Prefabricated White Space Module Time Study: Lessons from a High-Density Liquid-Cooled Deployment

White Paper 238

Version 1

Data Center Research Center

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Executive summary

Modern high-density compute deployments can require complex physical infrastructure in the IT space, including high-density power distribution, liquid cooling piping, containment, cable pathways, and supporting structural frameworks. AI workloads are a primary driver of these requirements, increasing pressure to deploy capacity quickly and predictably. Traditional construction relies heavily on onsite assembly, integration, and testing, which can extend schedules and introduce execution risk. Prefabricated IT pods shift critical work to a factory environment, where systems are engineered, assembled, and validated before delivery.

In this paper, we quantitatively compare traditional and prefabricated approaches to white space deployment, drawing on installations observed at a Compass Datacenters campus. The findings demonstrate how modular pods can shorten onsite installation time from 75.5 hours to 15 hours per pod, representing an 80% reduction for the configuration studied. By shifting work offsite and enabling parallel project activities, this approach can help bring AI compute capacity online sooner.

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Key takeaways

1. **Modern white space infrastructure increases coordination demands amid growing pressure to accelerate deployment.** Higher-capacity power distribution, liquid cooling piping, cable pathways, containment, and the supporting frameworks needed to mount and secure these systems must be integrated within the same overhead and rack-adjacent space, making system integration and installation sequencing more complex.

2. **Prefabrication shifts assembly and integration from the site to the factory.** Infrastructure systems can be assembled and validated offsite while site preparation proceeds in parallel, reducing the amount of work and trade coordination required within the white space.

3. **The modeled comparison indicates an 80% reduction in onsite installation time.** The prefabricated IT pod configuration evaluated in this study was jointly developed by Schneider Electric and Compass Datacenters to meet the deployment requirements of a high-density, liquid-cooled data hall. This design required 15 hours of onsite installation activities, compared with 75.5 hours for the traditional case. The traditional onsite time included 20.5 hours for containment system handling and installation plus an estimated 55 hours for field installation of the ceiling-supported technology cooling system (TCS) loop, busway, and cable shelving.

4. **Pre-integration reduces field-intensive activities.** The largest reductions come from replacing field layout, framing, overhead support, panel installation, trim, and field-fabricated end conditions with pre-integrated assemblies and a shorter onsite sequence.

5. **Standardization enables predictable, repeatable deployment and continuous improvement.** A common prefabricated IT pod design and installation sequence reduces site-specific engineering and coordination across repeated deployments. Factory-validated assemblies and repeatable installation procedures help reduce variability and improve predictability. Measured installation durations decreased from 18 hours to 15 hours between observed prefabricated deployments, demonstrating how deployment efficiency can improve over successive installations.

Introduction

Higher-density computing environments increase both the capacity and complexity of the physical infrastructure required in the IT space. AI workloads are a primary driver of this trend, with higher rack densities, large clusters of similarly dense racks, and increasing adoption of liquid-cooled servers placing new demands on data center infrastructure. These racks concentrate power and cooling demand within the data hall, increasing the amount of infrastructure that must be installed and coordinated around the IT equipment. White Paper 110, How Six AI Attributes Change Data Center Design, describes the broader characteristics of AI workloads and their implications for data center infrastructure.

Delivering power to high-density racks requires careful consideration of attributes such as distribution capacity, voltage, conductor requirements, and equipment placement. Many high-density servers, including those supporting AI workloads, use direct liquid cooling, adding technology cooling system (TCS) piping, coolant distribution units, connections, and structural supports within or near the IT space. White Paper 126, Retrofitting Existing Power Systems for AI Clusters, examines power considerations for existing facilities, while White Paper 210, Direct Liquid Cooling System Challenges in Data Centers, describes liquid-cooling architectures and their supporting facility infrastructure.

Power and cooling infrastructure must also be coordinated with containment, cable pathways, structural supports, and the IT equipment itself. In a traditional buildout, much of this infrastructure is assembled onsite, where multiple trades work within the same space and dependencies among activities can limit parallel work. These conditions increase installation effort, coordination requirements, and schedule risk.

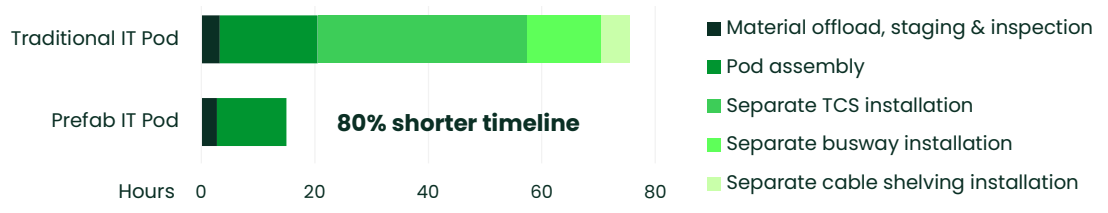
At the same time, rapidly growing demand for compute capacity, particularly AI capacity, is increasing pressure to bring new computing capacity online faster. This has elevated the importance of deployment methods that reduce onsite construction effort and shorten the time required to deliver operational IT white space.

Prefabricated IT pods, also referred to as white space modules, offer a different deployment model within the data hall. Power distribution, cooling piping, containment, cable pathways, and supporting structures can be assembled and validated on the pod frame in a factory before delivery. This allows factory production and site preparation to proceed concurrently while reducing the amount of assembly, integration, and trade coordination required onsite.

We quantify the onsite installation-time impact by comparing a traditional IT pod buildout with a prefabricated IT pod co-engineered with Compass Datacenters and deployed at one of their campuses. The comparison focuses on the pod frame and the associated infrastructure systems required to prepare the pod for IT equipment installation, including containment, busway, cable-support shelving, TCS piping, and supporting structures. As summarized in **Figure 1**, the prefabricated approach can reduce onsite pod installation time from 75.5 hours to 15 hours per pod, representing an 80% reduction for the configuration studied. This is largely the result of needing separate installation phases for TCS, busway, and cable shelving installation with traditional IT pods, significantly lengthening the project timeline.

Figure 1

Comparison of onsite installation time for traditional and prefabricated IT pod approaches



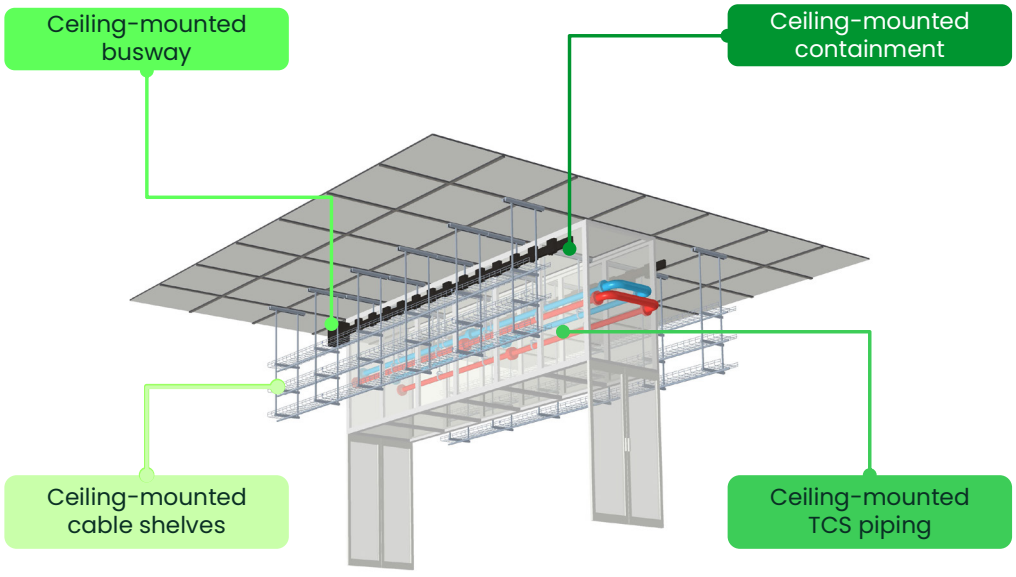
To place these findings in context, we first examine the challenges of traditional IT space buildouts and the characteristics of prefabricated IT pods. We then explain how modularization and factory integration streamline deployment activities before presenting the results of the comparative deployment-time study. Lastly, we discuss additional benefits that prefabricated IT pods can provide throughout the project lifecycle.

Challenges of traditional IT pod buildouts

A traditional IT pod buildout refers to an approach in which the primary IT space infrastructure systems are delivered separately and then assembled, routed, and integrated onsite. These systems may include power distribution, technology cooling system (TCS) piping, air containment systems, facility cooling piping for rear door heat exchangers (RDHX), cable pathways, and the structural systems needed to support them. Where racks must be installed or removed independently, the containment structure must also be supported independently of the racks. An example is illustrated in Figure 2. Although each system is well established, integrating them within a high-density liquid-cooled environment can require significant onsite labor, coordination, and field installation effort.

Figure 2

Example of a traditional IT pod, showing the containment, TCS piping, busway, and cable shelving, all supported by the ceiling.



Material receiving and packaging management

Traditional whitespace deployments generally require infrastructure systems to be delivered as numerous individual components. These components must be received, unpacked, inspected, organized, inventoried, and staged before installation can begin.

The large number of individual items increases the effort required for material handling and job site logistics while creating additional opportunities for misplaced components, delivery issues, or installation delays. Storing and staging these materials can also consume floor space needed by other trades.

In addition, the packaging associated with these deliveries can generate substantial quantities of cardboard and other protective materials that must be managed throughout the installation process. Collecting, sorting, removing, and recycling packaging material adds to housekeeping responsibilities and may create additional site-management and waste-handling requirements.

Coordinating multiple infrastructure systems

Traditional deployments require multiple infrastructure systems to be installed and integrated within the same physical space. As rack densities and cooling requirements increase, the available space for routing and equipment placement becomes more constrained. TCS piping must be routed alongside power distribution, cable pathways, containment systems, and structural supports while maintaining required clearances, accessibility, and serviceability. Valves, electrical distribution equipment, and other components must remain accessible after installation is complete. Installation teams must coordinate designs, material delivery, and construction activities across multiple disciplines to ensure that systems can be installed without interfering with one another.

Installing ceiling-mounted support systems

In traditional IT pod deployments, TCS piping, busway, cable pathways, and other supporting equipment are frequently suspended from ceiling-mounted support systems[1] as shown in **Figure 2**. These systems can alternatively be routed below a raised floor, although that approach presents different access, space, coordination, and maintenance considerations. Before these infrastructure systems can be installed, crews must first establish the supporting framework using channel supports, threaded rods, hangers, brackets, and attachment hardware. The weight of these systems collectively, and across multiple pods, means the ceiling must be designed to withstand this significant load.

Installing the support structure requires field layout, anchoring, leveling, alignment, and inspection activities at elevated heights, including repeated positioning and movement of lifts as work progresses. Once the support system is in place, individual infrastructure systems must be separately lifted, secured, and supported from the overhead framework. In liquid-cooled environments, overhead support systems may be required to carry several thousand pounds of piping and coolant[2]. White Paper 263, Analysis of How Data Center Pod Frames Reduce Cost and Accelerate IT Rack Deployments, estimated that installing 1,000 ft² (93 m²) of ceiling-mounted support

[1] Ceiling support structures may range from engineered overhead framing systems such as Unistrut® metal framing and T-grid assemblies to custom structural frameworks. Heavier infrastructure systems, particularly liquid-cooling piping, may require square steel tubing, angle iron frameworks, reinforced attachment points, or direct anchorage to concrete structural elements to safely support the imposed loads.

[2] For the pod configuration evaluated in this study, the TCS piping system weighs approximately 2,949 lb (1,338 kg) empty and 5,393 lb (2,446 kg) when filled with coolant.

infrastructure can require roughly two days of labor, illustrating that the support system itself represents a meaningful portion of the overall deployment effort.

Traditional TCS piping installation

TCS piping is one of the most significant infrastructure additions associated with high-density AI deployments. In a traditional buildout, the piping system is typically delivered as a separate installation scope from the containment structure itself.

Once the piping assemblies are fabricated, they are transported to the deployment site, where they are installed and connected as part of the onsite construction process, requiring crews to separately receive, stage, lift, align, support, and inter-connect multiple overhead pipe sections while working around containment systems. Because TCS piping systems have more stringent quality requirements than conventional facility piping, constructing and commissioning the system onsite can increase installation time and require additional quality-control measures to ensure consistent performance.

Field integration and rework

Traditional buildouts require numerous infrastructure interfaces to be created and verified onsite. Alignment differences, insufficient clearances, incompatible connection points, or conflicts among piping, power distribution, containment, cable pathways, fire protection systems, and other overhead room infrastructure may not become apparent until adjacent systems have already been installed.

Resolving these issues can require repositioning equipment, modifying supports, or rerouting piping and cable infrastructure. In some cases, portions of the cooling system may require additional inspection, pressure testing, or commissioning activities following modifications. These conditions can increase onsite labor requirements and introduce variability into deployment schedules.

Together, component-level installation, onsite system integration, and field coordination make deployment outcomes more dependent on site conditions and construction execution.

Prefabricated IT pods

A prefabricated IT pod is a modular white space deployment approach that integrates a structural frame with selected power, cooling, containment, and cable-management infrastructure before delivery to the data center. The pod provides predefined attachment and connection points for the infrastructure systems supporting a group of IT racks. Depending on the configuration, factory-integrated elements may include TCS piping, facility water piping for RDHXs, containment components, cable pathways, and power distribution. Schneider Electric's RapidScale IT Pod is an example of this approach.

Prefabrication can take many forms, including containerized modules, power and cooling skids, and prefabricated equipment rooms. The approach examined in this paper focuses on integrated IT pods installed within a larger data hall to support a defined group of IT racks. The example prefabricated IT pod in **Figure 3** illustrates the structural frame and major infrastructure elements.

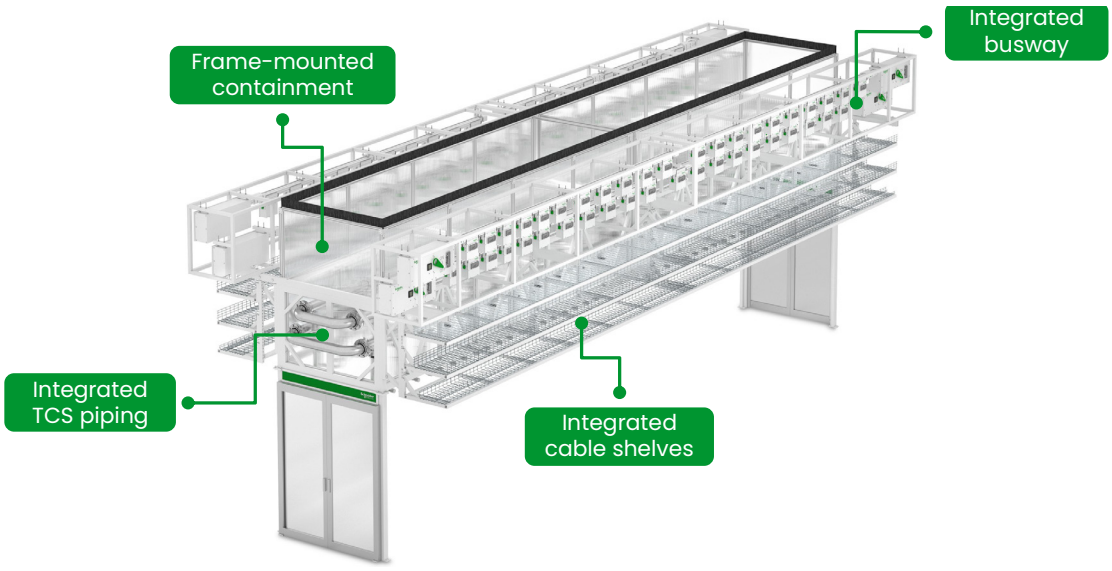


Figure 3

Example of a prefabricated IT pod for a high-density liquid-cooled white space, including busway, TCS piping, containment, and shelving for power and data cables.

Unlike traditional deployments, where these systems are delivered and installed as separate scopes, prefabricated IT pods consolidate selected physical infrastructure into transportable module assemblies. Component locations, support structures, and connection points are established during the design and manufacturing process, allowing portions of the infrastructure to be assembled and integrated before arriving onsite.

The division of work between the factory and the deployment site varies based on project requirements, transportation constraints, and site conditions. In the factory, components may be fabricated, installed, aligned, inspected, and, where applicable, tested prior to shipment. At the deployment site, crews receive and assemble the pod sections, position and anchor the structure, complete remaining assembly activities, and prepare the pod for subsequent facility and IT system connections.

For liquid-cooling deployments, much of the TCS piping can be installed directly on the pod frame in the factory. Pipe routes, support locations, valve placement, and connection points are established as part of the module design. The pod frame supports the integrated piping rather than relying on separate ceiling-supported infrastructure for those sections. Factory-installed piping sections can be cleaned, passivated, and leak tested prior to shipment, reducing onsite integration effort before final flushing, pressure testing, and commissioning of the complete TCS loop. The approach shifts selected fabrication, integration, and verification activities from the deployment site to a controlled manufacturing environment.

Transportation and site access considerations

Realizing the benefits of prefabrication requires early planning for transportation, handling, and site logistics. Unlike traditional onsite construction, where infrastructure components are delivered separately and assembled within the facility, prefabricated assemblies must be designed around transportation and access constraints from the outset. Module dimensions and section sizes must be compatible with the transport

envelope[3] and the facility's access route, including doors, corridors, turns, and other potential restrictions. Its size and weight also influence rigging and crane access, and the amount of staging space required. Evaluating these conditions during design and deployment helps ensure that the prefabricated assemblies can be delivered and installed as intended while preserving the benefits of factory integration.

How prefabrication compresses the onsite construction schedule

The differences described in the previous sections fundamentally change the amount of work that must be completed onsite. Traditional deployments require separate installation and integration of support structures, containment, power distribution, cable-management systems, and TCS piping. In contrast, the prefabricated approach shifts portions of this work into factory-integrated assemblies. The following deployment-time study quantifies how these differences affect onsite installation duration and labor requirements.

Deployment time study

This study compares the onsite installation of a 1.2 MW traditional IT pod assembled onsite with a functionally comparable prefabricated IT pod. The prefabricated IT pod was co-engineered by Schneider Electric and Compass Datacenters to meet the deployment requirements of a high-density, liquid-cooled data hall, and occupies approximately 1,000 ft^2 (93 m^2). Both approaches provide the structural frame, containment, TCS piping required, busway, and power and data cable-support infrastructure to support 42 rack positions with 2N redundancy.

All 42 rack positions are served by the TCS distribution, allowing liquid-cooled racks to be placed anywhere within the pod rather than confined to a dedicated liquid row or position. This provides deployment flexibility as rack densities evolve over time. The pod supports up to 42 rack positions and 1.2 MW of IT load, with rack count and power capacity acting as independent design limits. As rack densities increase, the power capacity may be reached before all rack positions are occupied[4].

The objective is to evaluate how integrating infrastructure before delivery affects onsite deployment activities, installation sequence, and overall installation duration. Rather than comparing individual components in isolation, the analysis considers the complete set of activities required to physically assemble the pod structure, install supporting infrastructure, and complete installation verification activities. As shown in **Figure 1**, the prefabricated IT pod reduces onsite installation time by 80% compared with the traditional deployment approach.

The following sections describe the study scope, methodology, detailed findings, and discussion of the results.

[3] Transport envelope refers to the maximum physical dimensions and weight that can be transported from the factory to the site without requiring special handling, permits, or route modifications.

[4] The 42 rack positions represent maximum floor utilization, which supports lower-density air-cooled racks if required. Using all 42 positions means an average of ~29 kW per rack.

Study scope and methodology

The analysis begins with material offloading and staging, and ends with completion of installation verification and quality checks immediately prior to a Level 2 inspection.[5] Activities occurring after this milestone, including facility power and cooling connections, IT rack installation, startup, commissioning, and operational testing, are outside the scope of the comparison.

To create a functionally equivalent comparison, both deployment approaches include the structural frame, containment, TCS piping, busway, and power and data cable-support infrastructure required to support the pod environment.

The prefabricated IT pod schedule is based on observed installation durations from an actual Compass Datacenters deployment. The traditional deployment schedule is based on observed installation durations from an actual traditional containment system installation, supplemented with estimator-developed schedules for the additional TCS piping, busway, and power and data cable-support infrastructure required to achieve a functionally equivalent traditional deployment. The comparison therefore combines observed installation data with estimator-developed schedules for activities that were not present in the observed traditional installation, as summarized below:

- **Prefabricated IT pod:** Task durations observed during an actual installation at a Compass data center.
- **Traditional IT pod containment system:** Task durations observed during an actual traditional installation at a Compass data center.
- **Traditional IT pod infrastructure systems:** Typical installation durations developed by MEP scheduling specialists for the TCS piping, busway, and cable-support infrastructure required for a functionally equivalent traditional deployment.

To establish a consistent comparison basis, several assumptions were applied:

- The same crew size was used for both projects.
- The gantry lifting system required for the traditional installation is assumed to be installed and available before the start of work.[6]
- All offsite fabrication and manufacturing activities associated with either deployment approach are excluded because the study focuses exclusively on onsite deployment activities.
- For the traditional deployment, installation of the ceiling support structures used to suspend containment, busway, cable-support infrastructure, and TCS piping is assumed to have already been installed and verified before the analyzed installation sequence begins. As noted earlier, this can be a meaningful portion of the overall deployment effort, adding two days per pod.

[5] Construction & Commission, "Level 2 inspection ensures the successful delivery, installation, and thorough verification of all equipment, facilities, and components through pre-start-up activities".

[6] A gantry lifting system is a temporary freestanding beam-and-hoist structure used to lift and position pod components during installation. MEP scheduling specialists estimate approximately 2 to 3 hours for assembly and setup.

- For the prefabricated deployment, the floor required to support the pod has been appropriately specified, constructed, and verified before the installation sequence begins. Structural accommodations required to support pod loads, such as increased slab thickness, additional reinforcement, or higher-strength concrete, are assumed to have been completed prior to pod delivery and are excluded from the deployment-time comparison.
- Traditional TCS installation assumes pipe spool subassemblies are prepared offsite, installed with clear access, no field welding, and no significant delays caused by trade sequencing or concurrent construction activities in the same work area.
- Installation of coolant distribution units (CDUs), computer room air handlers (CRAHs), and power distribution units (PDUs) are excluded from the deployment-time comparison because they fall outside the pod-level scope evaluated in this study.

Results and findings

The prefabricated IT pod reduced onsite installation time by 80% compared with the functionally equivalent traditional deployment. This reduction was not driven by faster execution of the same tasks. Instead, several installation activities required in the traditional deployment were either eliminated onsite or substantially reduced because containment, TCS piping and supports, busway, and cable-support infrastructure were integrated into the pod before delivery. Therefore, in the traditional approach installation of TCS piping, busway and cable-support trays require separate phases in the process, adding to the project timeline.

To better understand where these time savings occur, the installation sequence was divided into five major phases: material handling, pod assembly, TCS installation, busway installation, and cable-support infrastructure installation. See the **Appendix** for details of the steps analyzed in each phase.

Figure 4 compares the activities associated with receiving, offloading, staging, and inspecting materials prior to installation. While the prefabricated deployment requires slightly more time for delivery and staging activities, the difference is largely attributable to the handling of larger, preassembled pod components delivered on two trucks. These assemblies must be carefully offloaded, transported into the facility, inspected, and positioned for installation. In contrast, the traditional deployment consists primarily of smaller, individual components that can be unloaded and staged more quickly. However, the traditional approach shifts additional effort downstream, requiring crews to unpack, organize, and verify a significantly larger number of discrete components in the field. As a result, the modest increase in receiving and staging effort for the prefabricated deployment is offset by substantially reduced installation activities later in this phase.

Figure 4

Comparison of tasks in the pod material offload, staging & inspection phase of the project



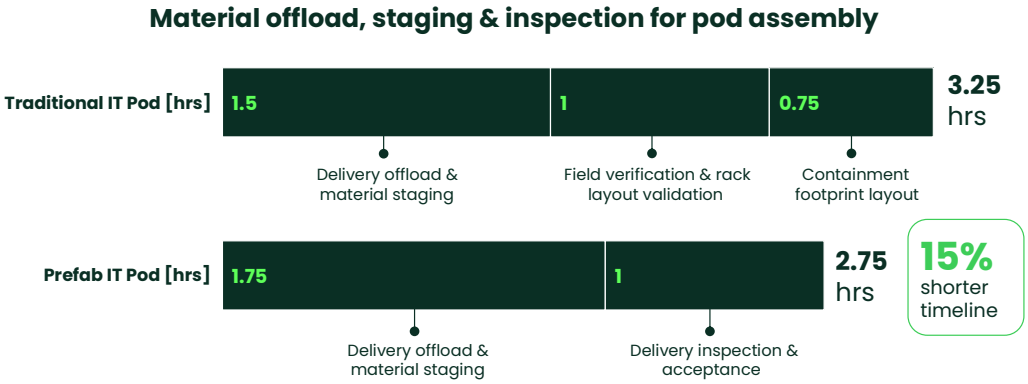


Figure 5 compares the activities required to assemble the pod structure and containment system. While both approaches result in a completed containment enclosure, the scope of work accomplished during this phase differs significantly. In the traditional deployment, pod assembly is largely limited to constructing the containment structure from individual framing and enclosure components. The prefabricated deployment extends beyond containment assembly by incorporating the supporting cooling and power infrastructure into the same sequence. The structural truss is delivered in two 22.5 foot (6.9 m) halves, each including pre-mounted TCS piping that is joined together to create the 45 foot (13.7 m) truss assembly. After the pod is lifted and anchored, busway assemblies and cable-support shelving are installed. As a result, the prefabricated deployment exits this phase with multiple infrastructure systems already in place, whereas the traditional deployment must still complete separate TCS, busway, and cable shelf installation activities before reaching an equivalent level of completion.

Figure 5

Comparison of tasks in the pod assembly phase of the project



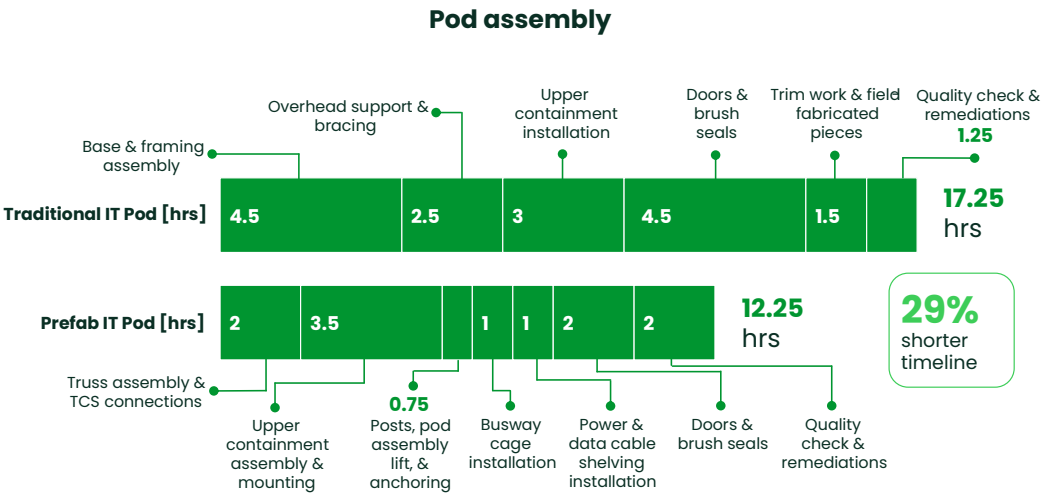
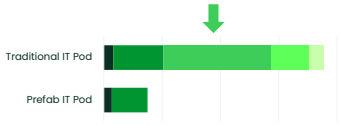


Figure 6 highlights one of the largest differences in onsite scope between the traditional and prefabricated deployments. Following containment assembly, the traditional liquid-cooled IT pod requires a dedicated TCS installation phase involving material staging, elevated pipe installation, loop connections, and final quality inspections. Crews must first offload and stage individual pipe spools and fittings before beginning installation of the supply piping network. Once the upper supply

piping is in place, crews need to install the lower return piping network, often working around previously installed components and within increasingly congested overhead spaces. These activities require multiple installation passes, coordinated material handling, and sustained elevated work to complete the cooling loop. Together, the TCS installation activities account for 37 hours of onsite labor. In contrast, the truss & TCS connections for the prefabricated IT pod required 2 hours, as illustrated in **Figure 5**.

Figure 6

Comparison of tasks in the separate TCS piping installation phase of the traditional project



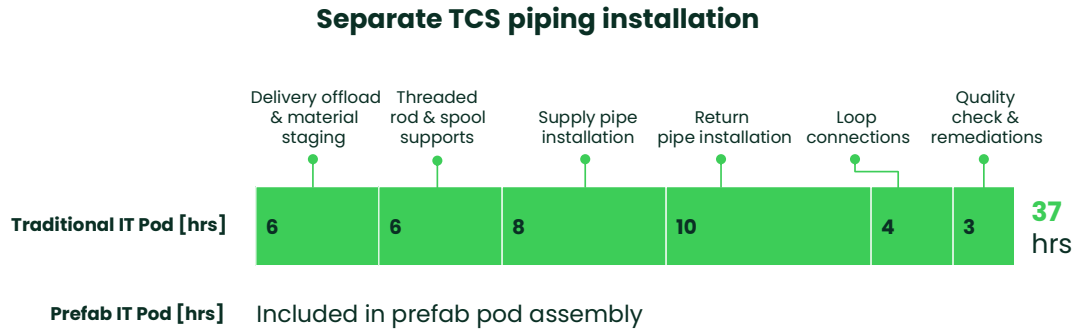
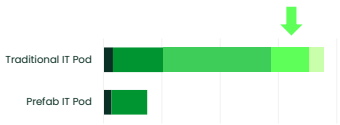


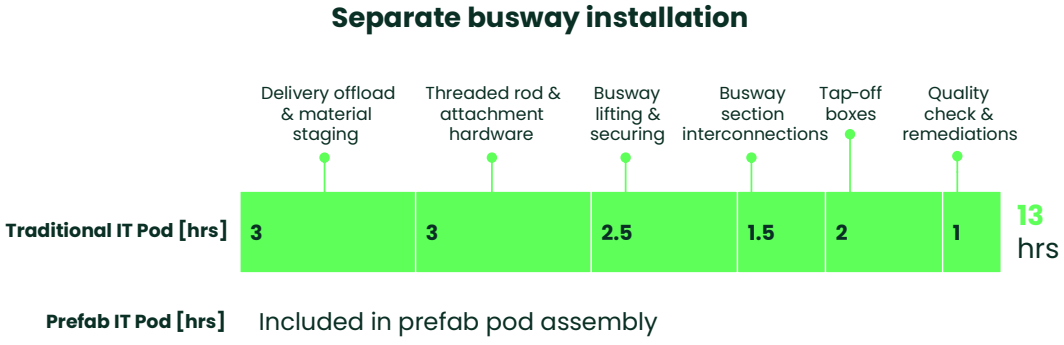
Figure 7 and **Figure 8** show that a common contributor to both busway and cable-shelving installation effort with the traditional approach is the need to construct dedicated overhead support systems using threaded rod and attachment hardware suspended from the ceiling-mounted support structure. This work is typically performed in multiple stages, requiring crews to repeatedly access the overhead workspace to install supports and then return to install the actual system components.

Busway sections must be lifted, aligned, secured, and interconnected. The traditional design analyzed required joining four busway segments and an end tap box plus numerous plug-in units for each of four busway straights. In the prefabricated deployment, as was illustrated in **Figure 5**, the busway is delivered within an integrated busway cage assembly that is mounted directly to the pod structure, eliminating much of the onsite busway assembly and alignment effort.

Figure 7

Comparison of tasks in the separate busway installation phase of the traditional project



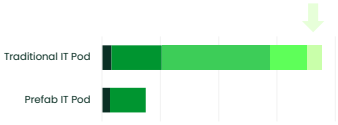


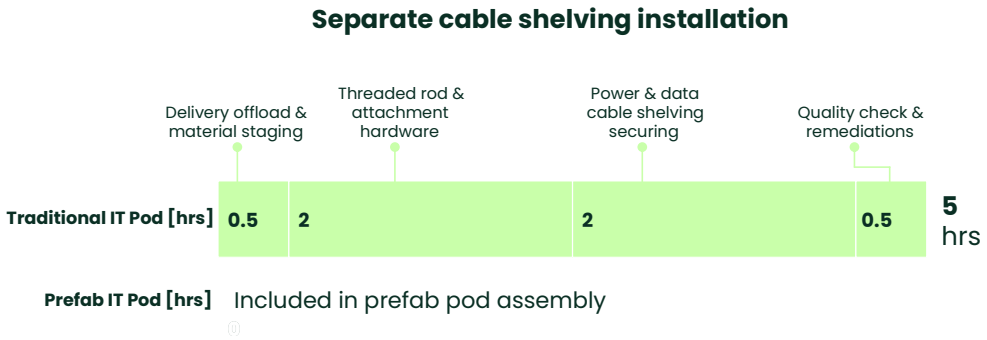
Also, because busway and shelving each require their own dedicated support arrangement, many of the same elevated installation activities must be repeated to enable the mounting of separate shelving segments. By comparison, both the busway and shelving mount to the prefabricated module frame directly rather than requiring complex overhead support assemblies. This not only reduces onsite installation effort,

but also avoids the additional ceiling reinforcement infrastructure required to suspend and support these systems from the building structure.

Figure 8

Comparison of tasks in the separate cable shelving installation phase of the traditional project





While the prefabricated IT pod required 15 hours of onsite installation time, the functionally equivalent traditional deployment required 75.5 hours. This represents an 80% reduction in onsite installation duration (see **Table 1**). The reduction is not attributable to a single installation activity. Rather, it results from integrating TCS piping, busway, and cable-support infrastructure into the pod before delivery, eliminating the need for separate onsite installation of these systems. While both approaches require material handling, assembly, alignment, and quality verification activities, the traditional deployment requires additional infrastructure installation work that accounts for most of the difference in total deployment time.

Table 1

Comparison table results with percentage time saved

Phase of project	Traditional IT pod [hrs]	Prefabricated IT pod [hrs]	Percentage time saved
Material offload, staging & inspection for pod assembly	3.25	2.75	15%
Pod assembly	17.25	12.25	29%
Separate TCS piping installation	37	0	100%
Separate busway installation	13	0	100%
Separate cable shelving installation	5	0	100%
TOTAL	**75.5**	**15**	**80%**

Note: TCS piping, busway, and cable shelving for prefabricated approach is installed during pod assembly.

Learning curve effects

Installation performance can improve as deployment teams gain familiarity with assembly procedures, tooling requirements, and installation sequencing. This effect was observed during deployment of the prefabricated IT pod, where an installation 15 pods earlier required 18 hours to complete onsite activities, compared with 15 hours for the installation analyzed in this study, representing a reduction of 17% in onsite installation time.

Unlike traditional deployments, where installation activities can vary from project to project based on site layouts and constraints, supporting infrastructure, and field coordination requirements, prefabricated IT pods are delivered as standardized and repeatable assemblies. The integrated design allows installation teams to perform the same core deployment activities repeatedly, creating opportunities for process refinement and improved execution across successive deployments.

The observed reduction in duration suggests that a portion of the installation duration is attributable to workforce familiarity and process optimization rather than the inherent complexity of the deployment itself.

Additional benefits of prefabricated IT pods

This deployment time study demonstrates the value gained from a measurable reduction in onsite installation time through the use of prefabricated IT pods. Having each pod engineered once and then produced repeatedly under controlled conditions, introduces additional advantages that compound as organizations scale their data center capacity. These benefits include more consistent quality with reduced risk, greater repeatability across deployments for future expansions, lower total cost of ownership (TCO), and the ability to adapt the design as needs evolve.

Controlled quality and reduced risk

Consistent quality results from moving fabrication into a controlled manufacturing environment. The structural frame, power distribution supports, cooling piping, and containment are integrated, inspected, and tested before shipment, allowing issues to be identified and corrected earlier and with less disruption than in the field. As a result, onsite assembly becomes shorter and more predictable, reducing the construction risks associated with site congestion and coordination among multiple trades operating in the white space.

The TCS integration illustrates how these benefits extend beyond construction and into reduced operational risk. In a traditional buildout, crews must stage, align, support, and connect numerous pipe sections onsite, creating opportunities for variation, rework, and installation errors while potentially generating more debris within the white space, which can increase the cleaning and verification effort required before the space is turned over for IT equipment installation. In a prefabricated pod, the TCS loop is assembled, mounted, and verified in the factory, requiring only a limited number of connections onsite. This reduces installation variability, minimizes disruption within the white space, and improves confidence in the long-term reliability of the cooling infrastructure. This relationship between standardization and reliability aligns with the findings of White Paper 163, Benefits and Drawbacks of Prefabricated Modules for Data Centers, which identifies improved reliability as a key benefit of standardized, pre-tested designs.

Repeatability and ease of scaling

As discussed in the previous section, repeatable pod designs can improve installation efficiency as deployment teams gain experience. Beyond these learning-curve effects, repeatability also simplifies the expansion of data center capacity by allowing proven designs, assembly processes, and deployment methods to be reused across additional pods, buildings, or campuses.

Once a pod design is engineered and validated, the same bill of materials, assembly processes, and installation sequence can be reused across additional deployments. This standardization facilitates rapid scaling of IT infrastructure while reducing engineering effort and enabling capacity to be added incrementally as demand grows.

Because a greater portion of the infrastructure arrives as a pre-integrated assembly, expansions can often be completed with less construction activity, trade coordination, and disruption within operational data center environments. The ability to reuse a proven design and deployment approach can also improve predictability across successive expansion projects, helping organizations scale capacity more efficiently as demand increases.

Reduced total cost of ownership

Because of the above stated ease of scaling, prefabricated modular IT pods enable capacity to be deployed incrementally as demand grows, rather than deploying capacities for uncertain future loads. This reduces the need to install power and cooling infrastructure years before it is required. Moreover, these future deployments may have significantly different requirements that could make early overbuilds obsolete. The scalable prefabricated approach provides flexibility as AI rack densities, power requirements, and cooling architectures continue to evolve while helping avoid the cost and risk of stranded capacity associated with overbuilt infrastructure.

White Paper 218, Quantitative Analysis of a Prefabricated vs. Traditional Data Center, found that prefabricated deployment can achieve cost parity or modest capital cost savings compared with traditional construction, demonstrating that faster, more predictable deployment does not necessarily come at a cost premium. White Paper 164, TCO Analysis of a Traditional Data Center vs. a Scalable, Containerized Data Center, further quantified the long-term financial benefits of prefabricated deployment, showing nearly a 30% reduction in total cost of ownership (TCO) when modular power and cooling infrastructure is deployed incrementally and scaled alongside load growth.

Together, these findings suggest that the economic value of prefabrication extends beyond construction efficiency by helping align infrastructure investment with actual capacity demand and reducing the likelihood of overbuilt, under-utilized infrastructure.

Engineering agility and continuous design improvement

Over the course of the Compass Datacenter deployment, the pod design evolved as project requirements changed. Certain pod configurations removed liquid cooling and later units increased in density. Because the pod is a pre-engineered platform with established structural interfaces and a defined installation sequence, these changes were largely contained within the module. Adding or removing a system did not require re-coordinating overhead supports, routing, or trade sequencing across the white space, and refinements were incorporated directly into the next unit scheduled for fabrication rather than retrofitted in the field. In a traditional buildout, the same change discovered midway through construction is more disruptive, because the affected systems are already installed and interdependent onsite.

Next steps

Prefabricated IT pods substantially reduce onsite installation effort by shifting assembly, integration, and verification activities to the factory. However, the achievable benefit depends on how effectively the pods are integrated into the broader facility design and construction plan. Project teams considering this approach should take the following steps:

1. **Evaluate prefabrication early in project planning.** Consider modular pod options before major project decisions are finalized. Use manufacturer reference designs, Tradeoff Tools, and prefabrication specialists to assess whether the anticipated deployment scale, schedule, site conditions, and degree of design repeatability make the project a suitable candidate for prefabrication.

2. **Compare functionally equivalent deployment scopes.** When assessing the schedules and costs of different design options, include all planned pod-level infrastructure and installation activities, including supports for traditionally ceiling-mounted systems. Also account for project activities such as installing and verifying the building's ceiling support structure or confirming that the floor can support the pod and its integrated equipment, including concentrated loads at support points.

3. **Define factory and field responsibilities.** Establish which components will be fabricated, integrated, inspected, and tested before shipment, as well as the connections, assembly activities, and verification steps that will remain onsite. Document these boundaries by system to avoid gaps or overlapping responsibilities among suppliers and trades.

4. **Confirm site readiness and installation logistics.** Validate access routes, staging areas, floor conditions, lifting methods, anchoring requirements, structural constraints, and the sequence for positioning and assembling the pod components. Coordinate factory production and delivery with the milestones required for the site to receive and install the assemblies.

5. **Standardize the pod design and refine it across deployments.** Reuse common interfaces, bills of material, and installation sequences where practical, while incorporating lessons learned and changing rack, power, and cooling requirements into subsequent builds. Track installation durations, field modifications, and interface issues to identify improvements for later pods.

About the authors

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Acknowledgements

Special thanks to **James Kummer**, **Alan Gonzalez, Dustin Barks, Robert McDaniel, Robert Gillis, Joseph Bergesch, Maria A. Torres Arango,** and **Mayela Sanchez** for their expertise and technical review of this white paper.

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Appendix

Table A1 details the tasks included in the traditional deployment time analysis, while **Table A2** details the corresponding prefabricated deployment tasks, from equipment delivery onsite through Level 2 inspection readiness.

Table A1

Traditional IT pod deployment steps included in this analysis

Task	Description
MATERIAL OFFLOAD, STAGING & INSPECTION FOR POD	
Delivery offload & material staging	Receive and offload delivered containment pod materials, remove packaging as needed, perform material shakeout, and stage components and installation hardware at the designated work area.
Field verification & rack layout validation	Verify field dimensions, rack layout, alignment of pod, and opening height against the design requirements before installation begins. Confirm that site conditions and equipment locations support the planned containment layout.
Containment footprint layout	Lay out the hot aisle containment footprint, including control lines, framing boundaries, and door locations, to establish reference points for subsequent assembly.
POD ASSEMBLY	
Base & framing assembly	Assemble the primary containment framing, including vertical framing members, upper framing, and structural support components.
Overhead support & bracing	Install the overhead attachment brackets and connect the assembled containment framing to the ceiling-supported structure. Secure and brace the assembly in its final position.
Upper containment installation	Install the upper containment panels and associated brackets, then position and secure the panels along the top of the containment structure to complete the overhead enclosure.
Doors & brush seals	Install the sliding-door assemblies, adjust the doors for proper operation, and install the brush seals, foam gaskets, and related sealing hardware along the containment openings.
Trim work & field-fabricated pieces	Install trim, closure pieces, end-condition components, and other field-fit elements required to complete the containment structure.
Quality check & remediations	Perform final alignment, inspection, punch-list work, cleanup, and remediation of identified deficiencies.
SEPARATE TCS PIPING INSTALLATION	
Delivery offload & material staging	Receive and offload pipe skids, transport pipe sections to the work area, and prepare rigging points.
Threaded rod & spool support system	Install threaded rods, support brackets, spool supports, and attachment hardware required to suspend and support the TCS piping system from the existing overhead support structure.
Supply pipe installation	Lift and position the upper supply-pipe spools, align and bolt the center flange connections, set the required elevation, install the prefabricated support and L-brackets, and complete final alignment for each supply run.

Table A1 (continued)

Task	Description
Return pipe installation	Lift, position, align, connect, and support the lower return-pipe runs. Complete the work below the previously installed upper piping, which can restrict access during installation.
Loop connections	Install the return bends or loop sections that complete the piping loop, perform final flange tightening, verify piping alignment, and inspect the installed supports.
Quality check & remediations	Verify piping elevations and support spacing, confirm that flange connections are torqued as required, complete the installation inspection and cleanup, and correct identified deficiencies.
SEPARATE BUSWAY INSTALLATION	
Delivery offload & material staging	Receive and offload busway materials, remove packaging as needed, and stage busway sections, tap-off units, support components, and attachment hardware near the installation area for lifting and assembly.
Threaded rod & attachment hardware	Install threaded rods, support brackets, and attachment hardware required to suspend the busway system from the existing overhead support structure.
Busway lifting & securing	Lift, position, align, and secure the 16 busway straight sections onto the installed support hardware to establish the overhead power-distribution pathway.
Busway section interconnections	Install busway joint connectors, connect adjacent busway sections, and torque connections in accordance with manufacturer requirements to create four continuous busway runs.
Tap-off boxes	Install and secure plug-in-units (PIU) at designated locations along the busway to provide power-distribution points for the IT racks below.
Quality check & remediations	Verify busway alignment, support attachment, section interconnections, tap-off unit installation, and connection torque requirements; inspect the completed installation and correct identified deficiencies.
SEPARATE CABLE SHELVING INSTALLATION	
Delivery offload & material staging	Receive, offload, inspect, and stage cable shelving sections, support components, threaded rods, brackets, and attachment hardware in the installation area in preparation for assembly.
Threaded rod & attachment hardware	Install threaded rods, support brackets, and attachment hardware required to suspend the cable shelving system from the existing overhead support structure.
Power & data cable shelving installation	Lift, position, align, and secure cable shelving sections onto the installed support hardware to provide overhead pathways for power and network cabling.
Quality check & remediations	Verify shelving alignment, support attachment, hardware tightness, and overall installation quality; inspect the completed installation and correct identified deficiencies.

Table A2

Prefabricated IT pod deployment steps included in this analysis

Task	Description
MATERIAL OFFLOAD, STAGING & INSPECTION FOR POD	
Delivery offload & material staging	Receive, offload, inspect, and stage prefabricated pod assemblies, upper containment assemblies, busway cages, shelves, doors, and installation hardware in the work area in preparation for assembly.
Delivery inspection & acceptance	Verify delivered components for shipping damage, completeness, and conformance with project requirements prior to installation.
POD ASSEMBLY	
Truss assembly & TCS connections	Position the prefabricated truss assemblies, join the two truss sections together, join the two TCS sections together, and install the required crossbars, shelf offset brackets, and structural support components.
Upper containment assembly & mounting	Assemble the upper containment section, position it on the pod structure, and secure the containment assemblies and mounting brackets in their final locations.
Posts, pod assembly lift, & anchoring	Lift the assembled pod structure into position, install and secure the support posts, and anchor the assembly to the floor.
Busway cage installation	Lift, position, and secure the two busway cage segments on each side of the pod structure (four total), and join the segments at their connection points.
Power & data cable shelving installation	Position, align, and secure the shelving assemblies to provide overhead pathways for power and network cabling to distribute to racks in the pod.
Doors & brush seals	Install and adjust the sliding-door assemblies, brush seals, and associated hardware required to complete the containment enclosure.
Quality check & remediations	Verify assembly alignment, anchoring, containment installation, door operation, TCS piping, busway cages, shelving; inspect the completed installation and correct identified deficiencies prior to inspection.