Provisioning for Azure   
Cost Optimization & Monitoring Project  
 Project Starter Template

STEP 0: Problem Background

Company “X” is an engineering company that has offices in both the US East & West Coast. They currently host all their data and applications in a single East coast data center and are constantly worried about both cost and resiliency. Below is how their current servers are configured.

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| Server(s): | **Purpose:** Windows/Linux Server  **Environment:** Physical Servers  **Operating System:** Windows  **Operating System License:** DataCenter  **Servers:** 10  **Procs per server:** 2  **Core(s) per proc:** 8 Cores  **RAM:** 256 GB  **Optimize By:** CPU  **GPU:** None  **Usage:** These are the servers where all your engineering workloads happen. Currently they all are being leveraged at regular capacity. |
| Server(s): | **Purpose:** Web App  **Environment:** Physical Servers  **Operating System:** Windows  **Operating System License:** DataCenter  **Servers:** 3  **Procs per server:** 1  **Core(s) per proc:** 8 Cores  **RAM:** 64 GB  **Optimize By:** CPU  **GPU:** None  **Usage:** These are the web app servers for your company. Currently they all are being leveraged at regular capacity. |
| Server(s): | **Source:** Database Server  **Database:** Microsoft SQL Server  **License:** Enterprise  **Environment:** Physical Servers  **Operating System:** Windows  **Operating System License:** Datacenter  **Servers:** 3  **Procs per server:** 1  **Cores per proc:** 16 Cores  **RAM:** 64 GB  **Optimize By:** CPU  **Usage:** These three servers are running Microsoft SQL Server and provide the database for your engineering company. It is critical that they are always running.  **Destination**  Service: SQL Database  Purchase Model: vCore  Service Tier: Business Critical  Instance Cores: 2  SQL Server Storage: 5  SQL Server backup: 0 |
| Storage | **Purpose:** Storage  **Type:** Local Disk / SAN  **Disk Type:** HDD  **Capacity:** 1 TB  **Back-Up:** None currently  **Archive:** None |
| Networking | Amount of network bandwidth you currently consume in your on-premises environment: 1 GB |

# **STEP 1: Assessing the On-Premises Environment & Generating Total Cost of Ownership (TCO) Report**

Purpose: To identify the Azure services needed to ensure Company “X”’s business continuity in the cloud.

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| **Current Environment/** **Background**  Make a list of all current on-premises servers and services. | There are 10 Windows VM’s which are used for engineering purposes.  There are 3 web apps servers which host the front end of the company.  There are 3 database servers.  There is a storage which is also used to store data. |
| **Matching Azure Services**  Match the list of on-premises servers and services to the corresponding Azure ones. | - 10 VMs with size Standard\_E32-16ads\_v5 (16 vCPUs and 256 GB RAM). The Size matches the specs of the on-prem servers. So we know that the servers will be able to handle the workload. I’d then monitor the server closely to decide if the servers can scaled down to a smaller size.  - 3 VMs with size Standard\_A8m\_v2 (8 vCPUs and 64 GB RAM). Same reason as above.  - 3 Vms with size Standard\_B16ms (16 vCPUs and 64 GB RAM). Same reason as above.  - Azure Storage (standard hot tier). It will be attached to the database servers to host the data. For a database we need a storage with low latency. |
| **Screenshot 1**  Submit the screenshot for each of the above configurations from Azure TCO.  VM and Web Apps Server screenshot should be submitted here. |  |
| **Screenshot 2**  Submit the screenshot for each of the above configurations from Azure TCO.  Database screenshot should be submitted here. |  |
| **Screenshot 3**  Submit the screenshot for each of the above configurations from Azure TCO.  Storage configuration screenshot should be submitted here. |  |
| **Screenshot 4**  Submit the screenshot for each of the above configurations from Azure TCO.  Networking configuration screenshot should be submitted here. |  |
| **Screenshot 5**  Once the TCO Report is generated, submit a screenshot of the price comparison graph (line graph) here. |  |
| **Screenshot 6**  Once the TCO Report is generated, submit a screenshot of the price comparison graph (pie chart) here. |  |
| **Screenshot 7**  Once the TCO Report is generated, submit a screenshot of the price comparison chart (tabular format) here. |  |
| **Explanation 1**  Explain the breakdown of the costs and show your understanding of how on-prem costs versus Azure compare | Both on-prem and Azure have Compute, Networking, Storage, and IT Labor costs.  On-prem, the Compute costs constist of many factors including hardware and electricity. Also, we have to consider data center costs.  In Azure, we don’t have any of these costs. So the compute costs and the total costs are much less than on-premise.  Storage and IT Labor are relatively speaking more expensive than on-prem. But due to the low overall costs, we’re still saving a lot of money. |

# **STEP 2: Azure Pricing Calculator Cost Estimates**

Purpose: You want to only move the engineering workloads (so just your VM’s) to Azure first to try and understand how Azure cloud works. In addition, this will also help you demonstrate to your CIO that by doing that small migration your company can achieve resiliency. You want to provide precise monthly costs to your CIO.

Use the Azure Pricing Calculator to submit the following screenshots.

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| **Task 1** | Matching Azure Services: Match the list of on-premises servers and services to the corresponding Azure ones.  Here is the VM configuration you will pick.   * 5 VM’s will be in US East Coast, and 5 will be in US West Coast. * The instance will be B16MS in both regions (16 vCPUs, 64 GB RAM, 128 GB Temporary Storage, $0.73 per hour). * Compute Option will be pay-as-you-go; so, there are no upfront costs. * The default of 730 hours is selected. |
| **Screenshot 1**  Submit the screenshot for each of the above configurations from the Azure Pricing Calculator. Submit the US East Coast monthly costs here. |  |
| **Screenshot 2**  Submit the screenshot for each of the above configurations from the Azure Pricing Calculator. Submit the US **West Coast** monthly costs here. |  |
| **Screenshot 3**  Submit the screenshot for total cost per month for both US East and West Coasts. |  |
| **Explanation 1**  Explain how resilience is built in by moving to Azure | Resilience means that a system/service is high available, has disaster recovery and backups.  In Azure, we can use availability zones to improve the reliabiliy of our systems/services.  For VMs, we can also setup Azure Disaster Recovery to minimize the downtime or the data loss in case of an outage. And for backups, we can setup recovery service vaults. |

# **STEP 3: Azure Cost Management + Billing**

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| **Background** | You have now configured your Azure Production Workload environment and been using Azure for a few days. You have now been tasked by your CIO to present some metrics on how the costs are being billed within Azure and also what other functionalities Azure has in regards to cost management, which were not previously available. |
| **Question 1**  Submit the explanation | What is the purpose of Azure Cost Mgmt + billing Dashboard? |
| **Explanation 1** | Azure Cost Management and Billing Dashboard help us with analyzing, managing, and optimizing the costs or our Azure resources.  It helps us set spending threashholds. We can pay our bill from there and download cost and usage data. |
| **Screenshot 2**  Submit the screenshot for main Cost Mgmt + Billing Dashboard. |  |
| **Explanation 2**  Explain the key components of the screenshot submitted. An explanation to be provided for  Scope and Area dropdown from the screenshot submitted. | The dashboard shows the cost analysis for the subscription Udacity CloudLabs Sub – 64 for July 2022.  The top graph shows the accumulated costs of all resources.  The three pie charts at the bottom show the costs per service type, location, and resource group.  With the scope dropdown, we can choose the level of granularity for our report. In our case, we have a report on subscription level. We could also do it for the management group or a specific resource group.  With the area dropdown we can change the style of the top graph. We can choose area, line, column (stacked), or table. |
| **Screenshot 3**  Submit the screenshot for breakdown of costs by Service Name and Location. |  |
| **Explanation 3**  Explain the key components of the screenshot submitted. | The left pie chart shows the costs pers resource type.  We can see that virtual machines are by far the most expensive resource type we are using.  The right pie chart shows the costs per region. We can see that our most expensive resources are located in us south central. |
| **Screenshot 4**  Submit the screenshot for breakdown of costs by Service Name and Location. | **Hint**: Navigate to Cost Management Section on the left and then click “Cost Alert” to reach this wizard. Next, click on “Add button” on top left under this tab. This is Part 1 of the wizard (of the 2-part process).  From here until Explanation 7, it’s the same screenshots and explanations I already provided.  And since the project rubrics doesn’t say anything about cost alert screenshots, I’rd rather not copy and paste anything from above. |
| **Explanation 4**  Explain the key components of the screenshot submitted. | - |
| **Screenshot 5**  Submit the screenshot for breakdown of costs by Service Name and Location | **Hint**: This is Part 2 of the wizard (of the 2-part process).  - |
| **Explanation 5**  Explain the key components of the screenshot submitted. | - |
| **Screenshot 6**  Submit the screenshot for breakdown of costs by Service Name and Location. | - |
| **Explanation 6**  Explain the key components of the screenshot submitted. | - |
| **Explanation 7**  Explain the summarized highlights of this part of the project, Azure Cost Mgmt + Billing | - |

# **STEP 4: Azure Policy to create and enforce policies**

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| **Background** | You have now configured your Azure Production Workload environment and been using Azure for a few days. You realize that many infrastructure administrators are creating VM sizes without doing proper due diligence, thus having a direct impact on cost.  You now decide to leverage Azure Policy features to ensure that appropriate controls are put in place. |
| **Screenshots 1 through 5**  Submit the screenshots for Azure Policy steps. | **Hint**: Navigate to and select the built-in Azure policy “Allowed virtual machine size SKUs;” then follow the wizard steps. Submit a screenshot for every single step of the wizard so that any mistakes in the final step can be caught by your reviewer.  **Very important note:**   1. Due to lab restrictions, while you go through the wizard, you will not be allowed to create the policy in the final step. Please submit all screenshots though 2. So for the Part 2 of this project to be submitted, a successful policy has already been created in the lab for you, which can be used to test the VM creation scenario. Please ensure to double check which VM series is allowed to be created in the lab and ensure that you do not use the same series for passing this part of the project   **Step 1:**    **Step 2:**    **Step 3**    **Step 4:**    **Step 5:** |
| **Screenshot 6**  Explain through screenshots what happens when you create a VM which is in violation with the policy you just created. | F |
| **Explanation 1**  Explain the summarized highlights of this part of the project, Azure Policy. | It looks like Microsoft updated the way policies work for VM sizes.  I was not able to select a VM size that is not allowed by the policy.  Under this link, we can see what sizes are allowed.    In general, policies allow us to allow/disallow certain resources/resource types, sizes, regions or force us to add specific tags to resources/resource groups.  How can policies help us control costs?  E.g. for VMs, we can allow only a certain set of SKUs to avoid the creation of expensive VMs.  Another type of policy we can use to avoid higher costs is to only allow certain regions. E.g. East US 2 is less expensive than East US.  For cost management purposes, we can add a policy that enforces a certain tag so that the costs for the resource can be associated with the right customer or cost center. |

**STEP 5: Azure Dashboards**

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| **Background** | Azure Dashboards are a one stop shop to monitor   * Your logs * Your infrastructure * Your applications |
| **Task 1** | You need to create an Azure dashboard that will pull in a few widgets: Percentage CPU, All Resources, Resource Groups & Avg CPU Credits Consumed. Submit the screenshots and explain the key components of the Dashboard. Be sure to include a screenshot of the final Dashboard. |
| **Screenshots1 through 3**  You will submit the screenshots for Overview tab. | **Step 1:** Create a new Dashboard and add four tiles:  - All Resources  - Resource Groups  - 2x Metrics Charts    **Step 2:**  For both metrics charts, set the scope to the VM we want to monitor and then select the correct metric:  - CPU Credits Consumed  - Percentage CPU    **Step 3 (Final Output):** |

# **STEP 6: Azure Monitor – Metrics**

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| **Task 1** | You need to navigate to Azure Monitor > Metrics screen and create a Percentage CPU as a metric and submit screenshot of the graph generated and pin to dashboard. |
| **Screenshots 1 through 3**  You will submit the screenshots for Monitor | Metrics screen as you are setting up | **Step 1:**    **Step 2:**    **Step 3:**  **Now we can see it in the Dashboard:** |
| **Screenshot 4**  Now that Azure Metrics Monitor is configured, please set an alert for that metric. The alert is whenever the Avg % CPU is greater than 0.3; then the alert will be triggered. |  |

# **STEP 7: Azure Monitor – Log Analytics**

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| **Task 1** | You need to create a Log Analytics workspace and submit step-by-step screenshots. |
| **Screenshots 1 through 4**  You will submit the screenshots for Log Analytics workspace creation screens. | **Step 1:**    **Step 2:**    **Step 3:**    **Step 4:** |

# **STEP 8: Azure Insights**

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| **Background** | Azure Insights can only be created once you have the Log Analytics workspace completed. |
| **Screenshots1 through 6**  You will submit the screenshots for the Monitor | Metrics screen as you are setting up. | **Hint 1:** Navigate to Insights > Applications and then click Add button  **Hint 2:** The Log Analytics workspace you created before will be used here    **Step 1:**    **Step 2:**      **Step 3:**    **Step 4:** |
| **Screenshots 7 through 12**  **You will submit screenshots of you enabling the VM.** | **Hint 1:** So now that you have created Azure Insights for the Resource group, you need to go to Virtual Machines tab and actually enable it for the VM itself.  **Hint 2:** The key is to select the Log Analytics workspace which you created above in STEP 7:  Azure Monitor – Log Analytics.  **Step 7:**  **--- It’s already enabled for the VM.**  **Step 8:**  **Step 9:**  **Step 10:**  **Step 11:**  **Step 12:** |

# **STEP 9: Azure Monitor – Smart Alerts**

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| **Task 1** | Navigate to Setup Alert & Actions under Azure Monitor >Overview.  The condition name should be CPU units consumed and its value should be greater than 0.3. |
| **Screenshots 1 through 8**  You will submit step-by-step screenshots for creating a Setup Alert & Actions. | **Step 1:**    **Step 2:**    **Step 3:**    **Step 4:**    **Step 5:**    **Step 6 (Summary after above steps):**    **Step 7 (Screenshot post-creation of the alert):**    **Step 8 (If you had any alerts, they would be submitted here):** |
| **Explanation 1**  Explain the purpose of Azure Dashboards, Azure Monitor and alerts | Azure Dashboards is a tool that can show us data and diagrams of important metrics, e.g. we can see the CPU utalization of our servers.  Azure Monitor is used to maximize the availability and performance of our applications and servers. It can recongnize and diagnose issues and can assist with automatically handling them.  Alerts are important for us. If we set up the right alerts, we get informed about anomalies in our tools. If a sever has a high cpu utilization over a long period of time, something might be wrong with it and we have to check it. |

# **STEP 10: Autoscale In-Out Based on Number of Users per CPU Core**

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| **Task 1** | The lab will have a Virtual Machine Scale set already created.  Navigate to Azure Monitor > Settings > Autoscale.  You will create an Autoscale rule as part of this project. |
| **Screenshots 1-5**  You will submit step-by-step screenshots for creating an autoscale rule under Azure Monitor. | **Step 1 (Browse to Monitor > Autoscale):**    **Step 2 (Select the option for Custom autoscale and within that Scale based on metric and then click “Add Rule”):**      **Step 3 (Create the scale rule. They key part on this screen is that Percentage CPU metric is selected):**    **Step 4 (Once scale rule is created, submit the summary screenshot):**    **Step 5 (Screenshot for “Autoscale Enabled”):** |
| **Explanation 1**  Explain the key details of autoscale screenshots you have submitted. | The VMSS had a manual scale set to 2. So the scale set was always running with 2 Vms.  We then updated it to a custom autoscale.  We added a new rule to increase the VM count by 1 if the average CPU percentage is greater than 70%. |