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Design with the Concept of Management & Operations in Mind

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Design with the Intent to Increase Operational Sustainability

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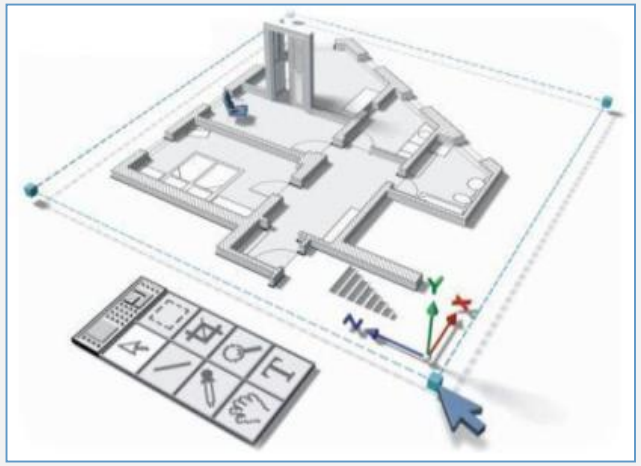
- Data centers are becoming more central to all parts of society (**IoT**), which is increasingly micro-managing things such as traffic systems, airports, hospitals, and utilities…

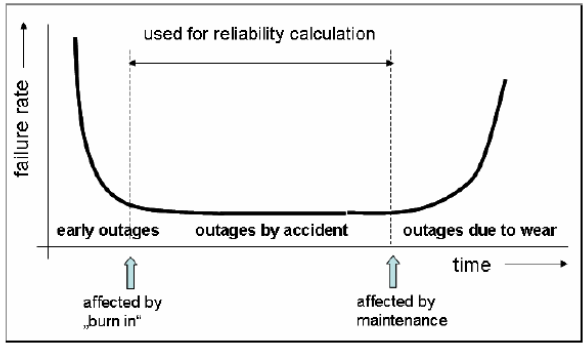
- Data Centers are Mission Critical Facilities (MCF) engineered for high reliability, with the intent to provide services continuously under **Normal, Maintenance, and Emergency Modes of Operations**.

- Data Centers are complex systems depending on both technology and human activity, and will inevitably fail at some point.

- Maximum Availability (Uptime/(MTBF + MTTR)) is achieved by:
  - *Tier Topology (**Tier II, III, IV**), and*
  - *Operational Sustainability (**Management & Operations, Building Characteristics and Site Location**)*

- In most cases, the underlying root cause of failures is **human error** whether during design, installation, testing, maintenance or operation. Increasing data center reliability is a matter of eliminating or reducing that wherever possible.





MTBF = uptime + downtime

Availability = uptime/MTBF

Concept of Data Center Operations Functions

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IT Operations:

Refers to the entire range of IT hardware/ software management (IMACs), IT hardware racking/stacking, equipment monitoring, first response to hardware/ software incidents, NOC, SOC, BCP/ITDR…

Security Operations:

Includes building and grounds security, raised-floor access control, parking lot management, package receipt/dispatch, first response to security breaches and fire/life safety events…

Housekeeping Operations (FM Soft Services):

In addition to all aspects of normal housekeeping, this FM function also includes reception, pantry, janitorial, health & safety, helpdesk, storage, and escorting customers...

Engineering Operations (FM Hard Services):

Refers to building engineers and technicians who are charged with operating and maintaining the site infrastructure, supporting tenants, escorting vendors, supervising project work, first response to infrastructure events and issues, including SOPs, EOPs, MoPs, CMMS…

Operational Sustainability Standard – Uptime Institute

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1. Management & Operations

Staffing and Organization

Shift Presence, Maintenance Hours (PMs, RCMs, Walk-rounds), Organization Structure: IT, Security, Facilities

Computer Room Change Management

PTW process, EIRs, IMACs

Training

Qualification & Skills, Staff & Vendor Training, Incident management, H&S

Operating Conditions

Load Management, Switching/ Rotating, Set Points, SPC redlines

Maintenance

PM Program, W.O., CMMS, Vendor Support, Spare Parts, Housekeeping, Failure Analysis

Planning, Coordination, & Management

Site Policies, Reference Library, Capacity Planning, Lifecycle Planning, Financials

Operational Sustainability Standard – Uptime Institute

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2. Building Characteristics

Commissioning

As-built drawings,
SOO,
Signage +Labeling +Tagging,
5 levels of T&C,
Warranties

Building Features

Purpose Built,
Building Size, Functions & Spaces,
Security and Access,
Setback

Infrastructure

Systems Complexity,
Ease of Maintenance,
Scalability, Modularity

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3. Site Locations

Natural Disasters

Floods, Earthquakes, Hurricanes, Lightning strike…

Man-Made Disasters:

- **Intentional** (Terrorism, Theft, Cybercrime, EMP…)
- **Accidental** (Explosion, Fire, Leaks, ...)

Environmental Conditions

OAT, RH, Dust/Contaminants, Elevation above sea level

Availability Of Services

Police, Fire brigade, Emergency Services

Availability of Utilities

Power, Water, Fiber, Sewage, District Cooling

Availability Of Resources

Qualified Staff, Vendors/OEM, Spares, Consumables

Operational Sustainability Standard – Uptime Institute

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Figure 1. According to Tier Standard: Operational Sustainability, the three elements of Operational Sustainability are Management and Operations, Building Characteristics, and Site Location.

Impact of Site Location on Building Characteristics & Operations

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Operational Sust. Element	Impact Effect	Impact on Bldg. Char. and M&O	Change Opportunity
Natural Disasters	High	Building Characteristics Health & Safety	▪ Building Life Safety, ▪ Train Staff against Natural Disasters, perform emergency drills more frequently
Man-Made Disasters - *Accidental*	High	Building Characteristics Health & Safety	▪ Building Life Safety, ▪ Train staff for firefighting, Evacuation and Assembly point, ▪ Fire Resistance, Fire Stopping, Compartmentalization, Smoke Extraction
Man-Made Disasters - *Intentional*	High	Building Characteristics Security Management	▪ Provide Multiple layers of security challenges to reach Computer Room
Environmental Conditions	High	Maintenance Housekeeping Operating Conditions	▪ Ventilation System, Change Filters more often ▪ CR Deep Cleaning, Clean Equipment from dust, Freeing clogged drains… ▪ Turn to Free Cooling Mode
Availability of Services	Low	Health & Safety	▪ If Emergency Services not available, Provide First Aid Kit and Infirmary facilities, ▪ Train Staff on Emergency Services

Impact of Site Location on Building Characteristics & Operations

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Operational Sust. Element	Impact Effect	Impact on Bldg. Char. and M&O	Change Opportunity
Availability of Utilities	Medium	Building Characteristics Operating Conditions Housekeeping	▪ Increase On-site storage of water, and Septic Tank (based on 3 shifts 24x7), ▪ Turn to DCP Mode ▪ Provide Water Softener for Humidifiers, Air Separator and Chemical dozer for Chilled water ▪ Provide Waste Management gears (oil separator, tank)
Availability of Resources	High	Building Characteristics Organization & Staffing Training Maintenance	▪ Increase Shift Presence, and therefore allocate space to accommodate more staff, including beds, and showers, cafeteria, recreation facilities… ▪ Internal Staff are trained and qualified for break-fix (not only minor PM) ▪ Increase Critical Spare parts and Consumables Safety Stock ▪ Provide storage facilities for Spare parts and tools, plus a Workshop ▪ Provide on-site storage for larger fuel capacity, and Fuel Polisher

Impact of Design on Building Features & Operations

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Operational Sust. Element	Impact Effect	Impact on M&O	Change Opportunity
Purpose Built (Enterprise Or Commercial)	High	Computer Room Change Management	▪ Process for Deliveries, in-Transit Storage, and Decommissioning ▪ Understand PTW, IMACS, EIRs processes ▪ Specify Field devices for DCiM
Building/Campus Size	Medium	Computer Room Change Management Maintenance	▪ Separate Car Park for Visitors and Staff, ▪ Separate access for material deliveries (Fuel/Water Tankers) ▪ Install a Dock Leveler, Service Elevator and Winch, ▪ Have a space for Forklift and Trucks ▪ Facilitate walk-rounds ▪ Ensure Faster Response to emergencies,
Support & Specialty Spaces	High	Computer Room Change Management Maintenance	• Provide NOC, SOC, IT support, BMS, and Engineering offices, Command Center (Crisis Management Team) • Provide meeting rooms, multi-purpose room, and other facilities such as larger loading dock, trash room, staging, IT storage, handling equipment storage, offices for Accounting, Customer Service… • Allocate space for Workshop, Spare parts and Storage of Consumables

Impact of Design on Building Features & Operations

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Operational Sust. Element	Impact Effect	Impact on M&O	Change Opportunity
Security & Access	High	Security Management	• Define Process for Access of DC Staff, Vendors, and Customers • Define Process for Access for People and Material • Provide Vehicle Trap, Turnstile, Speed lanes, Mantrap, Biometric, Dual-authentication • Provide CCTV monitoring, Intrusion detection, Real-time Location system
Setback	High	Security Management	• Ensure enough Standoff distance and provide perimeter anti-ram engineering (bollards, fences, planters), • Apply the concept of 5D's, or Crime Prevention through Environmental Design (CPED) • Facility Hardening and Blast Resistance
Life Safety	High	Health & Safety	• Civil defense requirements and Life Safety (travel distance, dead ends, means of egress, assembly points) • Fire protection means (Fire blankets, PFE, Trolleys, FHC, Fire Hydrants)

Impact of Design on Infrastructure & Operations

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Operational Sust. Element	Impact Effect	Impact on M&O	Change Opportunity
Systems Complexity	High	Commissioning Maintenance	• Plan for Testing & Commissioning • Know who will Operate and Maintain the system • Simplify SOPs, EOPs (Isolation, Sustain, Restoration) • Ensure Concurrent Maintenance and Fault Tolerance
Space, Power, Cooling Redlines	Medium	Operation Conditions	• Provide Design Limit (max. loading. Maximum OAT), • Plan Redundancy and Failover architecture (run/standby), • Ensure Power balancing, Avoid Stranded Capacities
Ease of Maintenance	Medium	Maintenance	• Provide Handling Equipment, Overhead Crane/Hoist, • Provide Adequate Space for Maintenance, Accessibility, • Provide enough Lighting, Power sockets, Disconnect switch • Provide Space for Installation/Retrieval of Equipment
Flexibility for Capacity Increase	High	Commissioning Capacity Management	• Show clearly Phasing of Construction on Drawings and BoQs • Ensure Flexibility in scalability (Hot-Swappable)
Infrastructure for Support Operations	High	Maintenance Incident Management	• Provide design requirements for Building Automation BMS/SCADA, LAN/WAN of Building services • Specify Field devices For Power Monitoring EPMS and DCiM

Impact of Design on Commissioning & Operations

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Operational Sust. Element	Impact Effect	Impact on M&O	Change Opportunity
As –Built drawings	High	Training Maintenance	• Use BIM from design up-to commissioning to facilitate transition management and handover to Ops. • Provide Details of Panel Boards, Cable Routes and Pathways • Use Exposed Conducting and Trunking for ease of traceability
Signage, Labeling & Tagging	High	Training Maintenance	• Show Location of Posters, Warning Signs • Provide numbering for Rooms, Doors, and Keys (Master) • Use Color Codes, LOTO, Mimic power flow • Decrease MTTR (increase Uptime) by facilitating PM and RCM activities • Provide unique and robust/durable, labeling and proper tagging, for quick identification
SOO	High	Commissioning Training Site Config. Policies Maintenance	• Provide SOO for BMS/SCADA, FAS, ACS, PAS to facilitate transition management and handover to Ops. • Provide Site Configuration policies under different modes of operations (Normal, Maintenance, and Emergency)

Impact of Design on Commissioning & Operations

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Operational Sust. Element	Impact Effect	Impact on M&O	Change Opportunity
Testing & Commissioning	High	Commissioning Training Site Config. Policies Maintenance	• Ensure all five levels of T&C are clearly specified FWT, SAT, FCT, FST, especially IST • Specify and provide BoQ items for Load banks, Fuel and other resources for T&C • Provide Testing & Commissioning scripts for proper Transition to Ops • Ensure replacement of certain Consumables after Commissioning (fuel, filters, fuses)
Warranties	Medium	Maintenance	• Specify after sales support (frequency of PM, RCM response time), • Ensure that Engineering skills and critical spare parts availability locally, • Specify Parts and labor that should be covered under warranty

Impact of Design on Management &Operations

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Operational Sust. Element	Impact Effect	Impact on M&O	Change Opportunity
Staffing & Organization	High	Building Features Maintenance	• Determine Operations Head Count • Account for Specialty spaces and support functions
Training	Medium	Training Reference Library	• Provide Training facilities, • Specify Training Simulation Software and/or Web Based Training Tool
Planning Coordination & Management	Medium	Capacity Planning Life Cycle Planning	• Separate/Reduce Impact of future phases on Current Operations especially during commissioning • Ensure chosen Technology will be supported in the future
Maintenance	High	Security Management Maintenance	• Separate IT from Maintenance • Separate Network from Systems • Separate Access to Service Providers and IT Vendors (Multiple Staging and Storage rooms)
Operating Conditions	High	Switching Schedule	• Provide Switching Schedule (Rotating redundant equipment Make before Break)
Change Management	High	Computer Room Management	• Allow Flexibility in IT equipment choices (rack sizes, types) • Facilitate storage, movement, handling, and retrieval of ITE

Q & A

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