Server Consolidation Toward Green IT
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Abstract

Based on the global needs of ecological friendly technology, makes Information Technology promote a new field called Green IT. Through literature review, this paper is to propose a framework for green IT from the perspective of server consolidation. Hopefully this paper would be the initial framework to realize Green IT in companies or any other agencies.

1. Introduction

With the growing needs of Green IT movement implemented for corporate users IT department is finding the way to make their current infrastructure uses less power, less electricity, and less air conditioner that will reduce the cost of IT operation and makes the datacenter a lot more “green”.

The resources that is used by the IT Operation is aligned with the CO2 emission that drive climate change to support faster data processing and increased storage capacity. The implementation of Green IT is to enhanced Energy Efficiency, that decreased IT related CO2 emission [8] and also power consumption that leads to heat emission of the datacenter.

To achieve Green IT in the datacenter one of the way to make is happened is by consolidating existing physical server environment to the virtual environment. Because in average servers are running around 10% from the total server capacity that uses the electricity, space, and cooling as if it runs on full capacity [1]. By converting the physical environment to the virtualized environment, will reduce multiple server workload to some physical servers. That will reduce the amount of physical servers, power consumptions, and air conditioner consumptions.

IT system resource optimization is needed to increase company competitiveness by optimizing the investment spend by the company to support operational cost. It is important to keep Green IT measurement align with the Business objective of the company. To contribute the research concerning Green IT alignment with Business Objectives, these research questions is arise:

• How to align Green IT with Company Business Objective to increase Company Competitiveness?
• What are the steps to achieve a Green Datacenter?

With this research paper, hopefully the journey to achieve Green IT is becoming easier and more measureable, and giving new insights concerning the strategic approach to achieve the potential of Green IT to enhance a value creation for Company Competitiveness.
2. Literature Review

Jason Harris studied 2 ways to reduce Company Operational Expanse, which is virtualization a technology that helps company to save hardware costs by creating multiple server instance in a single hardware and the Distributed Power Management is the way to disable or paused some un-accessed Virtual Machine so that the Physical server could be turned off. That saves power consumption and BIOS battery life.[9][10]

San Murugesan proposed a Green IT methodology that consists of Green use of IT System means that reducing energy consumption of servers and desktop PC, Green Manufacturing of IT System means that the manufacture hardware components or any other supporting devices has low or minimal environmental impact, Green Design of IT System means that the infrastructure design should use efficient electricity, cooling, sound and heat consumption, Green Disposal of IT System means that or re-use old hardware or refurbish the hardware in a friendly environmental manner.[11]

COBIT framework is used to monitor the transformation from common data center to a Green Datacenter. Because using COBIT framework has a governance layer that makes IT runs more efficiently and effectively. And COBIT uses the Balance Scorecard to translate high-level enterprise into manageable, specific IT-related goals and then map these to specific processes and practices.[2]

3. Server Consolidation based on COBIT Framework

Server Consolidation is the way of moving a workload from a physical server to a virtual server. Because in average servers are running around 10% from the total server capacity that uses the electricity, space, and cooling as if it runs on full capacity [3]. For example a single server could run multiple servers in a single physical server. That makes the cooling and electricity some physical server will become one physical server.

3.1. Physical to Virtual Migration

To migrate the physical server to a virtual server, some aspects should be considered such as the disk size, the used memory size, the processor utilization size, network throughput and disk IOPS. To achieve this a sizing tools is needed to measure the amount of load and then how many new physical server needed to run the migrated virtual environment to not only achieve the consolidated ratio, but also High Availability and Redundancy.

First the user would have to do the capacity planning phase; this phase is done to collect the server utilization for memory, processor, disks and network. So that at the end of the project the consolidation and redundancy aspects will be covered.

Second after the data is collected and the new hardware infrastructure is purchased, the next step is to do the physical to virtual migration using the migration tools. This step consume a lot of time and resources, because this step would involve the Management, Application team, Data base team, Infrastructure, Network and security, and the user that uses the application that is migrated to the virtual environment.

Third after the migration phase is done, the next step is to monitor the used of the capacity and the work load of the Virtual Machine so that the capacity is enough.

To monitor this activity, a framework is needed so that the whole activity will runs as good as it can be. COBIT 5 is one of the frameworks that can be used to monitor this activity.

3.2. COBIT 5

3.2.1. COBIT 5 Framework

COBIT 5 provides a comprehensive framework that assists enterprises in achieving their objectives for the governance and management of enterprise IT. Simply stated, it helps enterprises create optimal value from IT by maintaining a balance between realizing benefits and optimizing risk levels and resource use. COBIT 5 enables IT to be governed and managed in a holistic manner for the entire enterprise, taking in the full end-to-end business and IT functional areas of responsibility, considering
the IT-related interests of internal and external stakeholders. COBIT 5 is generic and useful for enterprises of all sizes, whether commercial, not-for-profit or in the public sector.

COBIT has five principles

1. Meeting Stakeholder Needs.
   Different Company has different needs and goals. COBIT translate high level enterprise goal to a specific manageable IT Goal.

2. Covering the Enterprise End to End.
   • COBIT treats information and related technologies as assets and manage it like any other assets in the company
   • COBIT considers all IT-related governance and management enablers to every aspects and end-to-end

3. Applying a single, integrated Framework.
   There are a lot of standards and best practice in IT, what COBIT do is align those standards at the high level and make it as the framework for governance and management of enterprise IT.

   For efficient and effective governance and management, COBIT defines a set of enablers to support the implementation of a comprehensive governance and management system.
   The enablers are:
   • Principles, Policies and Frameworks
   • Processes
   • Organizational Structures
   • Culture, Ethics and Behavior
   • Information
   • Services, Infrastructure and Applications
   • People, Skills and Competencies

5. Separating Governance from Management.
   COBIT 5 makes a clear separation between Governance and Management.
   • Governance
     Governance ensures that stakeholder needs, conditions and options are evaluated to determine balanced, agreed-on enterprise objectives to be achieved; setting direction through prioritization and decision making; and monitoring performance and compliance against agreed-on direction and objectives.
• Management

Management plans, builds, runs and monitors activities in alignment with the direction set by the governance body to achieve the enterprise objectives.

![COBIT Framework](image)

**3.2.2. COBIT 5 Process**

COBIT consists of 5 process for governance for ENTERPRISE IT. The process divided to 5 different domains. The domains are:

- Evaluate, Direct, and Monitor (EDM)
- Align, Plan, and Organize (APO)
- Build, Acquire, and Implement (BAI)
- Deliver, Service, and Support (DSS)
- Monitor, Evaluate, and Assess (MEA)
To determine the COBIT process used for server consolidation, it is important to highlight the most important process that involved if the servers are consolidated. From literature review and customer’s interview, the selected process are:

- Evaluate, Direct and Monitor (EDM04 Ensure Resource Optimisation)
- Align, Plan and Organize (APO06 Manage Budget and Costs)
- Built, Acquire and Implement (BAI04 Manage Availability and Capacity)
- Monitor, Evaluate and Assess (MEA01 Monitor, Evaluate and Assess Performance and Conformance)

Based on COBIT 5 Enabling Documentation, the detailed process is as followed:

**EDM04 Ensure Resource Optimisation**
This process is needed ensure that IT has sufficient resources to stay aligned with business needs, by ensuring the Resource optimized will achieve these IT Related Goal
Table 1 EDM04 IT Related Goal

<table>
<thead>
<tr>
<th>IT Related Goal</th>
<th>Expected Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>09 IT agility</td>
<td>• Because IT is agile makes Enterprise could adopt new system and application on their infrastructure</td>
</tr>
<tr>
<td></td>
<td>• Will increase user satisfaction from business executive and users for their new application requirements</td>
</tr>
<tr>
<td>11 Optimization of IT assets, resources and capabilities</td>
<td>• Will saved cost for new hardware requirement if Enterprise would like to implement new Application</td>
</tr>
<tr>
<td></td>
<td>• Will optimized used server resources</td>
</tr>
<tr>
<td>16 Competent and motivated business and IT personnel</td>
<td>• IT personnel skill will be updated due to training and enhancement for the new implemented system</td>
</tr>
</tbody>
</table>

Table 2 EDM04 RACI Chart

![RACI Chart](image)

BA104 Manage Availability and Capacity

Table 3 BA104 IT Related Goal

<table>
<thead>
<tr>
<th>IT Related Goal</th>
<th>Expected Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>07 Delivery of IT services in line with business requirements</td>
<td>• IT will have the ability to provide more application to support business needs by install it in a Virtual Machine</td>
</tr>
<tr>
<td>11 Optimization of IT assets, resources and capabilities</td>
<td>• Physical server usually only used 10% of its capacity. By using Virtualization multiple load could run in a single Physical Server</td>
</tr>
<tr>
<td>14 Availability of reliable and useful information for decision making</td>
<td>• By using Virtualization company will gets hardware redundancy features from the High Availability Clustering.</td>
</tr>
</tbody>
</table>

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Table 4 BAI04 RACI Chart

MEA01 Monitor, Evaluate and Assess Performance and Conformance
Table 5 MEA01 IT Related Goal

<table>
<thead>
<tr>
<th>IT Related Goal</th>
<th>Expected Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>04 Managed IT-related business risk</td>
<td>• IT related operations and implementation activity will have the risks covered by the risk assessor</td>
</tr>
<tr>
<td>07 Delivery of IT services in line with business requirements</td>
<td>• Customer will be satisfied by IT Service Delivery</td>
</tr>
<tr>
<td>11 Optimization of IT assets, resources and capabilities</td>
<td>• IT resources assets will be optimized, and IT operation costs will be reduced</td>
</tr>
<tr>
<td>15 IT compliance with internal policies</td>
<td>• All IT related activity will be comply with internal auditor policies</td>
</tr>
</tbody>
</table>
Table 6 MEA01 RACI Chart

APO06 Manage Budget and Costs
Manage IT related expanses is very important to ensure Enterprise goals is achieved efficiently and would not have huge impact on the Enterprise financial condition.

Table 7 APO06 IT Related Goal

<table>
<thead>
<tr>
<th>IT Related Goal</th>
<th>Expected Results</th>
</tr>
</thead>
</table>
| 05 Realised benefits from IT-enabled investments and services portfolio | • There will be budget comparison before the virtualization implementation and after implementation.  
• There will be Service Level Agreement comparison before the virtualization implementation and after implementation. |
| 06 Transparency of IT costs, benefits and risk       | • The use of IT budget should be transparent and comparable                        |

Table 8 APO06 RACI Chart
3.2.3. Physical Server Consolidation

After all process interview, and formulation is done, the next step is to consolidate the servers. Based on the physical assessment result and interview with the Accountable and Responsible person in BAI04 process. The example result is as followed.

Table 9 Example list of Existing server

<table>
<thead>
<tr>
<th>No</th>
<th>Device Name</th>
<th>Model / Jenis</th>
<th>Processor (GHz)</th>
<th>Memory (GHz)</th>
<th>Hard Disk (GB)</th>
<th>Rack</th>
<th>Operation System</th>
<th>Power Consumption (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Server Proliant</td>
<td>DL360 G5</td>
<td>1</td>
<td>2</td>
<td>110</td>
<td>R1</td>
<td>Redhat Linux 5</td>
<td>700</td>
</tr>
<tr>
<td>2</td>
<td>Server Proliant</td>
<td>DL360 G4</td>
<td>1</td>
<td>2</td>
<td>250</td>
<td>R1</td>
<td>W2K3</td>
<td>700</td>
</tr>
<tr>
<td>3</td>
<td>Blade Enclosure</td>
<td>Enclosure C7000</td>
<td></td>
<td></td>
<td></td>
<td>R1</td>
<td>-</td>
<td>900</td>
</tr>
<tr>
<td>4</td>
<td>Server Proliant</td>
<td>BL460 G6</td>
<td>2</td>
<td>16</td>
<td>120</td>
<td>R1</td>
<td>W2K8 64 bit</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Server Proliant</td>
<td>BL460 G6</td>
<td>2</td>
<td>16</td>
<td>120</td>
<td>R1</td>
<td>W2K8 64 bit</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Server Proliant</td>
<td>BL460 G6</td>
<td>2</td>
<td>16</td>
<td>120</td>
<td>R1</td>
<td>W2K8 64 bit</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Server Proliant</td>
<td>BL460 G6</td>
<td>2</td>
<td>16</td>
<td>120</td>
<td>R1</td>
<td>W2K8 64 bit</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Server Proliant</td>
<td>DL360 G5</td>
<td>1</td>
<td>1</td>
<td>50</td>
<td>R2</td>
<td>W2K</td>
<td>700</td>
</tr>
<tr>
<td>9</td>
<td>Server Proliant</td>
<td>DL380 G4</td>
<td>1</td>
<td>2</td>
<td>200</td>
<td>R2</td>
<td>W2K3 R2</td>
<td>700</td>
</tr>
<tr>
<td>10</td>
<td>Server Proliant</td>
<td>DL360 G4</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>R2</td>
<td>W2K3</td>
<td>700</td>
</tr>
<tr>
<td>11</td>
<td>Server Proliant</td>
<td>ML350G3</td>
<td>1</td>
<td>2</td>
<td>50</td>
<td>R2</td>
<td>W2K3</td>
<td>700</td>
</tr>
<tr>
<td>12</td>
<td>Server Proliant</td>
<td>ML370G5</td>
<td>2</td>
<td>2</td>
<td>300</td>
<td>R2</td>
<td>W2k3</td>
<td>700</td>
</tr>
<tr>
<td>13</td>
<td>System X server</td>
<td>X3650</td>
<td>2</td>
<td>1</td>
<td>80</td>
<td>R3</td>
<td>W2k3</td>
<td>750</td>
</tr>
<tr>
<td>14</td>
<td>System X server</td>
<td>X3650</td>
<td>2</td>
<td>1</td>
<td>80</td>
<td>R3</td>
<td>W2k3</td>
<td>750</td>
</tr>
<tr>
<td>15</td>
<td>System X server</td>
<td>X3550</td>
<td>2</td>
<td>1</td>
<td>80</td>
<td>R3</td>
<td>W2k3</td>
<td>750</td>
</tr>
<tr>
<td>16</td>
<td>External Storage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1000</td>
</tr>
</tbody>
</table>

From the table above we could roughly take data that the power that is needed for the infrastructure is 8050 Watts
After the servers are consolidated, the expected result is as followed.

Table 10 Example After Migration

<table>
<thead>
<tr>
<th>No</th>
<th>Device Name</th>
<th>Model / Jenis</th>
<th>Processor (GHz)</th>
<th>Memory (GHz)</th>
<th>Hard Disk (GB)</th>
<th>Rack</th>
<th>Operation System</th>
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<tbody>
<tr>
<td>1</td>
<td>Blade Enclosure</td>
<td>Enclosure C7000</td>
<td></td>
<td></td>
<td></td>
<td>R1</td>
<td>-</td>
<td>900</td>
</tr>
<tr>
<td>2</td>
<td>Server Proliant</td>
<td>BL460 G6</td>
<td>2</td>
<td>16</td>
<td>120</td>
<td>R1</td>
<td>W2K8 64 bit</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Server Proliant</td>
<td>BL460 G6</td>
<td>2</td>
<td>16</td>
<td>120</td>
<td>R1</td>
<td>W2K8 64 bit</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Server Proliant</td>
<td>BL460 G6</td>
<td>2</td>
<td>16</td>
<td>120</td>
<td>R1</td>
<td>W2K8 64 bit</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Server Proliant</td>
<td>BL460 G6</td>
<td>2</td>
<td>16</td>
<td>120</td>
<td>R1</td>
<td>W2K8 64 bit</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Server Proliant</td>
<td>BL460 G6</td>
<td>2</td>
<td>64</td>
<td>120</td>
<td>R1</td>
<td>ESXi</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Server Proliant</td>
<td>BL460 G6</td>
<td>2</td>
<td>64</td>
<td>120</td>
<td>R1</td>
<td>ESXi</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>External Storage</td>
<td></td>
<td>3000</td>
<td></td>
<td></td>
<td>R1</td>
<td></td>
<td>855</td>
</tr>
</tbody>
</table>

From the table above, the power consumption used is 1755 Watts. A very significant result showed in power consumption.

4. Benefits and Concerns

There are some factors that are considered as Benefits and Concerns when a company is using Virtualized environment.

4.1. Benefits

These are the benefit of Virtualized Environment\(^6\):

- Company would not pay for the hardware purchased to cover for business requirement for a certain time usually three to five years, depends on the hardware capacity.
- Company will get hardware redundancy by using the Cluster Features from the Virtualization vendors.
- Reduce the data center footprint by reducing the amount of used power, cooling, and racks.
- Have a testing environment that is not mixed with production environment.
- Faster server provisioning when deploying new Virtual Machine from a standardized Templates.
- Isolate applications, in the physical world one server could only contain one application, now multiple applications could run in one physical server using different Virtual Machines.

4.2. Concerns

There are some concerns if a company would like to implement Virtualized Environment\(^7\):

- Misconfiguring virtual hosting platforms, guests, and networks.
- Failure to properly separate duties and deploy least privilege controls.
- Failure to integrate into change/lifecycle management.
- Lack VM visibility across the enterprise
5. Conclusion & Futureworks

By using Virtualized Environment, a company could reduce the amount of electricity used to run the datacenter, more agile environment to support Business Needs, reduced cost of hardware purchased. In the future the green IT movement needs to be socialized.

6. Reference

[1] Reduce Hardware Costs Through Virtualization

[2] 4 reasons COBIT 5 should be part of your IT strategy http://www.enterprisecioforum.com/en/blogs/mylessuer/4-reasons-cobit-5-should-be-part-your-it


