Considerations for Owning versus Outsourcing Data Center Physical Infrastructure

White Paper 171

Revision 1

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Executive summary

When faced with the decision of upgrading an existing data center, building new, or leasing space in a retail colocation data center, there are both quantitative and qualitative differences to consider. The 10-year TCO may favor upgrading or building over outsourcing, however, this paper demonstrates that the economics may be overwhelmed by a business' sensitivity to cash flow, cash cross-over point, deployment timeframe, data center life expectancy, regulatory requirements, and other strategic factors. This paper discusses how to assess these key factors to help make a sound decision.

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Introduction

As a business evolves and grows, the IT requirements to support that business often grows. When a need for new IT equipment is identified[1], thought must be put into where the IT equipment will reside. For existing data centers with available power, cooling, and space capacity, the decision is often an obvious one, but when a data center is at or near full capacity, a decision must be made as to where to house the IT equipment. There are three fundamental approaches to meeting the new capacity requirement – upgrade, new build-out, or outsource to a colocation provider's data center.

The decision between these approaches is based on financial savings, sensitivity to cash flow, and other key strategic factors. **Figure 1** illustrates the three types of decision criteria that influence the decision to upgrade, build, or co-locate. The first two categories, cost and cash flow, are quantitative, while the third, strategic factors, consists of common business preferences and constraints that affect the decision qualitatively. Note, the figure illustrates common strategic factors but this does not represent a complete list. Some of the strategic factors may eliminate certain alternatives altogether, while other factors can heavily influence the decision, depending on the business objectives and priorities of the decision maker(s).

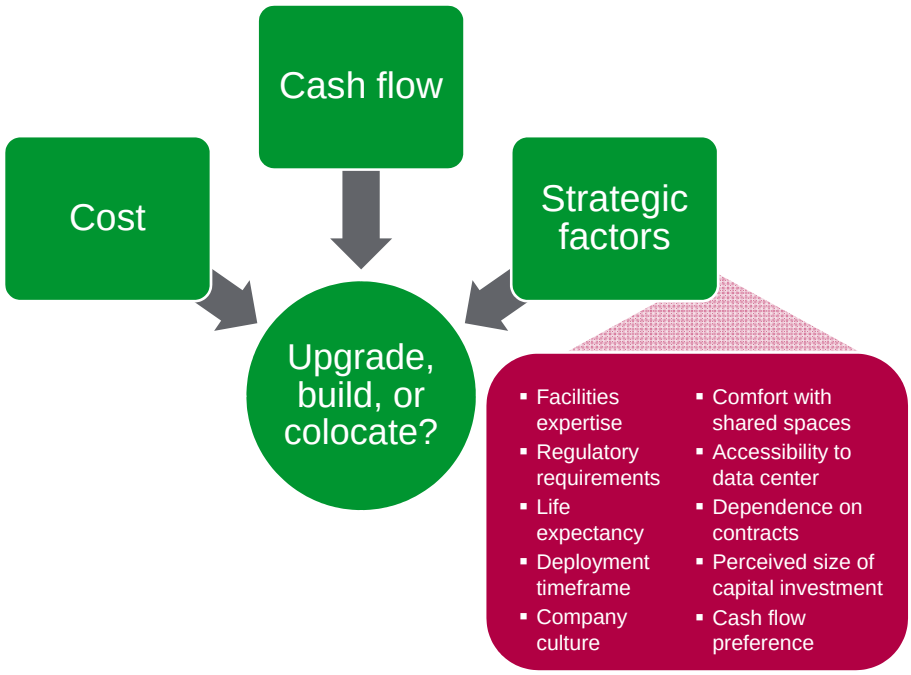

Figure 1

Own vs. outsource decision influence factors

This paper describes the approaches for meeting new IT capacity requirements and discusses the factors that must be considered in making a fully informed decision. While the cost analysis may favor upgrading or building over outsourcing over a 10-year lifetime, sensitivity to cash flow, cash cross-over point, deployment timeframe, life expectancy of the data center, and other strategic factors play important roles in the decision.

Note, this paper discusses outsourcing in the context of the physical infrastructure and does not consider outsourcing of the IT (i.e. the cloud, managed services, SaaS, PaaS).

[1] Assumes approaches to reduce IT equipment demand, such as virtualization, has been considered, and additional IT equipment is still needed.

Approaches to supporting new IT capacity

Before comparisons can be made between owning vs. outsourcing a data center's physical infrastructure, it is important to identify various approaches to supporting the new IT capacity. This section defines the three approaches:

- Upgrade an existing data center
- Build a new data center
- Outsource to a colocation provider's data center

Upgrading an existing data center

Depending on the capabilities of an existing data center, upgrading the facility may be sufficient to meet the new IT requirements. The level of disruption, cost, and capacity gain depends largely on the scope of the upgrade project.

A common upgrade may involve implementing simple air flow management practices like adding blanking panels, brush strips, and row-containment. This is done to increase utilization of the cooling systems already in place (see White Paper 153, *Implementing Hot and Cold Air Containment in Existing Data Centers* for best practices for air flow management). Another common upgrade may involve adding a high-density pod to increase power, cooling, and/or rack capacity in a low-density data center (see White Paper 134, *Deploying High-Density Pods in a Low-Density Data Center*). Adding power and cooling facility modules (sometimes referred to as containerized or pre-fabricated data centers) to a data center that has plenty of IT space but has no bulk power & cooling capacity is yet another example of an upgrade project (see White Paper 163, *Containerized Power and Cooling Modules for Data Centers*). **Table 1** summarizes the three types of upgrades that will be assessed throughout this paper and contrasted to outsourcing.

Table 1

Types of upgrades to existing data centers assessed in this paper

Approach	Description	Assumptions	Example
Increase utilization of installed equipment	Stranded capacity may exist that can be re-claimed	Data center has sufficient power & cooling capacity, but cooling system is de-rated due to poor airflow management practices	Blanking panels, brush strips, aisle containment
Add capacity with new high-density pods	One or more rows of racks can be added to a larger, low-density data center to increase capacity	Data center has sufficient switchgear & heat rejection capacity, and has available IT space	High-density pod(s)
Add capacity with facility modules	For larger capacity upgrades with available IT space, facility modules increase bulk capacity	Data center is out of UPS & heat rejection capacity, has no space in mechanical / electrical rooms, but has available IT space	Power and/or cooling facility module(s)

Build a new data center

Increasing levels of standardization, modularity, and data center infrastructure management (DCIM) are all playing an important role in simplifying the way data centers are deployed and operated. These technologies and approaches, which result in a more integrated power and

cooling infrastructure, significantly impact a data center's implementation time, cost, efficiency, and predictability. The expertise required to implement physical infrastructure has also changed. When systems are pre-assembled and integrated in a factory, the field work becomes much simpler, quicker, and less expensive now, in terms of both upfront and opex costs.

As discussed in White Paper 164, *TCO Analysis of a Traditional Data Center vs. a Scalable, Containerized Data Center*, building a data center with scalable, pre-assembled, and integrated data center facility power and cooling modules provide a total cost of ownership (TCO) savings of 30% compared to traditional, built-out data center power and cooling infrastructure. **Figure 2** illustrates an example of a standardized modular data center build-out. When evaluating the costs of building vs. outsourcing data center physical infrastructure, these new approaches, rather than legacy approaches should be considered.

Figure 2

Example of a standardized, modular, scalable data center build-out

Outsource to a colocation provider

There are some distinctions in colocation business models that can make the definition of a colocation data center unclear. For the purposes of this paper, a colocation data center is defined as follows:

- The provider owns and manages the entire physical infrastructure (fire, security, power, and cooling).
- Space is generally leased by the rack, by the cage, or by the room, depending on the scope of the needs.
- The tenant (end-user) owns and manages their IT equipment, but remote hands for technician services are also available.

Colocation has been of growing interest to businesses due primarily to the fast deployment capability, and the providers' core expertise in operating data centers which leads to a secure, highly available space with economies of scale that can help keep costs competitive. Smaller tenants often lease space with a retail colocation provider while larger data center tenants often lease with a wholesale provider, where the price models vary and the discounts per watt are greater. The colocation market, however, is rapidly evolving resulting in "blending" of retail and wholesale. This paper is primarily targeted at those data center managers considering retail colocation.

Outsourcing to the public Cloud is a further extension of this, where not only the physical infrastructure is outsourced, but also the software (SaaS), the IT infrastructure (IaaS), and/or the platform (PaaS) (see **sidebar** for information about how these technologies are impacting physical infrastructure).

> Outsourcing to the Cloud

Virtualization and the Cloud are growing in interest due to potential cost savings and productivity gains that can result. See white paper 118, *Virtualization and Cloud Computing: Optimized Power, Cooling, and Management Maximizes Benefits*, for further information on how these technologies are impacting physical infrastructure decisions.

Cost analysis

As with any business decision, a financial analysis of the alternatives is a critical input to making a sound decision of whether to upgrade / build a data center or outsource to a colocation provider. There are, however, several non-economic factors that are also critical inputs to the decision, as this paper will later discuss.

Any data center, regardless of whether it is owned or outsourced, incurs the same types of capital and operating expenses. A colocation provider generally has some economies of scale and negotiating power that allows them to build and operate their data center for less (i.e. lower cost/watt to build, better electricity rates, better bandwidth rates) compared to an end-user, but it's important to view the costs from the end-user's perspective when evaluating any potential savings.

The pricing structure to tenants varies from one colocation provider to the next, although in general, are based on monthly recurring charges. Some charge primarily by space consumed while others charge by cost per kW reserved or cost per kW used. Some also offer discounts as the kW capacity reserved increases. In this cost analysis, the main variables for a retail colocation provider's price structure to their customers are assumed to include:

- Charge for the space – often done on a per rack or per cage basis
- Charge for circuits – a 20 amp circuit costs less than a 30 amp circuit, some are moving to "pay per use" instead of "pay per circuit"
- Charge for bandwidth – a T1 line costs less than a T3 line
- Charge for remote hands – an extra fee for basic IT technician services
- Charge for reserving future space – different cost models exist for reserving space for future growth

For an end-user building or upgrading a data center, on the other hand, the cost analysis assumes the following major costs are incurred:

- Capex for design / engineering, project implementation
- Capex of data center physical infrastructure system costs
- Energy and bandwidth costs
- Facilities staff
- Maintenance costs
- Real estate – lease costs

The following subsections compare TCO and cash cross-over point for four scenarios: the three upgrade scenarios presented earlier, as well as building a new data center vs. outsourcing to a colocation provider. *Note that these results are based on specific cost assumptions and can be highly sensitive to the variables shown below.* Therefore, a specific analysis may be required for cases with different assumptions for these variables.

- Colocation cost per rack or per kW
- Future space reservation costs
- Power usage effectiveness (PUE)
- Density / rack and IT input voltage (i.e. 120V, 230V)
- Cost to build power & cooling infrastructure (dependent on level of modularity and scalability)
- Cost of capital

Cost Comparison 1: Increase utilization of installed equipment

Often times, data centers strand cooling capacity over time due to lack of proper air flow management practices. This scenario considers a Tier 3, 1 MW data center that is currently only utilized to 900 kW of IT load because of the air mixing inside the IT space. This, in effect, de-rates the CRAH units (i.e., the "delta T" across the cooling systems is decreased). With the addition of blanking panels, brush strips, and cold-aisle containment panels to isolate the hot and cold air streams, the data center can claim 100kW of additional load (as well as re-claim its intended redundancy level).

The cost for re-claiming this 100 kW of load capacity is roughly $210K or $2.10 / watt. Over a 10-year life time, the TCO is $15 / watt. The 10-year TCO of using a colocation provider for the 100 kW is $39 / watt. **Figure 3** illustrates the cumulative costs of upgrading and operating this 100 kW of data center in-house vs. the cost of outsourcing 100 kW of load to a colocation provider. The cash cross-over point for these minor upgrades is less than a year. See **Appendix A** to review the details of this analysis.

When minor upgrades like installing air flow management solutions can be done, keeping the IT load in-house makes financial sense. Over a 10-year lifetime, upgrading may save over 60% compared to outsourcing.

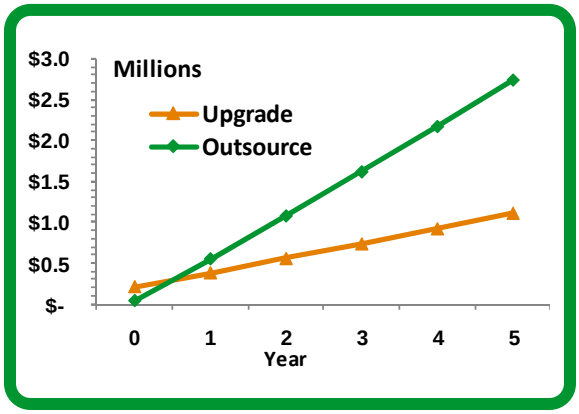

Figure 3

Air flow management upgrades to re-claim capacity vs. colocation has a typical cash cross-over point of less than 1 year

Cost Comparison 2: Add capacity with new high-density pods

A data center may run out of power (UPS, distribution) and cooling (distribution) capacity before it runs out of available space in the IT room. When additional load is identified, and the "low hanging fruit" options (like that in scenario 1) have already been implemented, further load can be added to a data center by adding a high-density pod. This scenario considers the addition of a 40 kW pod (at 6 kW / rack) in an existing data center. It assumes the existing service entrance and switchgear, as well as the heat rejection (chiller, cooling tower) equipment can support this additional load.

The cost to implement the 40 kW pod is about $184K or $4.84 / watt. The 10-year TCO is $20 / watt, compared to a 10-year TCO of $39 / watt for colocation of 40 kW of load. **Figure 4** illustrates the cumulative costs of upgrading and operating this 40 kW pod in-house vs. the cost of outsourcing 40 kW of load to a colocation provider. The cash cross-over point for the high-density pod upgrade is two years. See **Appendix B** to review the details of this analysis.

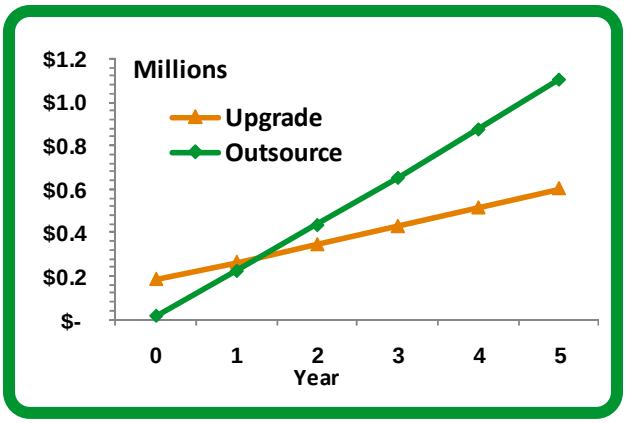

Figure 4

Addition of a high-density pod vs. colocation has a typical cash cross-over point of 2 years

When an upgrade consisting of a high-density pod can be implemented to meet the new IT requirement, keeping the IT load in-house makes financial sense. Over a 10-year lifetime, upgrading may save 50% compared to outsourcing.

Cost Comparison 3: Add capacity with facility modules

When a data center is out of bulk power (switchgear, UPS) and/or cooling (heat rejection) capacity and there is no mechanical and electrical room space, but there is available (stranded) IT space, it may be possible to upgrade the site to meet the new requirement. Adding power and/or cooling facility modules, as described earlier, is one means of extending the life of an existing data center. This scenario considers a data center that adds 500 kW of pre-fabricated power and cooling facility modules to support 450 kW of new IT load.

The cost to add a power facility module and a cooling facility module is $3.8M or $8.45 / watt. The 10-year TCO of this upgrade is $24 / watt, compared to $39 / watt for a colocation provider for the same 500 kW of load. **Figure 5** illustrates the cumulative costs of operating this data center addition vs. the cost of outsourcing 450 kW of load to a colocation provider. The cash cross-over point for the facility module upgrade is 3 years. See **Appendix C** for details of this analysis.

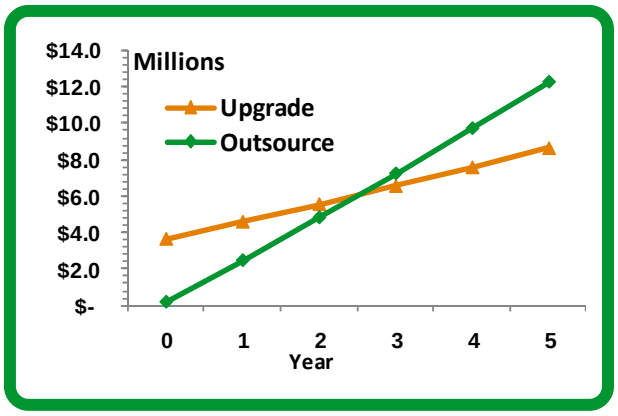

Figure 5

Addition of power and cooling facility modules vs. colocation has a typical cash cross-over point of 3 years

When a data center can be upgraded with facility modules to meet the new IT requirement, keeping the IT load in-house makes financial sense if the data center life expectancy is greater than 3 years. Over a 10-year lifetime, upgrading may save over 30% compared to outsourcing.

Cost Comparison 4: Build a new data center

When an existing data center is completely out of power, cooling, and space capacity, and new IT requirements are identified, the business may consider building a new data center. This scenario considers the costs to build and operate a new 1 MW data center vs. the cost of outsourcing 1 MW of IT load to a colocation provider. The new data center is assumed to be built with scalable, modular, and standardized infrastructure, so that capex and opex are optimized (expenses are avoided or deferred until needed based on the growth plan). Both options assume a starting load of 200 kW and a final load of 1 MW achieved in year 5. Note that in the build scenario, the switchgear and water piping were assumed to be fully built out on day one to the maximum 1MW capacity.

The capital cost of the project (including the incremental infrastructure added during growth years) is estimated to be $11 / watt. The TCO cost to build and operate the new data center for 10 years is $26 / watt and the TCO to co-locate the same scaled load in a provider's data center is $33/ watt. **Figure 6** illustrates the cumulative costs of operating this new data center vs. the cost of outsourcing it. The cash cross-over point for the new data center build is 5 years. See **Appendix D** to review the details of this analysis.

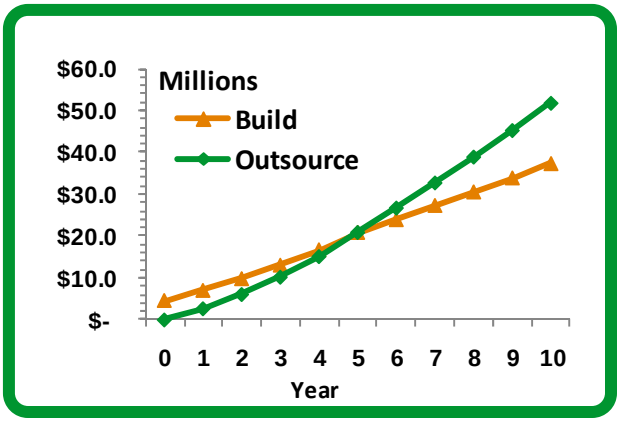

Figure 6

Building new data center vs. colocation has a typical cash cross-over point of 5 years

Based on these assumptions, when a data center has an expected life of 5 years or less, going to a colocation provider makes more financial sense. When a data center has an expected life of more than 5 years, however, building a data center makes financial sense. Over a 10-year lifetime, the TCO to build a new data center may save 20% compared to outsourcing.

The cost of capital in these analyses was assumed to be 8% per year, as documented in the Appendices, but the value used by a particular business for cost of capital can vary significantly. The value should represent the rate of return that the capital could be expected to earn in an alternative investment. **Figure 7** illustrates the impact this variable has on the differences in NPV TCO values for the two approaches.

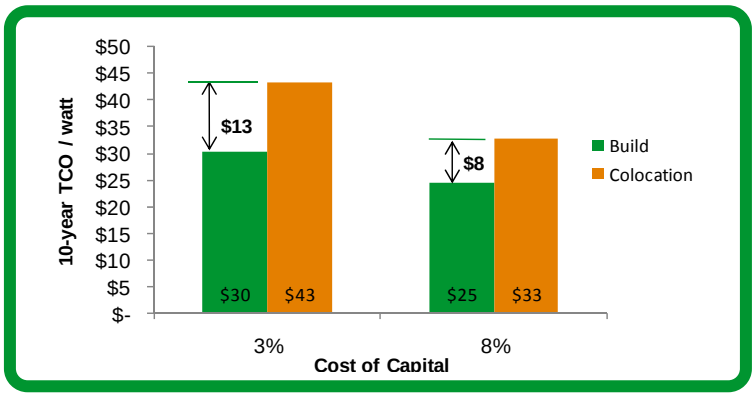

Figure 7

Impact of cost of capital on scenario 4 comparison – the TCO difference between the 2 approaches narrows as cost of capital increases

A summary of the four cost analyses is shown in **Table 2**. It is important to note, however, that these analyses don't take into account any operational advantages a colocation data center will likely have. For instance, a colocation data center would experience a higher reliability / availability, and be better run, at least in theory, because operating data centers is their core competency. These types of considerations are discussed in greater detail in later sections of this paper.

Table 2

Summary of cost analysis for 4 upgrade / build scenarios

Approach	Project cost per watt	10 year TCO per watt	Cross-over point	% Savings over lifetime
Increase utilization of installed equipment	$2.10 / watt	$15/ watt	< 1 year	61%
Add capacity with new high-density pods	$4.84/ watt	$20 / watt	2 years	50%
Add capacity with facility modules	$8.45 / watt	$24 / watt	3 years	37%
Build new data center	$11 / watt	$26 / watt	5 years	20%

Other cost considerations

Although not factored into the cost analyses above, there are additional cost considerations that may influence the decision on whether to build in-house or go to a colocation provider. These include:

- **Migration costs** – Migration of a data center to a new location can be costly and result in downtime.
- **Cost to lay fiber** – If there is no existing fiber optic cable to the new data center location, there would be an additional capital expense to lay the fiber.
- **Opportunity costs** – Building and operating a data center consumes resources that may otherwise be used on other business initiatives.

Cash flow

While the TCO and cash cross-over analysis in the previous section may point to in-house data centers, there are other financial considerations that factor into the decision. The cash flow model (year over year capex and opex) for building a data center and using a colocation provider are very different.

On one hand, there's a large upfront capital expense to build-out the infrastructure, with annual operating expenses for staff, maintenance, bandwidth, and energy cost of the equipment (physical infrastructure and IT), as well as any building/leasing costs. When that data center is scaled based on a forecasted load profile (with modular, scalable infrastructure), the initial capital expense decreases with subsequent capital expenses occurring at periodic years of growth. This is the optimized approach to building a data center, as it defers both capital and operating expenses until they are actually needed.

On the other hand, the cash flow for a data center that is outsourced to a colocation provider is more predictable, with increases that occur more steadily. It is true that cost models for

colocation vary from vendor to vendor, but there is generally a monthly expense consisting of a per rack cost (or per square foot cost) plus a cost per circuit, with additional costs for remote hands or future space reservations. This is appealing to businesses that prefer a steady monthly expense over the highly variable capex and opex of building and operating in-house, or for those businesses that simply don't have the available capital. This cost model is also appealing when the business has other capital expenditure projects that compete for the funding. If the major capital expense of building a new data center can be avoided, that capital can be applied to another project. Those businesses that are sensitive to large capital expenditures will see the colocation cost model as a benefit, despite a higher long-term TCO outcome.

Figure 8 illustrates an example of how the two run-rate models differ in their profile. Note, the IT cash flow is not depicted in these graphs, but would be the same in both models, since the tenant owns their own equipment and incurs the same capex and opex for those systems. Outsourcing to the Cloud is a further extension of creating a steady, predictable run-rate model. Note, in this example, the data center is fully built out on day 1. Modular approaches where the data center is scaled over time would result in deferred capital expense throughout the growth years.

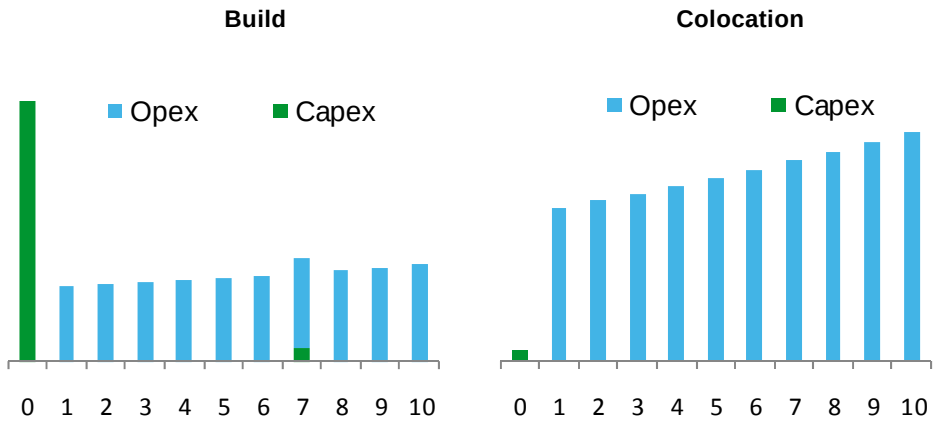

Figure 8

Characteristic run-rate model of building a data center upfront vs. outsourcing to a colocation provider (excludes IT costs)

Schneider Electric developed a TradeOff Tool to analyze the financial differences of building a data center vs. outsourcing to a retail colocation provider. This tool, illustrated in **Figure 9**, allows the user to adjust variables and assumptions based on their specific requirements.

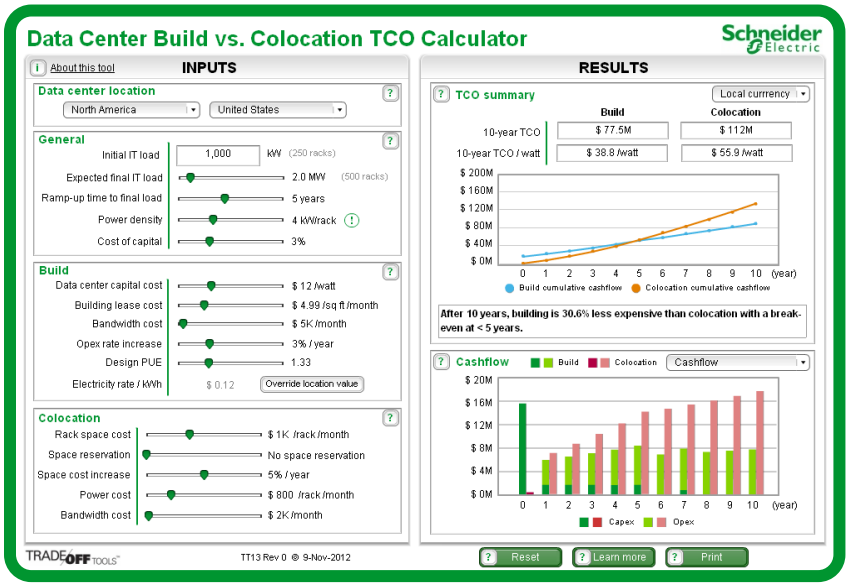

Figure 9

TradeOff Tool 13, Data Center Build vs. Colocation Financial Calculator

Strategic Factors

The two previous sections discussed financially quantifiable factors that influence the decision whether to own or outsource a data center's infrastructure. But, when people make this decision, they may be heavily influenced for reasons other than financial ones.

In this section, ten key strategic factors are discussed that can heavily influence the decision. Some of these factors are more quantitative or deterministic, some relate to preferences with the financial model, and some are related to the culture or values of the organization. Often times, a particular business requirement or preference will dominate the decision, and eliminate certain alternatives under consideration. **Table 3** illustrates three common examples of this. If a business has a hard requirement to deploy their data center loads in three months, for example, upgrading with facility modules or building a new data center would be eliminated as possibilities, regardless of economic comparisons. Likewise, if the business' data center requirement is determined to be temporary, it would not be practical or economical to invest in a big capital expenditure project. These decision filters can vary from business to business, depending on the priorities, resources available, and philosophies. It is important to identify what the filters are for a particular business before continuing with the assessment of options.

Table 3
Common examples of decision filters

Decision Filters	Criteria	Utilization or pod upgrade	Facility module upgrade	Build new	Colocation
Deployment timeframe	Data center is needed in less than 6 months	√	X	X	√
Life expectancy	Data center is temporary need (less than 5 years)	√	X	X	√
Regulatory requirements	Regulatory requirements to keep IT equipment in-house	√	√	√	X

* A red X means the alternative is not practical

Once any filters have been identified and alternatives eliminated, the remaining strategic factors should be considered. **Table 4** illustrates the ten key strategic factors that can influence the decision of upgrading or building vs. co-locating. The table is set up as a decision scorecard to help provide a relative rating to guide the decision. The closer the score is to a 10 (the minimum), the greater the indication that the IT loads should be located in an in-house facility; the closer the score is to a 100 (the maximum), the greater the indication that the IT loads should be located in a colocation facility.

Critical facilities expertise

A business should consider what facilities resources they have available and whether it matches the needs of the business. There is an element of "control" in deciding whether a business wants to maintain a level of expertise in operating an in-house data center, or whether they are comfortable letting a third party be that center of expertise. Colocation companies are in the business of running data centers, so they are more likely to have a high level of talent in operating them reliably and effectively.

Colocation facilities are generally designed with the highest levels of security, with robust systems and security staffing. They also generally build their facilities to Tier 3, and to a lesser extent Tier 4, standards for high availability; and with their business centered around

operating data center facilities, generally have well-established operation and maintenance practices to reduce interruptions caused by human error.

Colocation data centers also generally have more available and lower cost options for bandwidth than a typical small to medium data center. They generally have multiple carriers, as well as greater bandwidth to meet the varying needs of their tenants. The greater the requirement for bandwidth capacity and availability, the greater the value the colocation provider likely brings, as the in-house data center typically has limited carrier options and lower bandwidth capacity.

A related factor is the risk associated with inaccurate capacity planning. When building a data center, the end-user takes on this risk. Since it is very difficult to predict the future, there is always a bit of "art" associated with capacity planning. Over-building comes with unnecessary added capital and operating expenses and under-building comes with the costs associated with not being able to support the business requirements and/or having to retrofit sooner than expected or outsource to meet those needs.

Table 4

Worksheet tool to guide decision based on qualitative strategic factors

Key Qualitative Considerations	Rating guide	Score
Critical facilities expertise	1 = Strong critical facilities expertise exists within the company 10 = Little to no critical facilities expertise exists within the company	
Regulatory requirements	1 = Business has very specific regulatory compliance issues 10 = Business has no specific regulatory compliance issues	
Life expectancy	1 = Data center will be utilized for > 10 years 10 = Data center requirement is temporary	
Deployment timeframe	1 = Business requirement for deployment is in years 10 = Business requirement for deployment is in weeks	
Company culture	1 = Strong culture to keep direct control & avoid outsourcing any business function 10 = Company is open to outsourcing business functions	
Comfort with IT equipment in shared space	1 = Data center must be in company owned space 10 = Data center can be in shared IT space	
IT accessibility to the data center	1 = IT staff must be located in same facility as data center 10 = IT staff can be remote to data center	
Comfort with dependence on contract terms	1 = Low degree of comfort with contract dependence 10 = High degree of comfort with contract dependence	
Perceived size of capital investment	1 = Nominal capital expense is not viewed as significant to company 10 = Nominal capital expense is viewed as significant to company	
Cash flow model preference	1 = Comfortable with significant variability in capital expenses 10 = Prefer smooth predictable operating expenses	
	TOTAL SCORE *	

* The total score will range from 10 to 100 based on the relative scales from 1 to 10 for each of the 10 considerations.

Regulatory requirements

Depending on the business, regulatory requirements may exist that could influence which direction to take to address the new IT loads. There may be security or reporting-based regulatory requirements to keep the IT equipment in-house. If this is the case, colocation as an alternative may be eliminated. There are, however, some colocation providers who have the knowledge, capability, discipline, and/or certification to ensure compliance with regulatory requirements like HIPAA and Sarbanes Oxley. Therefore, this should be investigated before ruling out colocation in these circumstances.

Life expectancy

A data center's longevity is an important consideration during planning. A data center may be filling a short-term need, or it may have a long-term life expectancy of 10 years or more. If the data center is temporary in nature (i.e. needed for 1-2 years), the decision will steer towards quick upgrades or a colocation provider, because investing in long-term infrastructure is neither practical nor economical.

Deployment timeframe

A critical factor that affects the choice of owning vs. outsourcing a data center is the deployment timeframe for the new IT equipment. Business needs often drive this requirement, and the decision should consider this opportunity cost.

Because colocation providers have physical infrastructure already built-out and available, the deployment timeframe is near immediate. Realistically, the IT equipment can be up and running in 1-2 months, factoring in the time to identify a provider, close on a contract, and schedule the installation of the equipment. Building traditional data centers can take up to two years, from concept to commissioning, for delivery; However, building a data center with modular systems, on the other hand, is more on the order of 6-9 months from early planning to a commissioned data center (see White Paper 163, *Containerized Power and Cooling Modules for Data Centers*). Of course, if an upgrade to an existing data center can meet the business needs, the scope of the upgrade will determine the time required to ready the data center. Minor upgrades like adding containment are near immediate whereas adding a high-density pod could take 1-2 months.

If the need is identified to deploy the new equipment in under 6 months, and an upgrade is not feasible, the decision will steer towards a colocation provider, because deploying facility modules or a new data center will not meet the business requirement.

Company culture

In the end, company culture or philosophy towards outsourcing *any* business process can be a make-or-break deal for outsourcing the physical infrastructure. This is something that should be understood before bringing a case for co-locating to the management team. The culture of keeping things in-house often has to do with the importance of not losing control of the data center. This may be out of concern for what will happen if the provider doesn't honor their SLA or if they go out of business, etc.

Comfort with housing IT equipment in shared spaces

A data center in a colocation provider's facility is likely to share the same room as other tenants, unless the capacity requirement is large enough for a dedicated room. Sometimes tenants consume individual racks, and sometimes they consume an area secured off with a

cage. In either case, it is important to consider the colocation provider's acceptable use policy (AUP) to ensure one tenant doesn't impact another tenant's security or reliability. An example of a reliability risk would be a tenant facing his rack(s) such that the hot air is ejected from the servers into the intake of another tenant's servers, causing hot spots and possible overheating and server failures. White Paper 173, *Power and Cooling Guidelines for Deploying IT in Colocation Data Centers*, discusses how adherence to these policies helps reduce downtime and extends the life of the leased space.

IT accessibility to the data center

To address the concern of not having IT staff as accessible to the IT equipment when placed in a colocation data center, many providers offer "remote hands", which are technicians that can help with basic tasks like rebooting a hung server. Nonetheless, accessibility to the IT equipment should be factored into the decision. If a colocation provider is chosen, will the staff have adequate access in a reasonable timeframe, should the need arise?

Comfort with dependence on contract terms

In a colocation data center, the business is dependent on a contract's length of terms, conditions, and service level agreements. This is an important topic to discuss with any potential provider, as it has both short and long term implications to the business. Below are some common discussion points with regards to contract terms:

- Length of terms – typically 1-3 years
- Magnitude of rate increases
- Ability to renew the contract
- Ability to terminate the contract
- Service level agreements (SLA)
- Penalties for not meeting SLAs
- Implications for security breaches
- Future growth and space reservation

Being clear on these points helps establish a confidence level with the colocation provider by fully understand any business risks associated with the contract.

Perceived size of capital investment

The cost analysis section earlier in the paper showed how under typical circumstances the 10-year TCO cost / watt of upgrading or building is less than the TCO of using a colocation provider. It is important to consider the magnitude of the TCO savings and determine, for the particular business, if that value is significant enough to the business to warrant the upfront capital expenditure of those options.

Cash flow model preference

As discussed previously, in the Cash Flow section, owning vs. outsourcing the physical infrastructure results in two very different cash flow models. Some businesses have a strong preference towards one of these two models. In one case, the TCO is lower, but there's an upfront capital expense followed by fluctuating capital and operating expenses yearly; in the other case, there's a higher TCO, but no large capital expenditure upfront, and smooth predictable operating expenses. A preference for predictable, steady operating expenses may trump any potential long-term savings for some businesses.

Conclusion

Both quantitative and qualitative factors play a significant role in the decision of whether to keep IT equipment in-house or in a colocation provider's third party data center. Data centers should always first assess the feasibility of making upgrades to their existing facility, as these generally provide quick, cost effective means of adding capacity. When comparing common upgrades to the expense of a colocation provider, the cash cross-over point is less than 3 years.

If a new data center must be built, the life expectancy and the forecasted load growth play a key role in which alternative makes better financial sense. Generally, for data centers that are expected to last for five or more years, building provides a lower TCO than outsourcing. Required deployment timeframe and cash flow sensitivity also heavily influence the decision, because the alternatives have very different time-to-market and expenditure models.

Key strategic factors should also be assessed before making a decision, because there are risks and benefits with each of the approaches. Often times, cultural issues can dominate the conversation and having tools such as scorecards and calculators as described in this paper can help facilitate the process to ensure a fully informed decision is made.

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About the author

Wendy Torell is a Senior Research Analyst at Schneider Electric's Data Center Science Center. In this role, she researches best practices in data center design and operation, publishes white papers & articles, and develops TradeOff Tools to help clients optimize the availability, efficiency, and cost of their data center environments. She also consults with clients on availability science approaches and design practices to help them meet their data center performance objectives. She received her BS in Mechanical Engineering from Union College in Schenectady, NY and her MBA from University of Rhode Island. Wendy is an ASQ Certified Reliability Engineer.

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Resources

Implementing Hot and Cold Air Containment in Existing Data Centers
White Paper 153

Deploying High-Density Pods in a Low-Density Data Center
White Paper 134

Containerized Power and Cooling Modules for Data Centers
White Paper 163

TCO Analysis of a Traditional Data Center vs. a Scalable, Containerized Data Center
White Paper 164

Power and Cooling Guide-lines for Deploying IT in Colocation Data Center
White Paper 173

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Appendix A: Utilization upgrade cost analysis

The cost comparison of upgrading an existing data center to increase its utilization of existing infrastructure compared to using a colocation provider is detailed below. **Table A1** provides the general assumptions, **Table A2** provides details and assumptions for the upgrade scenario, and **Table A3** provides details and assumptions for the colocation scenario. **Figure A1** illustrates the yearly costs of the scenarios of this comparison.

Table A1

General assumptions for cost comparison 1

General Attributes	Value
Electricity rate	$0.12 / kWh
Cost of capital (for NPV TCO calculation)	8%
Maintenance, staff, & electricity rate increase	3% per year
Density for 100 kW of load	5 kW/rack

Table A2

Upgrade details & assumptions for cost comparison 1

Upgrade Attributes	Value
Cooling utilization increased through use of blanking panels, cold aisle containment, & brush strips, which increased CRAH return temperature	100 kW
Material cost for upgrades of existing 1 MW data center at 3 kW/rack, including new racks & containment for additional load at 5 kW/rack	$105K
Installation cost for upgrades	$105K
Maintenance cost for air management components	$100 / year
Total power consumed by 100 kW upgrade (includes increased proportional and square losses) * Note, no additional losses added for CRAHs due to fixed speed fans	150 kW

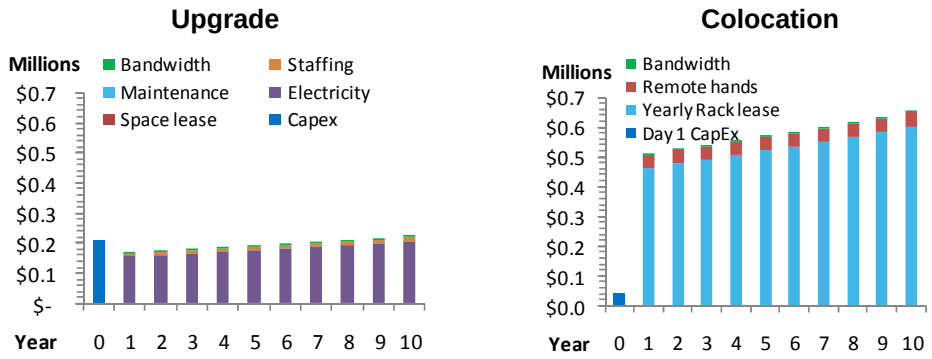
Table A3

Colocation details & assumptions for cost comparison 1

Colocation Attributes	Value
Capacity required in colocation facility	100 kW
Cost / rack per month	$1000
Power cost / rack per month	$925
Cost / rack rate increase	3% per year
Remote hands cost / rack per month	$187 at 5kW/rack
Bandwidth	T1 (1.5Mbps) $300/month

Figure A1

Yearly costs of upgrade scenario 1 vs. colocation



Appendix B: High-density pod upgrade cost analysis

The cost comparison of upgrading an existing data center with the addition of a 40 kW pod in the IT space compared to using a colocation provider is detailed below. **Table B1** provides the general assumptions, **Table B2** provides details and assumptions for the upgrade scenario, and **Table B3** provides details and assumptions for the colocation scenario. **Figure B1** illustrates the yearly costs of the scenarios of this comparison.

Table B1

General assumptions for cost comparison 2

General Attributes	Value
Electricity rate	$0.12 / kWh
Cost of capital (for NPV TCO calculation)	8%
Maintenance, staff, & electricity rate increase	3% per year
Density for 40 kW of load	5 kW/rack

Table B2

Upgrade details & assumptions for cost comparison 2

Upgrade Attributes	Value
Pod includes 2N UPS and distribution, 2N InRow cooling with VFD fans, & racks	40 kW
Power usage effectiveness (PUE) Note, includes increased proportional and square losses of shared infrastructure, and all losses for new 40kW infrastructure	1.5
Installed cost for 40kW pod	$184K
Maintenance cost for 40kW pod, 5% of pod cost, per year	$9K / year

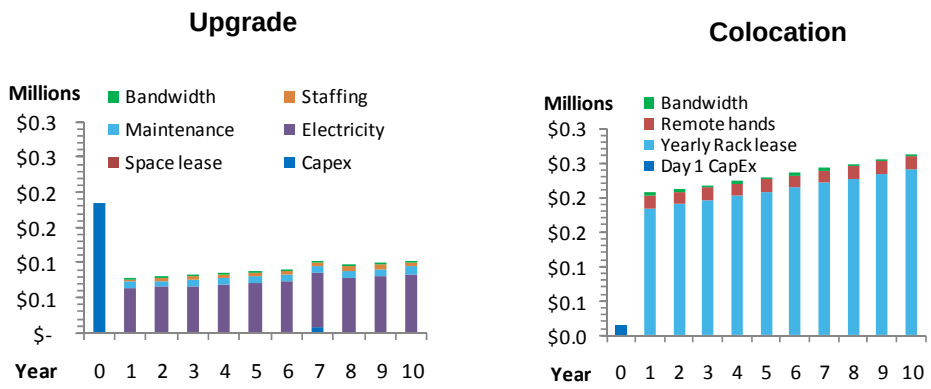
Table B3

Colocation details & assumptions for cost comparison 2

Colocation Attributes	Value
Capacity required in colocation facility	100 kW
Cost / rack per month	$1000
Power cost / rack per month	$925
Cost / rack rate increase	3% per year
Remote hands cost / rack per month (each rack takes 1 hour per month)	$187 at 5kW/rack
Bandwidth	T1 (1.5Mbps) $300/month

Figure B1

Yearly costs of upgrade scenario 2 vs. colocation



Appendix C: Facility module upgrade cost analysis

The cost comparison of upgrading an existing data center with the addition of 500 kW of power and cooling facility modules to support 450 kW of IT load compared to using a colocation provider is detailed below. **Table C1** provides the general assumptions, **Table C2** provides details and assumptions for the upgrade scenario, and **Table C3** provides details and assumptions for the colocation scenario. **Figure C1** illustrates the yearly costs of the scenarios of this comparison.

Table C1

General assumptions for cost comparison 3

General Attributes	Value
Electricity rate	$0.12 / kWh
Cost of capital (for NPV TCO calculation)	8%
Maintenance, staff, & electricity rate increase	3% per year
Density for 450 kW of load	5 kW/rack

Table C2

Upgrade details & assumptions for cost comparison 3

Upgrade Attributes	Value
Power facility module includes UPS, ATS, input & output switchboards, cooling, fire suppression/detection, physical threat & environmental monitoring, software	500 kW
Cooling facility module includes packaged chiller, pumps, hydronics, switchboard, & thermal storage tank	500 kW
Power usage effectiveness (PUE) at 100% load	1.5
Generator redundancy	N

Table C3

Colocation details & assumptions for cost comparison 3

Colocation Attributes	Value
Capacity required in colocation facility	450 kW
Cost / rack per month	$1000
Power cost / rack per month	$925
Cost / rack rate increase	3% per year
Remote hands cost / rack per month (each rack takes 1 hour per month)	$187 at 5kW/rack
Bandwidth	T1 (1.5Mbps) $300/month

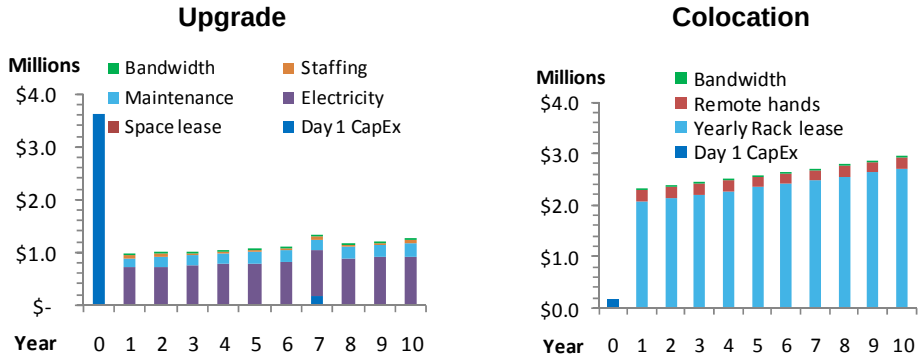


Figure C1

Yearly costs of upgrade scenario 3 vs. colocation

Appendix D: Build new data center cost analysis

The cost comparison of building a new data center with a starting IT load of 200 kW and a final IT load of 1 MW (at year 5) compared to using a colocation provider with the same growth profile is detailed below. **Table D1** provides the general assumptions, **Table D2** provides details and assumptions for the build scenario, and **Table D3** provides details and assumptions for the colocation scenario. **Figure D1** illustrates the yearly costs of the scenarios of this comparison.

Table D1

General assumptions for cost comparison 4

General Attributes	Value
Electricity rate	$0.12 / kWh
Cost of capital (for NPV TCO calculation)	8%
Maintenance, staff, & electricity rate increase	3% per year
Density for new data center	5 kW/rack
Bandwidth for both build and colocation model	T3 (45Mbps) $4,500/month (build) $2,000/month (colo)

Table D2

Build details & assumptions for cost comparison 4

Build Attributes	Value
Non-scalable physical infrastructure	30%
Power usage effectiveness (PUE) at 80% load	1.5
Battery refresh cost added	Year 7
Annual lease cost	$360 / m^2 ($33 / ft^2)

Table D3

Colocation details & assumptions for cost comparison 4

Colocation Attributes	Value
Capacity required in colocation facility	1000 kW
Cost / rack per month	$1000
Power cost / rack per month	$925
Cost / rack rate increase	3% per year
Remote hands cost / rack per month (each rack takes 1 hour per month)	$187 at 5kW/rack
Space reservation cost (as % of rack lease cost for future space per growth plan)	50%

Figure D1

Yearly costs of build scenario 4 vs. colocation