Determine the Hurdle Rate for the Development of Data Center Colocation in Asia Pacific Region

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Abstract

This paper is developed to determine the range of proper hurdle rate or Minimum Attractive Rate of Return (MARR) to be used for Data Center Colocation Project in some countries in Asia Pacific region by using Weighted Average Cost of Capital (WACC) as a floor base.

The author will also demonstrates how to determine the risk scoring range covers the types of construction, project location, power and cooling infrastructure utilization to be added into the MARR computation by using the Analytical Hierarchy Process (AHP). The paper concludes that range of 6.16% to 19.15% covers most conditions.

Keywords: Cost of capital, CAPM, WACC, hurdle rate, MARR, AHP, project risk

1. Introduction

1.1 Data Center Colocation in Asia Pacific Region

The data center colocation market in Asia Pacific region continues growing. This growth is expected to continue as an impact the growth of digital economic.

There are many data center enterprise from North America are driving up their presence in Asia-Pacific (APAC) region. Right now, there are 406 colocation data centers in the APAC market spread over 10 major countries. India boasts the highest concentration with 97 data centers, followed by Australia with 54 data centers while China, Hong Kong and Japan round out the top five, with 54, 40 and 38 data centers, respectively.¹

The APAC data center market is growing rapidly, but the data center provider is still catching up to meet the demand of high quality facilities. On the next few years, the APAC data center colocation market will be expanding as more global data center operators establish their bases in the region to challenge the current market.

1.2 Data Center Risk Index

Thirteen (13) of risks which commonly affect the successful operation of data center are Energy Cost, International internal bandwidth, Ease of doing business, Corporation Tax, Labour, Political Stability, Energy Sustainability, Natural Disasters, Population education level, Energy Security, GDP per capita, Inflation and Water availability. Those criterions are used to determine the rank of risks for the selected thirty (30) countries around the globe, representing emerging and established data center markets. The rank for APAC countries is shown on the Figure 2.

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2 Source 8, Hurley Palmer Flatt, Cushman & Wakefield (2013); Data Center Risk Index.
3 Source 8, Hurley Palmer Flatt, Cushman & Wakefield (2013); Data Center Risk Index.
The data center colocation business growth in APAC region is expected to accelerate both in the mature and the emerging markets. China has remained a big focus for many operators and end-users for entering or growing in the country. Hong Kong and Singapore remain as international hubs as well as the highest concentration of data center colocation taken-up by multi-national corporates, Australia and Japan are the other main established markets in the region, but mainly triggered by local demand and local operators.

1.3 Determining the Hurdle Rate for Economic Evaluation of a project

In business and engineering, the Hurdle Rate or Minimum Attractive Rate of Return (MARR) is the minimum rate of return where company is willing to accept before starting a project, given its risks and the opportunity of forgoing projects. One of the approaches to establish a MARR is by calculating the Weighted Average Cost of Capital (WACC). To perform WACC calculation, we will also need to compute the Cost of Equity based upon the Capital Asset Pricing Model (CAPM). Additional project specific or unique and country premium risk will also be added when adjusting WACC.
The survey conducted by the Association for Financial Professionals (AFP) to more than 400 financial planning and analysis professionals, shows that 85 percent use the Capital Asset Pricing Model (CAPM) to estimate their cost of equity. The CAPM calculates the cost of equity using the risk-free rate, volatility factor (beta) and the market premium for the average stock market risk. Nearly half-47 percent-of large companies with over $1 billion in annual revenue use 10-year Treasuries for estimating risk-free rates. To determine a “beta factor”, nearly two-thirds of organizations use Bloomberg as their source. And the country risk rating is the most commonly used method when adjusting WACC for international investment with one-third of organizations employing that approach.4

2. The Problem

In order to enable the engineers to evaluate the economic profitability of the data center project in Asia Pacific region, we will review the hurdle rates required for the business. We have selected ten (10) countries in the region which represent established and emerging markets for data centers i.e. China, Hong Kong, South Korea, Japan, India, Thailand, Malaysia, Singapore, Indonesia and Australia in the scope.

The scope of work included:
- Collecting the sample data to calculate the CAPM of two (2) Global Data Center Colocation Provider from North America who are now present in Asia Pacific region;
- Calculating the WACC of the companies;
- Review and analyze third party reports pertaining to project-specific risks;
- Computing the hurdle rate based on the company WACC, project-specific risks and country risk.

Following the above process, the author will also demonstrate how to determine the range of project risks percentage which can be added into the hurdle rate computation by using the analytical hierarchy process (AHP) based on the various type of construction, project location (country) and power and cooling system utilization.

3. Resolution of Problem

3.1 Collecting the Data to Calculate the CAPM

The capital asset pricing model (CAPM) is used to determine an appropriate required rate of return by considering the market risk, as well as risk-free asset and the expected return of the market. To compute the Cost of Equity based upon the Capital Asset Pricing Model or CAPM ($e_o$ or $R_s$), the following equation is used:

\[
R_s - R_F = \beta_s (R_M - R_F)
\]

Equation 1  *Capital Asset Pricing Model (CAPM) equation*

Where:

- \( R_S - R_F \) = the current risk premium associated with a stock \( S \) relative to a risk-free investment;
- \( \beta_S \) = the stock's contribution to the riskiness of the market portfolio;
- \( R_F \) = the risk free rate;
- \( R_M - R_F \) = the market premium for the average stock market risk.

Pablo Fernandez, Pablo Linares and Isabel Fernandez Acín from IESE Business School (2014) studied the Market Risk Premium (MRP) used in 88 countries. The study shows the average MRP in USA is 5.4%. Furthermore, this percentage will be used in this study to calculate the CAPM. The Risk Free rate used in this study is 3.125% which is based on 30-years tenor US Government Bond rated AA+ by S & P. And the beta stock values are taken from NASDAQ website dated as at August 19, 2014.

Furthermore, from the available data, we can then estimates the cost of equity by using the Equation 1 and the result is summarized in the following table 1.

<table>
<thead>
<tr>
<th>Company</th>
<th>Beta Value ( \beta_S )</th>
<th>The Market Premium ( R_M - R_F )</th>
<th>The Risk Free ( R_F )</th>
<th>Calculated CAPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equinix</td>
<td>1.07</td>
<td>5.4%</td>
<td>3.125%</td>
<td>8.90</td>
</tr>
<tr>
<td>Digital Realty Trust</td>
<td>0.6</td>
<td>5.4%</td>
<td>3.125%</td>
<td>6.37</td>
</tr>
</tbody>
</table>

Table 1 Beta Value, MRP, Risk Free and CAPM

### 3.2 Determining the Weighted Average Cost of Capital (WACC)

There a few information that we need to know, in order to calculate a weighted average cost of capital (WACC), i.e. :-

\[
\begin{align*}
\kappa_e &= \text{the cost of equity financing, as measured from historical performance of the CAPM;} \\
R_F &= \text{risk free rate;} \\
R_M &= \text{risk market return;} \\
\beta_S &= \text{level of market risk;} \\
i_b &= \text{the cost of debt financing, as measured from appropriate bond rates;} \\
\lambda &= \text{the fraction of the total capital obtained from debt;} \\
(1- \lambda) &= \text{the fraction of the total capital obtained from equity;} \\
t &= \text{effective income tax rate as a decimal}
\end{align*}
\]

For our purposes, the following equation is used to compute a WACC:

\[
WACC = \lambda(1-t)i_b + (1- \lambda)e_a
\]

Equation 2 The Weighted Average Cost of Capital (WACC) equation

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\(^5\) Google Finance website, data closed as of Aug 19, 2014
Equinix balance sheet shows $4,909,393 in debt and $2,459,064 in equity, meanwhile the Digital Realty balance sheet shows $6,075,229 in debt and $3,610,516 in equity (source: Yahoo Finance, Annual Balance Sheet as Dec 31, 2013). With these data, we can calculate the fraction of the total capital obtained from debt ($\lambda$) and from equity ($1-\lambda$).

As Digital Realty is currently a Real Estate Investment Trust (REIT) and Equinix is also currently pursuing to convert to REIT and will be effectively change the status from January 2015, in the WACC calculation, effective income tax rate ($t$) will be considered as zero.

The WACC can now be computed with the available data by using the Equation 2 and the result is summarized in the following table 2.

<table>
<thead>
<tr>
<th>Company</th>
<th>CAPM ($e_a$)</th>
<th>($\lambda$)</th>
<th>($i_b$)</th>
<th>Calculated WACC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equinix</td>
<td>8.90</td>
<td>1.07</td>
<td>3.125%</td>
<td>5.05%</td>
</tr>
<tr>
<td>Digital Realty Trust</td>
<td>6.37</td>
<td>0.6</td>
<td>3.125%</td>
<td>4.33%</td>
</tr>
</tbody>
</table>

Table 2 WACC calculation result

In this paper, the higher WACC i.e. 5.05% is used for further MARR calculation.

### 3.3 Review and Analyze Project –Specific Risks

Saaty in 1980 founded the Analytic Hierarchy Process (AHP). This method is allows the use of both quantitative and qualitative criteria in evaluation. Pairwise comparison of the criterion will be made with the grades which ranging from 1-9 as illustrated in the following Figure 3.

<table>
<thead>
<tr>
<th>Intensity of importance</th>
<th>Definition</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equal importance</td>
<td>Two factors contribute equally to the objective</td>
</tr>
<tr>
<td>3</td>
<td>Somewhat more important</td>
<td>Experience and judgement slightly favour one over the other.</td>
</tr>
<tr>
<td>5</td>
<td>Much more important</td>
<td>Experience and judgement slightly favour one over the other.</td>
</tr>
<tr>
<td>7</td>
<td>Very much more important</td>
<td>Experience and judgement slightly favour one over the other, its importance is demonstrated in practice.</td>
</tr>
<tr>
<td>9</td>
<td>Absolutely more important</td>
<td>The evidence favouring one over the other is of the highest possible validity.</td>
</tr>
<tr>
<td>2,4,6,8</td>
<td>Intermediate values</td>
<td>When compromise is needed</td>
</tr>
</tbody>
</table>

Figure 3 Saaty’s pairwise comparison grades
Furthermore, the risks ranking that are derived from Cushman & Wakefield, Source 8 and Hurley Palmer Flatt (2013) will be used to determine the hierarchy decision criteria for location.

3.3.1 Type of Construction

Generally the Data Center Colocation development is divided into three categories i.e. New Fit-Out, Green Field and Expansion Fit-Out.

The green field means the data center is constructed on a green field where there is no existing building or infrastructure. The construction of this development will have the greatest flexibility to the owner of the data center, because the building shell and core can be built to suit the distinctive data center infrastructure requirement. The project can also be planned to be executed in phases and the design can be made to suit the phasing/staging plan, including the delivery of major infrastructure. The Capital Expenditure (CAPEX) to build such data center is the highest, because the owner has to spend their investment in land and new building. The construction period required to build this data center is longest, to build the building only for about 5000 racks space of data center will takes about 18-24 months including design and development phase.

The New Fit-Out means the data center is built in the existing building, but no previous facility ever built in the building. Usually the owner will search for the suitable existing building to house their data center. A few things must be considered when selecting the suitable building, such as power availability, physical risks to the site, environment, network connection availability, space to locate the external equipment, etc. The construction cost of this type is cheaper than the green field.

The Expansion Fit-Out means that the data center is built in the existing facilities/data center, the major infrastructure such as power and cooling can be tapped from the existing system. Usually this expansion has been planned before in the project pipeline. And the infrastructure has also been designed to suit this expansion. The construction cost of this type is cheapest compare to green field and new fit-out.

3.3.2 Location

We have selected ten countries in Asia Pacific which represent established and emerging market for data center i.e. China, Hong Kong, South Korea, Japan, India, Thailand, Malaysia, Singapore, Indonesia and Australia.

Among ten countries, only Hong Kong (Ranked 6th) who stands at top ten (10) countries based on the Data Center Risk Index 2013. So Hong Kong is considered as the least risk country in Asia Pacific region. Meanwhile India ranked 29th of 30, the most risk country in the world to build the data center.

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3.3.3 Power and Cooling System Utilization

This risk is critically needed to be considered particularly to the expansion fit-out type of construction. Usually if the first built of data center is planned to have further expansion, the shared power and cooling infrastructure for future expansion have been catered for. This utility availability drives the complexity of the project which affecting the cost, construction methodology and construction period.

It is a common practice that the data center is built in modular/scalable manner as this will economically beneficial for the data center owner/provider. For example, the data center is going to be built for the capacity of 3,000 racks and divided into three (3) data halls equally. But for the first stage, only 1000 racks will be deployed. The other 2000 racks will be deployed at future 2 phases. Each thousand racks require 1000 RT cooling and the cooling system is Block Redundant or N+1 topology. Therefore at this first phase, there will be only 1000RT N Chiller installed plus 1000RT redundant. But the piping infrastructure shall be installed to cater for ultimate cooling capacity i.e. 3000 RT. So in future when the second stage is activated, we just need to extend the branch pipes to the data halls and deploy the additional equipment as per new load requirement.

3.3.4 Development of Analytic Hierarchy Process (AHP)

The first step to determine the risks scoring is to create the Hierarchical Tree based on type of construction for Data Center, Location (Countries) and Power and Cooling Utilization as illustrated in Figure 4.

Figure 4 Hierarchical Tree7

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7 By Author
The second step is to determine the relative weights and ranking of the criterion and sub criterion as illustrated in the Table 3, 4 and 5.

<table>
<thead>
<tr>
<th>TYPE OF CONSTRUCTION</th>
<th>Expansion Fit-Out</th>
<th>New Fit-Out</th>
<th>New Green Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansion Fit-Out</td>
<td>1</td>
<td>2/5</td>
<td>2/9</td>
</tr>
<tr>
<td>New Fit-Out</td>
<td>2/5</td>
<td>1</td>
<td>5/9</td>
</tr>
<tr>
<td>New Green Field</td>
<td>2/9</td>
<td>2/5</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 3 Comparison matrix of Construction Type Criteria (Source Author)**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>Hong Kong</th>
<th>South Korea</th>
<th>Singapore</th>
<th>Malaysia</th>
<th>Thailand</th>
<th>Australia</th>
<th>China</th>
<th>Japan</th>
<th>Indonesia</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong</td>
<td>1</td>
<td>1/2</td>
<td>1/2</td>
<td>1/3</td>
<td>1/8</td>
<td>1/8</td>
<td>1/8</td>
<td>1/8</td>
<td>1/8</td>
<td>1/8</td>
</tr>
<tr>
<td>South Korea</td>
<td>2/1</td>
<td>1</td>
<td>1</td>
<td>2/3</td>
<td>2/5</td>
<td>2/6</td>
<td>2/7</td>
<td>2/6</td>
<td>2/6</td>
<td>2/9</td>
</tr>
<tr>
<td>Singapore</td>
<td>2/1</td>
<td>1</td>
<td>1</td>
<td>2/3</td>
<td>2/5</td>
<td>2/6</td>
<td>2/7</td>
<td>2/6</td>
<td>2/6</td>
<td>2/9</td>
</tr>
<tr>
<td>Thailand</td>
<td>5/1</td>
<td>5/2</td>
<td>5/2</td>
<td>5/3</td>
<td>1</td>
<td>5/6</td>
<td>5/7</td>
<td>5/7</td>
<td>5/6</td>
<td>5/9</td>
</tr>
<tr>
<td>China</td>
<td>7/1</td>
<td>7/2</td>
<td>7/2</td>
<td>7/3</td>
<td>7/5</td>
<td>7/6</td>
<td>1</td>
<td>1</td>
<td>7/8</td>
<td>7/9</td>
</tr>
<tr>
<td>Japan</td>
<td>7/1</td>
<td>7/2</td>
<td>7/2</td>
<td>7/3</td>
<td>7/5</td>
<td>7/6</td>
<td>1</td>
<td>1</td>
<td>7/8</td>
<td>7/9</td>
</tr>
<tr>
<td>Indonesia</td>
<td>8/1</td>
<td>8/2</td>
<td>8/2</td>
<td>8/3</td>
<td>8/5</td>
<td>8/6</td>
<td>8/7</td>
<td>8/7</td>
<td>1</td>
<td>8/9</td>
</tr>
<tr>
<td>India</td>
<td>9/1</td>
<td>9/2</td>
<td>9/2</td>
<td>9/3</td>
<td>9/5</td>
<td>9/6</td>
<td>9/7</td>
<td>9/7</td>
<td>9/8</td>
<td>9/9</td>
</tr>
</tbody>
</table>

**Table 4 Comparison matrix of Location Criteria (Source Author)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exist. Power &amp; Exist. Cooling System</td>
<td>1</td>
<td>1/8</td>
<td>1/7</td>
<td>1/0</td>
</tr>
<tr>
<td>Exist. Power &amp; New Cooling System</td>
<td>5/1</td>
<td>1</td>
<td>5/7</td>
<td>5/9</td>
</tr>
<tr>
<td>New Power &amp; Exist. Cooling System</td>
<td>7/1</td>
<td>7/8</td>
<td>1</td>
<td>7/0</td>
</tr>
<tr>
<td>New Power &amp; New Cooling System</td>
<td>9/1</td>
<td>9/5</td>
<td>9/7</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 5 Comparison matrix of Power and Cooling System Utilization Criteria (Source Author)**
The third step is to calculate the matrix algebra for each criterion ranking as illustrated in the Figure 5, 6 and 7.

**Figure 5** Matrix Algebra to Calculate Construction Type Criterion (Source Author)

**Figure 6** Matrix Algebra to Calculate Location Criterion (Source Author)

**Figure 7** Matrix Algebra to Calculate Power and Cooling System Utilization Criterion (Source Author)
The risk scoring result for each country in Asia Pacific (APAC) in different Type of Construction, Location and Power and Cooling System Utilization is summarized in the following Figure 8 and Table 6.

Figure 8 Hierarchical Tree with Matrix Ranking Result (Source Author)

Table 6 Risk Score Range Result (Source Author)
3.4 Determining Minimum Attractive Rate of Return (MARR) or Hurdle Rate

The MARR for data center colocation project in Asia Pacific Region can now be calculated by adding the WACC, risk scoring and country risk as shown in equation 3. The result is reflected in table 7.

\[
\text{MARR} = \text{WACC} + \text{Risk Scoring} + \text{Country Risk}
\]

Equation 3 The Minimum Attractive Rate of Return (MARR) equation

<table>
<thead>
<tr>
<th>Countries</th>
<th>WACC</th>
<th>Risk Score Low</th>
<th>Risk Score High</th>
<th>Country Risk³</th>
<th>MARR Low</th>
<th>MARR High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong</td>
<td>5.050%</td>
<td>0.43%</td>
<td>1.06%</td>
<td>0.68%</td>
<td>6.16%</td>
<td>6.78%</td>
</tr>
<tr>
<td>South Korea</td>
<td>5.050%</td>
<td>0.87%</td>
<td>2.12%</td>
<td>0.77%</td>
<td>6.68%</td>
<td>7.93%</td>
</tr>
<tr>
<td>Singapore</td>
<td>5.050%</td>
<td>1.30%</td>
<td>3.18%</td>
<td>0.00%</td>
<td>5.92%</td>
<td>7.17%</td>
</tr>
<tr>
<td>Malaysia</td>
<td>5.050%</td>
<td>2.17%</td>
<td>5.29%</td>
<td>1.79%</td>
<td>8.13%</td>
<td>10.01%</td>
</tr>
<tr>
<td>Thailand</td>
<td>5.050%</td>
<td>3.03%</td>
<td>7.41%</td>
<td>2.10%</td>
<td>9.32%</td>
<td>12.44%</td>
</tr>
<tr>
<td>Australia</td>
<td>5.050%</td>
<td>3.03%</td>
<td>7.41%</td>
<td>0.35%</td>
<td>8.01%</td>
<td>11.76%</td>
</tr>
<tr>
<td>China</td>
<td>5.050%</td>
<td>3.03%</td>
<td>7.41%</td>
<td>1.31%</td>
<td>9.39%</td>
<td>13.77%</td>
</tr>
<tr>
<td>Japan</td>
<td>5.050%</td>
<td>3.47%</td>
<td>8.47%</td>
<td>4.10%</td>
<td>12.61%</td>
<td>17.62%</td>
</tr>
<tr>
<td>Indonesia</td>
<td>5.050%</td>
<td>3.90%</td>
<td>9.53%</td>
<td>4.58%</td>
<td>13.52%</td>
<td>19.15%</td>
</tr>
</tbody>
</table>

Table 7 Calculated MARR for 10 Countries in APAC Region (Source Author)

4. Conclusion

The study prove that an appropriate MARR for each country in APAC region are different, depending on the type of construction, location, power and cooling system utilization and country risk. The range is between 6.16% which is in Hong Kong to 19.15% in India which represent the lowest risk and the highest risk countries.

The Analytical Hierarchy Process (AHP) has also proven able to be used to calculate the specific risk factors; in this case three (3) factors are considered and processed to determine the risk scoring which then is used to adjust the WACC to get the appropriate MARR.

Country risk is also play a part in to adjust the WACC figures, so specific country risk is also covered in the ultimate MARR computation.

The computed WACC is not considering the risks of the individual project. In reality, every project should be evaluated on the basis of the risks it adds to the company as well as its return. If the risks are roughly normal, and if there are no significant capital limitations, then WACC is an appropriate hurdle rate (i.e. the MARR), but if the project riskier than the current business, then an upward adjustment in the MARR might be appropriate.

However this paper has proven that the accumulated WACC, using project specific risk and country risk, is one of the appropriate approaches to establish the hurdle rate/MARR.
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<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
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