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Planning for Data Center Physical Layout and Support Center Space

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Executive Summary

Planning for the physical layout and design of the data center building space should include more than just the equipment room. For example, areas for loading equipment, storage, and support personnel should be included in building space allocations to ensure that all space requirements of the data center are included in a high level budget.

This note will address:

- Allocating building space to support areas related to data center activity and functions.
- Planning for the physical space layout of the equipment room.
- Recommendations for allocating space in the data center building on an architectural level.

Consider all data center functions and space requirements before drawing up final architecture plans and determining a budget for the data center building space.



Implementation Point

Before data center building or refresh plans can be finalized, IT must pay careful attention to the layout and design of building space. Along with the room that houses servers and data center equipment, space must also be allocated to support rooms that relate to other data center functions and activities. A complete design will include building space that has areas of workspace for internal and external personnel, storage areas for extra equipment, room for cable and electrical requirements, as well as data center equipment.

While not all support areas are necessary for every data center, it is crucial to explore and evaluate what is required before the final build stage. Smaller data centers may only require minimal workspace, and can combine areas to include multiple functions and activities, while larger data centers may require separate areas for all functions and activities. However, it is still important for enterprises with both small and large data centers to examine data center needs and activities before committing to final building space design plans.

The emphasis for space allocation decisions should be based on the workflow of the data center to try to achieve a balance between cost and flexible space for future business growth and change. Some high-level criteria for space allocation might include:

- **Security.** Can the layout be utilized so that it enhances physical security and controls access to sensitive equipment?
- **Accessibility.** Consider the ease of access for delivering equipment. This should not only include small form factor servers, but also larger units for future changes such as power distribution units (PDU), air conditioners, and server cabinets.
- **Workflow/Function.** The layout should accommodate the functional usage of the facility and allow for efficient workflow, movement, and transport. These act as the input to the different areas in the facility such as build rooms, office spaces, mechanical rooms, power distribution, and network distribution.
- **Ingress/Egress.** The physical layout of the facility should not work counter to the outside services (power feeds, fiber/carrier data feeds) coming into the building. For example, if all the feeds enter the facility from the street on the north side, then having the mechanical rooms located on the south side of the facility will introduce additional costs to ride those feeds across the building. The placement of these types of network and power distribution spaces should minimize cabling requirements, not increase them.

Allocating the required building space to all critical data center functions and activities related to the enterprise will ensure that all aspects have been addressed in the estimated and finalized budget. Failure



to consider support space along with the equipment room can severely increase final data center costs as last minute or after-the-fact changes are expensive.

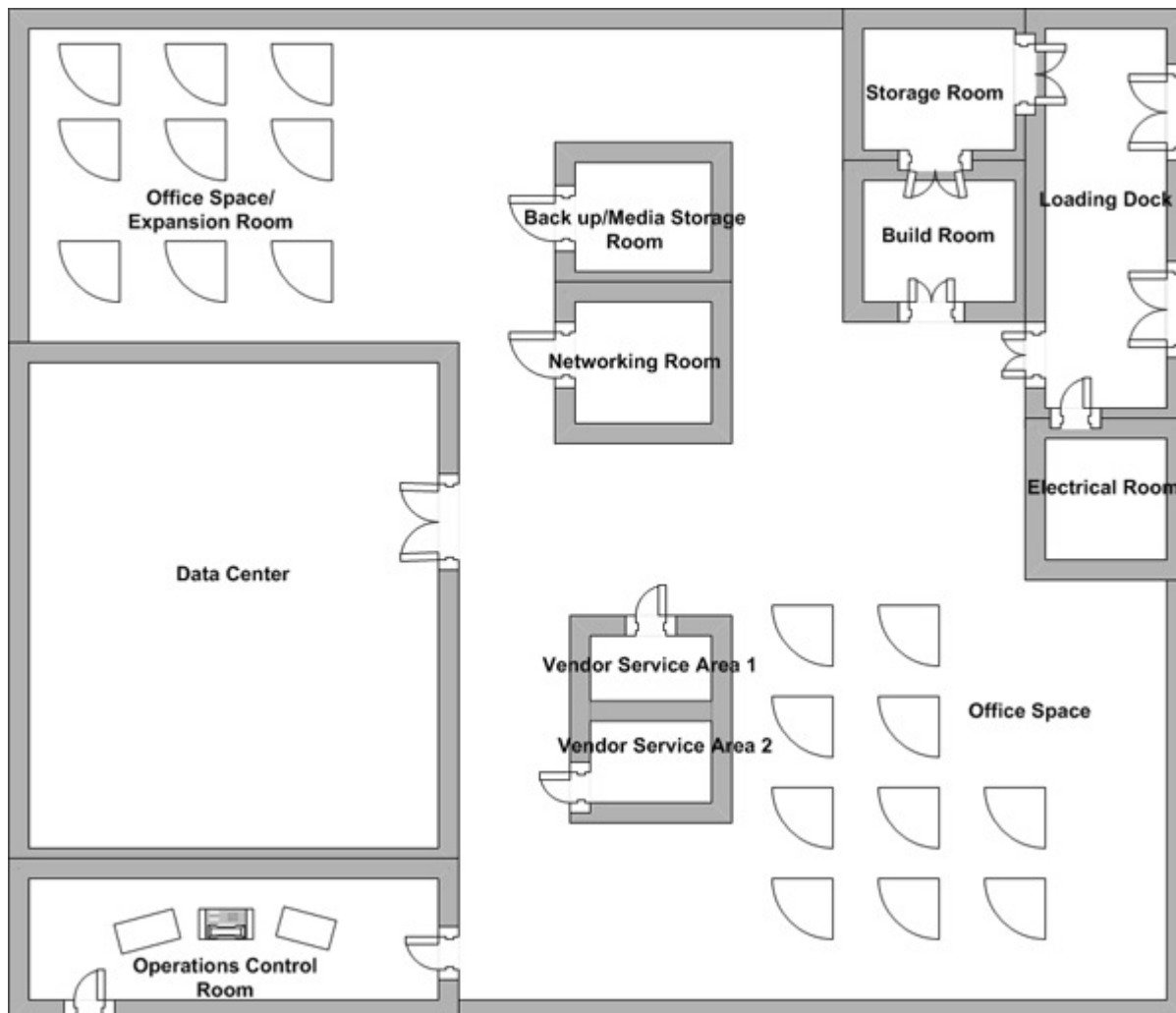
Key Considerations

Depending on data center activities and the size of the enterprise, there are multiple areas that should be taken into account. Although it is not a requirement to have all of the following, each function and activity should be considered during the planning phase.

Figure 1 is an example of a data center building layout that includes all support areas. Refer to this illustration for a visual explanation on the following support and equipment areas. Note that this illustration is not to scale as the size of each room will vary amongst organizations based on their needs.

Figure 1. Data Center Physical Room Layout

Source: Info-Tech Research Group, adapted from Alger, D. (2005). *Build the Best Data Center Facility for Your Business*. Indianapolis: Cisco Press



- **The electrical room** is used to store electrical equipment and switches that support the data center. It is usually separated from the data center to prevent electromagnetic interference with other equipment. This area can also be used to store backup batteries or generators.
- **The networking room** is the area where the structured data cabling route ends for the site. It includes all networking aspects of the data center and may include separate networks for desktop computers. It is generally equipped with a level of security, cooling, power, and standby power similar to the data center. The networking room does not need to be located near the data center; however, keeping it in a centralized location can save on cost of cabling.
- **The loading dock** is used to receive items such as servers, server racks, and other equipment for the data center. It should be able to accommodate various sizes of trucks where equipment can be easily transported into the building. Although it is convenient for the loading dock to be



situated close to the data center, it should not be located in the data center itself, as this may pose a security threat. It is best to have the loading dock lead to the build or storage room to prevent dust, dirt, and air exchange from entering the data center and damaging equipment.

It is also important to consider the placement of the loading dock for later stages in the building design process. In particular, floor loading and specific pathways for heavy equipment. For example, if a large AC unit has to be brought into the facility later on in the data center lifespan, how will it be transported from the loading dock to the equipment room without having to move racks or damage the floor?

- **The build room** is devoted to the unpacking, setup, and pre-configuration of data center equipment for system administrators and network engineers. It is essentially an empty room to assemble and house equipment before it is installed in the data center. Allocating an area where boxes are unpacked prevents dust, cardboard, and debris from entering the data center and damaging equipment. It also prevents clutter in the data center which can be a fire hazard. The build room should be in close proximity to the loading dock and the data center. It is best practice to keep the build room at the same temperature as the data center to acclimate the equipment before installation.
- **The storage room** is used to store equipment, generally on a short-term basis, that is waiting for repair or assembly, or for extra equipment meant for future use such as server racks and air handler filters. In a smaller organization, the storage room and build room would be combined as it is not entirely necessary to have both. It should be located in an area that is close to the data center and loading dock, and is generally about 15% of the size of the data center. It is best practice for the storage room to be equipped with the same security and kept at the same temperature as the data center and build room.
- **Operations control center** is an area where data center personnel can remotely monitor data center equipment. If a problem arises, employees in the operations control center are notified to deal with the matter immediately or contact the appropriate employee. The operations control center is traditionally equipped with multiple monitoring devices and telephones. This room does not need to be in close proximity to the data center. As a separate room, it is generally found in larger facilities or outsourced.

Although many enterprises still include an operations control center in the data center, it is not always a necessary space. Some IT departments keep the room as a security measure, to showcase IT's importance, or to use as part of a tour for visiting clients. If the organization has an operations control room, it should be a workable space. Part of it can be used as a meeting room equipped with a whiteboard and other collaboration tools for IT projects.

- **The backup room** is used as a workspace for employees monitoring backup devices to decrease the amount of activity taking place in the data center and prevent the risk of accidental



downtime. It is found mainly in larger facilities and should be in close proximity to the data center. Smaller facilities may combine this room with the media storage area.

- **The media storage area** is used to store any magnetic or optical storage devices that are used to back up data center information. The devices are kept in a separate room from equipment to limit dust, debris, and clutter in the data center. Depending on data center activity and media and backup storage needs, the media storage room can be combined with the backup room; however, to be conducive to a disaster recovery strategy, it is best to locate media storage in a separate building altogether.
- **The vendor services area** allocates space to specific vendors to come in and provide support and maintenance for equipment. The size and quantity of these rooms will depend on how many vendors require access, and the level of security required. Depending on the level of involvement, some vendors may have separate rooms. These rooms are especially common in environments with a mainframe. Smaller facilities and organizations may provide an area of office space, or a cubicle, to accommodate incoming vendors instead of a dedicated room.
- **The equipment room** is the main room in the data center building. It houses all critical equipment such as servers and storage devices that are essential to the continuity of the business. This room requires multiple considerations when planning and designing its space and layout. When designing the layout for the equipment room, plans should also include:
- **Physical security design.** The equipment room should not contain any exterior windows, doors, or skylights. It should also not have any windows facing inside the building. There should not be any access into the equipment room from any other support room in the building.
- **Clearances.** There should be a clear path or hallway that connects the build room, storage room, and loading dock to the equipment room to ensure that equipment can be transported. All entrances should have a minimum clearance height of 8 feet, and width of 4 feet. The height between the subfloor and false ceiling should be at least 10.5 feet to allow for a raised floor of 18 inches, and server cabinets 7.5 feet tall. This will also allow for extra space between the cabinet and the false ceiling.
- **Server cabinets.** Before installing server cabinets, a plan for their location and an estimate of their space should be determined. The number of server cabinets should be estimated based on both current and future business needs to sustain the equipment room.
- **Server row space.** Space between server rows will depend on building codes which vary by geographical location. A common standard for server rows is a minimum of 36 to 42 inches for walkways.
- **Major infrastructure components.** Equipment such as power distribution units, air handlers, and fire suppression storage containers should be placed in the equipment room first, as they may be oddly shaped and may require different layout options.
- **Raised floor.** Data centers that contain a raised floor in the equipment room may require a ramp. The ramp can be placed in the equipment room or in the hallway leading up to the data



center. Space must be allocated accordingly if the ramp is placed inside the data center. The raised floor should have a minimum height of 18 inches. Floor tiles for the raised floor should be estimated at 2 X 2 feet and be able to hold at least 2000 pounds of equipment in total.

- **Structural columns.** Space for structural columns must be accounted for when laying out the data center and surrounding rooms. These are most prominently important in geographical locations that experience natural disasters such as hurricanes and earthquakes, as more structural columns will be required in these areas.
- **Shape.** When possible, the data center should be square or rectangular in shape to optimize the available space and accommodate equipment. It is best to avoid areas in the building with alcoves or odd shapes.
- **Future expansion.** When planning space and location for the equipment room, it is best practice to locate it in an area where future expansion is possible. Anticipate expansion by locating the equipment room near a group in the organization that can be displaced at a later date, or establish a first right of refusal for neighboring properties in the lease. Not only is it important to have a room nearby that can expand the data center, but the room should also be easily transformed for efficient expansion and lower costs. Areas such as electrical rooms or kitchens are not good options for future expansion as they contain devices that are difficult to remove or work around, and require more construction. Figure 1 shows the data center beside office space.

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1. **Estimate data center sizing first.** Before laying out plans for the data center and surrounding rooms, a high level estimate of the required data center size should be determined. Engineers must know how much space they are working with in order to plan for space allocation. There are many methods used to estimate data center size. A good starting point is to use the employee-based sizing method.
2. **Determine which support rooms are needed.** Based on the size of the data center and its activities and functions, it is likely that only some of the support rooms mentioned in this research note are necessary for the organization. Some rooms can be combined to save space such as the storage and build rooms. The operations control center, although not a necessary support room, can be used as access control into the data center for security purposes. In smaller data centers, space can be saved by providing vendors with cubicles instead of designing separate rooms. Determine which support rooms are necessary before planning a layout for data center building space.
3. **Choose a space that can be expanded and consolidated.** Future business needs for data center expansion should be taken into consideration when finding a location for the data center. Conversely, if the data center needs to be consolidated due to decreased business needs or outsourcing, IT must be able to do so as well. Look into expansion and consolidation options



when planning the data center layout and location to ensure that they are feasible possibilities for the future.

4. **Map out possible layouts.** Before finalizing location and layout of the data center and surrounding facilities, IT should map out what the final design should look like to provide a few options to choose from. When taken to professionals, these maps can decrease costs and aid in final plans. It is best practice to use programs to prepare neat scale drawings, rather than free hand drawing to ensure that measurements are accurate and changes can be made efficiently. Although most layouts will differ, Figure 1 provides a representation for a layout example highlighting the areas and rooms discussed in this research note.
5. **Place the largest objects in the drawing first.** After determining the size and shape of the data center, place objects in the data center to ensure it is the appropriate size to fit all equipment. For example, in the equipment room, it is best practice to start with the largest objects such as HVACs, PDUs, and fire suppression systems as containers like these may be oddly shaped and take up more room.
6. **Consult with professionals.** Before drawing up the final plans for the physical layout of the data center and support rooms, IT professionals should seek external expert advice to ensure that all aspects have been accounted for.

Bottom Line

The physical layout of the data center building space should be carefully calculated and planned before the refresh or build stage. Apart from the room that houses servers and equipment, there are other support areas important to data center functions and activities that must be considered. Consider all aspects of the data center building to allocate space and determine a high level budget.