Augmented AI: The Power of Human and Machine

How AI/ML technologies can help agencies enhance customer experience with eligibility, claims and benefits systems

June 2020

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Abstract

In the fiscal year (FY) 2019, the US federal, state, and local Government agencies spent about $2.5 Trillion on various social and safety net programs,[1] which included Social Security, Medicare, Medicaid, and the Supplemental Nutrition Assistance Program (SNAP) and other programs that assist low income families. Tens of millions[2] of customers apply for these benefits every year. The enrollment can include a complex application, claims, eligibility, enrollment, and adjudication processes. In most cases, beneficiaries have to wait several weeks before their cases are approved due to the high-volume of these applications. Additionally, it takes a large work force to review and process these applications which are submitted multiple ways, such as web, mail-in, or contact center communications.

This paper discusses some of the challenges with this overall process and outlines a framework to enhance the customer experience using the Amazon Web Services (AWS) cloud, Artificial Intelligence (AI) / Augmented AI (A2I), and Machine Learning (ML) technologies.

Introduction

Agencies that offer social and safety net programs have a critical mission of serving millions of people every year to support their healthcare, unemployment needs and to keep them out of poverty. These agencies face many challenges when dealing with the benefits programs such as; increasing application backlogs and delayed benefits to citizens; complex application review, adjudication processes, and timely approvals; and handling large call volumes for follow up activities including interviews, application status, and appeals. The program leadership often lacks deep insights into program operations such as fraud, waste, and abuse. Reducing application backlogs through process automation, approvals and adjudication using AI and ML technologies, enabling self service capabilities, and streamlining the interview/appeals processes is important to providing timely assistance to the citizens that are in critical need of these benefits. The total US spend and the wide impact of these programs is presented in below in Figure 1.

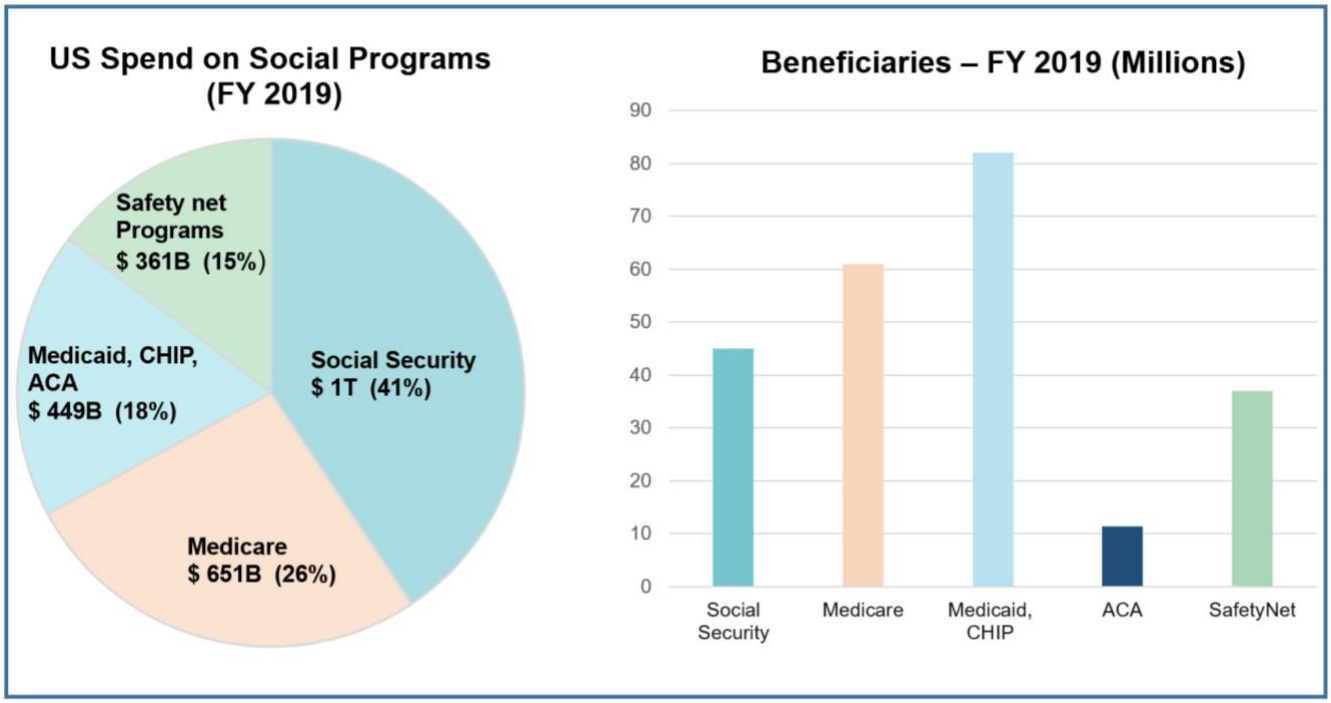

Figure 1 - *Statistics on US Federal, state and local social programs*[1]

This paper outlines a framework that includes the following capabilities:

- Enhance the customer and beneficiary experience by using self-service options such as chatbots, for application submission and communication with the agencies on status/approval updates.
- Improve case managers' productivity and help them make timely decisions by automating the verification and adjudication process using AI and A2I technologies / services.
- Enable the Benefits Program Leadership to make data driven decisions by providing deeper insights into program operations such as backlogs, budgets, and enrollment models. Minimize fraud, waste, and abuse in benefits programs.
- Improve contact center work force productivity by modernizing contact center processes and incorporating intelligent operations using AI/ML.
- Improve operational efficiencies of benefits systems including scalability, availability, and optimize costs through cloud migration and modernization.

Challenges for agencies dealing with benefits programs

There are a number of challenges in dealing with the large volumes of applications for social programs. The following section, outlines the most common challenges agencies face:

- **Customer/Beneficiary experience:** Timely and accurate application processing is critical in helping the customers that need immediate assistance with unemployment, healthcare, or SNAP benefits. Legacy benefits systems often provide poor consumer experience as they cannot scale to meet the surge during an open enrollment or during a crisis situation such as COVID-19. These systems also lack the capabilities required to provide a digital experience to customers such as self-service, mobile application submission, text communications on case status, and online scheduling for interviews. The AWS cloud offers multiple options to help address these challenges.

- **Workforce productivity**: Agency workforces have to deal with large volumes of applications and manual processes which result in increasing application backlogs and delayed benefits to consumers. Benefits application documents can include federal tax forms, pay stubs, SSN, and etc. These documents are in multiple formats such as PDFs and images, and are submitted from various sources such as the web, mail-in, and contact centers. The work force spends a significant amount of time to review, process, and validate these documents. Often, this process is manual which is error prone and requires specific domain expertise. Building human review systems can be time-consuming and expensive because it involves implementing complex workflows, developing custom software to manage review tasks and results, and in many cases, managing large groups of reviewers. AWS offers multiple services including Amazon Augmented AI, to address these challenges through process automation
- **Data scale, size, privacy and security**: As shown above in Figure 1, there are millions of customers applying for benefits every year resulting in tens of millions of documents and hundreds of Terabytes of data. For example, Healthcare.gov alone handled over 10.7 Million applications during the 2019 open enrollment period[3]. This data not only comes in from the applicants but is also exchanged with federal, state and local agencies,[4] as they communicate with each other to validate the application. Hosting a storage solution at scale is a major challenge for many agencies. Data security and privacy are also of primary concern as the agencies have to protect sensitive customer data. AWS provides multiple storage options including the Amazon Simple Storage Service (Amazon S3) to address this challenge.
- **Large call volumes**: This is a major challenge for various agencies as the follow up for each application results in multiple calls to the agency on activities related to pending applications. These activities can include interviews, status checks, appeals, and other benefits related questions. For example, the Social Security Administration (SSA) handled over 50 Million calls[5] during FY-2019. Another challenge, is to ramp up call center operations during disasters, such as COVID-19, which impacted the US workforce and resulted in unemployment insurance related calls and applications[6]. AWS has a number of services including Amazon Connect, and Amazon Lex to enable these capabilities.

- **Insights into program operations**: Having access to data-driven insights enables agencies to build programs and advocate for innovative policy changes to better serve constituents. These insights include visibility into enrollment models, backlogs, budget forecasting, fraud, waste, and abuse. Often, benefits program leadership lacks the level of visibility that is needed to optimize the program operations and costs. AWS provides a number of analytics and AI/ML services to address these challenges.

Focus areas for a modern benefits system

Figure 2 below provides important tenets of a modern benefits system and outlines major focus areas for benefits administrators based on the challenges described earlier.

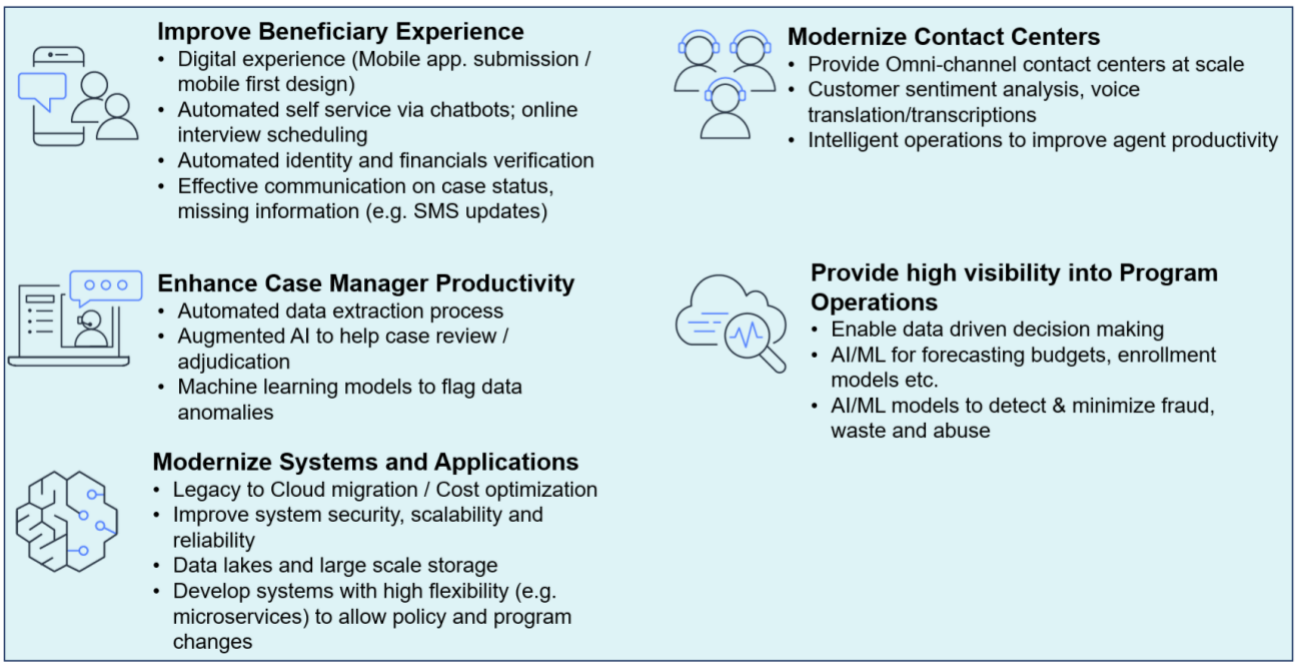

Figure 2 - *Major focus areas for benefits administrators*

High-level Framework

AWS cloud offers a number of services and capabilities to address the challenges discussed in the previous section. A high-level framework for a benefits enrollment system is shown below in Figure 3.

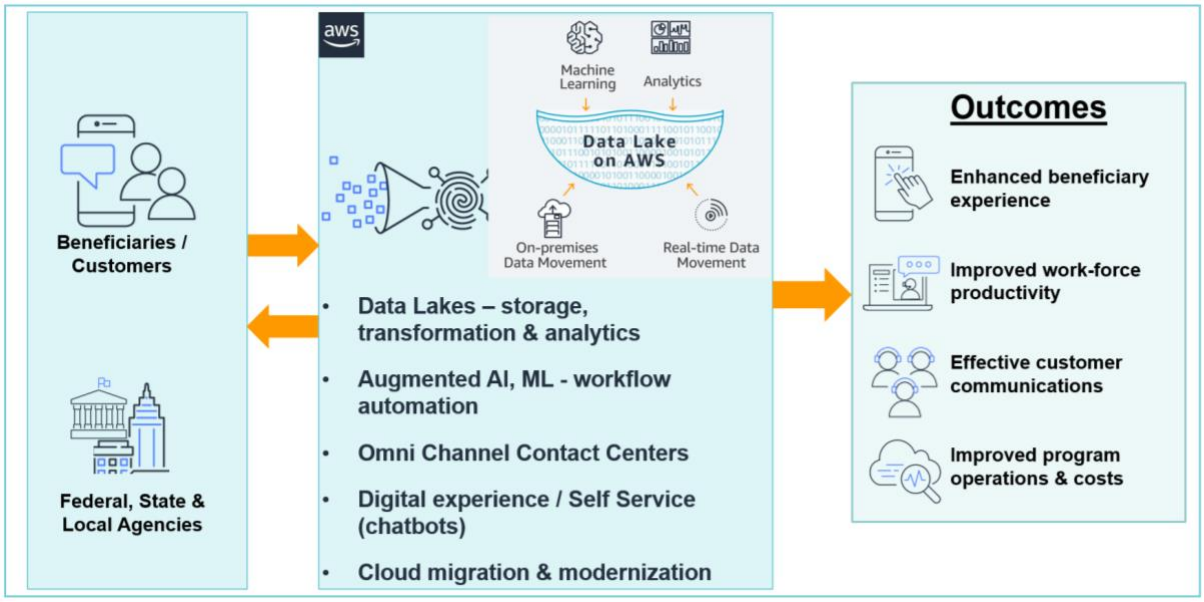

Figure 3 - *High level framework to address challenges with benefits enrollment*

Key aspects of the framework:

The following sections provide key aspects of the framework and the relevant AWS services.

Improve beneficiary/customer experience

Enhance the customer experience by providing digital capabilities for an end-to-end application process including submission, status, interviews, and approval. For example, this can include mobile document submission, online self-service for interview scheduling, automated financial verification, automated updates on case status, and effective communication on any missing information. Agencies can enable self-service and automated communications on web, mobile, and through contact centers using AWS services such as Amazon Pinpoint, Amazon Lex and Amazon Polly. Using these capabilities, beneficiaries can obtain their case status, execute routine tasks, such as a PIN resets, or obtain general information on claims.

Provide centralized storage with Data Lakes

As previously mentioned, identifying a solution to store data in multiple formats and at scale is important for agencies. The proposed framework enables data ingestion from multiple sources in disparate formats and stores information in centralized data lakes. There are a variety of options to gather the data from the beneficiaries on claims and applications. These options include standard web, mobile communications combined

with AWS services such as Amazon Kinesis Data Streams and Amazon Kinesis Data Firehose for streaming data, or the AWS Transfer Family service for batch data ingestion and storage into data lakes

The Data Lake solution automatically crawls data sources, identifies data formats, and then suggests schemas and transformations, so you don't have to spend time hand-coding data flows. For example, if you upload a series of claims and application documents to Amazon S3; AWS Glue, a fully managed extract, transform and load (ETL) tool, can scan these documents to identify the schema and data types present in these files. This metadata is then stored in a catalog to be used in subsequent transforms and queries.

The AWS Lake Formation service builds on the existing data lake solution by enabling you to set up a secure data lake within days. Once you define where your lake is located, Lake Formation collects and catalogs this data, moves the data into Amazon S3 for secure access, and cleans and classifies the data using machine learning algorithms.

Additionally, user-defined tags or meta-data about the documents such as SSN cards, bank statements, driver's licenses, or other claims data is stored in Amazon DynamoDB, a key-value document database, to add business-relevant context to each dataset. You can browse available datasets or search on dataset attributes and tags to quickly find and access the documents in S3.

To summarize, Amazon S3 combined with AWS Glue and AWS Lake Formation act as a centralized data lake for storing documents from multiple sources with disparate data formats. Amazon DynamoDB provides fast access to these documents by storing the document meta-data (e.g. claimant ID, document storage location in S3, etc.).

Extract relevant information from application documents

Claimant / benefits enrollment documents can be of different formats including pdf, images, audio (voice transcripts), or other formats. Amazon Textract can help extract text and data from scanned documents and images without the need for any custom coding; Amazon Rekognition can be used for image analysis for user verification / authentication purposes. The extracted information can be stored in databases such as DynamoDB, Amazon Elasticsearch, or Amazon Kendra, to enable the case managers with query capabilities.

Enhance Case worker and Manager's productivity:

One of the major challenges for agencies is to deal with a large backlog of pending applications due to the volume of people applying for these benefits. Customers may have to wait for several weeks before their applications are reviewed, verified and adjudicated. Often, these applicants have immediate needs for SNAP benefits, healthcare, or unemployment insurance. An ideal way to deal with this challenge is to introduce AI and ML into the entire application process and augment the human workforce with process automation and have human intervention only as needed. Specifically, there are two main areas of focus:

- **Build review / approval work-flow automation:** Amazon Augmented AI (A2I) makes it easy to build process automation and workflows required for human review of ML predictions. Amazon A2I brings human review to all developers, removing the undifferentiated heavy lifting associated with building human review systems or managing large numbers of human reviewers. Many machine learning applications require humans to review low-confidence predictions to ensure the results are correct. For example, extracting information from scanned application forms for healthcare, unemployment, SNAP or others can require human review in some cases due to low-quality scans or poor handwriting. Amazon A2I provides built-in human review workflows for common machine learning use cases, such as text extraction from documents. Using this service, you can allow human reviewers to step in when a model is unable to make a high-confidence prediction or to audit its predictions on an ongoing basis.

  For example, there could be an automated application review and adjudication process based on a certain confidence level. AWS customers[7] are implementing A2I with Textract to improve the efficiency of their document processing by combining the speed, efficiency and cost savings of ML with A2I in order to include human-in-the-loop validation to ensure accuracy of results.

- **Build Machine Learning models to identify anomalies / fraud**: Automated identification of standard vs. a high-risk application is key to improving efficiencies in the review and approval workflow. In order to achieve this automation, historical data may need to be used to build and train machine learning models. Amazon SageMaker is a fully managed service that provides developers and data scientists with the ability to build, train, and deploy machine learning (ML) models quickly. SageMaker removes the heavy lifting from each step of the machine learning process to make it easier to develop high quality models. SageMaker makes it easy to deploy your trained model into production with a single click so that you can start generating predictions on the claims and application data. This is not only useful in training models with accurate vs. inaccurate applications but also in flagging any suspicious or fraudulent application patterns or anomalous activities. For example, the ML models could be used to detect a suspicious activity that was reported by CMS during enrollment to the healthcare.gov[8]

Enhance customer experience through Contact Center Modernization

While claims and benefits applications come in mostly through web and mobile channels, contact centers are a critical part of serving customers and beneficiaries. In some cases, such as healthcare.gov, these calls could be seasonal during the open enrollment or may spike in disaster situations such as the COVID-19, where the unemployment claims and weekly certifications overwhelmed the call centers for a number of states[6].

A common challenge for agencies, is to scale-up contact center operations on-demand. While it may be feasible to scale-up hardware and software using the AWS cloud, it may take a while to ramp up on staffing. While increasing the contact center workforce may help in the short term to handle surge, augmenting the agents with AI/ML capabilities is a more effective strategy for long term sustainment of call center operations. An effective solution is to introduce additional capabilities into contact center operations. These capabilities can include; minimizing the time agents spend with customers for routine tasks by providing self-service chatbots and; minimizing the time agents spend on after call work by providing automated call transcripts from customer voice recordings.

Some effective strategies to build intelligent contact centers include:

- **Deploy scalable Omni channel contact centers**: Amazon Connect is an easy to use Omni channel cloud contact center that helps companies provide superior customer service at a lower cost. Amazon Connect provides a seamless experience across voice and chat for your customers and agents. This includes one set of tools for skills-based routing, powerful real-time and historical analytics, and easy-to-use intuitive management tools. This means Amazon Connect simplifies contact center operations, improves agent efficiency, and lowers costs.

- **Provide AI-powered speech analytics:** Amazon Contact Lens (currently in preview) is a set of machine learning (ML) capabilities integrated into Amazon Connect. With Contact Lens for Amazon Connect, contact center supervisors can better understand the sentiment, trends, and compliance risks of customer conversations to effectively train agents, replicate successful interactions, and identify crucial feedback on benefits/claimant services. Additionally, Amazon Transcribe and Amazon Transcribe Medical provide speech-to-text capabilities. Recorded speeches can be converted to text and analyzed for further insights.

- **Develop self service capabilities:** Self service capabilities will help minimize the burden on the agencies to provide large call center staff by minimizing the number of calls that are serviced by the agents. Amazon Lex is a service for building conversational interfaces into any application using voice and text. Amazon Lex provides the advanced deep learning functionalities of automatic speech recognition for converting speech to text, and natural language understanding to recognize the intent of the text, to enable you to build applications with highly engaging user experiences and lifelike conversational interactions.

  With Amazon Lex, the same deep learning technologies that power Amazon Alexa are now available, enabling you to quickly and easily build sophisticated, natural language, conversational bots (*chatbots*). These chatbots can be integrated into the AWS Connect call flows and provide self service capabilities to the customers so that agents' time can be optimized.

- **Provide language translation capabilities:** Amazon Translate can be used to convert text from one language to another (e.g. Spanish to English). Using Amazon Transcribe and Translate together, calls in one language can be first transcribed and then translated into a different language.

- **Build effective campaign management strategies:** Campaign management and effective communication with public is critical during a crisis (such as COVID-19) or during an open enrollment or for other purposes for benefits enrollment. Amazon Pinpoint helps the agencies engage with public by sending them personalized, timely and relevant communications via email, SMS and other channels.

Enable program leadership to improve operational efficiencies

Program leadership is often faced with operational challenges including budget and enrollment model forecasting, fraud, waste and abuse. This framework helps provide high visibility into program operations via real time and batch analytics using services such as Amazon Kinesis Analytics and Amazon Athena. Program leadership can get deep insights via operational dashboards that can be built using Amazon QuickSight which is a cloud powered business intelligence service. Additionally, Amazon Forecast can be used to forecast enrollment models and budgets. Using these capabilities, agencies can reduce forecasting from months to hours. Agencies can also proactively identify fraud, waste and abuse within the benefits programs using services such as Amazon Fraud Detector, or using a number of machine learning models that AWS provides.

Also, benefits systems migration to cloud and modernization[9] helps optimize costs and improve operational efficiencies; the modernization includes utilizing micro-services-based architectures, containers, and serverless technologies where applicable. These architectures help agencies build systems that are flexible to handle program or policy changes, enable advanced analytics, service delivery improvements, and digital transformation. Cloud migration enables agencies to take advantages of AWS cloud services and helps agencies to optimize costs and improve operational efficiencies such as scalability, reliability, availability, and security of the systems. Several Health and Human Services (HHS) agencies including Maryland DHS and Center for Medicare and Medicaid Systems (CMS' healthcare.gov) are using AWS to run mission-critical applications that administer healthcare and social benefits programs for millions of beneficiaries.

Provide data security and privacy

Security and privacy are a top priority for agencies dealing with benefits enrollment due to federal regulatory and compliance frameworks such as the National Institute of Standards and Technology (NIST) 800-53, US Health Insurance Portability and Accountability Act (HIPAA) and The Federal Risk and Authorization Management Program (FedRAMP). AWS provides a number of capabilities to enable data privacy and security for protecting customer data including encrypting data in transit and data at rest. AWS has also produced a quick start reference deployment for Standardized Architecture for NIST-based Assurance Frameworks on the AWS Cloud. This quick start includes AWS CloudFormation templates to build a standardized reference architecture that aligns with the requirements within the controls listed above. It also includes a security controls matrix, which maps the security controls and requirements to

architecture decisions, features, and configuration of the baseline to enhance your organization's ability to understand and assess the system security configuration

For more information on AWS security capabilities, please see the [AWS Cloud Security](#) page.

Reference Architecture and Best Practices

Figure 4 below outlines a reference architecture for utilizing AI/ML and Amazon A2I framework on the AWS cloud to process claims and benefits programs.

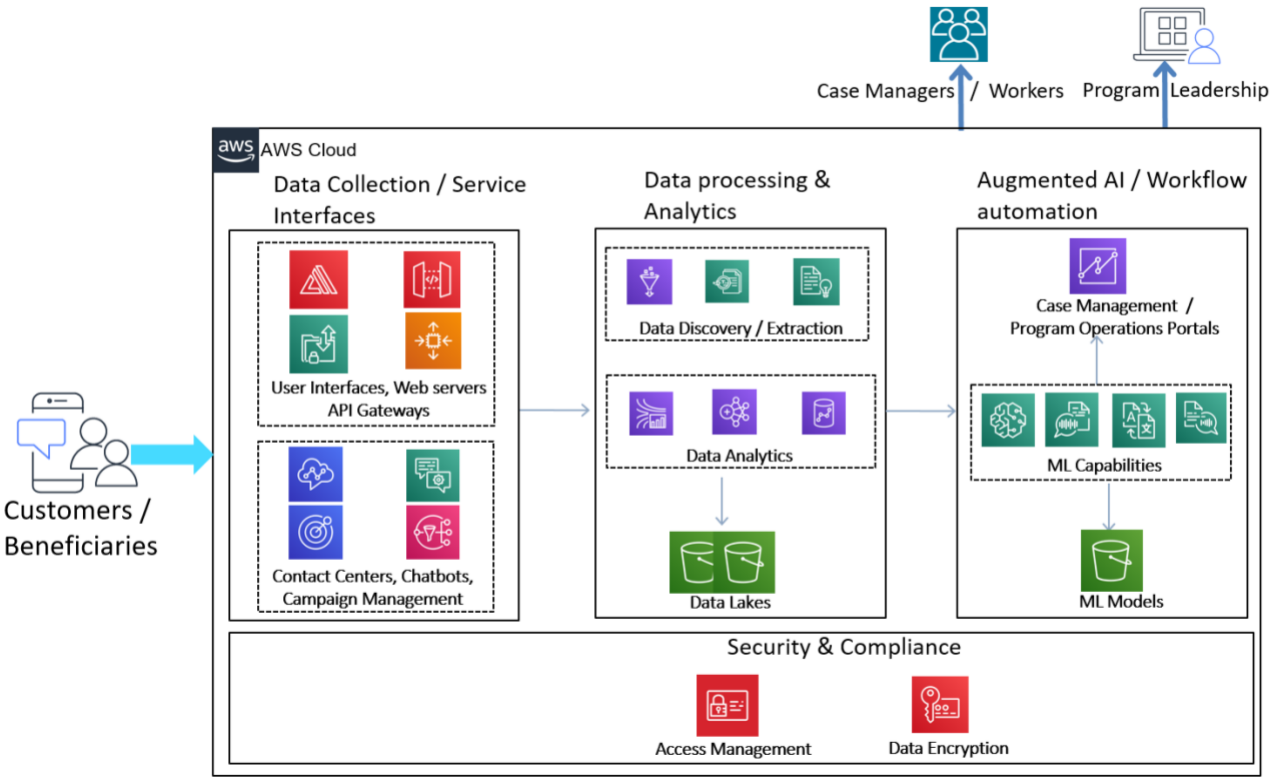

Figure 4 - Reference Architecture for Benefits processing with A2I

Objective	Services / Options
Data Collection / UI / Mobile interfaces	Amazon Amplify (rich web and mobile interfaces) AWS Transfer Family (batch / file transfer) Amazon API Gateway (support for data exchange via APIs) Amazon EC2 / Lambda (Scalable web/app layers) instances)
Data Lake / Storage / Databases / Data warehouse	Amazon S3 (Object storage) Amazon DynamoDB (NoSQL Database) Amazon Redshift (Data warehouse)
ETL / Data Analytics	Amazon Glue (Schema discovery, ETL) Amazon Textract (Extract information from documents) Amazon Comprehend (relationships within text) Amazon Kinesis Analytics (Real time analytics) Amazon EMR (batch analytics) Amazon Redshift (Data warehouse) Amazon Athena (Interactive query and analytics)
Workflow automation Data Visualization, Program Operations	Amazon SageMaker (ML model build, train and deploy) Amazon Augmented AI (benefits review/approval workflows) Amazon Quicksight (Data visualization) Amazon Fraud Detector (Fraud detection) Amazon Forecast (forecasting budgets, enrollment models)
Security Management	Amazon Key Management Service Amazon Identity and Access Management
Contact Centers / Campaign Management	Amazon Connect (Contact Centers) Amazon Lex (Build Chatbots for self service) Amazon Transcribe (voice recording/transcriptions) Amazon Translate (language translation) Amazon Pinpoint (Campaign management, outreach, communications)

Table 1: Objectives within the benefits/claims processing architecture & AWS Service mapping

Augmented AI Reference Workflow

Amazon A2I helps you integrate human judgment into AI/ML workflows. With Amazon A2I, you can let AI handle straight-forward data and invoke human reviewers only when their skills are needed. You can integrate Amazon Textract, Amazon Rekognition, or a custom ML model into your workflow. When you create a flow definition you will be able to specify conditions, such as confidence thresholds, that will trigger a human review. For example, you can specify confidence thresholds for certain fields in an eligibility verification document such as names, income, SSN etc. Additionally, you can have an inference confidence on an image/picture for verification or authentication purposes. These services create a human loop on your behalf using Amazon Augmented AI Runtime API when these conditions are met, and supply your input data directly to Amazon A2I to send to human reviewers.

The following diagram provides a high-level reference workflow to enhance case managers' / case workers' productivity; A2I is built into the workflow and human review is only needed when a document's confidence level falls below a certain threshold.

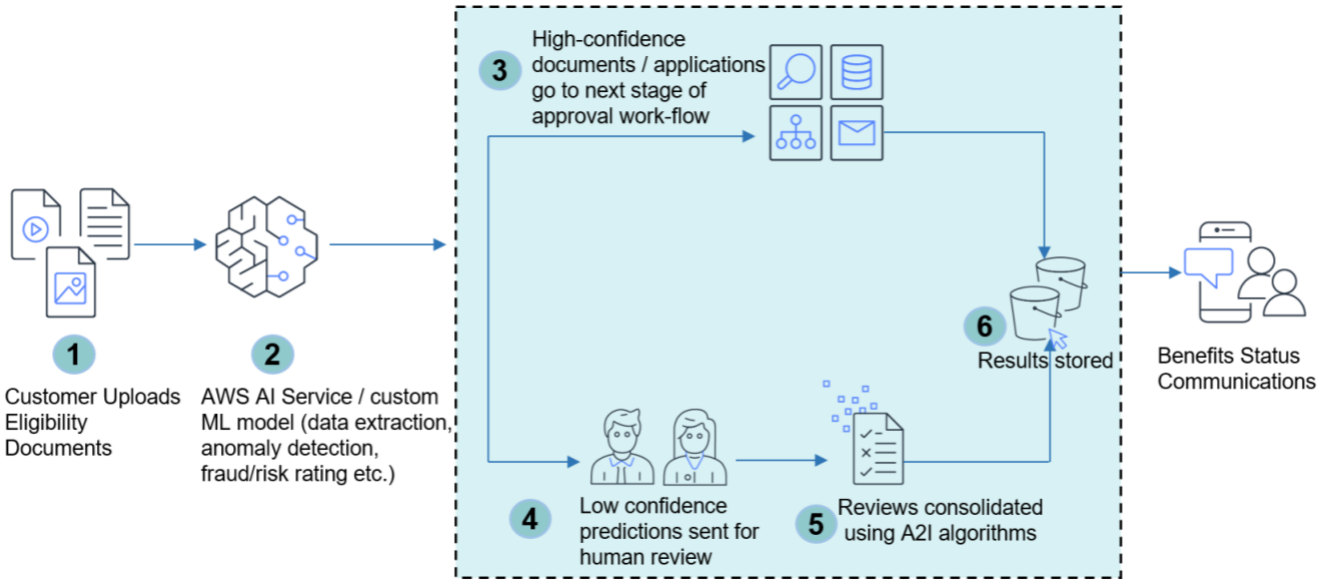

Figure 5 - *High-level reference workflow for augmented AI*

Conclusion

Public sector agencies that deliver benefits to citizens face a number of challenges. This paper outlined these challenges and a framework to address these challenges using Artificial Intelligence, Machine Learning, and Amazon A2I processes. This paper also outlined a high-level architecture to help modernize benefits systems and contact center operations to enhance service delivery to beneficiaries.

Next Steps

Adopting the AWS Cloud can provide you with sustainable advantages for benefits enrollment systems. Our customers in this space include the CMS (www.healthcare.gov), and the USDA Food and Nutrition Services (SNAP). Supplementing your team with specialized skills and experience can help you achieve those results. AWS works together with your team and your chosen member of the AWS Partner Network (APN) to execute your enterprise cloud computing initiatives. Call for action and next steps include; reaching out to AWS public sector team at mailto:aws-hhs@amazon.com or your AWS partner through the AWS Partner Network to get started; identifying cloud migration and benefits systems modernization objectives, identifying needs on contact center modernization; and getting started on AI/ML by visiting AWS Machine Learning, AWS Machine Learning Embark Program , or the ML Solutions Lab.

Contributors

Contributors to this document include:

- Srinath Godavarthi, Sr. Solutions Architect, AWS WWPS
- Eric Schwenter, Principal Solutions Architect, AWS WWPS

Further Reading

For additional information, see:

- AWS Augmented AI
- AWS AI Blog
- AWS Machine Learning Blog
- AWS Cloud Security
- AWS Whitepapers page

References

1. Center on policy and budget priorities: https://www.cbpp.org/research/federal-budget/policy-basics-where-do-our-federal-tax-dollars-go
2. https://www.cbpp.org/research/poverty-and-inequality/economic-security-programs-cut-poverty-nearly-in-half-over-last-50
3. https://www.cms.gov/newsroom/fact-sheets/final-weekly-enrollment-snapshot-2019-enrollment-period
4. https://www.healthcare.gov/tax-form-1095/
5. https://www.ssa.gov/open/data/800-number-call-volume-and-agent-busy-rate.html
6. https://labor.ny.gov/pressreleases/2020/april-09-2020.shtm
7. https://aws.amazon.com/augmented-ai/
8. https://www.cms.gov/newsroom/press-releases/cms-responding-suspicious-activity-agent-and-broker-exchanges-portal
9. https://www.govloop.com/medicaid-cloud-and-large-scale-it-modernization/
10. https://www.ssa.gov/policy/docs/statcomps/supplement/2019/supplement19.pdf

Document Revisions

Date	Description
June 2020	First release