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Synopsis

Within the data centre industry, the subject of modular data centres continues to be a source of widespread debate, disagreement and misunderstanding. This is particularly the case when discussion focuses on the extent to which modular data centres offer relative cost advantages over traditional alternatives.

In order to make sense of the diverse views that exist on the relative cost benefits of modular facilities over traditional alternatives, DCD Intelligence got together with three leading industry vendors to produce this white paper. The paper offers a neutral and independent analysis of the various costs that are involved in deploying and operating a modular data centre, and the extent to which these differ from traditional build models.

Contents

4 INTRODUCTION
6 MODULARITY AND MARKET DRIVERS
9 ASSESSING TOTAL COST OF OWNERSHIP (TCO)
11 PLANNING AND PREPARATION COSTS
14 DEPLOYMENT COSTS
18 OPERATIONAL COSTS
23 DECOMMISSIONING AND REDEPLOYMENT COSTS
25 CONCLUSIONS

Introduction

There are many factors to consider when assessing the cost deploying a data centre. This is true of both modular and traditional data centre facilities. This research, based on a sample of data centre technology providers and end users, suggests that cost savings can be achieved when a modular build is opted for. Among the factors contributing to lower costs are the shorter timeframes and less complex processes involved in installing and commissioning a new data centre. During operation, another source of cost savings to modular data centre operators is the enhanced energy efficiency which modular technology is able to achieve compared with many traditional data centres. Despite this, as this paper shows, a simple comparison of the costs involved in deploying and operating a modular facility relative to a traditional data centre is complicated by a range of other factors.

Modular data centres continue to grow in popularity, as evidenced by growing investment in modular technologies and by a recent spate of modular deployments by organisations across a diverse range of geographies and industry sectors. Organisations cite various reasons for investing in, or being attracted to, modular solutions. These include the significantly shorter timeframes required to plan and deploy a data centre. They also include reduced complexity – both in the deployment and operation of data centres – and enhanced performance thanks to a module's standardised repeatable design. Many modular vendors, and some end users, also refer to cost savings over traditional data centres as a key attraction of the modular model. However, as this paper demonstrates, the question of whether modular data centres offer cost advantages over traditional builds is more complicated than some commentators suggest. Although some end users certainly testify to the cost savings their own modular data centres have enabled over a range of traditional-build alternatives, other end users refer not to absolute cost savings, but rather the modular facility's ability to give them greater cost control. Cost control is not exclusive of cost savings. Nor however, is it the same thing. In addition to making the costs of data centre deployment more predictable, modular end users assert that the modular model gives them greater control over operational costs.

"A TCO approach to understanding the relative cost advantages of modular facilities over traditional alternatives needs to consider the entire lifecycle of a data centre from the planning and design stages through to eventual decommissioning"

In the discussions with modular data centre users which formed part of the research for this paper, some operators appeared unclear or unconvinced about the extent to which modular data centres offer absolute cost savings over traditional models, especially when a total cost of ownership (TCO) analysis is applied. A TCO approach to understanding the relative cost advantages of modular facilities over traditional alternatives needs to consider the entire lifecycle of a data centre from the planning and design stages through to eventual decommissioning. Some attempts to compare the costs of modular and traditional models only take into account the cost of deploying and operating the data centre. However, this approach means that many of the costs that are applicable to both modular data centres and traditional builds are overlooked. In addition, it is important to consider the range of hidden costs that can arise in the case of both traditional and modular deployments.

In some cases, the ability of modular data centres to deliver real cost savings for operators over traditional alternatives appears more obvious. These include cost savings on the labour required to deploy a data centre and the energy-related cost savings associated with running a data centre on a day-to-day basis. However, with regard to operational cost savings related to staffing and maintenance, some end users appear unconvinced about the extent to which modular technologies offer them a comparative advantage. Actual experiences with modular solutions vary considerably among different end users.

It is also important to acknowledge the challenges facing any attempt to calculate, with accuracy, the relative cost advantages of modular data centres over traditional alternatives. These include the relative immaturity of the modular market: end users, many of them new to deploy modular data centre solutions, have had little time to fully assess the range of possible cost savings these deployments have enabled. Other challenges include the situation-specific nature of data centre

deployments, regardless of whether they are traditional or modular. Real world data centre deployments have a huge number of variables that affect TCO over the data centre's lifetime. These include the size of a data centre deployment and the speed at which it expands or needs refreshing, security requirements, the impact of software and the growing demands of big data. They also include the impact which local laws, regulations and physical environments have on the deployment and operation of data centres.

After introducing the concept of modularity and the main factors driving the growth of the modular data centre market (including the quest for greater cost savings) this paper will investigate the range of costs associated with deploying and running a data centre. These include the costs attached to planning and designing a new deployment (including the costs involved in procuring the necessary permits and land and preparing the data centre site), as well as the costs involved in actually deploying the data centre architecture. Data centre deployment costs include the cost of all the hardware and software needed to run the data centre and the various processes involved in shipping, assembling, integrating and commissioning a new facility.

The paper will also explore the costs attached to running a data centre on a day-to-day basis. These include energy costs, as well as the costs involved in maintaining and repairing, staffing and securing a data centre. Finally, it will examine the costs associated with retiring an outdated data centre facility, including the costs of decommissioning, redeploying and replacing a data centre.

Modularity and Market Drivers

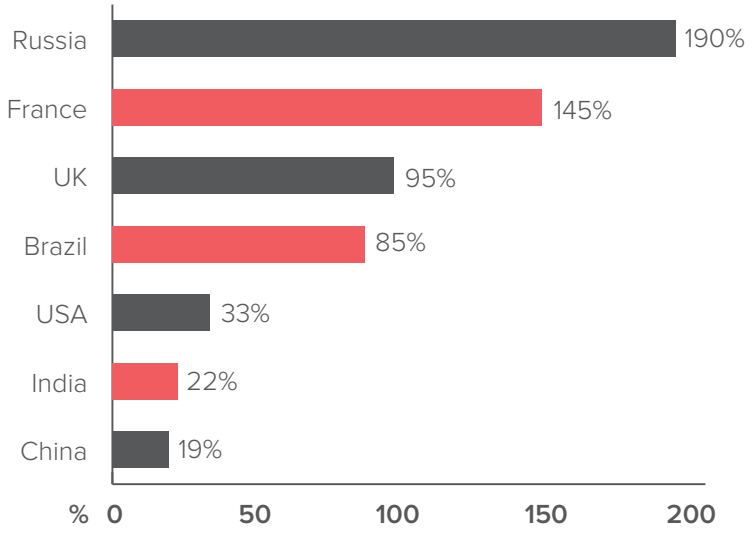
As a concept, modularity has often eluded definition. It can be understood as both an organisational strategy and an architectural design. Within the realm of IT, modularity can refer to the "pay as you deploy" or "pay as you consume" business models which characterise different cloud-based service offerings. Modularity also has a range of possible meanings within the data centre facilities realm. In terms of facilities, the concept traditionally referred to ISO (International Standards Organisation) shipping containers which are deployed as standalone "data centres in a box", complete with all the necessary IT, power and cooling technology. Containerised data centres are highly portable and continue to be widely used by organisations for the original purpose they were invented – as a way of supporting disaster recovery and temporary or transitioning IT projects.

Over time however, a distinction has emerged between containerised and modular data centres. This distinction has been reinforced by the proliferation of both types of solutions offered, in many cases, by the same service provider. In contrast to containerised data centres, this paper understands a modular data centre to be a data centre design based on prefabricated, pretested modules which are assembled in a custom-configured manner to form a complete solution, ideally defined by software. Although data centre modules are delivered to end users in a preassembled form, with hardware and software components already fully-integrated, it is common for power modules to be deployed alongside data centre modules as separate plug-in units.

"This paper understands a modular data centre to be a data centre design based on prefabricated, pretested modules which are assembled in a custom-configured manner to form a complete solution, ideally defined by software"

Modular data centres continue to grow in popularity, as evidenced by investment in modular solutions. In both established data centre markets such as France, the UK and US and emerging markets such as Russia, Brazil, India and China, data centre operators report growing investment in modular technology over the 2011-2013 period (figure 1).

Figure 1: Increase in Investment in Modular Data Centre Technologies, 2011-2013



Source: DCD Intelligence

Although there are many possible reasons for the increased investment in modular data centres, many respondents from markets with rapidly growing investment rates identify costs (especially energy costs) as among their biggest current and future concerns. Nevertheless, instead of simply assuming that cost concerns are the main motivating factors for modular data centre investments, it is important to appreciate the sometimes complex relationship between modular data centres and cost. This includes some of the knowledge-gaps that exist about the extent to which modular solutions help operators achieve cost savings.

Cost savings – One among Many Potential Benefits

It is sometimes assumed that the ability to help organisations reduce costs is one of the main attractions of the modular data centre model. However, although it is feasible that modular solutions do offer significant cost savings in a number of areas, it is too simplistic to argue that a modular approach always offers data centre operators significantly lower costs – especially when total cost of ownership (TCO) is taken into account.

As this paper shows, many of the costs associated with a traditional approach to data centre deployment are also present in the case of modular deployment strategies. Costs that are applicable to both modular and traditional build approaches include site selection and preparation costs, as well as (in some cases) the need to procure land and obtain both permits and planning permission. They also include costs associated with securing, powering and decommissioning the data centre at the end of its lifecycle.

"It is too simplistic to argue that a modular approach always offers data centre operators significantly lower costs – especially when total cost of ownership (TCO) is taken into account"

In addition to sharing costs with traditional build approaches, modular data centre deployments often come with their own sets of hidden costs which risk being overlooked by organisations considering the modular option. Hidden costs include the possibility that additional permits will be required precisely because a deployment is modular. For example, local authorities may view a modular data centre as a piece of equipment rather than a building and may ask for additional safety checks and approvals not normally required for buildings.

Much, however, depends on the actual modular products themselves and whether they have already attained safety certifications. It is notable that, in late 2012 IO announced that its IO.Anywhere modular data centre product suite had been awarded the data centre industry's first-ever modular data centre safety certification by Underwriters Laboratories (UL).

Moreover, when examining the motives which organisations claim to be behind their decision to go modular, it is clear that potential cost savings are just one of the factors influencing their deployment decisions. Other key drivers for data centre operators investing in modular technology include speed of deployment – with modular builds typically shortening the time to market for new data centre initiatives – and greater operational and energy efficiencies. Increased efficiencies over traditional data centres are achieved thanks to the optimised and standardised design of modular solutions. Several built-in design features ensure that modules typically have a more efficient approach to cooling and therefore power consumption. Indeed, many organisations claim energy efficiency and improved PUEs to be one of the biggest motivations for their decision to deploy a modular data centre solution. And although greater energy efficiency is not the same as reduced energy costs, more efficient energy usage should ensure that bills do not rise at the same rate as energy consumption.

In August 2013, IO announced the results of a third-party evaluation by Arizona Public Service (APS), which showed that a modular installation within IO's Phoenix data centre facility achieved a 19% reduction in energy costs due to improved PUE ratings. APS analysed 12 months of data from both IO.Anywhere modules and IO's traditional multi-tenant data centre in Phoenix. The analysis found that IO's traditional data centre environment had a PUE of 1.73 while the modular environment had a PUE of 1.41. The efficiency gain reportedly translated into annual savings of US$200,000 per MW of average IT power.

Along with greater energy efficiency, the standardised design of facility modules offers data centre operators several further potential benefits. These include reduced complexity (making modules easier to deploy, maintain and decommission) and improved reliability, with standardised factory-tested modules offering operators greater opportunities to predict data centre and overall business performance. In addition vendors assert that the use of a standardised, repeatable design means that it is easier for data centre owners to scale their operations more quickly and with fewer complications.

The mobility of modules is another key attraction of the modular data centre model over traditional routes to market. Although containerised solutions offer the greatest degree of data centre mobility, modular solutions make it easier for organisations to contemplate and facilitate the relocation and/or migration of their data centre footprint at a later date.

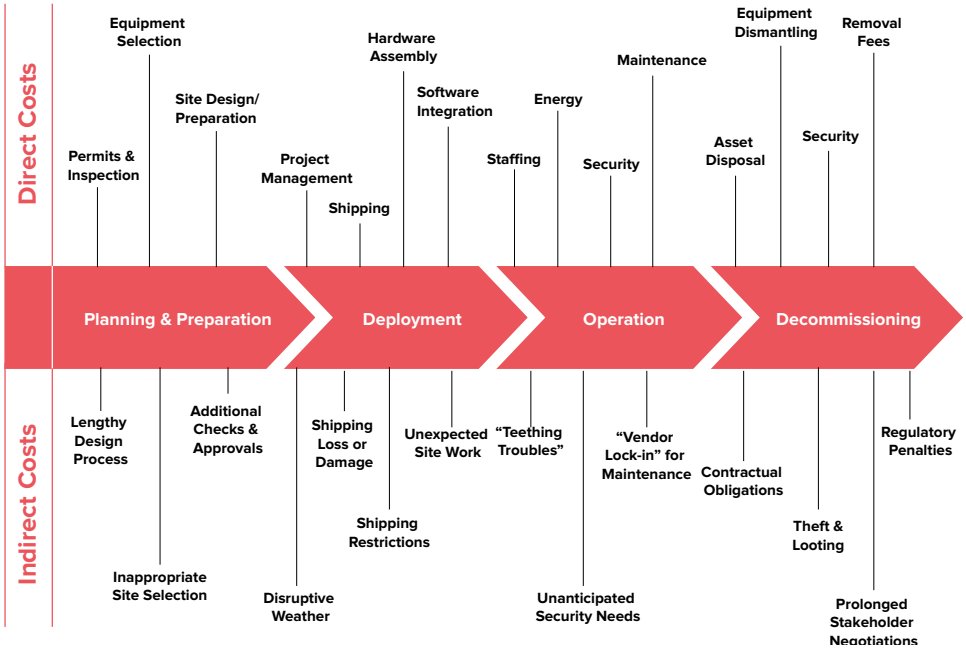
Finally, it is important to remember that, although some of the attractions of the modular data centre model do not directly involve costs, some of them nevertheless have important cost implications for data centre operators. For example, organisations looking to deploy modular data centre solutions often cite shorter time to market as one of the main attractions of the modular approach. A distinction can be made here between direct and indirect costs and, conversely, direct and indirect cost savings. The longer an organisation has to wait to get a new facility up and running, the more likely it will accumulate costs due to lost business, or because the organisation has an inadequate or inefficient facility. Similarly, a shorter time to market means that organisations are able to reap the financial benefits of a new facility sooner. These benefits include the enhanced capacity of an organisation to serve its customers. The distinction between direct and indirect costs will be discussed further in the following section.

"Key drivers for data centre operators investing in modular technology include speed of deployment – with modular builds typically shortening the time to market for new data centre initiatives – and greater operational and energy efficiencies"

Assessing Total Cost of Ownership (TCO)

Although the actual cost of deploying a data centre will vary across different deployment models (i.e. traditional versus modular), and according to the specific circumstances of individual deployments (e.g. size, location etc.), it is possible to identify four broad cost categories which are applicable to all data centres. These include the costs associated with planning and designing a new deployment (including the costs involved in procuring the necessary permits and land and preparing the site for the deployment). They also include the costs involved in actually deploying the data centre. Data centre deployment costs include the cost of all the hardware and software needed to run the data centre, as well as various deployment processes such as shipping, assembling, integrating and commissioning a new facility (figure 2).

Figure 2: Cost Categories and the Data Centre Lifecycle



Source: DCD Intelligence

In addition to the costs involved in planning for, and deploying, a new data centre, operators need to consider all of the costs associated with running a data centre on a day-to-day basis. These include energy costs, as well as the costs involved in maintaining and repairing, staffing and securing a data centre. Finally, it is important for operators to consider what happens to the data centre once it has fulfilled its useful purpose and needs to be retired. Although several options are available to organisations looking to retire an outdated facility – they include decommissioning, redeployment and replacement – all of these options present their own sets of actual and potential costs to an organisation.

In addition to the four broad cost categories associated with total data centre ownership, a

distinction can be made between direct and indirect costs and, conversely, direct and indirect cost savings. Direct costs are those that arise as a result of designing, procuring and deploying the modular equipment and preparing the data centre site for a new facility. They include project and site design costs, as well as the cost of obtaining land and any necessary permits for construction, shipping or otherwise. Direct costs also include energy, staffing, maintenance and other costs related to the day-to-day running of the data centre.

By contrast, indirect costs include those that arise as an indirect consequence of specific deployment and operating choices. Indirect costs include those that arise due to a longer time to market with a new deployment. The longer an organisation has to wait to get a new facility up and running, the more likely it will accumulate costs due to lost business, or because the organisation has an inadequate or inefficient facility. Similarly, a shorter time to market means that organisations are able to reap the financial benefits of a new facility sooner. These benefits could come in many forms and include the enhanced capacity of an organisation to serve its customers.

Indirect costs also include those associated with complications, unforeseen events and the emergence of unanticipated problems, including downtime scenarios. Situations which result in indirect costs for data centre operators can arise regardless of whether they have chosen a modular or traditional route to market.

Planning and Preparation Costs

Regardless of the type of data centre, any new deployment project requires a range of activities which must take place before physical deployment, assembly and installation can occur. These planning and preparation activities come with their own sets of costs, as well as risks and potential complications for data centre operators.

Planning and preparation costs encompass the costs that arise during the period when a new data centre and its chosen location are being designed and made ready for deployment to commence. They also include the costs associated with preparing the physical site and, in some cases, making the buildings ready to host the new facility. In addition, organisations planning a new data centre deployment need to account for costs associated with land procurement as well as the need to obtain planning permission and permits.

Data Centre Design

Designing a data centre involves various costs, some of which are tangible and some of which are related to the design process itself. The two main sources of tangible design costs are costs associated with equipment selection and design and costs related to designing the data centre site.

- **Equipment Selection and Design** – In a traditional build approach, end users must devote time and resources to selecting and procuring the various hardware and software components which will comprise the data centre. The new facility is then designed along with the overall site. By contrast, in a modular build the equipment is selected by the modular vendor according to a pre-determined, standardised design. Although this leads to a shorter and less complex equipment procurement process for data centre operators, the work of preassembling and pre-integrating a facilities module is passed on to operators in the form of higher procurement costs (see following chapter on Deployment Costs).

- **Site Design** – The site design process takes into account every aspect of a new deployment, including the structure of the new data centre and relationship with the surrounding environment. It involves examining the feasibility of a new project, as well as assessing potential risks and drawing the site plan. Site design costs are applicable to both traditional and modular data centres and are typically around 5% of the total cost of a new build (this includes the cost of obtaining planning permission and other permits – see later section). In some cases, site design costs can be higher, although estimates tend to put them in the 5%-10% range.

"Planning and preparation costs encompass the costs that arise during the period when a new data centre and its chosen location are being designed and made ready for deployment to commence"

In addition to the costs directly associated with equipment selection and site design, several further costs can arise which relate to the design process itself. For example, it is typical for the design process to involve several different companies and the participation of numerous specialists, including mechanical and electrical engineers and the IT and Facilities departments of the end user organisation. They also include external consulting companies to manage the project. The process by which these different parties come together requires numerous meetings spread over a timeframe which is often hard to predict. Depending on the length of the design process, the number of meetings required and consultants involved, the costs have potential to spiral. Costs arise not only because of the need to pay contractor fees but also because any delay in deploying and commissioning the data centre can result in lost business for the end user.

In the case of a modular facility, modules are designed and tested in the vendor's research and development lab prior to manufacture. End users are not directly involved in the design process because the module is a preassembled, pre-integrated unit which follows the design

specifications of a modular vendor. Nevertheless, despite the predesigned nature of the facilities module itself, there is a need to design, plan and prepare the data centre site and, regardless of whether a deployment is traditional or modular, this will involve the need for external contractors and engineers in the design process.

The contrasting design processes required for modular and traditional data centre equipment translate into very different design timeframes. Some estimates put the design of a traditional data centre at 24 weeks while, even longer for certain defence deployments, while in the case of a modular build, design requires just 12 weeks. In addition, the increased complexity of the traditional build approach makes it harder to predict when design will actually be completed and when deployment can commence.

It is important to also consider the role of research within the design process. In a traditional deployment approach, research occurs as part of the equipment selection and procurement process and is the way in which organisations assess the advantages and potential drawbacks of different vendor offerings.

However, research is also required in the case of modular deployments. No two modular offerings are alike and some are likely to be more suited to an end user's needs than others. As the market for modular facilities grows and as more vendor offerings become available, it will be even more of an imperative that end users carefully explore each supplier's offerings (and deployment and installation processes). Crucial questions for organisations to ask include whether a specific modular offering meets an end user's IT equipment requirements, and whether a design is able to fully support an end user's energy efficiency targets. Failure to address these questions during the preconstruction meetings with a modular provider can result in lost money, time and credibility at a later date.

Although research is essential to ensuring that the right design is selected for a new data centre deployment, it requires an end user to devote time and resources to the process. This has cost implications which are not always easy to ascertain.

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Site Selection and Preparation

When selecting a site for a new data centre, several criteria need to be considered if operators want to avoid long-term costs. The most obvious criteria include physical proximity and resource concerns such as access to target markets, the presence of good connectivity and the availability of adequate and sustainable power. However, there may be other concerns to consider when selecting a particular site, including problems that arise due to severe weather and natural disasters, insect or animal infestations, security threats and/or sabotage and possible damage from transport.

Furthermore, in addition to selecting a site according to physical, environmental and resource criteria, most sites need considerable work to be done on them before deployment can begin. Site preparation tasks include ground levelling and laying the concrete foundations on which a new facility will sit. They also include the creation of trenches to support the data centre's cabling systems. These tasks need to occur regardless of whether a traditional facility or a modular data centre is being deployed. Furthermore, in deployments which involve the use of an existing building (rather than a new construction) to house the IT equipment and other data centre assets, work may be required to renovate and upgrade the structure of the building. Although uncommon, international consultancy and construction company Mace notes the possibility of additional unexpected work arising when preparing a building or site for a new data centre deployment. For example, additional work could take the form of the need to decontaminate a building (typically a 3-4 week process).

In some cases, the costs and effort involved in site preparation will be borne by the modular vendor itself. This is especially the case if the vendor also plans to use its modular facility to

provide collocation services. For example, in early 2012, in preparation for its Netherlands 3 Data Centre, COLT levelled and covered the location site with foundation matting before driving piles into the soil and cementing them in place so that they would support the new concrete foundations. All of these processes took place before the steel structure housing COLT's modular facility was assembled.

In other cases however, organisations preparing for a new data centre deployment will need to engage in a full assessment of all the necessary site preparation tasks. Again, the process will typically require the use of external contractors to manage, plan and oversee the implementation of the project.

Planning Permission and Permits

Before any work can begin on preparing a site for the deployment of a new data centre, it is essential that planning permission is obtained and construction permits are issued. Planning permission is needed regardless of whether a new data centre is modular or a traditional "brick and mortar" facility. In addition, new sites will need to be inspected and this will involve both inspection fees and the need to allocate sufficient time for inspection. Furthermore, they often need several different surveys to be completed and this involves additional time and, potentially, cost. Part of the consultancy service Mace offers to companies looking to deploy a new data centre, involves advising them on the process of completing the necessary surveys and obtaining planning permission. In addition to planning permission, new data centre deployments in the UK require separate ground surveys, environmental surveys and noise surveys need to be completed. These are needed regardless of whether a deployment is traditional or modular.

"Planning permission is needed regardless of whether a new data centre is modular or a traditional "brick and mortar" facility. In addition, new sites will need to be inspected and this will involve both inspection fees and the need to allocate sufficient time for inspection"

Modular data centre deployments are not exempt from the need to have planning permission and permits for new deployments. However, in addition, local authorities may view a modular data centre as a piece of equipment rather than a building and may ask for additional safety checks and approvals not normally required for buildings. This scenario may be more common in instances where the module is defined as a container rather than a modular data centre made from prefabricated components. Alternatively, authorities may see modules as structures which need to comply with specific building regulations. Organisations looking to deploy a modular data centre should consult local authorities to establish all of the necessary permits and the amount of time required to complete the relevant documentation. Failure to devote proper time and attention to this process could result in lost time and unforeseen cost for operators.

Ultimately, the risk of modular deployments requiring additional, unexpected approvals could be eliminated as more modular products receive certifications such as IO's UL-listing, awarded to its IO.Anywhere product suite in 2012.

Deployment Costs

When identifying the costs associated with modular data centre deployment it is important to distinguish between costs related to the installation processes and costs associated with the modular equipment (i.e. the hardware and software). Although it is often stated that modular facilities are faster and less costly to deploy than the same physical equipment needed for a traditional facility, the actual hardware and software comprising a modular facility is typically more expensive than the same IT components associated with traditional facilities. This is because it is delivered to end users already fully assembled and integrated.

Hardware and software costs include the physical infrastructure of mechanical and electrical rooms (uninterruptible power supply, switches, panel boards, air-coolers, pumps, filters, lighting, security and fire suppression systems) as well as the management software and control systems. According to some vendors, these infrastructure costs are around 40% higher for modular facilities because of the cost of additional materials (including the container shell), and because the cost of preassembling and integrating the hardware and software components is included in the modular price tag. It is for this reason that modular vendors point to reduced operating expenses as an important counterbalance to any outlay of upfront capital expenditures. By contrast, the installation costs associated with traditional facilities are typically said to be considerably higher than their modular alternatives.

"Infrastructure costs are around 40% higher for modular facilities because of the cost of additional materials (including the container shell), and because the cost of preassembling and integrating the hardware and software components is included in the modular price tag"

Installation Costs

Installation costs include all the tasks involved in shipping, assembling, integrating and commissioning a new data centre facility. These tasks include:

- **Shipping** – In theory, it is considerably less expensive to ship a preassembled module compared with transporting the various parts of a traditional facility. However, much depends on the deployment location and the physical distance between the deployment site and the point of modular manufacture. In addition, hidden shipping costs include any loss or damage that can occur during transportation. On the one hand, there could be less opportunity for damage to occur when data centre modules are shipped in a preassembled format. On the other hand, shipping damage can still occur to preassembled modules. This could require the entire module to be reshipped instead of individual components. In addition to the risk of loss or damage, the shipping of modules could be affected by legal restrictions on length and width. These will vary across different jurisdictions. For example, in the United States, the Transportation Security Administration (TSA) sets length and width limitations on truck and train loads, in order for them to use certain roads, bridges and tunnels. Length and width limitations differ from one country to another and, in some cases, permits and special escorts may be required for particularly large loads. With regard to this latter point, much depends on the extent to which a modular vendor has pre-sized their units in accordance with local transportation requirements. For example, COLT notes that its modules are sized to be within the limits of shipping without an escort in both Europe and US. It is understood that much of the industry's leading modular providers have done the same, in order to avoid additional transport costs arising.
- **Hardware Assembly** – Both modular and traditional facilities have components which need to be unpacked, checked, assembled and integrated, both with one another and with the new data centre environment (the latter includes electrical and plumbing resources, as well as the physical space in which they are located). However, the fewer physical components involved in modular deployments means that the number and complexity of tasks are significantly reduced. Although figures vary, the reduced complexity of the physical assembly process results in cost savings of between 20% and 40%.
- **Software Integration** – In contrast to traditional facilities, which require the integration, programming and optimisation of software management systems to be carried out on site, modular facilities arrive with management software and controls already preinstalled,

programmed and optimised. As with data centre hardware, the elimination of (potentially complex) on-site assembly work means that installation costs can be further reduced. Data centre infrastructure management software (DCIM) ranges from the simple building management system on the one end, to a comprehensive, open platform operating system on the other.

- **Project Management** – Preconfigured modular designs mean that the installation process is significantly less complex. In addition, deployment of the entire physical infrastructure will be managed by a single provider. Reduced complexity results in simpler, and therefore less costly, project management. It is also the case that fewer people are generally required on-site during the data centre construction process. This has potential to further lower costs.
- **Commissioning** – In the case of traditional data centre deployments, several final processes need to occur before the data centre is considered ready for operation; these include various testing procedures, as well as the documenting and validating activities needed to establish quality assurance and quality control. The pre-integrated nature of facility modules means that many of these final checks and tests are unnecessary. In addition, pretesting occurs in the factory, further eliminating the need for on-site checks.

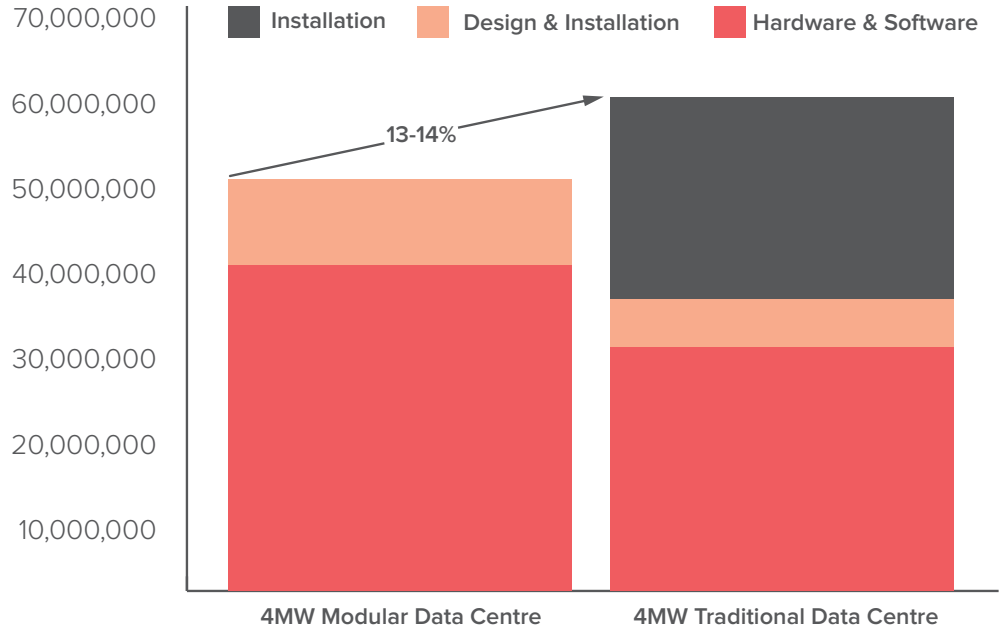
"Any attempt to evaluate the relative costs of a modular deployment with those of a traditional facility should consider potentially unpredictable costs, as well as the costs associated with 'time to market'"

In addition to costs associated with the data centre infrastructure (hardware and software) and the various installation processes discussed above, any attempt to evaluate the relative costs of a modular deployment with those of a traditional facility should consider potentially unpredictable costs, as well we the costs associated with "time to market". Unpredictable costs include the impact of difficult weather conditions on data centre assembly and installation, as well as the need for additional, unexpected site work. Although additional costs such as these will not always be present, their manifestation can affect both modular and traditional deployments, with implications for the time needed to complete a project.

Although actual data is limited and based on estimates from different sources, it is possible to make assertions about the cost of deploying a modular data centre relative to a traditional facility. The comparison assumes that the cost to an end user of acquiring the necessary hardware and software for their data centre is 40% higher in the case of a modular facility; this reflects the preassembled and pre-integrated nature of the modular equipment. However, the comparison also assumes that on-site installation costs are over 60% lower in a modular build scenario. This reflects the cost savings that are achieved due to less complex on-site installation processes, which require and shorter timeframes and fewer resources.

Based on these assumptions, upfront deployment costs are 13%-14% lower for a modular data centre compared with a traditional data centre built with a similar capacity (figure 3). It is important to note however that this comparison does not take account of the unpredictable costs that can arise. In addition, the comparison assumes that the costs related to site design and preparation are the same in both scenarios and amount to 5% of total deployment costs.

Figure 3: Modular vs. Traditional Data Centre Deployment Costs (US$)



Source: DCD Intelligence

Cost Predictability

Unpredictable costs aside, many end users of modular data centres refer to "cost predictability" as one of the biggest appeals of going modular. Being able to predict or control the costs associated with data centre construction is easier in the case of modular deployment, thanks largely to the standardised repeatable design of the modules and the fact that modules are delivered with much of the assembly, integration and commissioning already completed and included in the final cost. This makes it easier for businesses and other organisations to more accurately calculate the cost of both first-time deployments and expansions or retrofits of existing facilities. For example, LexisNexis, an information provider for the legal profession, identifies cost control as one of the reasons for its decision to adopt a modular data centre strategy for its business. As one of IO's data centre as a service (DCaaS) customers, LexisNexis deployed two D2 modules inside IO's modular data centre facility in Dayton, Ohio. Each of the existing LexisNexis modules houses 400kWh of IT load and the company plans to add another 400kWh of capacity over time. A long-term customer of IO, LexisNexis previously rented space inside IO's traditional raised-floor data centre facility in Scottsdale, Arizona.

"Being able to predict or control the costs associated with data centre construction is easier in the case of modular deployment"

Modular end user Verne Global identifies CAPEX predictability as a key driver for embracing modular solutions. Other modular end users agree and assert that the modular model gives them greater control over operational costs. This point will be discussed later in the paper.

Upfront versus Deferred Costs

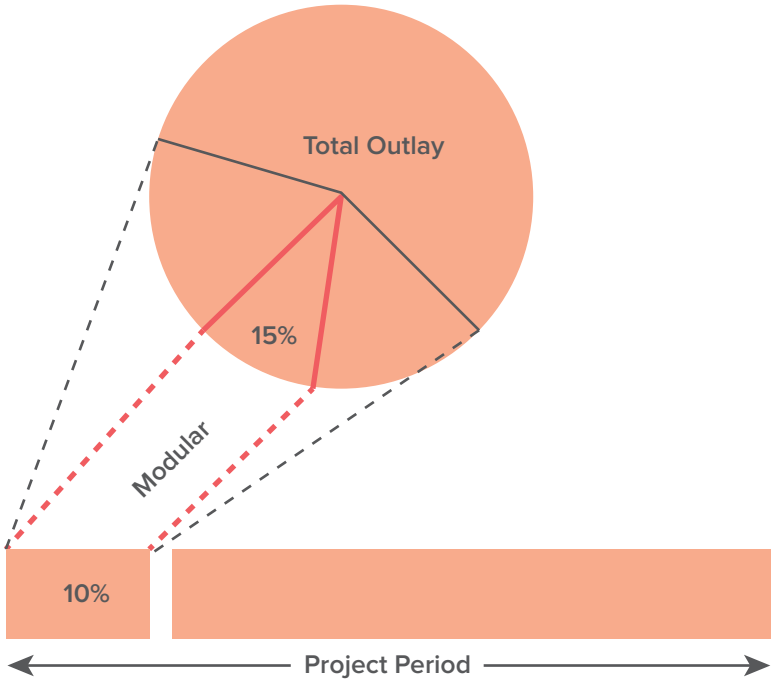
In addition to greater cost control and predictability, vendors and end users speak about the benefit of deferred costs as a key attraction of modular deployments. Deferred costs refer to the timing of CAPEX allocation (i.e. the point in time at which capital is allocated to data centre deployment). A data centre is a major capital expense which requires considerable upfront costs. In a traditional build approach organisations need to prepare for the anticipated growth in their IT requirements ten years or more in the future. The pace of technological change makes this difficult to predict and, consequently, many traditional data centres are built with enough overcapacity to accommodate future demand. However, not only does this make facilities more expensive to operate (for example, by increasing their power and cooling requirements), but it also makes them more costly to build in the first place.

"Modular facilities can be deployed quickly and incrementally in response to rising demand for additional IT resources"

By contrast, modular facilities can be deployed quickly and incrementally in response to rising demand for additional IT resources. This reduces the amount of capital which needs to be spent upfront. For example, rather than allocating US$80 million upfront to a new data centre deployment project – a scenario common to traditional build approaches – organisations can choose to purchase ten US$8 million modules as their requirements grow.

According to some estimates, new data centre deployments using traditional methods require 40% of total project costs to be spent upfront to cover the first 10% of the project period. Deploying a modular solution however, means that organisations only need to spend 15% of the total outlay to cover the first 10% of the project (figure 4). In addition to requiring a much larger share of total project costs to be spent upfront, it is often argued that, in the case of traditional build approaches, capital needs to be allocated at a much earlier point in the deployment project. In some cases, capital needs to be allocated as much as two years before the data centre is operational and before any return on investment can be achieved.

Figure 4: Upfront vs. Deferred Costs



Source: DCD Intelligence

Operational Costs

Operational costs refer to all of the costs involved in running a data centre on a day-to-day basis. These include energy costs – one of the biggest pressures on OPEX budgets which accumulate as a result of having to power and cool a data centre's space and equipment. However, they also include the costs involved in maintaining and repairing, staffing and securing a data centre.

Energy Expenditure

Energy already represents a significant part of the total cost of data centre ownership, with energy costs representing 60%-70% of total operational costs. Rising energy prices and increased consumption due to rapid technological change means that energy costs are one of the biggest pressures on OPEX budgets. In addition, energy consumption is both an ecological and political issue, and failure to conform to regulatory on energy conservation and efficient use can result in hefty fines for operators.

Many end users of data centres already claim that modular facilities allow them to significantly lower their energy costs. Furthermore, a growing number of organisations identify energy conservation and improved power usage effectiveness (PUE) as key motivations for their decision to opt for modular deployments.

"A growing number of organisations identify energy conservation and improved power usage effectiveness (PUE) as key motivations for their decision to opt for modular deployments"

Improved energy efficiency in a modular scenario is achieved partly through the more efficient use of data centre space and partly through the technology of the modules themselves. One problem which commonly arises in the case of traditional deployments is that of overcapacity. Traditional data centres are built with more IT and white space capacity than they require because of the need to accommodate future technological change and growing demand for additional IT resources. However, overcapacity means that energy is required to power to cool empty space and underutilised facilities.

Modular data centres directly tackle the problem of overcapacity by allowing end users to deploy capacity as and when it is needed. This allows end users to significantly lower their energy bills by eliminating their need to power and cool empty space.

In addition to the energy-related cost benefits associated with modular's "pay-as-you-require" business model, reduced energy consumption results from the inherent technology of the modules. On a most basic level, modular data centres contribute to lower energy bills because they are newer than legacy facilities and have been designed to be more technologically energy-efficient. Several features should be noted:

- **Efficient Design** – Modular solutions are designed to ensure a more efficient use of space and with features that promote greater energy efficiency. Specific features include sealed walls, floors and doors, as well as under-floor or overhead cooling systems (see following point). The use of more precise airflow systems allows modular data centres to support 20kWh or more per cabinet. This contrasts with traditional data centres which, because of their design, typically have an energy density of 0.1kWh per square foot.

The greater density and more efficient use of space mean that modular facilities are able to achieve a significantly better PUE compared with traditional facilities. In the case of modular data centres, these can be as low as 1.4 (by contrast, traditional data centres have PUEs in the 1.7 to 2.0 range). Some modular vendors claim their technology offers PUEs of 1.1 and below. Although this is theoretically possible, such figures typically refer to specialised, single-purpose environments (i.e. Facebook) and may refer to results achieved in test environments rather

than usage within real-world data centre environments. There remains a lack of independently verified data on the actual PUEs that can be achieved with modular technology. IO is the only provider known to have published PUE data which has been independently verified by a public utility.

Nevertheless, despite variations among actual PUEs, a growing number of end users report lower PUEs achieved thanks to modular technology. The possibility of achieving greater cost savings and improved IT energy efficiency was a key factor influencing investment bank Goldman Sach's decision to launch a modular data centre using IO technology. In addition to lowering average PUEs, the pre-engineered and standardised nature of modules ensures that organisations can predict PUEs with greater accuracy when planning new data centre deployments.

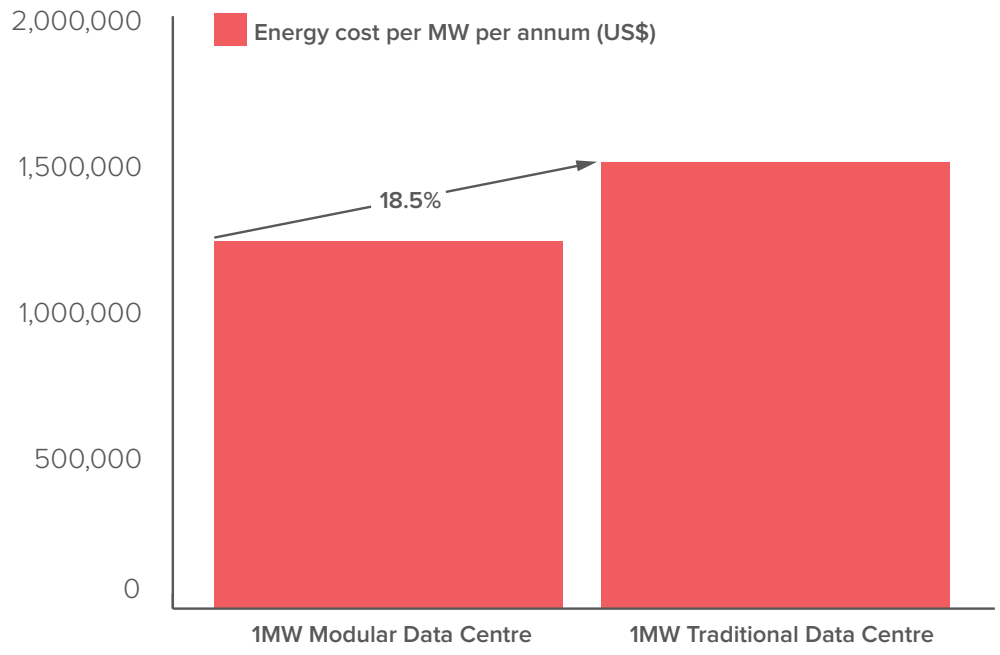
Many organisations claim energy efficiency and improved PUEs to be one of the biggest motivations for their decision to deploy a modular data centre solution. And although greater energy efficiency is not the same as reduced energy costs (a full energy cost analysis needs to consider both PUEs and total energy consumption), more efficient energy usage should ensure that bills do not rise at the same rate as energy consumption.

"Although greater energy efficiency is not the same as reduced energy costs (a full energy cost analysis needs to consider both PUEs and total energy consumption), more efficient energy usage should ensure that bills do not rise at the same rate as energy consumption"

- **Cooling Optimisation** – Modular data centres are designed with advanced cooling systems, which are built into the structure of the module itself. Modules typically feature air-side economisers which facilitate the use of natural (outside air) cooling. In addition, many modules are equipped with the ability to use evaporative cooling. This eliminates the need to provide a chilled water supply. These built-in cooling features not only ensure that modules are easier and less costly to deploy than traditional data centres (which require raised concrete floors for cool air circulation), but contribute to enhanced energy efficiency compared with traditional data centres. One study published by the General Services Administration (GSA) in the US suggested that modular data centres which require a chilled water supply have an average PUE of 1.16. By contrast, modules that are able to use evaporative cooling can have PUEs as low as 1.02.
- **Systems Management** – A growing number of modular data centre products are available with integrated DCIM software. This has implications for energy efficiency because, ideally, it gives data centre operators full visibility into all of data centre's critical components, including environmental conditions and the use of power and cooling. DCIM allows operators to identify where energy is being inefficiently used and to manage consumption more effectively. The pre-integrated nature of DCIM in a modular scenario removes the risk of delay or difficulty integrating a new DCIM solution. The inclusion of DCIM technology within a modular facility has additional implications for operator budgets. Opting for a modular solution which comes with DCIM pre-integrated potentially eliminates the need for operators to purchase a separate DCIM package a later date.

The following diagram illustrates the difference in energy costs per MW per annum for a 1MW modular data centre compared with a traditional alternative, taking into account the impact which different PUEs have on annual energy costs. The traditional data centre has a PUE of 1.73 whereas the modular facility has a PUE of 1.41. The cost per KWh is assumed to be US$0.1 for both facilities. In the case of the traditional data centre, the cost per annum is US$1.515 million while the annual energy cost for the modular facility is US$1.235 million. To the data centre operator, this represents an annual cost saving of 18.5%.

Figure 5: Modular versus Traditional Data Centre Energy Costs (US$)



Source: DCD Intelligence

Maintenance

Vendors and proponents of modular data centres often argue that the standardised nature of modules allows the use of universal maintenance programs. In addition, reduced complexity because of standardisation should ensure that data centre operators can cut maintenance times and allocate fewer numbers of (potentially more costly) specialist staff to resolving maintenance issues.

Despite this, many end users of modular solutions are either unsure about the extent to which they offer operational cost savings on maintenance. Some also claim that the impact of modular solutions on maintenance costs is negligible.

"Nevertheless, not all modular vendors are alike and there are reasons why maintenance costs could be higher in the case of modular data centres"

On the one hand, the pre-engineered and pre-integrated nature of modules makes it more likely that only one vendor will be responsible for the majority of maintenance issues that arise. Unlike maintenance issues in traditional data centres, whose many hardware and software components are supported by different suppliers, the fully-integrated nature of modular solutions makes it easier for operators to identify the vendor responsible for specific issues. In some cases, modular vendors strengthen their ability to provide maintenance support by working with a network of partners. For example, IO has a global ecosystem of external partners who are certified to provide support for its modular products internationally.

Nevertheless, not all modular vendors are alike and there are reasons why maintenance costs could be higher in the case of modular data centres. These include the fact that maintenance may have to be carried out in tighter spaces and the possibility that modular designs could result in several components failing simultaneously. In addition, having a maintenance contract with a single vendor does not guarantee lower maintenance bills. Maintenance fees may vary

considerably between different providers and the proprietary nature of modular products could reduce the ability of data centre operators to outsource maintenance issues.

Staffing

As with discussions about maintenance costs, industry vendors and proponents of modular products point to standardisation as a factor contributing to lower staffing costs for modular data centre operators. According to this argument, the standardised nature of modules, along with the way they are supplied pre-integrated and with a system-level interface, means that it is easier for organisations to provide operational training for their data centre personnel. Less time spent training IT and facilities personnel means that that human time can reallocated to other, potentially more productive, activities elsewhere within the organisation. In addition, quicker staff training times makes it easier for organisations to cope with turnover within their data centre personnel. It is also argued that the use of automated data collection in a prefabricated, standardised design reduces the need for manual work.

However, as with maintenance costs, some end users of modular solutions also appear unconvinced about whether modular solutions offer them operational cost savings on staffing. Some also claim that the impact of modular solutions on staffing costs is negligible.

"As with maintenance costs, some end users of modular solutions also appear unconvinced about whether modular solutions offer them operational cost savings on staffing. Some also claim that the impact of modular solutions on staffing costs is negligible"

Some observers have noted that many traditional data centres suffer from technical issues within the first two years of operation. Whether they result from onsite customisations or installations which have departed from original design plans, these problems require personnel to deal with them. This results in higher staffing costs for data centre operators. Although modular data centre deployments should be able to avoid many of the "teething problems" sometimes experienced with traditional build approaches, it is important to note that careful testing, documenting and validating during the commissioning stages of a traditional data centre could help to eliminate or mitigate teething troubles.

Security

In assessing total cost of ownership, all data centre operators – regardless of whether they are using a modular or traditional facility – need to also take security costs into consideration. The need for security extends to a data centre's physical and virtual assets. In the case of physically securing a data centre facility, a number of location and site-specific factors must be considered, including the possibility of risks related to natural disasters, insect or animal infestations, sabotage or damage from transport. Physical security may be enhanced if a data centre's most important assets are situated deep inside the building.

Irrespective of the type of facility opted for, operators could well accrue additional security costs as part of the day-to-day process of operating a data centre (they include the need for security guards, perimeter walls and fences, lighting, cameras and alarm systems). Because the need for different levels of security is often location-sensitive, security costs have potential to be considerable for operators depending on site location. The operational impact of security costs can be minimised through careful evaluation of the potential risks during the design and deployment phases of a new a data centre.

In addition to physical security it is important to also consider the ongoing threat to data centre operators from cyber attacks. Modular vendors often argue that traditional building management systems do not monitor enough data points to have a comprehensive view of the entire data centre. The built-in security software in modules is said to offer a higher level of protection against hacking attacks on critical data centre infrastructure such as cooling systems.

Balance Sheet Considerations

Some observers have noted that accounting regulations, in some jurisdictions, may allow data centre modules to be defined as equipment or as a temporary structure rather than a building or “real property”. This has implications for a data centre operator’s balance sheet by influencing the rate at which modules are said to depreciate. Normally, power and cooling equipment is treated as being part of the data centre building. As a result, it has to be depreciated over a period of 30 years or more. However, if it a data centre module can be classified as a piece of equipment rather than part of the building, it becomes possible to depreciate it over a shorter timeframe, potentially between 5 and 15 years. Modular data centre operators argue that this is a much more realistic time horizon than the 30-year span that is favoured by the Real Estate Investment Trusts behind most traditional data centres.

Shorter depreciation timeframes have positive implications for a company’s tax burden. Because depreciation is deducted from a company’s profits before income tax is calculated, being able to discount something as significant as a data centre module has potentially significant implications for a company’s cash flow.

Decommissioning and Redeployment Costs

Many attempts to assess total cost of ownership (TCO) for data centre operators focus on the capital costs associated with designing and deploying a facility and the operational costs associated with running it. Although data centre design, deployment and operational costs represent a lion's share of any TCO model, it is important to also consider what happens to the data centre once it has fulfilled its useful purpose for an organisation, in its existing form, and needs to be retired. Simply walking away from a retired facility is not an option for organisations, regardless of individual migration plans. Although a number of options are available to organisations looking to retire an outdated facility – they include decommissioning, replacement and redeployment – all of these options present their own sets of costs to an organisation.

Decommissioning

Decommissioning occurs when a data centre needs to be retired. This situation can arise in different scenarios, including when an organisation decides to move its data centre operations to a new location. There are many processes involved in decommissioning a data centre, regardless of whether they are modular or traditional. Most of these processes have costs attached, not all of which are immediately obvious to data centre operators. A distinction can be made between costs directly associated with decommissioning (e.g. service fees for equipment removal) and costs that arise because of complications and unforeseen events.

"Although data centre design, deployment and operational costs represent a lion's share of any TCO model, it is important to also consider what happens to the data centre once it has fulfilled its useful purpose for an organisation"

The various physical activities involved in decommissioning a traditional data centre have been well documented. They include the removal of old cabling, the disabling of fire suppression systems, the draining of chilled water systems and the disposal of hazardous waste. However, in addition to dismantling a data centre's physical assets, an operator will likely have different contractual obligations whose termination needs to be managed. These include building leases, contracts governing specific pieces of equipment and agreements with utilities such as power, water and communications service providers. Unless the timing by which these contracts are unwound is carefully coordinated, a data centre operator could face additional unwanted costs.

In addition, there are several risks associated with the decommissioning process which carry their own potential costs. These include the risk of theft or looting from a partially decommissioned site and the consequent need to pay for extra security. They also include possible penalties which could arise from failure to comply with local recycling and waste disposal regulations. When decommissioning traditional data centres, potential costs also arise from the need to manage the interaction between different stakeholders involved in the decommissioning process. These include an operator's own IT and facilities staff, as well as external contractors and project management firms. Depending on the complexity of the decommissioning process and the number of stakeholders involved, additional costs to the operator can arise due to unexpectedly long timeframes for completion.

Operators looking to retire a data centre facility have the option of employing a certified third-party specialist to plan, manage and execute a decommissioning project. Although specialist firms have the necessary tools, staff and resources for overseeing complex decommissioning projects, they could be costly for an operator. Moreover, some of these firms may be unable to manage all of the processes associated with a decommissioning project; further costs would then arise from the need to employ additional specialists. Some decommissioning firms specialise in asset recovery and recycling, in addition to equipment dismantling and removal. Such companies should be able to help operators recoup some of the costs of decommissioning.

In the case of modular data centres, many of the decommissioning costs described above can be avoided or minimised. Although there is still a need to manage the termination of contracts with utilities and, in some cases, leases with real estate firms, fewer physical dismantling processes are required to decommission a modular data centre. This is because the module is dismantled and removed from the

site as an integrated unit. Although the need to pay for additional site security can also arise in the case of modular data centre decommissioning, the amount of time for which security is needed will likely be less. This is because of the shorter time frame which is required to dismantle the site.

In addition, software-defined modular data centres can be dynamically refreshed or repurposed with a software upgrade. This reduces and, in some situations, could eliminate, the need to decommission a facility.

One of the decommissioning options available to modular data centre operators is full disposal of the data centres physical and logical assets. Because of fewer complexities and shorter timeframes, it is likely that total disposal costs will be lower. However, it is possible that, at the time of retirement, data centre modules could still retain residual value which allows them to be sold or deployed elsewhere. The standardised nature of facility modules means there are opportunities for modular vendors to introduce standardised processes for decommissioning and recycling. This has potential to simplify these processes and make them less costly for end users.

Redeployment

"The standardised nature of facility modules means there are opportunities for modular vendors to introduce standardised processes for decommissioning and recycling. This has potential to simplify these processes and make them less costly for end users"

Sometimes, the need to decommission a data centre accompanies an organisation's decision to relocate its data centre operations. There are many reasons why an organisation may choose to relocate its data centre operations, including the need for a larger and/or better facility, the need to consolidate diverse data centre assets, or as part of a move to comply with, or benefit from, legal or regulatory frameworks. Regardless of the reason for relocation, organisations need to minimise the downtime of business-critical applications and services while they make their move.

As part of its relocation plan, a data centre operator should develop a full inventory of every part of the facility which needs to be moved. A thorough inventory will not only help operators get a more accurate quote from the relocation firm handling the move, but will make it easier to track, insure and reassemble the data centre at its new location. In the case of traditional data centres, the number of individual components which need to be dismantled, transported and reassembled is significantly higher than for a modular facility of a similar size. Because they are less complex move, modular facilities will likely require much shorter inventories while the likelihood of complications (and therefore costs) arising during the relocation will be reduced.

Another major source of cost for organisations relocating traditional data centres is insurance. This is needed to protect the organisation against damage, loss or theft during the relocation process. In a traditional data centre scenario, the larger number of items that need to be relocated, together with the increased complexity of the move, mean that the cost of insurance to the data centre operator is likely to be higher.

Other sources of cost to data centre operators relocating a facility include failure to account for, and guard against, excessive downtime experienced during the move. Due to longer dismantling and reassembly periods in the case of traditional facilities, the risk of miscalculating the amount of expected downtime could well be higher compared with a modular facility. This adds to the potential costs which could be incurred by the traditional data centre owner.

Relocation costs that have potential to be similar in the case of both traditional and modular data centre relocations include costs that arise through a failure to properly prepare the new site (see section on Planning and Preparation Costs for more information). Similarly, data centre relocations, regardless of whether they are traditional or modular, may encounter the same sort of shipping and transport risks that can be present in the case of first-time deployments. These include the risk of loss or damage during transportation and the possibility that relocation could be affected by rules restricting the size of units transported (see section on Deployment Costs for more information).

Conclusions

There are many factors driving the growing interest among data centre operators and end users in modular technology. These include the potential for modular facilities to help operators achieve cost savings.

It is possible to identify four broad cost categories which are applicable to the deployment and operation of all data centres. These include the costs associated with planning and designing a new deployment (including the costs involved in procuring the necessary permits and land and preparing the site for the deployment). They also include the costs involved in actually deploying the data centre. Data centre deployment costs include the cost of all the hardware and software needed to run the data centre, as well as various deployment processes such as shipping, assembling, integrating and commissioning a new facility.

In addition to the costs involved in planning for, and deploying, a new data centre, operators need to consider all of the costs associated with running a data centre. These include energy costs, as well as the costs involved in maintaining and repairing, staffing and securing a data centre. Finally, it is important for operators to consider what happens to the data centre once it has fulfilled its useful purpose and needs to be retired. Options are available to organisations looking to retire an outdated facility include decommissioning, redeployment and replacement; all of these present their own sets of actual and potential costs to an organisation.

Although modular solutions offer potential significant cost savings in several areas, it is too simplistic to argue that a modular approach always offers data centre operators significantly lower costs. Firstly, it is important to recognise the vast number of modular data centre products that are now available on the market, not all of which offer the same standards and certifications and levels of support to end users.

"it is important to recognise the vast number of modular data centre products that are now available on the market, not all of which offer the same standards and certifications and levels of support to end users"

Secondly, when evaluating the wide range of modular and traditional data centre deployment options available to them, it is important to consider the range of costs associated with the entire lifecycle of a data centre from planning and design through to retirement. A total cost of ownership (TCO) approach to understanding the relative cost advantages of modular facilities over traditional alternatives needs to take into account both direct and indirect costs. Direct costs include the design, procurement and deployment of the data centre equipment, as well as the costs involved in powering, staffing and maintaining the data centre. By contrast, indirect costs include those accumulated due to complications, unforeseen events and unanticipated problems.

Many of the situations which create indirect costs for operators can arise regardless of whether a modular or traditional route to market has been chosen. Indirect costs also include those that arise due to a longer time to market with a new deployment. The longer an organisation has to wait to get a new facility up and running, the more likely it will accumulate costs due to lost business, or because the organisation has an inadequate or inefficient facility. Similarly, a shorter time to market means that organisations are able to reap the financial benefits of a new facility sooner. These benefits could come in many forms and include both enhanced capacity to serve customers and greater operational and energy efficiency.

In addition to considering both direct and indirect costs, a TCO approach to understanding the relative cost of operating a modular data centre over a traditional one should consider the range of hidden costs that can arise in the case of both traditional and modular deployments. These can arise at any point in the lifecycle of a data centre. For example, in the case of building and/or site preparation, additional unexpected costs can arise from work needed to decontaminate a building or site. Unexpected costs can also arise during the deployment of a new facility and include the possibility of equipment loss or damage during the shipping and delivery

process. They also include the impact of difficult weather conditions on data centre assembly and installation. Although additional costs such as these will not always be present, their manifestation can affect both modular and traditional deployments, with implications for the time needed to complete a project.

Nevertheless, despite limited data, it is possible to draw tentative conclusions about the comparative cost of deploying a modular data centre relative to a traditional facility of a similar capacity. The comparison assumes that the cost to an end user of acquiring the necessary hardware and software for their data centre is 40% higher in the case of a modular facility; this reflects the preassembled and pre-integrated nature of the modular equipment. However, the comparison also assumes that on-site installation costs are over 60% lower in a modular build scenario. This reflects the cost savings that are achieved due to less complex on-site installation processes, which require and shorter timeframes and fewer resources.

Based on these assumptions, the cost of deploying a modular data centre is 13%-14% lower compared with a traditional data centre of a similar capacity. This comparison does not take account of the unpredictable costs that can arise. It also assumes that the costs related to site design and preparation are the same in both deployment scenarios and amount to 5% of total deployment costs.

"Data on the cost of deploying a modular data centre relative to a traditional facility offers only a glimpse of total potential cost savings to an operator over the lifetime of a data centre"

Data on the cost of deploying a modular data centre relative to a traditional facility offers only a glimpse of total potential cost savings to an operator over the lifetime of a data centre. It is important to also consider operational costs, of which energy costs represent the largest 60%-70% share of the total. Figures provided to DCD Intelligence during the research for this paper indicated that a 1MW modular facility with a PUE of 1.41 produces annual cost savings to operators of 18.5% compared with a similar traditional build facility with a PUE of 1.73. However, as with deployment costs it is important to recognize the range of variables that can result in lower operational cost savings for modular data centre operators compared with operators of traditional data centres. These include the possibility of fitting traditional build facilities with more energy-efficient technologies.

To conclude, there are many factors to consider when assessing the cost deploying a data centre. This is true of both modular and traditional data centre facilities. Data provided by a small sample of data centre technology providers and end users suggests that cost savings can be achieved when a modular build is opted for, with one of the main contributors being the shorter timeframes and less complex processes that are involved in installing and commissioning a new data centre. The other main source of cost savings to modular data centre operators is the enhanced energy efficiency that modular technology is able to achieve compared with many traditional data centres.

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