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KEYNOTE SPEAKER

LOAD-ON DEMAND DELIVERY SYSTEMS AND INNOVATIVE DESIGN TECHNIQUES

by Dennis Julian, PE, ATD, DCEP

Design and engineering firms in the data center market builds must have a firm understanding of the ever-evolving needs of their clients. As the industry moves toward new trends in delivery systems and other innovative design techniques, the firms who have experience with this type of approach have begun to stand out above the competition. The buzzword in data center design today is "modular construction". Unfortunately, the term has different meanings to different people. For that reason, at Integrated Design Group (ID) we prefer the term "load-on-demand" when discussing modular data center design. Load on demand is a strategy used in developing and implementing a data center design that provides IT, cooling and electrical load capacity on demand with a "just in time" philosophy. There are several ways to provide load on demand, each providing its own relative advantages. For the sake of discussion, ID breaks down load on demand concepts into four distinct design approaches.

1. **Master Planned Phased Construction**
2. **Skid or Container Based Component Modular**
3. **Repeatable "Kit of Parts" Modular**
4. **Modular Off-Site Constructed Data Center**

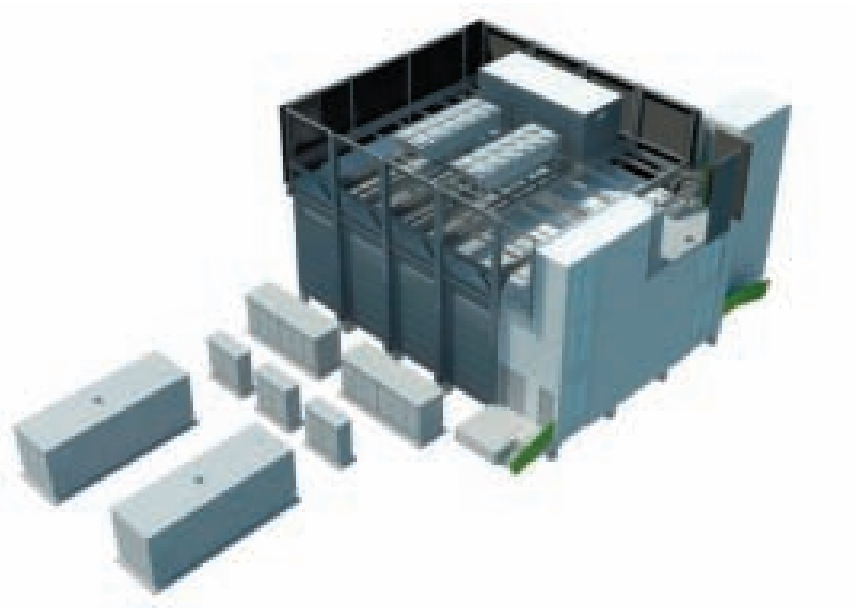
Each approach provides a solution to the challenges of delivering a data center expansion in a cost effective manner designed to fast-track the construction phase of a build. Each also offers unique advantages and disadvantages. During the early phase of every project we take on, ID leads a discussion of these various options as part of the overall project approach. Where appropriate, as guided by cost, schedule, availability, or client preference, one or more of them may be implemented.

Keep in mind, any of the load on demand options discussed in this article require the establishment of a standard growth increment that it must be adhered to unless a redesign is completed.

The final solution often includes a combination of the following strategies:

For over twenty years, ***master planned phased construction*** has been the most utilized and most basic method for providing load on demand. This method calls for designing a data center for the ultimate phased construction but installing only part of the system on the first day. During the first phase of construction, accommodations are made for the installation of the future equipment using strategies such as installing conduit and concrete pads for future equipment and sizing rooms large enough to accept the future gear. The obvious advantage to this approach is the time saved in construction during future phases. As a result, the team simply needs to order additional pre-specified equipment and have it set in place,

connected and tested. Be cautioned, however, that without careful planning, inefficiencies and stranded capacities may arise. Clients should be aware that certain parts of the system installed day one must be sized for the future builds, even when the growth may never be required. When using this phased construction model, pipe sizes, switchgear, electrical feeders and other systems, as well as the equipment spaces all need to be oversized day one to accommodate the future growth. If the growth does not happen, money is wasted. Additionally, if significant time elapses between phases, technology may change or equipment models evolve, resulting in preplanned and constructed accommodations that may no longer be appropriate. Furthermore, testing of the new equipment may be impossible without disruption to operations.



Skid and container based modular construction addresses the schedule and often space challenges associated with a particular component of the data center construction. With this approach, specific equipment or rooms/systems such as electrical rooms, pump rooms, chiller plants and even raised floor/rack space are standardized, built in a factory and installed as a complete system into a shell space. Examples include the use of the I/O container to replace traditional raised floor. The container can slide into a warehouse or even be installed outside and quickly attached to an existing infrastructure, making additional load immediately available. If existing infrastructure is not available, developing a modular electrical system with modular chiller plants and modular white space can result in a very fast build out. The challenge with this approach is twofold. Often each individual system is highly customized and unique to each particular vendor. Getting standard chiller plants with electrical skids, generators and IT containers sized at matching capacities takes careful planning and may not be feasible given project constraints in terms of budget, schedule and size. Secondly, the modular white space containers often restrict the IT vendor options available to the ultimate end users. With technology evolving so quickly, many don't want to risk having a facility solution that limits future technology choices. However, utilizing specific components, such as modular chillers within a traditional build out, can be effective in reducing space, lowering cost and improving time to market.

The ***kit of parts modular solution*** includes selecting standard readily available components and component sizes for generators or chiller plants and utilizing them to create multiple combinations to achieve a variety of data center solutions. An excellent example of the kit of parts in action is Digital Realty's (DLR) POD™ architecture. DLR utilizes a standard components study in a variety of combinations to provide data centers that achieve a desired Tier rating. Their design allows for loads ranging from 1.125 MW to virtually any multiple of that size. Using this approach, DLR is able to preorder components prior to the final determination of installation details and ultimately ship them to the build site. They take this a step further by integrating modular components such as electrical and pump skids into the mix providing an additional advantage. Furthermore, DLR has developed multiple cooling options to enable alternate solutions by geography to take advantage of "free" cooling in certain environments. By taking these steps, a team can leverage buying power, streamline provisioning and reduce overall construction time.

Limitations to this approach are that it is most applicable to a company building multiple data centers simultaneously. Additionally, when constructing much larger facilities, the deployment of multiple smaller systems will use many more components and be less cost effective. Cost issues, however, may be offset by the increased buying power that this approach enables. In addition, the time value of money or the need to reduce initial costs can be considerations.

The ***off-site constructed data center*** is similar to any modular structure. Whether it's a house, school or dormitory the entire building may be constructed in a factory and shipped to the site and assembled. The modular data center is self-contained and incorporates its own power and cooling infrastructure as well as network room and IT whitespace. All that is required prior to commissioning are basic utilities such as network, water and power that any traditional data center would need.

This approach is described in detail in the 451 Research Long Format Report titled **"Market Monitor: Datacenter Technologies – Prefabricated Modular Datacenters"** dated May 10, 2012. To date, utilization of this approach has been limited and therefore cost remains higher than traditional construction. As more of these projects are implemented, the cost should come down quickly.

It can be argued that the modular off-site data center is in fact equipment, and not a building at all. If this is the case, the depreciation schedule will drastically reduce actual total cost of ownership and make this approach very cost competitive.

A recently commissioned off-site constructed data center consisting of a 500kW prototypical Tier IV modular data center, Centercore, is located at Research Triangle Park, Raleigh, North Carolina. A financial services company sought to explore the feasibility for a modular data center product. The result is a fully modular data center which allows for scalable growth in 500kW increments. The power and cooling infrastructure is designed as a fault-tolerant and concurrently maintainable system. Centercore is constructed of a robust steel frame module wrapped in a weather resistive insulated metal panel envelope and Miami-Dade rated louvers. The prototype offers end users significant flexibility in IT deployment with over 2800 sq ft of 36" raised floor. The space is vendor neutral and can accommodate virtually any IT equipment type with power densities as high as 10kW/cabinet. The cooling system uses outside air economization for all CRAH units as well as hot aisle containment for increased efficiencies. Generators and substations are located directly outside of the modules on equipment pads.

Ultimately, many projects may incorporate a combination of these approaches. The Equinix data center in North Bergen, New Jersey was also master planned for phased construction. The initial build made provisions for the installation of equipment in multiple future phases. Additionally, two modular chiller plants were utilized to save space and reduce overall schedule. To date, three phases of this project have been implemented with no disruption to service. In order to determine the most successful solutions for your project, evaluation of all load on demand options should be evaluated according to the criteria set forth above. Each provides benefits for short- and long-term growth, expansion and cost efficiency. The key is determining the unique solution that is a fit for your project needs.

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