Designing and Building Agile and Scalable Data Centers
IBM Site and Facilities Services helps your business respond to change
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Global Offering Center of Excellence
Data center facility requirements are being driven by four important trends:

- **Cloud**
  - Hybrid environments become the norm
  - Density requirements outpace infrastructure

- **Mobile**
  - Increasing demand for new applications
  - Data center as "first point of contact" for customers

- **Analytics**
  - Extreme performance
  - Located close to customer

- **Social business**
  - Platform for everything from customer support to employee collaboration

**More agility**

**More scalable resources**

**More reliability**

**More bandwidth**

Increasing demand for new applications

Data center as "first point of contact" for customers
Evolving technology forces demand strategy considerations over and above those of traditional IT-centric data centers.

**Facilities**
- Number
- Location
- Controls
- Capacity

**Infrastructure**
- Servers
- Storage
- Network
- Virtualization
- Cloud adoption
- Emerging trends

**Operations**
- Maintenance and support
- Upgrades
- Lease or ownership
- Sourcing and staffing
- IT roadmap
- Continuity

**Financial**
- Transition and recruiting costs
- Cost savings and ROI
- Budgets
- Metrics
- Growth strategy
Data center strategy aligned to business priorities provides a roadmap for agility, scalability, and cost optimization

**Design for agility**
- Choose IT investments that provide the scalability to support rapid changes in demand
- Design mechanical and electrical systems to be redundant and available to avoid disrupting the operation
- Provide cooling support for higher density servers

**Optimize total costs over the long term**
- Measure energy efficiency and power consumption in real time
- Allow for tradeoffs between capital and operating costs
- Implement actions that provide rapid payback
- Migrate and consolidate workloads
- Control operations through a command center

**“Right-size” and scale for future requirements**
- Find underutilized assets and make changes
- Use analytics to define capacity and availability to meet business needs
- Use real-time monitoring and management systems to stay focused continued improvement

**Business growth**
- Operational efficiency and resiliency
- Application availability

Optimize total costs over the long term

Design for agility
Data center professionals need to manage requirements over a 15 – 20 year life – these emerging technology trends add a new variable

**Business objectives**
- Meet business and IT growth
- Align capital and operating costs
- Flexible to support new technology
- Faster time to deploy
  - Reduce risk
  - Security

**Data center requirements**
- High availability
- Provide required capacity
- Optimize capital costs
- Maximize scalability
  - Maximize flexibility for technology and computing model adoption
- Minimize capital and operational costs
- Interconnect IT, data centers and buildings for data center operations

Data center professionals need to manage requirements over a 15 – 20 year life – these emerging technology trends add a new variable
Modular data centers can defer 40-50% of the lifecycle costs providing flexibility for the future including cloud computing.

Data center capital costs
60% costs from mechanical / electrical systems

- Mechanical 20%
- Power 36%
- Instrumentation & Controls 4%
- Shell 7%
- Fit-Up Costs 9%
- Fees 24%

Source: IBM Estimates

Pay as you grow
Modular approach aligns capacity to business need

Year
Power (range of kw)

Big Bang Build
Modular Capacity
Power Consumption over time
The economics of modular data center implementation

"Up-front" vs Phased

- Challenges
  - Big CapEx cost up front
  - Bad PUE at low loads

- Benefits
  - Capacity tracks IT load
  - Reduces part-load PUE penalty

Source: 451 Research, "The Economics of Prefabricated Modular Datacenters" (May 2012)
A singular focus on capital costs can lead to sub-optimized data centers

**Capital Cost Analysis**
Show 5x difference in technology alternatives

**Operating Cost Analysis**
Show 2.5x difference for vendor alternatives

Reduce data center total costs 15-30% over its useful life
Improve decisions looking at vendor and technology tradeoffs
Availability analysis can be used to identify the cost and impact trade-offs for your organization to frame a complex decision.

Additional annual expenses:
- "N": US$498K
- "N+1": US$765K
- "2N": US$980K

Reduction in annual outages:
- "N": 3.618
- "N+1": 3.864
- "2N": 3.865

Cost per outage to justify additional expenses:
- "2N": US$400M
- "N+1": US$1M
- "N": US$498K

1Other applications include cooling system redundancy, electrical system distribution, UPS technology, etc ...
2Based on IBM Proprietary Analytics using expected lifespan of equipment, data center vulnerabilities and operational quality.
“No Regrets” Design Decisions with 1-3 year Payback Based on cost of $0.10 kilowatt hour

<table>
<thead>
<tr>
<th>Design Decision</th>
<th>Payback Period</th>
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</thead>
<tbody>
<tr>
<td>Employ premium efficiency motors.</td>
<td>Less than 1 year</td>
</tr>
<tr>
<td>Provide Variable Frequency Drives (VFD) on pumps and motors.</td>
<td>Less than 2 years</td>
</tr>
<tr>
<td>Use plug fans and EC motors on CRACs.</td>
<td>Less than 3 years</td>
</tr>
<tr>
<td>Select higher efficiency chillers.</td>
<td>Less than 3 years</td>
</tr>
<tr>
<td>Adopt free cooling, check your climate zone for available the number of hours per year.</td>
<td>1,000 hours with less than 5 years</td>
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Variable Speed Pumps

High Efficiency Chillers

Free cooling Water side economizer
Modular design allows for expansion of power and cooling density with minimal disruption to operations

- Electrical and Mechanical system sized to meet future capacity needs.
- Provisioned for potential water cooling.
- Modular UPS design and chiller plant design.
- Electrical switchgear sized to grow. Electrical distribution scalable per module.
- Any to any connectivity between chillers, water side economizers, and pumps.

5 to 10% initial cost increase DC life expectancy

Meeting future high density IT requirement

Adapt Opex and Capex to business needs

Meet growth requirement without down time; match spending to growth

Improved service with lower risk for minimal cost

Piping for water cooling

Modular design – future CRAC capacity

Electrical switch gear – sized to grow
Modular solutions take the best ideas for design, reliability and efficiency and create optimized “modules”

Keep Pace with Business Demands
Standardized solutions result in quick timeframes from order to deployment. Modular data centers can be ordered, customized and delivered to the data center site in a accelerated timeframe.

Ensure future scalability, flexibility and agility
Easily match business demand by either scaling infrastructure quickly or evolving IT strategies.

Drive Efficiency and Effectiveness
Internal subsystems are tightly integrated which results in efficiency gains in power and cooling in the module. In modular solutions, space is used very efficiently and features densities as much as 20 kilowatts per cabinet or more vs. 3 to 5 kilowatts in traditional environments.

Right-size your environment
Enables an optimized delivery approach for matching IT needs. This ability to right-size infrastructure as IT needs grow enables enterprise alignment with IT and data center strategies.
IBM’s family of modular data centers is designed to adapt to various business IT needs—today and tomorrow.

- **Scalable Modular Data Center**
  - Can be installed in existing facility without raised floor
  - 500 – 2,500 square feet
  - Deployed in 8 to 12 weeks after design is complete
  - 15-25% lower TCO than traditional data centers

- **Enterprise Modular Data Center**
  - Turnkey design/build, single or multi-story
  - 5,000 square feet and up
  - Plug-and-play capacity for power and cooling
  - Defers 40-50% of capital cost and operating expenses

- **Prefabricated Modular Data Center**
  - Fully functional data center in a "prefabricated" format
  - Standard sizes and configurations for fast deployment
  - Custom solutions to support unique site and customer needs
  - Suitable for harsh climates

- **High Density Zone**
  - Employs hot-aisle/cold-aisle design
  - Brings cooling to the rack
  - 35% lower cost than site retrofit

1 Based on select previous IBM engagements; individual client results vary.
IBM Compact Cloud Solution:
A self contained cloud data center delivered complete in 6 months or less
A complete solution including compute, storage and networking hardware, software, power, cooling, racks, security, remote monitoring and services.

**Speed & Agility**
Less than 6 months to deliver a complete cloud data center solution, instead of 18 – 24 months for a new data center
Global applications can be configured for use in any country, anywhere in the world

**Future cloud growth**
capability built in to most configurations

**Flexibility & Scalability**
Data center solutions from 100VMs to 10,000VMs
Install outdoors to free up valuable interior space

**Simplified Installation**
Only require power and data connection to operate
Indoor or outdoor installations
IBM Compact Cloud Solution:
Preconfigured private modular cloud solutions
A complete solution including compute, storage and networking hardware, software, power, cooling, racks, security, remote monitoring and services.

X86 Platform
1000 Virtual Machines:
- 3 x 42U IT racks
- 20kW power
- 7kW/rack
- Future growth

2000 Virtual Machines:
- 5 x 42U IT racks
- 41kW power
- 8kW/rack
- Future growth

20000 Virtual Machines:
- 13 x 42U IT racks
- 130kW power
- 10kW/rack
- Future growth

PureFlex Platform
1000 Virtual Machines:
- 1 x 42U IT racks
- 12kW power
- 12kW/rack
- Future growth

2000 Virtual Machines:
- 2 x 42U IT racks
- 25kW power
- 12.5kW/rack
- Future growth

10000 Virtual Machines:
- 4 x 42U IT racks
- 95kW power
- 24kW/rack
- Future growth

Cisco UCS Platform
Configurations and power densities coming soon
IBM Compact Cloud Solution:
Example configuration

- Indoor and outdoor applications
- Support:
  - PureFlex 10,000 VM’s
  - Requires 4 IT racks and 95kW (24kW/rack) using InRow cooling
  - Expandable to 7 IT racks (2x cloud capacity) at 24kW/rack N+1
- Secure and stand alone solution
IBM Compact Cloud Advantages

Complete preconfigured private cloud solutions:
- Compute, storage and network hardware
- Cloud management software / hypervisors
- Data center infrastructure:
  - Critical power and cooling
  - IT racks
  - Security
  - Remote monitoring
  - Structure

Quick to deliver
- Complete data center solution available within 6 months of order
- Not 18 – 24 months for traditional data center design / build

Modular Construction
- Flexible and scalable
- Prefabricated in quality controlled factory
- Witness testing available

More energy efficient than traditional data centers / lower opex
Lower Capex (~15% - 20% less)
What is DCIM?

**Data Center Infrastructure Management** is an emerging suite of software solutions that merges the areas of facilities systems management and IT systems management to provide operators a holistic view of availability and capacity in today’s data centers. DCIM solutions have agnostic data gathering capabilities and present data in a variety of reports and dashboards with the goal of helping data center operators maximize availability and efficiency. While decisions on how to operate the data center are made and implemented manually, it is likely that DCIM solutions will automate much of the data center lifecycle process as we move toward the future.

“DCIM should be a requirement in all major data center builds and renovations.” - Gartner, Magic Quadrant for Data Center Infrastructure Management Tools (Sept 2014)
End-to-end Data Center monitoring and management

BMS
Data Centre Infrastructure Management

IT
Network Management Systems

Capacity Planning
Asset Tracking & Change Management
Energy Monitoring & Management
Environmental Monitoring
Network Management
Alerts

Dashboards Graphical User Interface
RFID Asset Tags Bar Code
Power Circuit Tracing
SENSORS Temp, Humid, Motion, Water, Fire
Intelligent / Manual Patch Management
Data Aggregation Open API
Notifications Alarms SMS / Mail
Automated Control Intelligent Provisioning

Energy Monitoring & Management
Capacity Planing
Network Management
work order Management
Environmental Monitoring
Alerts

End-to-end Data Center monitoring and management

IBM
DCIM selection requires a process

Establish requirements
- Suite or point tool approach

Collect information from the market
- Which vendor capabilities meet your requirements
- Conduct a formal RFI

Engage with vendors for a rigorous Proof of Concept
- Test capabilities and ability to be resourceful
- Ability to integrate with existing toolsets

Down-select to two or three
- Formal RFP and contracting process

Implementation phase
Even efficiently designed data centers can be inefficient at startup if not operated efficiently.
- Ensure high availability
- Save 20-25% on cooling
- Recapture stranded capacity
- Reduce maintenance costs

Challenges with every day operations of the data center can cause waste and inefficiency.
- Ensure high availability
- Reduce cooling usage by 30%
- Ensure SLA compliance
- Continuously improve DCIE

Future data center growth must be diligently managed to minimize TCO.
- Avoid capital expenses for additional, unneeded servers
- Minimize operational expenses by matching Facilities to IT needs

Success depends as much on the integration of stakeholders as it does on the integration of technologies.

- Maintain optimal utilization of IT assets
- Ongoing capacity and energy management
- Match redundancy capabilities to business needs
- Ensure optimal asset utilization with efficient resource management
- Recapture stranded capacity
- Reduce maintenance costs
- Save 20-25% on cooling
- Even efficiently designed data centers can be inefficient at startup if not operated efficiently
AAA of Northern California, Nevada and Utah reduces costs with a modular data center solution in support of their consolidation efforts. Two world-class data centers provide reliable member service support.

The need:
AAA of Northern California, Nevada and Utah serves the travel needs of 4.5 million members. As the company grew, its IT infrastructure became fraught with disparate systems and data centers near natural disaster-prone areas that placed development, test and disaster recovery operations at risk. AAA sought a site and facilities solution to improve its efficiency and mitigate risk.

The solution:
IBM site and facility services designed and built a new, state-of-the-art, energy-efficient Tier 3 data center to provide the foundation for the consolidation of six existing data centers into two new sites that address the current needs and future requirements of AAA of Northern California, Nevada and Utah. Construction of the new site was completed in two months.

The benefits:
- Reduces operating expenses by USD14.2 million in the first year using an energy-efficient, scalable modular data center design
- Decreases data center service delivery time by 75 percent for the business unit and partner clubs
- Delivers disaster recovery capabilities for existing systems and requires disaster recovery provisions for newly deployed systems
A U.S.-based information solution provider developed a cost-justified strategy to support merger and acquisition business growth

**The need:**
- Adjust to rapid growth from years of acquisitions
- Rationalize the IT environment to provide flexibility to support growth
- Reduce the complexity of managing 76 independent data centers.

**The solution:**
- Reduced 76 data centers to six data centers
- Implemented three pairs of redundant centers to provide resiliency
- Defined standardized service levels to ease future integration of acquired IT environments
- Established a five-year transition plan that included data center builds, relocations, staff retraining and process changes.

**The benefits:**
- Reduced corporate operating budget by 50 percent
- Enhanced integration of data center environments of acquired companies
- Implemented zero downtime and data loss to support fault-tolerant computing infrastructure
- Increased acquisition investment returns.

Profile: A U.S.-based global information provider with five corporate divisions
IBM is especially suited to help you optimize your data center facilities to deliver business value.

- Dedicated Site and Facilities team since 1986 with a proven track record:
  - Designed and built over 30M sq. ft. of raised floor worldwide
  - Own and operate over 330 IBM data centers, over 6.3M sq. ft. of data center space
- Global reach with local partners in all geographies
- Full life cycle of services, from assess and plan to design and build
- Understanding of the relationships between facilities and technology and operations
- Technology leadership, from modular data center design to energy efficiency and management
- Single point of contact throughout project