



DIGITAL REALTY TRUST

The Industrialization of the Datacenter

A Digital Realty Trust Position Paper

560 MISSION STREET, SUITE 2900
SAN FRANCISCO, CA 94105
TEL 415-738-6500
FAX 415-738-6501
WWW.DIGITALREALTYTRUST.COM

2323 BRYAN STREET, SUITE 2300
DALLAS, TX 75201
877-DRT-DATA (378-3282)
TEL 214-231-1356
FAX 214-231-1345
WWW.DIGITALREALTYTRUST.COM



Datacenter capabilities continue to become a more important element of today's corporate culture. As evidenced by a variety of market studies, the next 24 months alone will result in a substantial addition to the current demand for datacenter space. The level of complexity associated with acquiring, designing, building and operating these new facilities is accelerating accordingly. This increasing level of complexity is rapidly outstripping the ability of even the largest companies to effectively acquire, design, build, and operate their own facilities. These demands have prompted a revolution not dissimilar to past eras of industrial change within modern economic history in which an effective "division of labor" emerges as the most reliable method of delivering the sophisticated end product that customer's require. As a result, this new construct of the "Industrialization of the Datacenter" includes many of the same elements that have characterized the rise of industrialized production methods throughout a variety of industries for the past 100 years.

Defining the Contemporary Datacenter

As a result of factors including enhanced processing power, virtualization, more efficient server technology and the needs of low latency processing, the contemporary datacenter can be described, now more than ever, as a dynamic environment which must constantly be recalibrated to maximize its effectiveness. In essence, datacenters have moved from the "back office" to the organizational "front lines". They are the railroads of this generation providing the infrastructure



to support the global economy. Formerly tucked away as line item in the IT budget, datacenters are in the forefront of CxO's minds as they look at their critical IT operations. No longer is mission critical confined to trading and transaction applications. Imagine if JP Morgan Chase's CEO, James Dimon's, email had not been working during the frantic acquisition discussions for Bear Stearns. In analyzing the rapidly changing nature of the contemporary datacenter there appear to be three (3) distinct forces that are converging to define the requirements for new computer processing facilities:

- The rise in high density computing and storage
- Energy usage and heat dissipation needs within datacenters
- Increased cost of energy utilization.

kW of IT Load. The Common Language

The convergence of the three forces defining today's datacenter requirements call out the need for a paradigm shift under which a new facility is no longer a customized deliverable, but rather, a commodity. This shift in perception then logically begs the question, "what is the commoditized unit within the datacenter itself?" The answer is, of course, the facility's power as expressed in kilowatts (kW). Understanding the importance, or "magic", of kW is essential for any datacenter customer who intends to expand their operations over time. kW of IT load is the kW of datacenter delivered electrical power drive the facility's computing devices (servers, for example). As a measure of power and capacity,



kW most directly translates into the environment required to support the volume of MIPS and terabytes that the datacenter is to support both now, and in the future. More directly, computers do not run on oil or wind. They run on kW, both today and 20 years from now. There is no functional obsolescence of kW of IT load. As each successive generation of computing and storage gets more efficient per kW, the datacenter gets more MIPS/terabytes out of the same level of kW of IT load.

Viewing your power requirements in terms of kW of IT load is a fundamental principal of the concept of future proofing a datacenter. Adopting this method of determining and expressing a customer's datacenter needs requires them to view their power requirements based on the footprint of all the components that will reside above the raised floor. The measure of kW of IT load provides a counter-balance to the tendency to overestimate power needs due to assuming all components require the same level of power. A patch panel obviously does not require the same level of power as your computers for example. Using kW of IT load as the standard unit of quantification enables decisions to be made from a cost/kW standard that enables both the customer and supplier to be sure they are making their decisions based upon a common base of understanding. The use of kW of IT load provides customers with a level of design flexibility and "futureproofing" for their datacenters that metrics like square footage and Watts/square feet do not provide.



The Increasing Obsolescence of the “Make v. Buy” Decision

Although many firms will continue to examine their datacenter source and construction decisions using traditional “make vs. buy” constructs, a powerful argument can be made that for the majority of organizations the choice to “do it ourselves” is one fraught with a wide degree of declining efficiencies. Before beginning our explanation of this point, let’s begin with the assumption that every datacenter’s applications are mission critical, and therefore, maximum uptime is a universal requirement. To ensure that the maximum amount of flexibility is available across the decision making process requires expertise in real estate, design and construction, and operations. In most companies not all of these skill sets exist or do not exist within the same organization or department Alternately, if they do exist, they often have narrow experience in these areas or, more commonly, conflicting agendas. Therefore, in many instances, the participants in the process may be working with differing goal directives and timetables that bog the project down leading to costly delays in the building of the new facility along with inconsistencies in operational processes and procedures. In short, the inability to take a holistic view of the project often results in sub-optimal decision making with long term costs. The concept of the Industrialization of the Datacenter shifts the responsibility for this holistic decision making process onto an experienced partner. Thus, the customer and the partner are working under the construct of a “division of competency” to ensure that the datacenter



delivered is maximized from a real estate, architectural, design, construction and operational perspective. This division of expertise permeates our economy. For example, FedEx doesn't build its trucks or planes even though these assets are mission critical for the company. FedEx is in the delivery business, not transportation or manufacturing. These goals are most effectively achieved through the use of partners whose business is datacenter facilities. In this area, experience does count and the lack thereof is typically measured in inefficiency and added costs. And in extreme cases, the result is a datacenter that is fallow long before it should be, or over-engineered pet projects that are not in the shareholders' best interests.

The Industrialization of the Datacenter—Components

As the name implies, the concept of the Industrialization of the Datacenter harkens back to the historical constructs of efficiencies derived through the division of component production into smaller, discrete units that maximize the efficiency of delivery of the finished product. The use of a partner allows the customer to focus their efforts on the skill sets that are most closely aligned with the success of their business (applications, for example) with clearly projected costs defined over an extended period of datacenter operations. In evaluating potential partners under this new decision making structure the following components are essential for the establishment of an effective relationship:



Understanding of the “Balance of Forces”

The world of datacenters is no different than any other in that anything can be achieved for a price. Five 9 levels of reliability, fully redundant power architectures and other methods and measures of resiliency and redundancy are all worthy and achievable goals. The important distinction in establishing the primacy of the “buy” decision on the part of a customer is to determine that a potential partner understands the critical relationship between the four forces that affect these decisions. Achieving key operational datacenter objectives is based upon understanding the interrelation between the elements of design, cost, operations and risk. They are all part of any equation used to determine the most efficient method of achieving an operational objective. Due to the importance of today’s datacenter supported applications, the relationship between these four “forces” begins with determining the customer’s level of risk adversity and then determining the most cost efficient solution to be incorporated into their datacenter. The sum of this process is typically based on the customer’s answers to five essential questions:

- What risk am I concerned with and what is the likelihood?
- How can I design my facility to mitigate these risks?
- How can facility operations mitigate that risk?
- What are the capital and operating costs of the various approaches?



- Which investment is the business prepared to make to mitigate that risk?

To exemplify the interplay between these four elements lets look at a brief example: a company with an existing “plus one” generator solution wishes to incorporate an added level of reliability to this structure. Among their options is (1) physically upgrading the design to build this capability into the facility or (2) adding an additional generator to “wheel in” when necessary. Option one is obviously a design related approach with specific higher upfront capital costs. Option two is more operational in nature and may be lower in initial capital expense but higher long term operational cost over the life of the datacenter (and may not totally mitigate the risk of datacenter downtime). Neither approach is necessarily wrong or right on the surface. However, an effective datacenter partner recognizes that achieving the most effective solution must also factor in the customer’s tolerance for risk and the costs they are willing to bear to mitigate it. The important point to recognize in this example is that whatever the selected solution it is a business decision rather than a technical one. Ultimately, the answers to all datacenter issues are guided by the fundamental question: *how much is the business willing to spend to mitigate their level of perceived risk?* This requires the partner to work closely with the customer to understand both their needs and their level of sensitivity to all four areas affecting the final capabilities of the datacenter. To perform this important task effectively, a strong



partner will work with the customer to quantify all elements of the equation, including costs, to enable them to make the most effective business decision possible. The alternative to this “balance of forces” approach are “one off” decisions that generate related issues that result in an increasing level of “scope creep” and associated costs. This is where new datacenters can become the bane of a CIO’s existence.

One Size Does Not Fit All

In terms of datacenters, one size does not fit all. A key function of a partner’s size is the ability to offer its customers a suite of solutions to further erode the limitations of the historical “make” vs. “buy” decision. In practical terms these product limitations equate to a “take it or leave it” approach when attempting to select a datacenter that suits your needs. A strong potential partner is one whose product set has been developed to embrace the full range of customer needs from move-in ready facilities to powered shell offerings for those who wish to build out and operate a facility themselves. In either case, shared facilities instead of dedicated infrastructures, should be optional and only apply to those companies wishing to get an extra level of cost benefit for the lack of control on their own destiny. This multi-faceted product line is analogous to the automotive transport industry where customers are offered cars, trucks and vans to meet their specific desires and requirements. By providing this depth of



product a partner is able to offer multiple alternatives for customers to weigh against their risk mitigation requirements.

The Datacenter is a Product with a Bill of Materials (BOM)

For firms viewing the construction of a new datacenter as a “one off” proposition, the components used for its construction are identified and procured based on the singular requirements of the site. In the “industrialized” approach the construction of the datacenter is the function of an assemblage of standard “parts”. As the facility is viewed not as a single contiguous entity, but rather, a combination of discrete units that are individually optimized to perform at peak efficiency for the area being built out, each project is viewed by the number of these units that will be required to complete the project. Each unit then is made up of its own standard bill of materials (BOM), including components like generators and UPS systems, that are used in the assembly process. It is important to note that alongside these standard components are complementary standards for their actual implementation. Thus, the “assembly” of the base configuration is consistent across sites to ensure both on time delivery of the facility and the highest level of operationally reliability. As a result of these standard BOMs and practices, efficiencies are gained in construction costs, component delivery and the on-going operational expenses of the facility.

An example of this BOM structure is the POD Architecture™ that we use here at Digital Realty Trust. This structure has arisen from our datacenter design



and construction experiences. In North America, the basic building block in this design and construction scheme is a generator system working in conjunction with a common transformer and switchboards to support an 8,000 to 12,000 square foot raised floor space with 1125kW or 1350 kW of IT load. The resulting benefit of incremental construction methods like the POD Architecture is that they allow you to take advantage of “natural breaks” in electrical design to gain peak component efficiency while eliminating the unnecessary waste of materials and their associated costs.

Advanced Supply Chain Methodologies and Accurate Forecasting

Our experiences in working with leading component vendors have enabled us to identify and establish essential processes that facilitate the accurate and timely delivery of components when they are required to ensure our ability to achieve our customer’s required facilities’ delivery dates. Among the initiatives that have arisen from this process of continual refinement (we are now in our fifth generation), are elements such as the development and use of pre-engineered “Digital Realty Trust specific” part numbers, and advanced forecasting techniques. These two elements combine to enable us to achieve a high level of order processing accuracy and efficiency which when coupled with our ability to pre-purchase major components ensures that the right part arrives at the datacenter at the time that it is needed within the production schedule. The confluence of these capabilities provides us with the maximum level of flexibility



DIGITAL REALTY TRUST

in supporting all of our projects in both the U.S. and Europe. Thus, by regularly enhancing our supply chain capabilities in terms of parts and services we continue to bolster our ability to meet our customer's most demanding delivery schedules.

Operational Consistency

Some may attempt to discredit or dismiss the POD Architecture™ design and construction methodology due to “resiliency” requirements. This is not the case however. Through 2007, Digital Realty Trust has a documented uptime level of 99.999% across all of its Turn-Key Datacenter™ facilities. This figure exemplifies our commitment to integrating the use of the “four forces” into our overall corporate philosophy. By examining what is required to achieve the appropriate balance between risk, design, operations and risk we have made the business decision to develop datacenters that consistently achieve this high level of reliability. As a result, our customers have benefited from a cost and operationally effective design and construction scheme with no sacrifice to their level of uptime.

Due to our size and purchasing volume we have also entered into national agreements with a variety of systems and operational vendors. Along with the benefits of reduced costs that we pass on to our customers and our ability to avoid construction delays by receiving equipment when we need it, these contracts also enable us to offer our customers something that many datacenters



DIGITAL REALTY TRUST

can't—consistency. Our goal is the seamless support of your datacenter infrastructure. By drawing upon the experience we have gained in managing over 1.5 million square feet of datacenter space worldwide we have been able to develop well-documented processes and procedures to ensure that each of our facilities operate under the amalgam of our field tested best practices. Through the use of global agreements with firms such as Honeywell, and TEGG, coupled with their use of our documented and field tested procedural guidelines, we are able to ensure that your Digital Realty Trust datacenter in Phoenix will be operated and maintained in the same way as its counterpart in Paris. This capability is further bolstered through our use of of “best of breed” Critical Facilities Management™ software to monitor and administer all of our facilities, both locally and centrally, using a common methodology to eliminate potential areas of misreporting or confusion. Through the power of field tested and documented processes and procedures, Critical Facilities Management™ management software, and global agreements, Digital Realty Trust enables your personnel to focus on what they do well without worrying about the operation of your datacenter's infrastructure.

Size Matters

The primary objective of a potential partner is to harness their market position to deliver to its customers true “economies of scale”. This capability is beyond the scope of both the many regional firms currently providing datacenter



DIGITAL REALTY TRUST

space within the marketplace today and corporate facility's groups. In the case of regional providers their smaller levels of capitalization limit their ability to add and develop properties thereby placing firm boundaries on the benefits that they can actually deliver to potential partners. A viable partner must possess ready access to capital and a diversified portfolio to enable them to deliver the benefits of the functional "economies" required to deliver not one datacenter at a time, but dozens of facilities around the world in the most timely and cost effective manner possible. In the case of internal facilities groups, the limited number of datacenters that they develop since they only service their parent company often dramatically limits their negotiating capability with suppliers and real estate organizations as well as, the benefits of best practices from other industry sectors. Thus they are unable to deliver the benefits of economies of scale that are available through a dominant datacenter provider.



DIGITAL REALTY TRUST

Summary

This new paradigm of the Industrialization of the Datacenter carries with it unique requirements for potential partners including size, experience, and technical knowledge that fall within the range of only a select few firms. The increasing level of importance of today's datacenter based applications requires a greater level of focus by IT personnel than ever before. By using a division of labor scheme that assigns responsibility for the acquisition, design, construction and operation of the facility to a partner, corporate IT staffs are better able to focus on the applications they support from a datacenter they know they can rely on. Based on its position as the industry's leader in datacenter acquisition, design, construction and operation Digital Realty Trust stands as secure choice for those firms seeking a visionary partner to assist them in navigating this rapidly changing marketplace.



DIGITAL REALTY TRUST

About Digital Realty Trust

Digital Realty Trust is the largest purchaser, owner, developer and operator of datacenter space in the industry. Since 2004, we have purchased over \$2 billion in datacenter assets and designed and built facilities across North America and Europe. We currently own over 60 properties in 25 markets and manage over one (1) million square feet of datacenter space worldwide. This is why over 50 Fortune 500 firms rely on Digital Realty Trust to provide their datacenter solutions.