Effective IT Operations with Data Center Infrastructure Management (DCIM)

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Executive Summary
Faced with rapidly expanding requirements for increased reliability and cost-effectiveness in IT services, today's enterprise IT Operations are challenged with increasingly complex data center infrastructures. Data Center Infrastructure Management (DCIM) delivers the key capabilities necessary to transition to more efficient and effective IT service and systems management by delivering automated monitoring and management support that enhance service delivery at every stage in the maturity of an IT infrastructure. By unifying asset and status information from all infrastructure hardware, software, and environmental elements, a complete and holistic view is provided that facilitates informed decision making on optimal configurations, proactive problem management, and service improvements. By delivering broad support for DCIM processes and through direct integration with IBM management solutions, Emerson Network Power is leading the charge in bridging the gap between facilities and IT operations to deliver a truly complete IT infrastructure management platform.

Primary Challenges of Data Center Operations
The foundation for success in any modern day enterprise lies with its ability to deliver reliable and cost-effective IT services. With the attainment of organizational goals so intricately tied to IT operations, it should be no surprise that a great deal of pressure is placed on ensuring effective data center management. As the reliance on data center resources has expanded, however, the role of IT operations has increased proportionally in ensuring resources are performing optimally and are continuously available. Additionally, data center operations are expected to have the flexibility to rapidly reconfigure infrastructure elements and to provision new resources in order to meet constantly changing business requirements. Data center managers are held accountable for achieving these IT performance goals by tracking their service delivery against very stringent service level agreements (SLAs), and requirements for regulatory compliance often add significant oversight on the security and reliability of IT services. As if this was not challenging enough for IT managers, organizations are expanding these business IT requirements while also enforcing or expecting budgetary constraints. In fact, data center managers are often expected to reduce costs while actually increasing the number and quality of services. It is not too different from the fine art of juggling with one hand for IT managers to maintain IT performance, availability, and reliability while improving cost-efficiencies.

The core of the problem is increasing complexities in IT infrastructures. Just like peeling back an onion, a data center can be seen as having scaled layers that need to be managed – from individual hardware devices, to system environments (i.e. operating system, data, applications), to racks of multiple systems, to data centers, to a facility that may include colocated data centers and multi-tenant deployments, and perhaps even to managing the entire enterprise including multiple management facilities. With each layer up the stack, the complexity of the environment increases exponentially as it builds on the support requirements of the preceding levels. Further, technologies such as virtualization, grid, and cloud computing increase management complexity by adding new layers of abstraction that cross multiple systems or whole facilities. These obscure physical infrastructures from the workloads they are supporting, making it very difficult for IT operations to identify and resolve performance issues with traditional management processes. Infrastructure architectures that are broadly heterogeneous will also be challenged with increased complexity as each disparate platform requires separate configuration and management processes.
In order to deal with complex infrastructures, enterprises often distribute data center management responsibilities across multiple support organizations. For example, a facilities management group is typically responsible for data center environmental conditions (such as power availability, temperature control, airflow, and space allocation), while support for the actual IT resources is performed separately by an IT operations organization. IT operations are themselves often segmented into disparate teams for supporting specific IT disciplines (e.g. networking, systems, and storage) or platforms (e.g. UNIX, Linux, Windows, and virtual) or dedicated to support specific projects. Segmented management groups gravitate toward adopting support processes and tools specific to their practices that do not address monitoring and management requirements in other areas. In this way, individual management silos are unable to see how changes to their unique support stacks will affect the performance of the infrastructure as a whole and how their resources will be impacted by changes in other areas.

It is important to recognize that an IT infrastructure is, in fact, an ecosystem. Any changes or additions performed on one IT element will affect all other support elements in a data center. For example, consider the effect of poor thermal management where a simple accidental act of blocking a cooling unit causes a file server to over-heat and fail. Unable to access data on the file server, this could cause significant performance errors on production servers that flood the network with error messages impacting other critical systems. This domino-effect is completely obscured by siloed organizations and management tools that only focused on seeing a portion of the problem, and the initial cause of the problem (the blocked cooling unit in this case) will likely go undiscovered and unresolved. No individual IT management solution set available today is able to completely and independently monitor and manage all the disparate elements across an entire data center infrastructure. Systems management solution suites, for instance, are designed to support operating systems and workloads, but have little, if any, understanding of the physical facility and environmental conditions in which
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the system is functioning. Utilizing multiple automation resources for monitoring and data collection may provide granular intelligence across the infrastructure, but the resulting flurry of information from non-integrated sources will likely be too overwhelming for IT administrators to quickly and effectively identify problems, potential problems, and opportunities for improvement.

Lacking the visibility necessary to accurately correlate data center events and perform true root cause analysis on incidents, organizations often fall into the break/fix cycle of reactive “firefighting,” where problems are never truly resolved, only patched and destined to occur again. This inability to place systems and events in context with the whole of the infrastructure compromises the agility of the enterprise to reliably introduce business-focused improvements and additions. Organizations with unreliable IT infrastructures are unable to meet SLA requirements, damaging customer confidence and reducing business productivity. These out-of-control data centers also come at a high price due to inefficient system utilization, excessive environmental costs (e.g. for power and cooling), and the unnecessary expenditure of administrative staff time and effort.

Effective and Efficient IT Operations with DCIM

The key to establishing control over data center cost-effectiveness and efficiency is establishing holistic monitoring and management across each support layer, identifying not just the individual assets, but also how the individual IT components interact with each other. Converged infrastructure solutions provide a good foundation for enabling data center improvements as they consolidate data collection, reporting, and automation processes onto a single centralized interface. However, even the best converged infrastructure implementations are not designed to actively identify the relationships of individual data center components and the effect changes to the environment will have on their performance. This truly holistic management view requires the modeling and analytics capabilities only available in DCIM solutions working in conjunction with more traditional systems and network management platforms. DCIM provides integrated processes for asset management, space management, environmental management (i.e. power and cooling), access and control, reporting and alarming, and systems management all accessible from a single, unified management interface.

Collected data across all these disciplines is digitally modeled to deliver a complete picture of the actual data center status, and analytics are employed to identify interactions across environmental and system resources. This unified view of the complete data center infrastructure delivers accurate details on data center conditions that bridge the gap across siloed facilities management and IT operations so that all support teams can draw common conclusions on optimal configurations. Additionally, DCIM helps attain visibility into computing fabrics, enabling a more complete understanding of the relationship between the physical environment and the virtual workloads they support so that production environments can be optimized for performance and cost-effectiveness.

Although not strictly required in a DCIM solution, a key capability necessary for enabling prompt data center status and informed decision making is the ability to visually model the IT infrastructure. The human brain is wired to more rapidly absorb visual information than written, so a graphical representation of a data center that accurately depicts the status of all its individual components allows IT administrators to identify failure events and potential problems with a single glance. This increases administrator efficiency by allowing them to more rapidly determine potential problems and enables more effective IT by easily identifying opportunities for improvement. For example, environmental conditions, such as power and thermal status, can be laid over the data center model to rapidly indicate
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how they affect the performance of individual systems. A point-and-click visual interface is also much more intuitive to use and learn, simplifying training processes and day-to-day operations. With the ability to expand up or shrink down the scale of the visual representation, holistic views can be achieved for each support layer, from a single device to the entire enterprise IT ecosystem. Drilling into specific devices provides direct access to logs, reports, and status information necessary to perform audits and reduce the mean time to detection (MTTD) and mean time to resolution (MTTR) of problems. The consolidation of all essential data center information into a single easily digestible interface eliminates the inefficient practice of “swivel-chair management” in correlating events for true root cause analysis. Taking the concept a step further, hypothetical models can be created to predict the effects of planned changes or additions before actually implementing them.

The holistic views provided by DCIM can be leveraged by IT operations to greatly improve the reliability and high-availability of IT services through the introduction of proactive environment improvements. Analytics is a key enabler for this in its ability to cut through the vast amounts of configuration and status information to quickly alert on incidents and potential problems, allowing administrators to respond quicker to alert, preventing or minimizing the impact of failure events. In this way, the state of the physical environment (i.e. hardware, power, temperature, etc.) can be directly related to the performance of the workloads, and strategic decisions can be made on how to reliably optimize their performance and availability. Once a business-focused update or improvement has been identified and
implemented, the continuous monitoring of all IT infrastructure elements inherent in DCIM “closes the loop” on their introduction by identifying any unanticipated consequences to an environment change, achieving performance assurance. By minimizing unplanned outages and performance degradation, IT administrators are freed-up to address more business-focused projects.

Simplifying IT management with DCIM is also instrumental in enabling greater IT flexibility. With all critical infrastructure information easily accessible through a single interface, IT administrators are able to more quickly respond to business requests. Organizations employing virtualization implementations and/or computing fabrics can also more rapidly make decisions on expanding or improving their environments by mapping the abstracted environments to their physical hosts in the DCIM models. Perhaps nowhere is this advantage more evident than in the ability to perform capacity assurance. DCIM models provide an immediate identification of available space, power, thermal, and networking resources so new systems can be rapidly provisioned and optimally configured before thresholds are exceeded. This ability is particularly essential for maintaining the illusion of infinite scalability and the eminent elasticity of cloud implementations.

It should also be noted that a key ingredient for DCIM is the ability to monitor and manage IT infrastructures remotely. Limiting physical access to data center resources is integral to achieving security and compliance goals. Infrastructure modeling, for example, eliminates the need for on-site audits of assets and space availability. Even more secure are DCIM solutions that integrate with remote access and control platform to enable a single interface for identifying issues and implementing resolutions. All administrator activities can be logged on the remote access platform to add accountability, and alarms can be enabled to warn when security policies have been breached. The DCIM interface can then help ensure continuous compliance while maintain records necessary for proof of compliance.

**DCIM Adoption Strategies for Improved IT Operations**

The adoption of DCIM solutions to enhance management processes in IT Operations is directly related to IT service management (ITSM) best practices. The purpose of ITSM is to provide a process-focused framework that defines the interaction of IT Operations staff with end users and/or business customers. Best practices in ITSM focus on implementing and managing IT services that are designed to meet the needs of the business.

The most popular set of ITSM best practices is included in the Information Technology Infrastructure Library (ITIL), which leverages decades of practical enterprise IT management experience in delivering optimal process improvements. Among the key concepts outlined in ITIL is the need for the consolidation of all asset, configuration, and status information into a centralized data repository that is commonly accessible by multiple automated management solutions. With a federated approach, data is added to and referenced from the central repository by all management resources, ensuring completeness, consistency, and accuracy in the reporting and analysis of the IT infrastructure state. DCIM solutions provide critical support to this process by sharing environmental and asset information not available on any other platform, and they are advantaged by this integration in having the ability to acquire software and operating environment details to develop a more complete view of the support stack. Similarly, the ITIL Service Transition Model discusses processes for configuration management, change management, and release and deployment that are directly enhanced with DCIM contextual asset and inventory management views that assist in space planning, capacity management, and the development of optimal configurations.
ITIL also strongly recommends the adoption of automation whenever possible to simplify management while ensuring the consistency and reliability of implementations. All repeatable tasks can be automated, and groups of automated tasks can be bundled together with basic job scheduling. When consolidated job scheduling is integrated with ITSM practices, workload automation is enabled that performs complex IT processing to support a variety of business-aligned services, such as event-driven workloads, web services, composite applications, Service Oriented Architectures (SOAs), virtualization, and dynamic resource allocation. DCIM supports workload automation by providing critical asset and environmental intelligence that helps enable dynamic resource allocation, load balancing, dynamic thresholding, heuristic monitoring, and any other processes requiring a deep understanding of data center conditions to perform tasks accurately and reliably.

The EMA Prescriptive Model for IT Operations

Organizations adopt ITSM and automation solutions at different rates – though, typically always in response to expanding business requirements. ITIL recommends a systematic approach to introducing process improvement where only one or a few changes are introduced and allowed to settle before moving on to other priorities. Introducing too many changes simultaneously can actually increase, rather than diminish, infrastructure complexity. In order to provide guidance on where enterprises should invest in IT process improvements, EMA has developed a maturity model that identifies key milestones in the advancement of service capabilities. Organizations are advised to determine which level their infrastructure most closely resembles and then systematically introduce process improvements that will enable the achievement of the next higher phase of development. Described below are the four phases of the EMA Maturity Model and some of the key related processes that can be assisted by or improved with the adoption of a DCIM solution.

![Figure 3: Key IT Operations Processes Assisted by DCIM by Level of Management Maturity](image-url)
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Level 1 – Reactive Management
This is the starting point for most organizations where IT Operations are principally trying to survive day-to-day crises. Management processes are triggered primarily by incidents and addressed with mostly manual activity supplemented by some scripting. Management tools tend to be device-specific, with few enterprise-class tools and little or no automation. Key management processes supported by DCIM solutions at this phase include:

- **Incident Management** – Environmental conditions and other data center elements must be continuously monitored in real time. Should a failure event occur, it will then be immediately alarmed and a visual dashboard indicator will promptly bring the issue to the attention of administrators (i.e. reducing MTTD), and consolidated status and asset data will assist in incident remediation (i.e. reducing MTTR).
- **Inventory Management** – Details about physical assets are collected and recorded in a centralized repository, enabling the easy identification of the configuration detail of all data center hardware components, including brand, model, size, weight, power consumption, thermal requirements, and many other characteristics.
- **Access and Control** – Remote connections to servers and other devices minimize the need for physical access to the data center while providing a centralized location for logging administrative activities.
- **Service Desk** – Integration with DCIM alarming simplifies the process for identifying environmental (e.g. power and cooling) issues and other incidents that will degrade production performance and assists with initiating and tracking remediation efforts.

Level 2 – Active Management
Day-to-day operational issues are still paramount at this stage, but some processes are now documented and repeatable. Management tools are employed by whole departments and include some, though limited, automation. Business impact reporting may be available, but typically just to measure IT performance against SLA requirements.

- **Asset Management** – Monitoring the status of assets and the environment conditions that support them ensures they are functioning optimally and within acceptable tolerances. The status of assets is tracked through every phase of their lifecycle, from initial deployment through final retirement.
- **Space Management** – The identification of available space, power, and networking simplifies and optimizes additions, moves, and reconfigurations while ensuring they do not exceed established tolerances, such as for weight and heat distribution.
- **Change and Configuration Management** – The availability of space and environmental resources assist in the establishment of device configurations and reconfigurations while providing essential intelligence for developing the processes necessary in implementing changes. Continuous monitoring of the environment ensures changes have been successfully implemented and any unexpected impacts can be quickly identified and resolved.
- **Problem Management** – Potential problems with physical and environment data center elements can be identified through alerts and dashboard alarming before they impact the production environment.
- **Job Scheduling** – Infrastructure intelligence helps administrators develop standardized management process unique to their environments that can then be organized into workflows.
Level 3 – Proactive Management
At this stage, a service organization becomes a fundamental and consistent interface to the broader business. Management processes are still primarily problem driven, but are more easily remediated with procedures in place for root cause identification. This constitutes a shift away from reactive incident management toward problem prevention. Management tools are integrated and automated across multiple managed environments and real-time alerts, and other metrics are available to easily identify IT health and business value.

- **Visual Modeling** – Real-time graphical imaging of each layer of data center management – from individual devices, to racks, to whole facilities – allows administrators to more easily contextualize IT elements and more quickly identify how they relate to each other for proactive planning and problem solving.

- **Capacity Planning** – Environmental monitoring (such as power consumption, heat generation, and server densities) is essential for anticipating resource availability to support future expansion, ensuring steps can be taken early to prevent reaching facility limitations that may impede business growth.

- **Root Cause Analysis** – Holistic infrastructure views and reports allow administrators to easily correlate events that will identify the actual cause of a failure event and prevent the incident from occurring again.

- **Workload Automation** – Real-time infrastructure status data directly feeds the dynamic allocation of workloads and the availability of workload dependencies.

Level 4 – Dynamic Management
At the most mature stage in pragmatic data center management, day-to-day performance and availability issues are largely managed by automation, so that IT can focus on capturing business advantage and optimizing the infrastructure dynamically to suit shifting business conditions. Planning new services and improving quality of service is the focus rather than simply sustaining services or fixing breakages. Management tools provide detailed, environment data that enable real infrastructure decisions that will improve business agility and profitability, effectively closing the gap that exists today between physical infrastructure and the business layers it supports.

- **Responsible Autonomics** – Service, systems, and workload management processes are reliably automated to respond to changing hardware and environmental conditions reported by the DCIM platform. Minimal effort is necessary from administrative staff on day-to-day activities.

- **Dynamic Service Provisioning** – Leveraging infrastructure status information to identify resource availability and enable load-balancing, services are delivered elastically – provisioning automatically when needed and releasing when they are no longer being used.

- **Analytic Reporting and Management** – Administrators are only alerted to events and conditions that require their attention, eliminating time-wasting log sifting and the potential to inadvertently overlook critical information.

- **Hypothetical Modeling** – The effects of moves, adds, and changes in the IT infrastructure are proactively identified in visual models, allowing administrators the ability to generate multiple “what-if” scenarios and choose the one that is least impactful or achieves the best performance. This also dramatically improves change management by helping to determine which organizations and data center elements will be affected by the change event so accurate deployment workflows can be created.
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IT Operations Success with Emerson Network Power’s DCIM Solutions

Recognizing the critical role DCIM can play in supporting IT Operations, Emerson Network Power has specifically developed capabilities in its solution that support the delivery of service and systems management processes. The core of Emerson’s DCIM solution is the Trellis™ platform, a purpose built and fully integrated product set that leverages proven technologies adopted from its Avocent, Aperture, and Liebert product lines. The Trellis platform collects granular asset and environment status details via a wide variety of protocols across the entire IT infrastructure and consolidates data center management with a centralized console and data repository. The intuitive operational dashboard provides real-time analytics to promptly alarm on incidents and potential problem, and all data center elements can be visually modeled with detail graphical views of each management layer (i.e. device, rack, data center, facility, and enterprise). Hypothetical models can also be created to explore the effects of adds and changes before actually implementing them.

Directly integrated with the Trellis platform is the Avocent® Universal Management Gateway (UMG), an appliance designed to provide a centralized interface for secure remote access and monitoring to devices across the IT infrastructure. Servers and other systems are accessed over a broad range of in-band or out-of-band connectivity options, including serial console over IP, direct KVM, KVM over IP, single interface into RDP, and standard IP-based remote network access. The UMG also extends remote access support to a wide variety of service processors, including HP iLO, Dell DRAC, IPMI, and many others. With this access, data can be collected in real-time on critical assets even when they are powered off. To ensure devices are completely secured, all access to systems and critical data are restricted to only those with proper authorization and all activities are logged to ensure accountability.

Built on a Service Oriented Architecture (SOA), the Trellis platform is able to achieve federated integrations with ITSM solutions. Most notably, Emerson has recently entered into a partnership with IBM to directly integrate the Trellis platform with the IBM Tivoli portfolio of automated management solutions. The integration allows for a single orchestration layer between the solution sets that federates monitoring and management processes. This unified support structure enables IT Operations to respond more quickly to requests and incidents, and this greater flexibility translates into improved service quality. Service management is also enhanced with unified real-time data center analytics that can correlate events and conditions for root-cause analysis and determine optimal configurations across hardware, software, and environmental elements in the data center. The synergies between the two product sets also increase operational efficiencies by reducing administrative efforts (such as by simplifying the identification of space and resource availability for new assets) and by decreasing operational costs (such as by enabling processes for reducing energy consumption). Shared holistic monitoring across all data center elements enables increased reliability by facilitating processes for higher availability and reduced risk while improving cost-effectiveness.
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EMA Perspective

The foundational principle of DCIM is to provide a complete holistic view of IT infrastructure across all hardware, software, and environmental elements. It is unfortunate, then, that the majority of tools claiming to provide DCIM support focus only on addressing requirements for facilities management, such as power, cooling, and asset management. Lacking the ability to bridge the infrastructure management gaps between siloed organizations with a more extensive feature set and/or points of integration with ITSM and systems management tools, these platforms fail to bridge the infrastructure management gap between siloed organizations. The core challenges of increased infrastructure complexities are not diminished when management resources fail to correlate environmental events with system level events.

Emerson Network Power is the only DCIM solution provider that has intentionally developed broad integrated support for IT Operations. To be fair, some other vendors have left the door open for ITSM integrations with their DCIM platforms by adopting open standards and APIs, but these require a level of customization that is typically beyond the capabilities of most organizations. Only the Emerson Trellis™ platform has been purpose-built with direct integrations that allow out-of-the-box support for core IT Operations management processes and facilitate the establishment of complete and holistic infrastructure management views. This unique ability is evidenced by the direct integrations that have been enabled across the IBM Tivoli portfolio.

The terms “single-pane-of-glass management” and “unified infrastructure management” and “end-to-end management” are inappropriately used much too often in the IT marketing sphere. Whereas an ITSM solution may address broad hardware and software management requirements, they usually neglect environmental support needs, so the picture is really not complete. Only the combination of broad environmental support of the Emerson DCIM solution set coupled with the extensive systems and ITSM support delivered by IBM Tivoli allows companies to achieve truly holistic monitoring and management support across an entire enterprise IT infrastructure.
About Emerson Network Power

Emerson Network Power, a business of Emerson (NYSE:EMR), delivers software, hardware and services that maximize availability, capacity and efficiency for data centers, healthcare and industrial facilities. A trusted industry leader in smart infrastructure technologies, Emerson Network Power provides innovative data center infrastructure management solutions that bridge the gap between IT and facility management and deliver efficiency and uncompromised availability regardless of capacity demands. Its solutions are supported globally by local Emerson Network Power service technicians. Learn more about Emerson Network Power products and services at www.EmersonNetworkPower.com.

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About Enterprise Management Associates, Inc.

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