Jeys Consulting Group

Cloud Infrastructure Design

C769 Capstone

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Proposal Overview

Problem Summary

Ma & Pa's is a small-town retailer that has been serving its local rural community for decades with products designed to improve the everyday lives of its customers. Recently, a new product has been developed that goes above and beyond all other products created to this point. This new product has the potential for exponential growth if a marketing and advertisement campaign, along with supporting infrastructure, is properly planned and deployed successfully. This requires something that *Ma & Pa's* has never had before, a modern retail website where products can be advertised and sold to its consumers.

There needs to be more than the current on-site infrastructure to support this initiative, as it predates the Internet age. Another issue is that existing infrastructure lacks the required computing resources and data center floor space to house any newly purchased equipment. The problems can easily be overcome by deploying the retail website in the cloud. This will allow *Ma & Pa's* to pool computational resources and network backbone with Cloud Service Providers (CSP)s rather than purchasing and maintaining the hardware equipment internally. By using a CSP to deploy this solution in the cloud, responsibilities for maintaining the underlying hardware and networking infrastructure will be provided by the chosen CSP. This eliminates *Ma & Pa's* need to provision and maintain any hardware. Focus can now be directed toward product development and updating the retail web page with specific and individualized content instead of administrative and operational tasks.

IT Solution

Ma & Pa's has contracted with CJEYS LLC to architect, build, & deploy a new retail website utilizing a 3-tier architecture in the cloud. This supporting

solution is to be loosely coupled, allowing for high availability and scalability while also keeping costs to a minimum. With that objective in mind, the major CSPs have been researched and vetted. It has been determined that Amazon Web Services (AWS) is the best fit for this solution based on available resources, features, functionality, and due to the discount and overall cost savings associated with the partnership between AWS and CJEYS LLC.

CJEYS LLC has designed a solution consisting of the following 3-tiers, Presentation, Application, and Database. To begin the architecture build, an AWS Virtual Private Cloud (VPC) will be provisioned and divided into nine subnets. By deploying the various resources making up this solution in different subnets, we can scale across those subnets while isolating them so that a failure in one subnet will not affect any other subnets. Building out the three tiers can commence with the VPC provisioned as mentioned and with non-overlapping IP addresses and CIDR ranges configured.

The Presentation tier makes use of AWS EC2 instances to run WordPress. The EC2 instances provide the virtual servers for this solution, while WordPress is a free and open-source program commonly used to build small and medium size websites. With the WordPress software running on the EC2 instances, customers can view and purchase the latest products available from *Ma & Pa's* anywhere in the world that has public internet access. This exponentially increases the potential for new customer outreach during the upcoming advertisement and marketing campaign.

One feature of AWS that will be used at the Presentation tier is Auto Scaling Groups (ASGs). With ASGs, the number of EC2 instances and computing power can scale in or out based on system utilization associated with changing customer traffic flow. During high customer traffic and system utilization periods, additional EC2 instances can be deployed and terminated as that traffic and system usage return to normal. The security of this tier will use network Access Control Lists (ACLs) and Security Groups to only allow required traffic while restricting all other traffic that falls outside of these set parameters.

The Application tier will utilize Amazon Elastic File System (EFS) as a network-attached filesystem that can be mounted to the EC2 instances. The EFS service will store files and media content for the WordPress application. The benefits of using EFS in this solution include the ability to span the filesystem across multiple availability zones, provide scalability based on the filesystem size, and the options to enable default encryption at rest and automatic backups. For security measures, EFS will be placed in a private subnet to restrict internet traffic. In addition, ACL & Security Groups will be configured only to allow access between EFS, staged EC2 instances, and the Database tier covered next.

The Database tier will take advantage of the fully managed database service Amazon Relational Database Service (Amazon RDS). High availability will be achieved at this database tier by using the Amazon RDS Multi-AZ deployment method to ensure multiple database instances can be used in a passive/failover scenario or to share the database read workload.

The data stored in Amazon RDS includes WordPress-generated metadata, information about *Ma & Pa's* web advertisements, social media tags, users, and comments. This metadata will be tremendously valuable for the organization's future growth. In-depth analytics can be performed by querying this metadata to gain more significant insights into the current customer base, products they are purchasing or interested in, and the successful marketing strategies in the advertisement and marketing campaign that can easily be reused in future campaigns.

An application load balancer (ALB) will be used to evenly spread the internet connections across the EC2 instances to make this solution fully elastic and scalable. Another great feature of ALBs is using Health Checks to monitor the EC2 instances. With Health Checks, consumer traffic can be redirected to another EC2 instance if there are any HW issues on an instance or as the ASG scales in or out with overall user traffic.

To complete this architecture, Amazon CloudWatch will be used at each layer to collect and analyze resource and application data. This will help *Ma & Pa's* team improve system performance by using alarms and associated automated actions, troubleshoot issues from the generated logs or metrics, and maintain the system's supportability as it grows and develops over time.

Implementation Plan

This project and cloud architecture is critical to *Ma & Pa's* successful journey in the Internet age. The Implementation Plan will begin with CJEYS LLC meeting with stakeholders to understand the existing business, its history, and the final goals of this current project. This information will be documented in a Project Plan so all parties can stay updated and aligned toward the common goals and objectives. CJEYS LLC Solution Architects will then review project requirements and perform research to choose the right CSP for this solution. Once the CSP is chosen, the Solution Architects will design and create an architectural diagram for a 3-tier cloud application. CJEYS LLC SysOps administrators will then build and deploy the retail website and supporting cloud infrastructure. Next, security measures will be implemented, along with the installation of audit and compliance tools. The security measures will be vetted reports generated to demonstrate that the solution complies with all auditing guidelines and regulatory compliance. To finish the Implementation Plan, the Project and system analysis will be completed a month after the 'go-live' date to ensure that all objectives, goals, and deliverables have been met and for mutual agreement to close the project.

Review of Other Work

The internet created an entirely new and untapped consumer market akin to an electronic trade show with a near-endless group of potential buyers (Peterson et al., 1997). This has dramatically changed the retail industry and made an already

competitive market even more cut-throat. The emergence of major online retailers like eBay and Amazon.com now threatens to monopolize the industry and force the closure of small brick-and-mortar businesses like *Ma & Pa's*. Even though the internet is leading to the demise of some small businesses, the internet can also be used to grow and develop a small business over time.

While big corporations and businesses are typically at the forefront of consumers' minds, small businesses make up most of the companies in the United States (Brown, 2015). This proves that small businesses remain a major cornerstone of the American economy and can be competitive and grow in the Internet age. With the implementation of this project, *Ma & Pa's* will adapt to the current retail environment and successfully bring its products to the market effectively and efficiently, allowing it to grow and stay competitive in the Internet age.

One method of staying competitive in the Internet age is by using cloud computing technology. Cloud computing technology leverages the power of the internet to access computing and storage resources that otherwise would take months for a business to purchase and deploy in an on-premises environment. This technology can allow small businesses to scale current infrastructure to meet consumer demands and better communicate with other vendors and partner corporations while maintaining operational efficiency and costs (Attaran, 2017). Utilizing cloud computing technology in Ma & Pa's solution will provide the best potential for profit and organizational growth for years to come.

What is more, the additional business value of using cloud computing technology makes it easier to innovate with fast access to new cloud solutions and services like machine learning, artificial intelligence, advanced analytics, and other technologies which would be too slow and expensive to deploy otherwise (Linthicum, 2022). This proves that the current proposal built by CJEYS LLC is future-proof and utilizes the best and most modern technology for Ma & Pa's betterment.

Project Rationale

Ma & Pa's is a very successful retail business in its rural community. An incredible product recently developed is selling very well and has the potential for tremendous profits with a properly planned and executed advertisement and marketing campaign. The existing company infrastructure and customer base are insufficient and unable to meet the needs of the planned campaign. As it stands, advertisement and customer outreach are performed through radio and newspaper ads and local word of mouth in the community. While this has proven successful in years past, *Ma & Pa's* stakeholders have determined this will not work in the Internet age. They understand the need to modernize their business model and overall approach to stay relevant. Ma & Pa's infrastructure must be modernized and updated to support the planned marketing and advertisement campaign. CJEYS LLC has vast and in-depth experience with projects very similar to this. There is no doubt that the goals and objectives of *Ma & Pa's* stakeholders can be achieved through the successful implementation of this project.

Current Project Environment

Ma & Pa's current environment is based in the pre-Internet age and desperately needs to be modernized to support future advertisement and marketing campaigns. As it stands today, the existing infrastructure includes a single brick-and-mortar building with a basic landline and fax machine, computer, mouse, and printer. There is no room for additional hardware in the current retail office and no budget to expand by adding additional office space.

Current marketing and advertisement campaigns utilize radio ads, newspaper posts, & simple word-of-mouth. While this may have been suitable for previous decades, this will severely limit new customer outreach and *Ma & Pa's* growth potential. A unique and modern approach is needed to grow the existing customer base and company revenue to stay relevant in the Internet age.

The deployment of a 3-tier architecture will provide *Ma & Pa's* with a future-proof solution that is fully elastic, scalable, and highly available. This will be a much-needed and dynamic shift that will bring *Ma & Pa's* retail business into the 21st century and maintain relevancy into the next.

A significant component not present in *Ma & Pa's* existing infrastructure is a database and analytical environment. A robust analytical environment will be required to grow and compete in the aggressive retail market strategically. This will allow *Ma & Pa's* marketing team to create a comprehensive and insightful campaign that targets the right consumer demographic using their preferred form of media. The proposed solution recommends the use of Amazon RDS. This will provide *Ma & Pa's* marketing team with a data warehouse to store and analyze large data sets in a highly available, scalable, and fully managed analytical environment.

Methodology

The ADDIE model is commonly used by CJEYS LLC and is a perfect fit for this project. The ADDIE model is comprised of five phases: Analysis, Design, Development, Implementation, and Evaluation. While there are many alternatives, the ADDIE model is commonly used, globally accepted, and provides several advantages to this project's implementation (Budoya et al., 2019). Some of those advantages are the clearly defined phases of the model, the ability to document and align with goals and objectives throughout the project, and the encouragement of feedback and evaluation at each stage. With the use of the ADDIE model, CJEYS LLC feels confident that the project will be successful and completed on time.

During the analysis phase, CJEYS LLC will meet with *Ma & Pa's* stakeholders to ensure that all parties are aligned with the same project goals, objectives, and deliverables. This will occur through several meetings and investigative sessions over a month. Once these goals are identified, various CSPs will be vetted and chosen based on the available services that best fit this solution and cloud architecture.

The design phase will take direct input from *Ma & Pa's* stakeholders, and in partnership with the chosen CSP vendor, CJEYS LLC will begin to design the new cloud architecture, ensuring that it is highly available, scalable, and supports the current project with room for system growth in the future. All parties will thoroughly examine the design to ensure agreement before moving to the next phase.

In the development phase, CJEYS LLC Solution Architects will build an infrastructure diagram and network chart for the proposed implementation. This will include a 3-tier application architecture consisting of a Presentation, Application, and Database layers utilizing security safeguards, least-privilege best practices, and auditing for government and regulation compliance.

During the implementation phase, the CJEYS LLC SysOps team will be tasked with building out the solution following the infrastructure diagram and network charts developed from the previous phase. This includes the setup and configuration of AWS resources, network & subnet design, audit tools, and reporting. Additional internal testing will also be conducted during this phase to verify that security measures are in place and that the solution's scalability is vetted. Also, during this phase, the solution will go through an extensive review with all stakeholders to ensure that testing results meet the project's goals and objectives. Once all parties agree during this review, the solution will be fully deployed and closely monitored during the first few weeks after the go-live date. System metrics will also be collected and reviewed in the next phase.

Finally, in the evaluation phase, CJEYS LLC will consolidate the metrics, generate reports, and present them to *Ma & Pa's* stakeholders for review. This review will include lessons learned during the project's implementation, consumer feedback, and initial financial analysis to determine the short-term return on investment (ROI) and trajectory for long-term ROI. CJEYS LLC offers all its partners the ability to request minor configuration changes to the current solution. This offer stands for 30 days after project closure, and change requests ultimately

must be approved by CJEYS LLC; therefore, implementing the change requests is at the sole discretion of CJEYS LLC.

Project Goals, Objectives, and Deliverables – Table & Descriptions

Goal	Supporting Objectives	Deliverables
A modern retail website and supporting infrastructure	1.a. Determine and agree on the project scope	1.a.i. Project plan with clearly stated goals, objectives, and deliverables so all parties are aware of and are working toward the same
	1.b. Cloud architecture design	1.b.i. Architecture and network diagram to guide the deployment of the retail webpage and supporting infrastructure
	1.c. Retail website and supporting cloud infrastructure built and deployed	1.c.i. Cloud resources are provisioned, and networking configured
	1.d. Security measures and least-privilege access implemented	1.d.i. Network ACLs and Security groups are configured only to allow required access between resources
	1.e. Audit and compliance tools installed	1.e.i. Audit report and tabulated analysis of the results from the campaign

The main goal of this project is to create a retail website and supporting infrastructure to conduct advertisement and marketing campaigns. This will be achieved with a 3-tier architecture that's loosely coupled to enable scalability, ease of maintenance and support, and extensibility for future growth. This will support future advertisement and market campaigns that facilitate revenue growth and help modernize Ma & Pa's retail strategy to keep the organization relevant.

- Objective 1.a: Understanding the need for this project is critical to ensuring that CJEYS LLC is in sync with *Ma & Pa's* stakeholders. Meetings will be conducted so that all stakeholders can determine and

agree on the project scope and for CJEYS LLC to gather information and gain an understanding of the existing environment. This objective will be met once a project plan is generated to provide guidance throughout implementation.

  - Deliverable 1.a.i: Meet with *Ma & Pa's* stakeholders to generate a project plan that provides a project overview stating the goals, objectives, and deliverables to ensure roles and responsibilities of all team members working on the project are aligned.

- Objective 1.b: Research the various cloud vendors and compute resources available. Once this is complete, a cloud architecture will be designed to support the deployment of a retail website. This objective will be marked as complete when a cloud architecture and networking diagram is generated.
  - Deliverable 1.b.i: CJEYS LLC Solution Architects will build a solution and network diagram to guide the deployment of the retail website and the supporting cloud infrastructure.
- Objective 1.c: Partner with CSP to build the required cloud infrastructure and deploy the retail website. This objective will be marked as complete once the cloud resources are provisioned, and network connections established between them.
  - Deliverable 1.c.i: CJEYS LLC SysOps administrators will build and deploy the retail website and supporting cloud system based on the solution and network diagrams created in Objective 1.b.
- Objective 1.d: This objective is to put security measures in place and to implement least-privilege access throughout the solution. This will help prevent security threats and data breaches.
  - Deliverable 1.d.i: Network ACLs and Security groups will be configured for each tier of the solution. This will allow only the access needed for the cloud resources to operate within the designed architecture and prevent all other access to the same resources.

- Objective 1.e: This objective will install audit and compliance tools required for this solution to comply with all industry standards and government regulations.
    - Deliverable 1.e.i: Audit and compliance reports will be generated and reviewed to prove functionality, verify regulatory compliance, and demonstrate the successful implementation of the project by analyzing the results from the advertisement and market campaign.

Project Timeline with Milestones

Milestone or Deliverable	Duration	Projected Start Date	Projected End date
Project plan with clearly stated goals, objectives, and RACI diagram	14 days	3/1/2023	3/15/2023
Architecture and network diagram	14 days	3/16/2023	3/30/2023
AWS resources are provisioned, and networking configured	7 days	3/31/2023	4/7/2023
Network ACLs and Security groups are configured	3 days	4/8/2023	4/10/2023
Audit report and tabulated analysis of the sales campaign results	3 days	4/11/2023	4/14/2023

Outcome

The new cloud-based infrastructure will be more than necessary to meet the needs of *Ma & Pa's* future advertisement and marketing campaigns. The potential for rapid company growth and profits is tremendous with proper utilization and management. The cloud infrastructure built for this project will lead to a successful marketing and advertisement campaign for the current and future products not yet developed.

The success and effectiveness of this project will be measured at the one-month mark. Two elements will be measured at this juncture. The first is that

system availability remained above 99.9% throughout the new marketing and advertisement campaign. The second is that the new marketing and advertisement campaign has generated a 100% increase in product sales from the previous month. Once these two elements are confirmed, *Ma & Pa's* stakeholders will confirm the success and effectiveness of this project and will mark it as closed.

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