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. | Make a list of all servers and services you would create on Azure and explain why you chose each.  - Azure Virtual Machine for Windows Server(CPU: 8Core, RAM: 16GB, OS license: Standard, Virtualization: Hyper-V) x10  - Azure Virtual Machine for Web App Server(CPU: 8Core, RAM: 16GB, OS license: Standard, Virtualization: Hyper-V) x3  - Azure Virtual Machine for MS SQL Server(CPU: 16Core, RAM: 64GB, Purchase model: vCore, Service Tier: Business Critical, SQL Server Backup: No ) x3  - Azure Storage(HDD: !TB, Backup/Archive: No) x1  - Azure Network(Outbound Bandwidth: 1GB) x1 |
| **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 | In the case of on-premise, there are computing costs including hardware, data center costs, network construction costs, storage costs, and IT personnel costs. On the other hand, with Azure, only slightly more expensive computing costs (excluding hardware!), storage costs, and IT personnel costs are incurred. and storage costs, and IT human resource costs. In total, Azure is more cost-effective. |

# **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.

**Note:** *If you are using Udacity Cloud Labs, you will be allowed to create a few VM sizes only. Visit*[this](https://portal.azure.com/" \l "create/Microsoft.VirtualMachine) *link to see all possible VM sizes and go through the classroom instructions for more details.*

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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. * Choose the instance you want to create in both the regions from the possible VM sizes mentioned in the classroom. * 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 | Moving to Azure can enhance resilience in multiple ways.  Firstly, Azure offers high availability features such as availability sets and availability zones, which distribute resources across fault domains to ensure continuous operation even in the face of hardware or software failures.  Secondly, Azure provides disaster recovery options like Azure Site Recovery and Azure Backup, enabling replication of applications and data to a secondary Azure region for failover in case of primary site failure.  Lastly, Azure's scalability features, such as Virtual Machine Scale Sets and App Service, allow for automatic scaling of resources based on demand, ensuring that applications can handle increased traffic or workload without performance degradation. |

# **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** | The purpose of the Azure Cost Management + Billing Dashboard is to provide insights and control over the costs associated with your Azure resources. It allows you to monitor and analyze your usage and spending patterns, helping you optimize costs and stay within budget. |
| **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. | Key components:  - Actual cost (USD): This component displays the actual cost incurred in USD for the selected time period.  - FORECAST UNAVAILABLE: This component indicates that the forecast for future costs is currently unavailable.  - BUDGE:The budget component allows you to set a specific spending limit or budget for your Azure resources and services.  - Area chart: This component shows the accumulated cost of all resources in last 30 days.  - Pie chart: This component shows the accumulated cost per service type, location, and resource group.    With the “Scope” dropdown, we can choose the level of hierarchy for our report.  With the “Area” dropdown we can change the style of the top graph. |
| **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 pie charts on the left and right provide insights into the cost distribution based on resource type and region, respectively. The left pie chart reveals that virtual machines account for the majority of our expenses, indicating that they are the most costly resource type we are utilizing. On the other hand, the right pie chart highlights that our highest expenses are associated with resources located in the us east region. |
| **Screenshot 4**  Submit the screenshot for breakdown of costs by Service Name and Location. | Same as Screenshot 3 |
| **Explanation 4**  Explain the key components of the screenshot submitted. | Same as Explanation 3 |
| **Screenshot 5**  Submit the screenshot for breakdown of costs by Service Name and Location | Same as Screenshot 3 |
| **Explanation 5**  Explain the key components of the screenshot submitted. | Same as Explanation 3 |
| **Screenshot 6**  Submit the screenshot for breakdown of costs by Service Name and Location. | Same as Screenshot 3 |
| **Explanation 6**  Explain the key components of the screenshot submitted. | Same as Explanation 3 |
| **Explanation 7**  Explain the summarized highlights of this part of the project, Azure Cost Mgmt + Billing | Azure Cost Management + Billing is a comprehensive tool provided by Azure to help users evaluate and manage their costs effectively. It serves as a one-stop location for users to monitor and analyze their cloud costs.  The main purpose of Azure Cost Management + Billing is to provide transparency and visibility into the costs associated with Azure resources. It allows users to track and analyze their spending patterns, identify cost-saving opportunities, and optimize resource allocation.  By using Azure Cost Management + Billing, users can:  Monitor Costs: The dashboard provides a consolidated view of cost-related information, including cost breakdown by resource, service, and subscription. It helps users understand how their spending is distributed and identify areas where costs can be optimized.  Budgeting and Forecasting: Users can set up budgets and receive alerts when their spending exceeds the defined thresholds. This feature helps users stay within their budget and avoid unexpected cost overruns.  Cost Analysis: Azure Cost Management + Billing offers powerful analytics capabilities to analyze cost trends over time. Users can generate reports, visualize cost data, and gain insights into cost drivers. This information enables users to make informed decisions and optimize their resource usage.  Cost Optimization Recommendations: The tool provides recommendations for cost optimization based on usage patterns and historical data. Users can leverage these recommendations to identify opportunities for cost savings and implement necessary changes.  Resource Tagging: Azure Cost Management + Billing supports resource tagging, which allows users to categorize and organize their resources. This feature helps in cost allocation, tracking, and reporting.  Overall, Azure Cost Management + Billing is a valuable tool for managing and optimizing costs in Azure. It provides users with the necessary insights and controls to effectively monitor, analyze, and optimize their cloud spending. |

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# **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. |  |
| **Explanation 1**  Explain the summarized highlights of this part of the project, Azure Policy. | Azure Policy is a powerful tool that allows administrators to set controls on how infrastructure is created in Azure. It helps ensure compliance and governance by enforcing rules and regulations. By using Azure Policy, you can define and enforce specific requirements for resources, such as virtual machines, storage accounts, and more.  The purpose of Azure Policy is to provide centralized control over cost management and resource deployment. It helps organizations maintain consistency and security by enforcing specific policies across their Azure environment. With Azure Policy, you can prevent the creation of resources that don't comply with your organization's standards, ensuring that only approved resources are deployed.  By setting up Azure Policy, administrators can effectively manage costs by controlling resource usage and preventing unnecessary spending. It allows you to define policies related to cost optimization, such as limiting the size or type of virtual machines that can be deployed. This helps ensure that resources are provisioned efficiently and cost-effectively.  Overall, Azure Policy is a crucial component of cost optimization and governance in Azure. It provides administrators with the ability to set appropriate controls on resource creation, ensuring cost management and compliance with organizational standards. |

**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:**  **Step 2:**    **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:** |
| **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. | **Step 1:**    **Step 2:**  **Step 3:**    **Step 4: Click “Go to resource”** |
| **Screenshots 7 through 12**  **You will submit screenshots of you enabling the VM.** | **Step 7:**      **Step 8:**    **Step 9:**  **Step 10:**    **Step 11:** |

# **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, Azure Monitor, and alerts are important tools in Azure that help monitor and manage your resources effectively. Let's break down each of these tools and understand their purpose:  Azure Dashboards: Azure Dashboards allow you to create customized dashboards to monitor and visualize the performance and health of your Azure resources in a single view. You can add various widgets to the dashboard, such as charts, graphs, and metrics, to track the important metrics and key performance indicators (KPIs) of your resources. With Azure Dashboards, you can have a centralized view of your resources' status, which helps in monitoring and troubleshooting.  Azure Monitor: Azure Monitor is a comprehensive monitoring solution that provides insights into the performance and availability of your applications and resources in Azure. It collects data from various sources, such as Azure resources, operating systems, and custom applications, and provides a unified view of the health and performance of your entire environment. Azure Monitor helps you identify and diagnose issues, optimize resource utilization, and ensure the overall reliability of your applications.  Alerts: Azure Monitor Alerts allow you to set up proactive notifications based on specific conditions or thresholds. You can define alert rules to monitor metrics, logs, or events and trigger actions when the conditions are met. For example, you can set up an alert to notify you when the CPU usage of a virtual machine exceeds a certain threshold. Alerts can be configured to send notifications via email, SMS, or even trigger automated actions like running a script or scaling resources. By using alerts, you can stay informed about critical events and take timely actions to resolve issues.  In summary, Azure Dashboards provide a centralized view of your resources, Azure Monitor helps monitor and diagnose the performance of your applications and resources, and alerts enable proactive notifications and actions based on specific conditions. These tools work together to ensure effective monitoring, troubleshooting, and optimization of your Azure environment. |

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# **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%. |