 °C. ABB robots are being considered for some duties, such as moving servers or cables, in the hot aisle, where humans cannot comfortably operate.

In these extreme environments, tight control of temperature is critical to ensure the server does not overheat. One

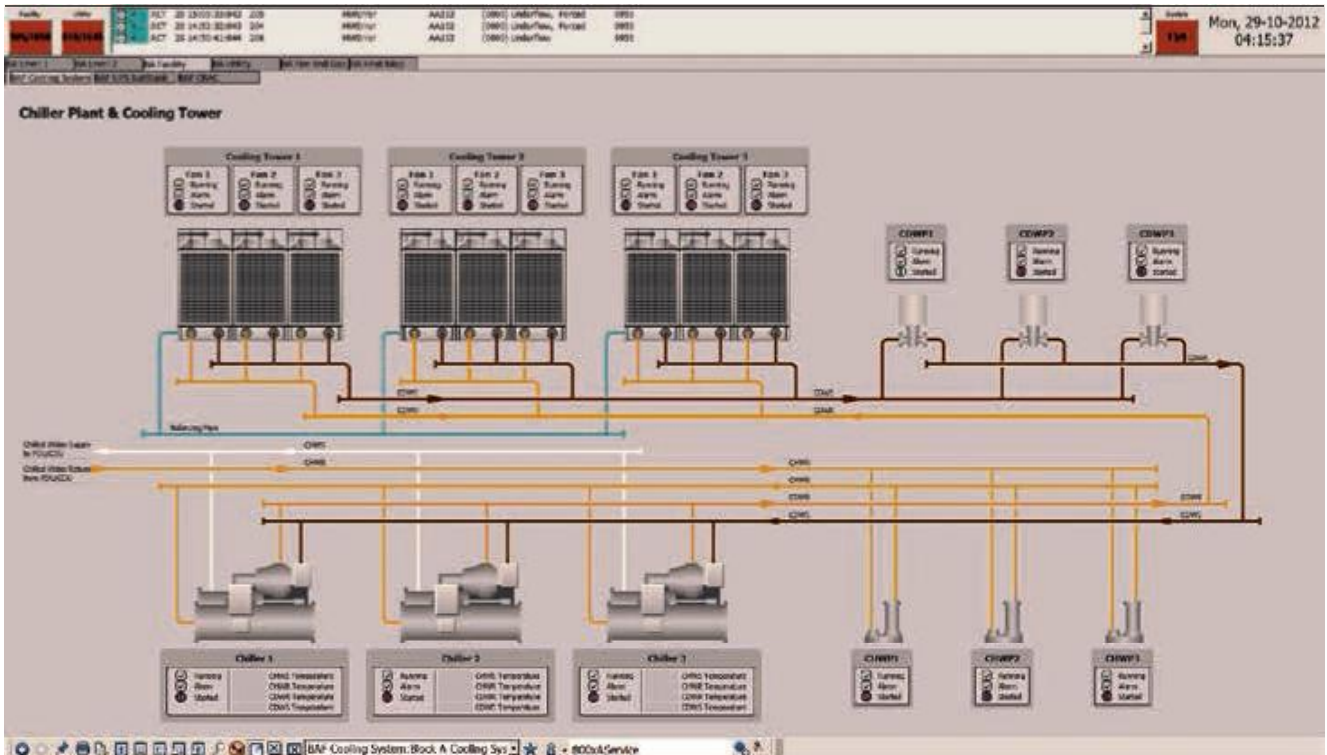
Essentially, a data center converts power to transactions and generates a lot of data and heat (that has to be removed) in the process. It is instructive to look at this entire chain of events in a little more detail to understand some of the mechanisms

way to achieve such control is to look not just at the environmental temperature sensors around the racks, but to look at onboard server temperatures too. This means reading CPU temperatures from each server via a simple network management protocol (SNMP), then averaging this across each rack of, typically, 30 to 40 servers. By controlling the environment based on CPU temperature – the hottest part of the data center – higher efficiency can be achieved and problems with individual servers can be detected early. (See article on data center cooling on page 52 of this issue.)

Building management

A building management system (BMS) monitors and controls the environmental and safety systems – such as those for lighting, ventilation and fire – in a large building. As concerns about energy conservation gained critical mass, BMS feature enhancements evolved to become more aligned to energy efficiency. However, a BMS cannot cope with the rapid and dynamic expansion (and consolidation) of data center operations where data from onboard sensors in thousands of servers at multiple sites are factored into uptime and optimization strategy and tactics. Decathlon, which is built on the ABB Extended Automation System 800xA platform, collects, normalizes, records and analyzes the large amounts of data from both IT and facility systems. Furthermore, Decathlon exploits its rich history in control

3 Chiller overview graphic



technologies and automation, such as advanced process control, autotune and advanced alarm handling, to optimizing the data center. For the purpose of data center performance monitoring and optimization, a traditional BMS is more problematic and expensive because it is not designed for broad and granular data capture, analysis and user configuration.

tion of the entire power tree from the grid connection right down to each server motherboard.

Capacity management

From the time a server enters the data center in a box to the time it is decommissioned three years later, it goes through many stages of racking, imaging, burn-in,

power and network allocation, live deployment and so on. All these stages need to be tracked and managed. To accomplish this, an asset management and capacity planning application is employed. Decathlon uses Nlyte or other

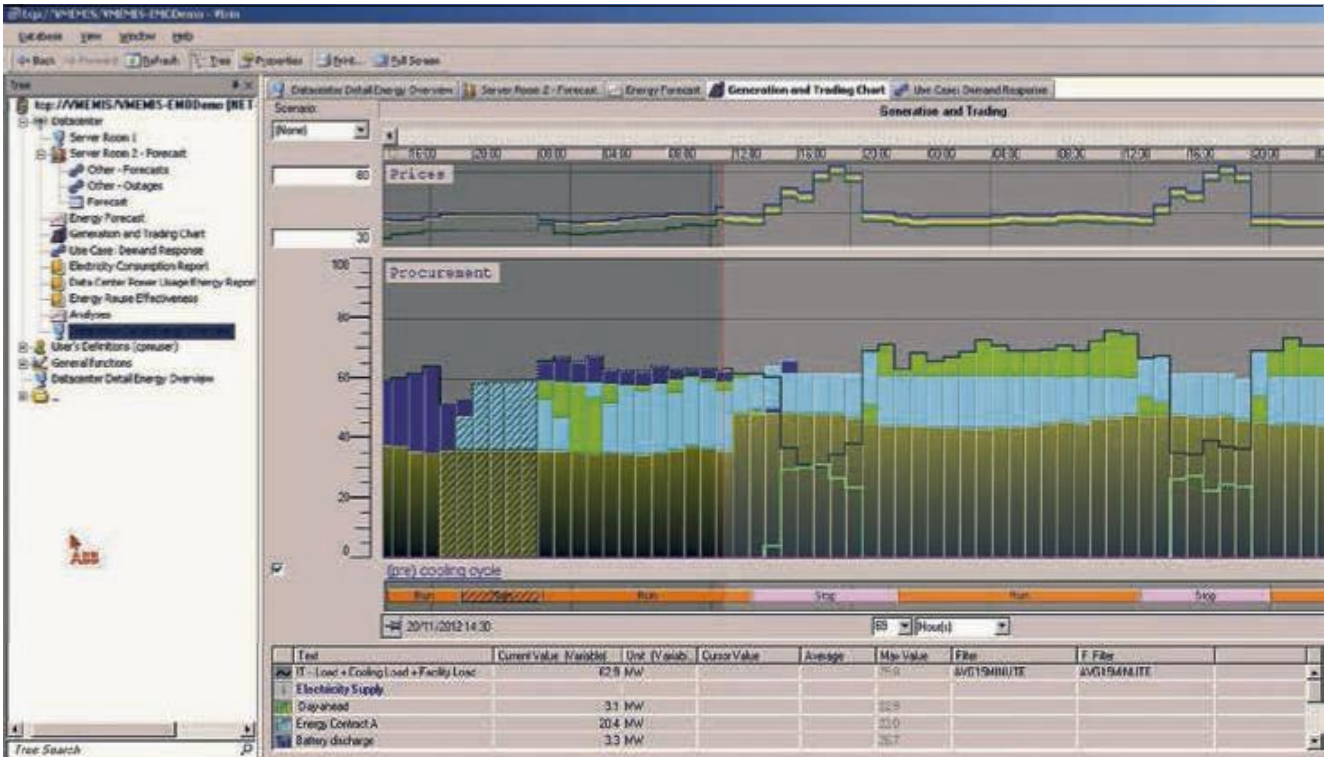
Decathlon tracks server location to automatically allocate a new server to an optimal rack position to make best use of available power, cooling and network connections.

Power monitoring

On the electrical side of the facility, the power chain from pylon to processor provides a myriad of opportunities to monitor and optimize. Decathlon does not just measure and report on power from installed meters, breaking data down by user, area and source, it also analyzes power quality events such as spikes, manages breakers for load shedding or alarming, and provides visualiza-

technology partner solutions and synchronizes the server location information with its internal database. This application can automatically allocate a new server to an optimal rack and position within that rack to make best use of available power, cooling and network connections. This can extend the life of the entire data center by ensuring that all available capacity is used and that there is no “stranded” power, cooling or network capacity. The

4 Generation and trading chart



system also issues work orders to manage the entire process for server additions, moves or changes, and can track which virtual machines, operating systems and applications run on each physical “server metal.” By combining the asset management system’s knowledge of server physical location and connections with the real-time information on the server’s environment and onboard parameters, Decathlon can close the control loop to provide tight control and advanced reporting across the traditional silos of facilities and IT operations.

Asset health

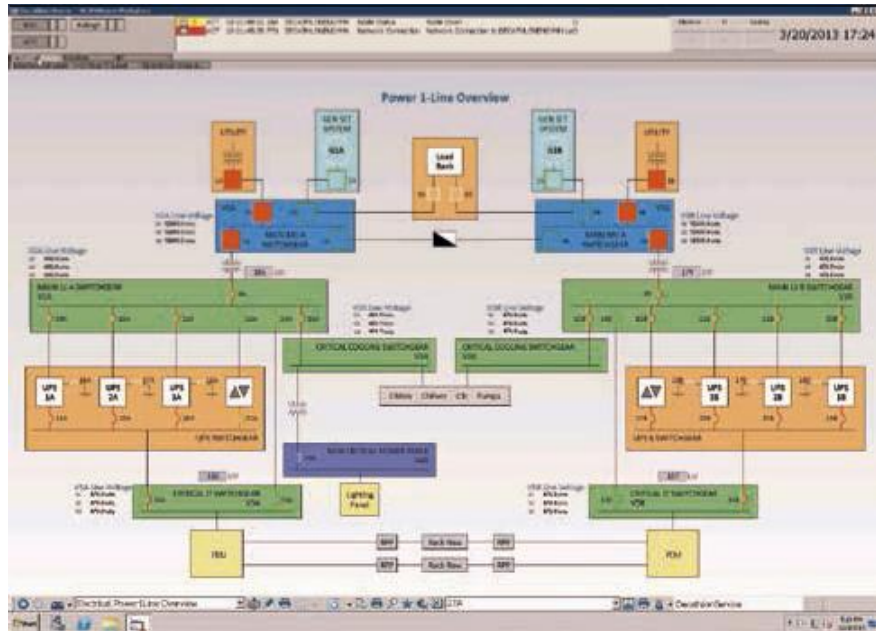
Apart from IT assets like servers and network switches, a normal data center has standby generators, UPSs, batteries, switchgear, chillers, pumps, computer room air handlers or conditioners (CRAHs or CRACs), fire detection and suppression systems, access control systems, leak detection systems, etc., all of which have regular maintenance requirements. Decathlon can be interfaced with some industry-standard computerized maintenance management systems (CMMSs) such as SAP or Maximo or it can be bundled with an ABB CMMS such as ServicePro or Ventyx Ellipse → 2. Decathlon can deploy asset monitors on critical equipment items to ensure they are

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operating correctly. Should they start to drift outside acceptable limits, a maintenance work order can be raised even before the equipment itself goes into an alarm state. This condition-based maintenance is further enhanced by Decathlon’s remote operations center (ROC) service where data center subject matter experts (SMEs) are on hand to prevent an incident from escalating to an outage by assisting the responding technician.

Compute load can be shifted from one bank of servers to another, or from one data center to another, to save energy or for reasons of cost or availability of power.

5 A typical data center power one-line diagram in Decathlon



Moving loads

Decathlon can monitor CPU utilization across all of the servers in a data center, or across multiple data centers. In a process known as run book automation, and through integration with virtualization solutions, compute load can be shifted from one bank of servers to another, or from one data center to another. This can be done to save energy, where the unused servers are put into a sleep mode, or for reasons of cost or availability of power. Global energy intelligence (GEI) provides a data center owner with a single interface to all of the world's energy markets so that IT loads can be shifted between data centers based on power market or demand-response opportunities. ABB's investment in Power Assure, a company based in Santa Clara (United States), delivers GEI, run book automation and power capping to Decathlon. Energy market pricing and trading facilities can also be provided to Decathlon through the Ventyx suite of products.

Clever energy

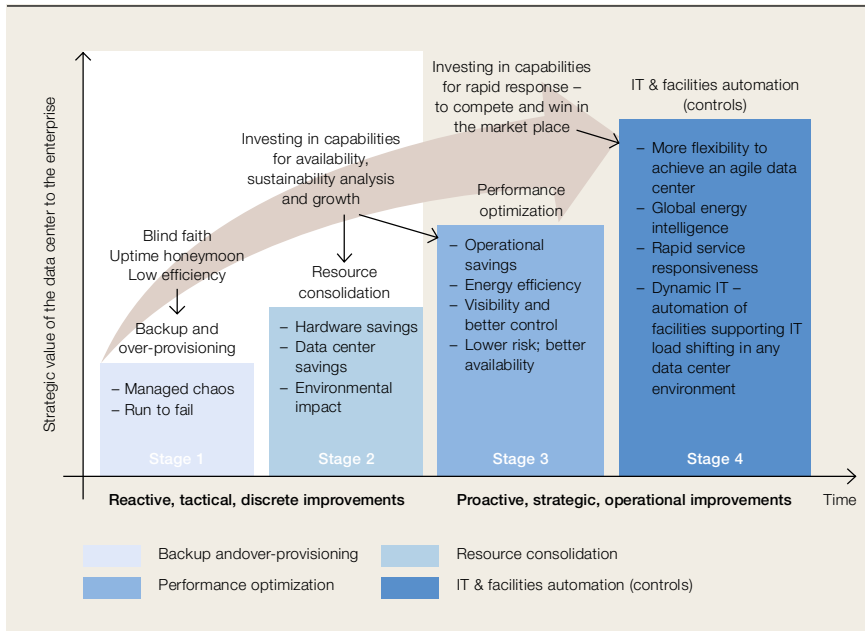
Decathlon uses the features of Energy Manager, a solution successfully used in pulp and paper and other industries, together with GEI to help data centers minimize their peak demand, or to make revenue from their grid connection – for example by using their standby generators to sell power back to the grid under a demand-response program. In this

instance, rather than perform monthly generator tests where the power is dissipated into a load bank, the generators are run when needed by the grid and the owner can earn significant revenue. This bidirectional grid connection also significantly improves the resilience of the data center over a conventional automatic transfer switch (ATS) arrangement.

Server efficiency can also be increased by using server “power capping,” where a limit is imposed at certain times on the power that can be drawn by CPUs performing noncritical functions. Increased utilization can be achieved without increased risk by balancing compute infrastructure with actual demand. Decathlon determines the optimal capacity required for a given IT load and dynamically adjusts server availability in real time along with required cooling and facility resources. This, in turn, results in significantly increased operational efficiency and decreased energy costs. (Please refer to the article on data center design optimization on page 48 of this issue of *ABB Review*.)

High visibility

Decathlon presents all of this information to the user through a “single pane of glass” → 3–5. Basic measures of data center facility efficiencies like power usage effectiveness (PUE) are supplemented in Decathlon's configurable dashboards and reports by more com-



prehensive metrics like corporate average data center efficiency (CADE) that calculate efficiencies by taking server utilization into account. The jury is still out as to which metric will replace PUE as a more comprehensive data center efficiency indicator. However, with its end-to-end visibility, Decathlon offers

center. This means that as a data center starts to deploy a DCIM solution, it can progressively move up the data center maturity model in manageable steps, rather than have to deploy everything at once. Most owners starting a DCIM deployment will be at stages one or two of the model → 6.

The underlying trend in data centers today is that over-provisioning of equipment is being supplanted by software resilience. The future – where entire data centers go on a standby mode and consume no power or where an entire compute load can be seamlessly shifted from one data center to another based on energy availability or cost – is today's emerging reality. And it is all enabled by DCIM.

Decathlon helps minimize peak demand or helps generate revenue by using standby generators to sell power back to the grid under a demand-response program.

An existing facility operator may have had a couple of years of “uptime honeymoon” with a new facility before gradually realizing that more attention to real-time monitoring and maintenance is required to avoid

the data center owner or operator a unique and comprehensive view into their systems with the possibility to configure custom performance indicators.

Apps and modules

Decathlon is a modular system, meaning that once the core system is installed, additional application modules can be added easily. In practice, each application enhances and leverages the core database so that as mechanical, electrical or IT equipment and systems are added, the visualization, reporting and analytics applications can provide a more comprehensive picture of the data

incidents and outages. In this instance, a power management solution can improve uptime by providing early warning of issues like breaker trips or power spikes before they cause outages, while asset monitors can prevent outages on critical equipment through condition-based maintenance. A more mature operator can turn his grid connection from a cost item to a source of revenue while increasing uptime by installing a bidirectional grid connection and participating in automated demand-response programs.

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