

Creating Order from Chaos in Data Centers and Server Rooms

By Dennis Bouley

White Paper #119

APC[®]
by Schneider Electric

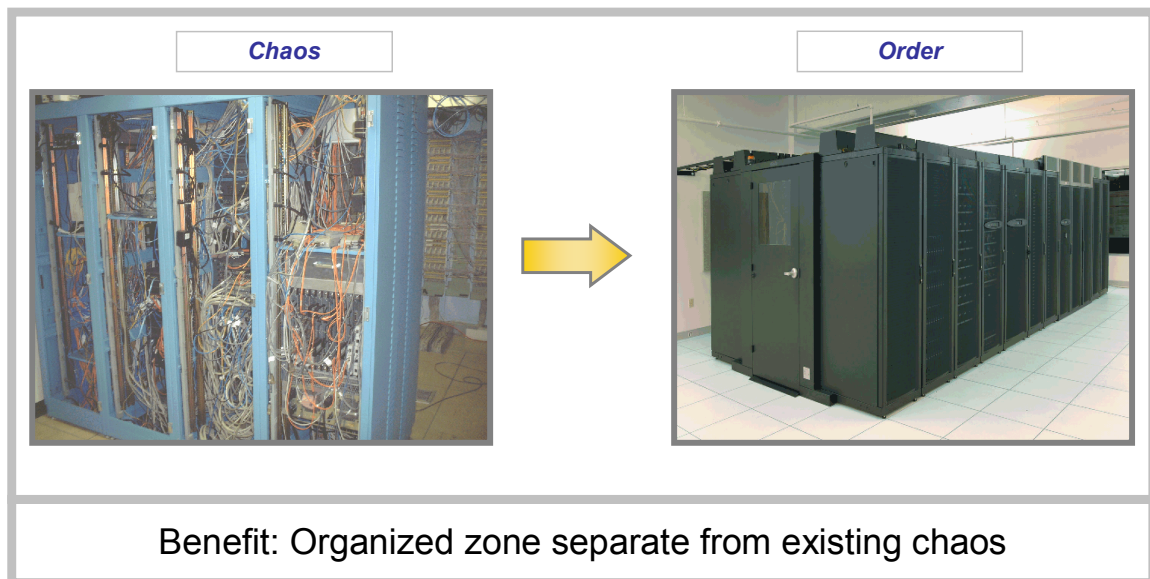
Executive Summary

Data center professionals can rid themselves of messy racks, sub-standard under floor air distribution, and cable sprawl with a minimum of heartache and expense. Whether the data center mess is created over years of mismanagement or whether the cable-choked data center is inherited, solutions for both quick fixes and longer term evolutionary changes exist. This paper outlines several innovative approaches for dealing with the symptoms of chaos and for eliminating the root causes of disorder.

Introduction

In many data centers, the symptoms of chaos are readily apparent. A cursory tour of an unplanned data center exhibits numerous undesirable symptoms such as missing floor tiles, masses of disorganized cabling, and rudimentary spot cooling. Fortunately, solutions can be deployed and processes can be instituted that either force revolutionary change or that encourage an evolutionary migration to an orderly data center.

Figure 1 – Establishment of order through modular deployment of zones



Taking Control: Tools and Methods to Resolve Chaos

An IT manager faced with the symptoms of chaos can resolve the issues by taking charge of two areas: physical infrastructure deployment and change management behaviors. Hardware innovations which allow the easy deployment of self-contained zones of racks, and software developments which enable rational physical infrastructure change management are two keys for an affordable and non disruptive data center face lift.

Imaginative physical infrastructure deployments

Since data centers are evolving to scalable modular rack-based solutions, a “cure” can be applied to the chaos problem. By deploying a rack-based system that includes the UPS power, electrical distribution, monitoring, cable routing and air flow solutions, an integrated approach can be easily adopted, at reasonable cost.

Racks have evolved to accommodate higher density IT equipment. Selecting a standard rack size is an important first step. For information regarding rack selection criteria, please see APC White Paper #72, [“Five Basic Steps for Efficient Space Organization within High Density Enclosures”](#).

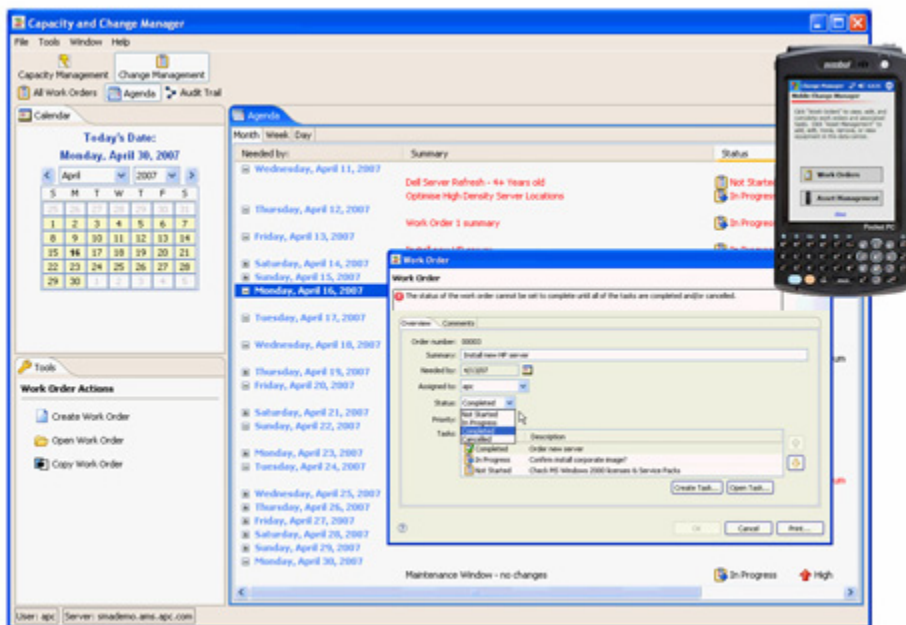
A new row of racks can be set up as a self contained “zone” that resides on the data center floor but which operates independent of the existing infrastructure (see **Figure 1**). These organized zones can proliferate as the existing chaotic infrastructure begins to phase out, either rack by rack or row by row. By leveraging the opportunity to install integrated rack systems, chaotic growth can be transitioned to controlled growth as the new equipment phases out the old.

Alteration of change management behaviors

Change control is a systematic way for the IT manager to control his or her destiny. Traditional IT change control is characterized by a formal request to initiate a change in the IT environment, followed by a formal review of the suggested change, followed by an analysis of the predicted outcome, and formulation of a back-out plan if the change does not work out as planned.

Frequently overlooked in this methodology, however, is the power of the change control process to direct the evolution of both the IT and physical infrastructure. After all, a failure in the IT infrastructure impacts one application or system, while a failure in the physical Infrastructure (power, cooling) can potentially impact all applications and systems.

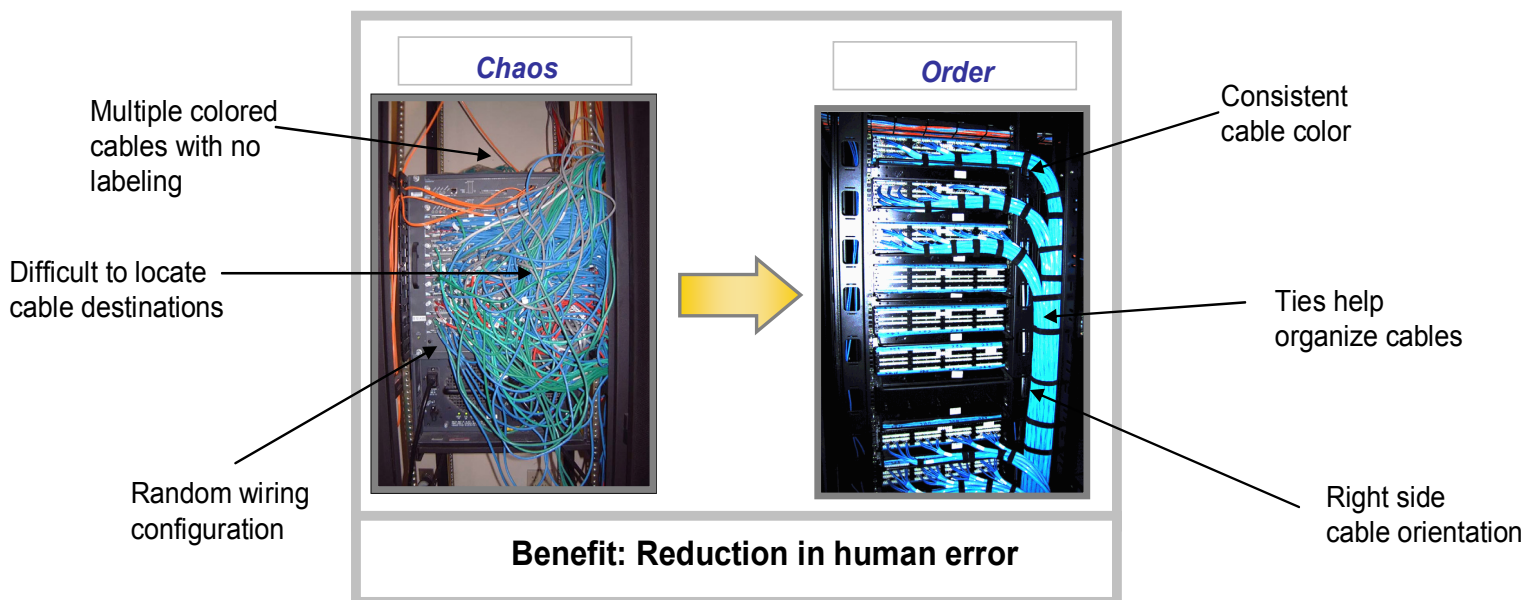
Figure 2 – Screen from APC Capacity and Change Manager tools



By adopting an automated change control process (see **Figure 2**), an IT manager can positively influence how the data center evolves from a systems perspective. By including the facility or physical infrastructure side of the data center environment, the IT manager can also steer the evolution of the data center away from one that breeds organizational chaos.

Robust vendor management is also an important tool for avoiding chaos. The trend towards the outsourcing of facilities and systems to third parties has blurred the issue of accountability for quality of performance. An IT manager seeking to evolve from a chaotic situation should insist on strict adherence to standard data center practices, including a change control process, as part of any contract for services outside of the direct chain of command. Only by having all data center personnel operating under the same standards of performance can the evolution from chaos to order occur.

Figure 3 – Wire management in back of the rack



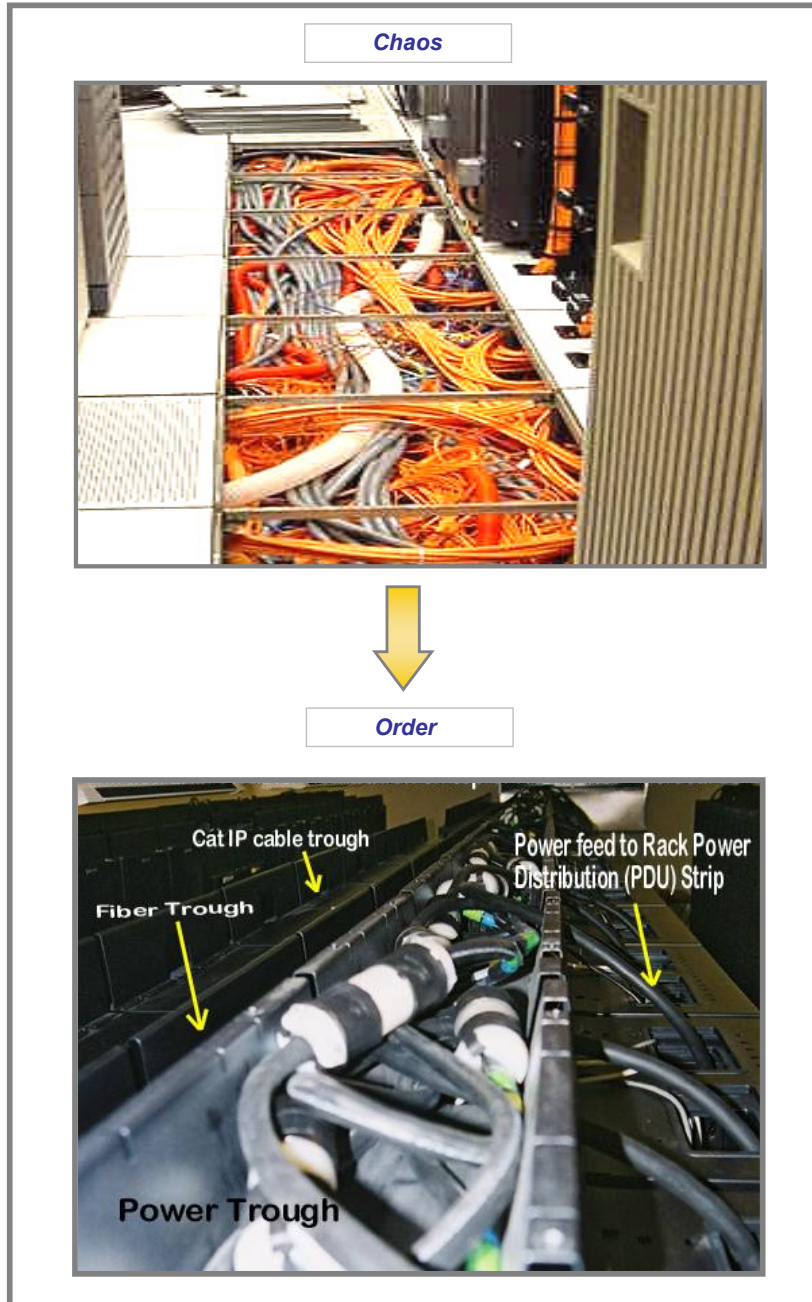
The Cause of Chaos

The primary cause of chaos is unplanned, uncontrolled growth. As the business introduces new processes to help drive the growth, IT responds by building and supporting new applications. IT equipment is rolled into the data center to support the applications and new systems are deployed in a hectic deadline driven environment.

New servers and applications can be obtained and pressed into service within days. However, the installation of the accompanying physical infrastructure (raised floor, cable, racks, cooling, UPS, PDUs) can take months. Under the pressure of time, equipment is often installed with no regard to the long term implications to the data center integrity and reliability.

The chaotic environment is compounded by turnover in IT staff and supplier personnel. This turnover cuts short any institutional learning that may develop over time and thereby prevents the fostering of order and organization. In the end, a typical response is to keep adding servers and accompanying communications and power cables rather than to institute an orderly replacement or reuse process.

Figure 4 – Overhead cabling provides a way out of the plenum mess



If a legacy cable problem is at the root of the chaos in the data center, and that the cable problem is below the raised floor, then the obvious solution is to install overhead cable and power distribution systems to

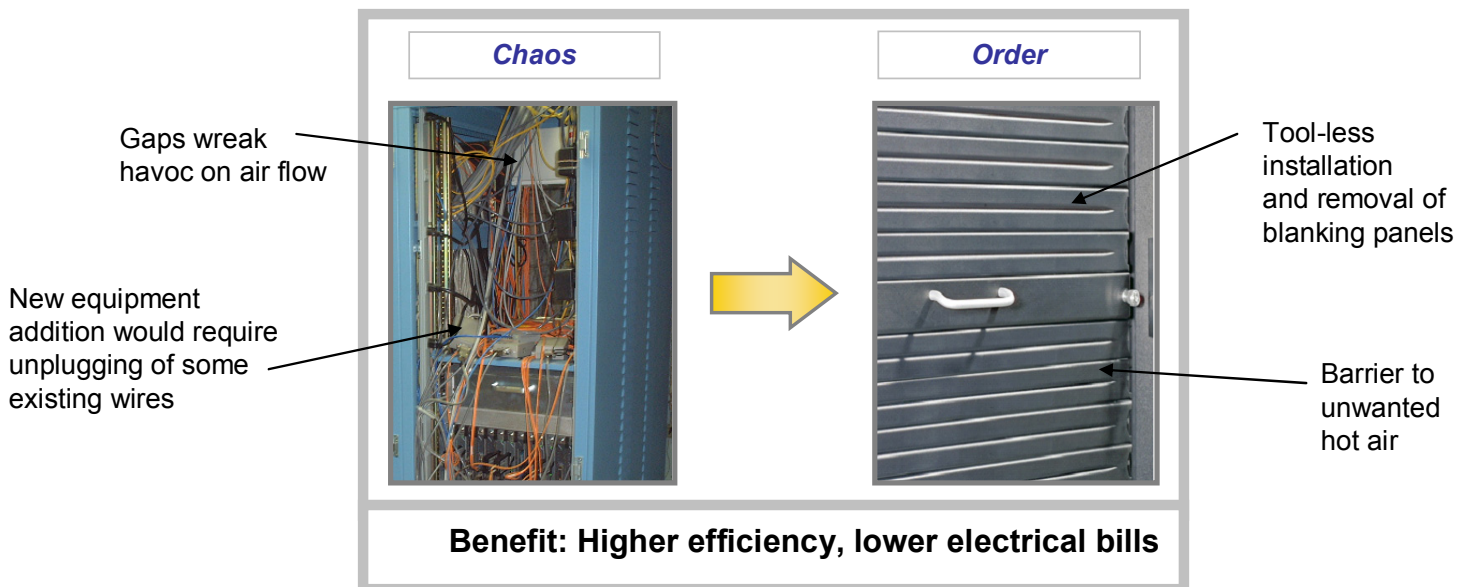
support the IT equipment see **Figure 4**. As the new equipment is powered and cabled from overhead, the under floor cable and power can be abandoned in place until it can be removed safely with minimal risk.

The Effects of Chaos

Poor air distribution

Poor air distribution can cause servers and related IT equipment to overheat. IT server equipment typically requires an air flow of 150-200 cubic feet per minute. This rate of air flow will remove enough heat to raise the exhaust air temperature by 15-20°F (8.3-11°C). If this heat transfer does not take place, the device may shut down, fail prematurely, or corrupt the data being processed.

Figure 5 – Installation of blanking panels



Poor power system capacity management

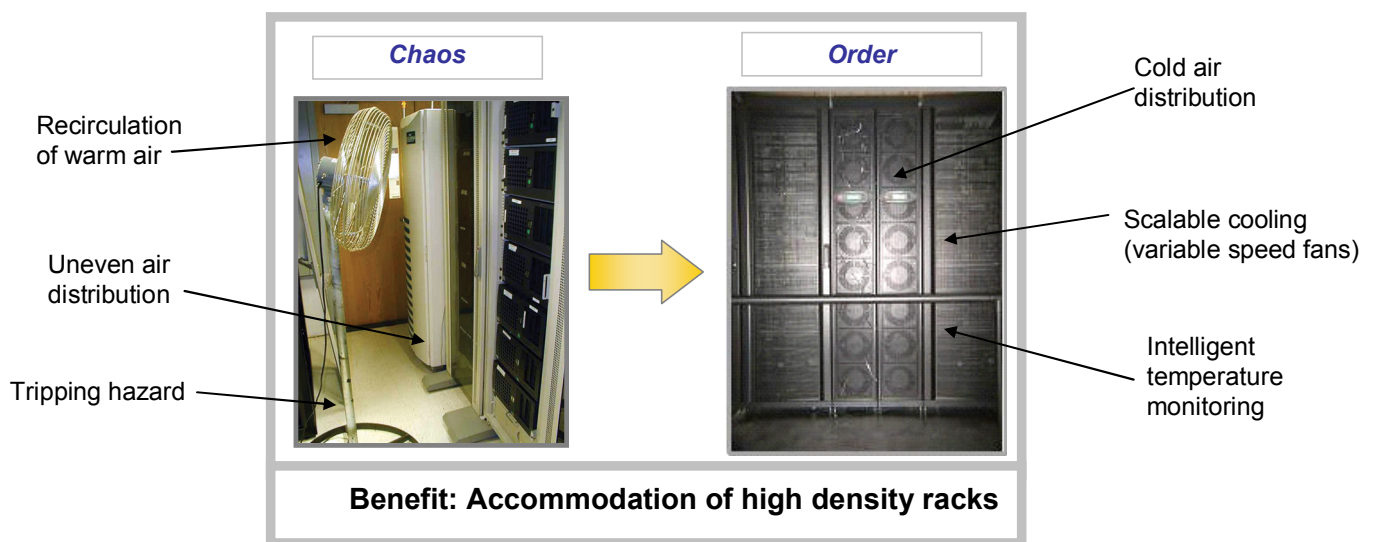
Electrical distribution circuits have defined capabilities that limit the amount of load that can be placed on them before the circuit protector (fuse or circuit breaker) opens. Uncontrolled circuit assignment can lead to downtime when circuit limitations are exceeded. Downtime can also occur when conditioned power sources, such as UPS systems, are not well managed and maintained.

The automated capacity management system (see **Figure 2**) can automatically distribute and track single and three-phase equipment power draw, ensuring that all three phases on the power system carry a balanced load. In addition, the system maps the power path and illustrates the physical system relationships and dependencies.

Disrupted communications

Poor planning can constrain telecommunications when the cabling system, patch panels and device interconnects reach capacity limits. As cable technologies evolve over time, the avenues or paths the cables take to link systems to one another become saturated with abandoned legacy cable. This can have a profound impact when fiber optic telecommunication cables are mixed with copper cables in a random fashion. Fiber is easy to break, and the quantity of data riding through is large, magnifying the impact if a cable problem occurs. The inability to address cable issues without impacting the data center operation is the primary reason why chaos is allowed to proliferate. IT managers are loath to remove “dead” or unused cables if the potential impact is downtime or a break in communications.

Figure 6 – Migration to contained close-coupled™ cooling



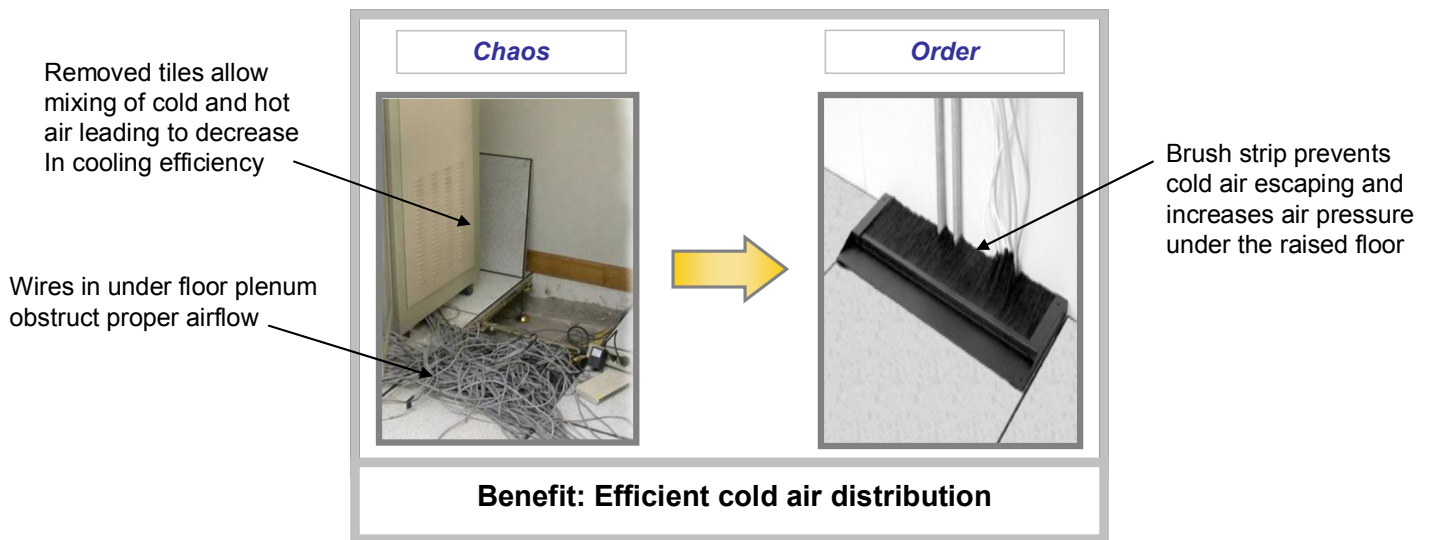
Quick Fixes to Eliminate Chaos

Numerous actions can be taken to begin the process of establishing order in the data center:

- Organize power and data cables in a standard manner (see APC White Paper #72, “[Five Basic Steps for Efficient Space Organization within High Density Enclosures](#)” for details) (Figure 4)
- Label power cables identifying both specific cable origin on one end and load targeted at the other end
- Assign specific power cables to specific loads and document cable assignments
- Remove poor grade power strips and deploy vertical PDUs in back of racks to distribute power that can be monitored
- Replace damaged or missing ceiling tiles – this will improve the efficiency of the air flow

- Audit locations of perforated raised floor tiles. Remove damaged tiles and replace any that are in cold aisles.
- Seal any cable cut outs in floor tiles that support cables coming through the raised floor (**Figure 7**)
- Eliminate fans and supplementary air conditioned units and install row-based air conditioning to address hot spots (**Figure 6**)
- Remove all packaging materials, spare parts, unused equipment that are present from the data center floor
- Install blanking panels so that open gaps in racks which disrupt air flow patterns are eliminated. These gaps complicate hot air removal (**Figure 5**)

Figure 7 – Sealing of open floor cutouts



Leverage Evolution as a Long Term Solution

As data centers continue to evolve over time, an opportunity exists for leveraging the changes to breed order instead of chaos. An IT manager faced with a legacy mess, inherited or created must recognize that the bad situation developed over time. Fortunately, the same forces that lead to the creation of the chaos also offer a way out.

As business requirements drive new solutions and generations of equipment, they offer the opportunity to migrate to a more stable, reliable environment. By exercising control going forward in the selection of data center infrastructure methodologies and equipment that support the mission critical environment, an IT manager can resolve the legacy chaos through the natural equipment replacement and upgrade process.

Conclusion

An IT professional faced with the challenge of managing a chaotic data center now has some available options for solving the problem. Many of today's technologies provide integrated rack-based data center solutions for power, air, cable routing, and management that allow for a migration from a chaotic to a managed data center with minimal risk of downtime. The key is to leverage the natural evolution of IT systems and communication platforms.

A paradigm shift may be required that relegates the traditional raised floor environment to obsolete status, but this is easily done with today's technologies. The IT manager must standardize behavioral methodologies by instituting a change control system that accounts for both the IT infrastructure *and* the physical infrastructure. Only through the effective use of these tools and methods can order evolve from chaos.

About the Author:

Dennis Bouley is a Strategic Research Analyst at APC's Data Center Science Center, in West Kingston, RI. He holds a Bachelor's degree in Journalism and French from the University of Rhode Island and a Certificat Annuel from the Sorbonne in Paris, France. Over the last 20 years (10 with IBM and 10 with APC) he has interviewed data center professionals regarding their data center IT and physical infrastructure environments.