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. | 1. There are 10 Windows VM’s = Azure Virtual Machines (VMs). It  provides the ability to create and manages virtual machines in the cloud, provides replicate VM function, scale resources up or down as needed. 2. There are 3 web apps servers = Azure App Service. Azure App Service: Azure App Service is a fully managed platform for building, deploying, and scaling web apps. It supports multiple programming languages and frameworks, making it suitable for hosting the front end of the company's web apps. 3. There are 3 database servers = Azure SQL Database. Azure SQL Database is a managed relational database service that provides a highly available and scalable platform for hosting databases. It offers features like automatic backups, high availability, and built-in security. Migration DB is the useful function. 4. There is a storage = Azure Storage Account. It provides different storage options, such as Blob storage, File storage, and Queue storage, to store and retrieve data. |
| **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 | Hardware Costs: On-premises infrastructure requires upfront investment in purchasing servers, networking equipment, storage devices, and other hardware components. These costs can be significant and contribute to the overall on-premises expenses. In Azure, hardware costs are included in the pricing model, and you only pay for the resources you use, eliminating the need for upfront hardware investments.  Software Costs: On-premises infrastructure often requires purchasing licenses for operating systems, databases, middleware, and other software components. These costs can add up, especially for large-scale deployments. In Azure, the cost of software licenses is included in the pricing, reducing the need for separate software purchases.  Maintenance Costs: On-premises infrastructure requires ongoing maintenance, including hardware repairs, software updates, security patches, and system administration. These maintenance activities can be time-consuming and require dedicated IT staff. In Azure, Microsoft takes care of the infrastructure maintenance, reducing the maintenance burden on your organization. |

# **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/#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 | 1. High Availability: Azure ensures your apps stay accessible during failures. Deploy across regions for redundancy. 2. Fault Tolerance: Services withstand failures without downtime. Azure Storage replicates data for protection. 3. Disaster Recovery: Shield apps from disasters using Azure Site Recovery for failover and Azure Backup for data protection. 4. Load Balancing: Optimize app performance with Azure Load Balancer and Application Gateway for traffic distribution and failover. 5. Auto Scaling: Automatically adjust resources as needed for peak or low demand, ensuring cost-efficient performance. 6. Monitoring and Alerting: Proactively detect issues with Azure Monitor. Set alerts for rapid response and maintain app health. 7. Security and Compliance: Azure offers robust security, including encryption, access control, and compliance with standards.   Top of Form |

# **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 users and organizations with a comprehensive tool to monitor, manage, and optimize their spending and usage on Microsoft Azure services. It offers insights and controls related to the financial aspects of running workloads in the Azure cloud |
| **Screenshot 2**  Submit the screenshot for main Cost Mgmt + Billing Dashboard. | **Hint:** Navigate to the Cost Management Section on the left and then click “Cost Analysis” to reach this dashboard. Students need to submit the main screenshot of the 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. | **Hint**: Make sure the right time period is selected to see the data.    Effectively manage and monitor costs associated with resources. It provides a structured approach to organizing resources, allocating costs, and gaining insights into resource usage patterns. |
| **Screenshot 3**  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 Analysis” to reach this dashboard. These pie charts are under the above graph submitted. |
| **Explanation 3**  Explain the key components of the screenshot submitted. | This allows to track spending at a granular level and identify areas where cost optimization can be achieved. Generate reports, set up budgets, and apply cost management practices specific to each service name and location combination. |
| **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). |
| **Explanation 4**  Explain the key components of the screenshot submitted. | A page cost alert is a feature that allows to set up notifications when Azure spending reaches a certain threshold. It helps to stay informed about the costs and take proactive actions to manage and control spending. |
| **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. | Alert rules provide support for proactively monitoring and managing costs in the Azure cloud. Alert rules allow to set up notifications based on specific cost or usage thresholds. This helps you stay informed about any unexpected spikes in spending or usage, allowing to take immediate action. |
| **Screenshot 6**  Submit the screenshot for breakdown of costs by Service Name and Location. |  |
| **Explanation 6**  Explain the key components of the screenshot submitted. | Budgets in Azure Cost Management provide valuable support for keeping track of spending and ensuring that you stay within your budget. It helps make informed decisions about resource allocation and cost optimization in Azure environment. |
| **Explanation 7**  Explain the summarized highlights of this part of the project, Azure Cost Mgmt + Billing | Providing multiple screenshots of the Azure TCO (Total Cost of Ownership) Calculator. These screenshots should show the steps took to create a cost estimate and compare the costs between on-premises and cloud-based solutions. Make sure to explain the details in the screenshots to demonstrate familiarity with the TCO. |

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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. | Once the Azure policy creation is complete, try to create a VM which is of a “NOT ALLOWED” size.   **Hint**: pick any size; it doesn’t matter as long as it's not in the allowed list in Azure policy you just created.   Once you go through the wizard, in the final step you will see the following screenshot, which needs to be submitted. |
| **Explanation 1**  Explain the summarized highlights of this part of the project, Azure Policy. | Using Azure Policy to enforce allowed virtual machine size SKUs, it can ensure that only the approved sizes are used, which helps in controlling costs, optimizing resource allocation, and maintaining consistency across your Azure environment. |

**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:**    **Step 2:**    **Step 3:** |
| **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:**  **Step 5:**  **Step 6: Click “Go to resource”** |
| **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:**    **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 Monitor is a comprehensive monitoring solution that collects and analyzes data from various sources, including Azure resources, applications, and external services.  Azure Dashboards allow to create customized dashboards that provide a consolidated view of your Azure resources. Add various widgets to dashboard, such as charts, metrics, and logs, to monitor the health and performance of resources.  Alerts in Azure Monitor allow to set up notifications based on specific conditions or thresholds. |

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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. | Auto Scaling in Azure Monitor allows you to automatically adjust the capacity of your Azure resources based on predefined rules and metrics, in this sample rule which bases one CPU metric. It helps you optimize resource utilization and ensure that your applications can handle varying workloads efficiently. |