Modern American Journal of Business, Economics, and Entrepreneurship
ISSN (E): 3067-7203
Volume 01, Issue 09, December, 2025
Website: usajournals.org

THE EXPERIENCE OF COUNTRIES IN APPLYING NLP METHODS AND TECHNOLOGIES TO THE PROCESSING OF PUBLIC APPEALS

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Abstract
In recent years, the rapid development of digital technologies and artificial intelligence has led to profound transformations in systems of public administration worldwide. One of the key directions of this transformation is the integration of Natural Language Processing (NLP) methods and technologies into the management of public appeals to state authorities. NLP technologies enable the automated processing, classification, and interpretation of large volumes of textual information, thereby enhancing the efficiency, transparency, and responsiveness of the procedures for handling public appeals.
This article analyzes the experience of countries that have successfully implemented NLP technologies in their public appeals management systems, with particular attention given to their practical mechanisms, institutional structures, and legal foundations. It also reveals the role of NLP technologies in limiting subjectivity arising from the human factor, increasing the accuracy of administrative decision-making, strengthening public trust in state authorities, and reducing corruption risks. In addition, the study assesses the prospects for adapting international best practices within the framework of ongoing public administration reforms and the development of digital governance in the Republic of Uzbekistan, as well as the potential challenges associated with this process.

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Keywords: Natural Language Processing (NLP), public appeals to state authorities, digital governance, artificial intelligence, public administration, e-government, automated text analysis, transparency.

INTRODUCTION

In recent years, the rapid global development of digital technologies has triggered profound transformational processes across all levels of public administration. In particular, the modernization of procedures for receiving, reviewing, and resolving appeals submitted by individuals and legal entities to state authorities through advanced information and communication technologies has become a crucial condition for improving the quality of public services and ensuring their openness and transparency. Within this process, the introduction of Natural Language Processing (NLP) methods and technologies into the circulation and processing of public appeals has acquired distinct scientific and practical significance.

NLP technologies represent one of the priority areas of artificial intelligence systems, enabling the automated analysis, understanding, and processing of human language. Through these technologies, the possibilities for automatic categorization of appeals, their sorting, semantic analysis, identification of the substance of complaints, prediction of recurring problems, and the formation of rapid response mechanisms are significantly expanding. As a result, subjective approaches inherent to the human factor in the handling of appeals are substantially reduced, while the soundness, accuracy, and timeliness of administrative decision-making are enhanced.

The practice of foreign countries demonstrates that the introduction of NLP technologies into the activities of public authorities, including systems for handling citizens' appeals, not only increases organizational efficiency but also enhances the level of public trust in state authority, contributes to the reduction of corruption risks, and ensures the sustainable development of e-government institutions. For this reason, advanced states pay special attention to the integrated development of organizational, technological, and legal infrastructure for the implementation of such technologies.

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In the Republic of Uzbekistan, in recent years, important legal and organizational conditions have been created for reforming the system of handling public appeals, its digitalization, and the gradual introduction of elements of artificial intelligence into public administration. Nevertheless, the current system still relies heavily on human resources in the process of analyzing appeals, which, under conditions of a growing volume of submissions, gives rise to certain problems in ensuring their prompt, impartial, and high-quality review. Therefore, the issue of introducing NLP technologies in this field has become particularly relevant from both scientific and practical perspectives.

This scientific article provides a comprehensive analysis of the experience of foreign countries that have implemented NLP methods and technologies in the circulation of public appeals, examining their practical mechanisms, levels of effectiveness, and features of legal regulation. In addition, the prospects and possibilities for applying this experience under the conditions of Uzbekistan are substantiated on a scientific basis.

THE EXPERIENCE OF DEVELOPED COUNTRIES IN THE IMPLEMENTATION OF NLP TECHNOLOGIES

Today, many countries around the world are actively introducing Natural Language Processing (NLP) technologies into systems for handling citizens' appeals and inquiries. In this context, the term "appeals" refers to citizens' complaints, service requests, applications and proposals, as well as general inquiries addressed to public authorities. Academic literature indicates that countries leading in the development of e-government—particularly the United States, Estonia, and Singapore—make extensive use of NLP methods in order to ensure that their public services become faster, more efficient, and more accessible to the population.

This section summarizes the main conclusions drawn from academic research, government reports, and analytical materials published in English, Russian, and Uzbek, and highlights how these countries have integrated NLP technologies into their public appeals management processes. In addition, a comparative approach is applied with the aim of identifying best practices that may be

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adapted to the conditions of Uzbekistan, as well as the key lessons that should be taken into account.

Implementation and Effectiveness of NLP Technologies in Public Administration in the United States

In the United States, the process of implementing Natural Language Processing (NLP) technologies within the public administration system is decentralized, meaning that it is being carried out gradually across various federal, state, and local government agencies. One of the largest and most successful projects at the federal level is the virtual assistant known as "Emma," developed by the U.S. Citizenship and Immigration Services (USCIS). This artificial intelligence–based chatbot operates in English and Spanish and automatically responds to questions related to immigration procedures. According to statistical data, "Emma" processes nearly 1 million user inquiries per month [1], directing users to the relevant services, application forms, and regulatory information. This project has demonstrated in practice that chatbots can significantly enhance service delivery quality in areas characterized by a high volume of inquiries.

At the state and local levels, the use of NLP technologies is also gaining rapid momentum. For example, during the COVID-19 pandemic in the state of Texas, the support service of a government agency was required to handle up to **2,000 inquiries** per day. Under conditions of such an abrupt increase in workload, NLP technologies were introduced to automatically read incoming emails, classify them, and route them to the appropriate departments. Research findings indicate that approximately **80 percent** of the inquiries consisted of simple technical issues [2] (such as password recovery and system access problems), and the NLP system enabled the automatic separation of these requests while directing more complex matters to specialists. As a result, service delivery speed increased significantly, while the workload of staff members was substantially reduced.

In addition, the Texas Center for Advanced Artificial Intelligence Practices reports the use of sentiment analysis based on NLP technologies. This technology analyzes the tone and content of incoming appeals and prioritizes those with the most negative sentiment and highest urgency. This enables public servants to address the most critical issues first and make prompt administrative decisions.

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Similar initiatives have been implemented in many other regions of the United States. For instance, in the state of Mississippi, a chatbot called **"MISSI"** [3] provides citizens with information on public services via text messages or through the Amazon Alexa voice assistant. In the city of Los Angeles, "CHIP" and similar voice assistants guide residents regarding municipal and administrative services. These systems function as 24-hour virtual assistants and are integrated in real time with existing public service platforms.

At the same time, public authorities place particular emphasis on maintaining a balance between automation and the human factor in the implementation of NLP technologies, rather than pursuing full automation. For example, when complex questions arise, the "Emma" chatbot automatically transfers the inquiry to a human operator. Such an approach prevents a decline in service quality and contributes to strengthening public trust in government services.

Implementation of Seamless Public Services in Estonia through NLP and Artificial Intelligence Based on "KrattAI"

Estonia is one of the global leaders in the field of digital public administration and has been consistently integrating Natural Language Processing (NLP) and Artificial Intelligence (AI) technologies into its public services system. Within the framework of the national artificial intelligence strategy known as "KrattAI" [4], the Estonian government has designated AI technologies as a key instrument for transforming public services into more proactive, personalized, and seamless systems. According to official data, by 2020 dozens of AI-based practical solutions had been introduced across various ministries and public agencies in Estonia, and each public authority was encouraged to pilot machine learning technologies.

Within Estonia's public administration system, a large volume of textual data—electronic appeals, applications, and petitions—is generated on a daily basis. In 2019, following the merger of two independent supervisory authorities in the fields of consumer protection and technical regulation, a unified electronic public appeals portal was launched. This development complicated the process of determining which department was competent to handle a particular issue. To address this challenge, an NLP-based automatic **"topic tagging"** system was introduced. This system automatically classifies appeals based on keywords and

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semantic context and promptly routes them to the relevant departments. As a result, the volume of manual work was significantly reduced, and the speed of processing appeals increased substantially.

In this process, Estonia's well-known **X-Road** data exchange infrastructure plays a crucial technological role. Through X-Road, more than 3,000 public and private databases [5] are currently integrated, enabling NLP systems to automatically transmit classified appeals to the appropriate authority or official. As a result, the circulation of appeals has been transformed into a fast, transparent, and less human-dependent governance mechanism.

Another important area of application of NLP technologies in Estonia is the development of virtual assistants. In accordance with the "KrattAI" concept, the creation of a personalized AI assistant capable of interacting continuously with each citizen on a 24-hour basis has been established as a long-term strategic goal. At present, specialized knowledge-based chatbots have been deployed within the tax authorities, police, and border guard services, where they operate in an integrated manner. Pilot projects conducted in the Police and Border Guard services during 2020–2021 confirmed in practice the feasibility of providing citizens with "single-window" services.

In addition, in Estonia, a speech-to-text system known as **"HANS"** [6] is used to automatically transcribe parliamentary sessions, and plans are underway to extend its functionality to convert citizens' voice appeals into text. Furthermore, significant investment has been directed toward machine translation and speech synthesis technologies in the Estonian language, ensuring that public services function fully in the national language.

Overall, the Estonian experience clearly demonstrates that the successful implementation of NLP and AI technologies in public administration depends on the existence of a unified national strategy, strong inter-agency integration, modular technological solutions, harmonization with the human factor, and robust legal and ethical safeguards. This model is of substantial practical relevance for Uzbekistan as well and may be gradually adapted and implemented taking into account the specifics of the national legal system and institutional framework.

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Implementation of NLP Technologies in Singapore Based on the "Whole-of-Government" Approach

Singapore has been consistently implementing the **"whole-of-government"** (WoG) approach in the introduction of Natural Language Processing (NLP) technologies within its public service system. This model is aimed at creating a unified, stable, and high-quality public service environment for citizens across all government agencies. One of the largest and most successful initiatives under this policy is the virtual assistant "Ask Jamie." This chatbot was launched in 2014 and is now recognized as one of the largest government chatbot systems in the world.

"Ask Jamie" has significantly simplified the process of citizens' interaction with public authorities. Instead of navigating complex institutional websites or telephone menus, users can now obtain fast and accurate responses by asking questions in simple natural language. By **2019, "Ask Jamie" had been deployed on nearly 80 government websites** [7], including the websites of ministries, agencies, and certain intranet systems. The chatbot operates on the basis of a knowledge base consisting of more than 42,000 question-and-answer pairs [8], which were formed through real interactions between citizens and public authorities. Using NLP and machine learning algorithms, the chatbot identifies key phrases in user queries and provides responses with a level of accuracy approaching that of a human officer.

The system demonstrates particularly high accuracy in handling simple and repetitive questions. In the case of more complex inquiries, **"Ask Jamie"** automatically redirects the request to a human officer, while preserving the conversation history. This mechanism plays an important role in ensuring service quality and continuity. According to data from **GovTech Singapore**, within its first five years of operation, the chatbot responded to more than 15 million inquiries, and over 50 percent of all cases were resolved automatically without human intervention. As a result, the workload on call centers was significantly reduced, allowing civil servants to focus on more complex issues requiring an individualized approach.

Singapore has not limited the application of NLP technologies to text-based chatbots alone. Within the framework of the **"Ask Jamie Voice" project** [9],

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speech recognition technologies for handling voice inquiries were introduced and piloted in **the Ministry of Education and the Ministry of Social and Family Development** during 2020–2021. In addition, within tax platforms, the chatbot was integrated with the SingPass national digital identity system, enabling user authentication and redirection to electronic public services.

Furthermore, the Gov.sg Messenger chatbot enables the dissemination of official information via Facebook Messenger, allows users to submit complaints regarding deficiencies in public services, and provides real-time tracking of their status. This chatbot is fully integrated with the government's central complaints management system.

Overall, Singapore's experience demonstrates in practice that the centralized yet citizen-centered implementation of NLP technologies can significantly enhance the efficiency of public services, reduce operational costs, and strengthen public trust in government institutions. This approach is of particular scientific and practical relevance as an advanced model that may also be gradually implemented under the conditions of Uzbekistan.

Comparative Approaches and Best Practices

A comparison of the experiences of the United States, Estonia, and Singapore shows that in all three countries NLP technologies effectively expand the capacity of human resources in processing large volumes of citizens' appeals. In all three cases, chatbot technologies serve as the primary **"front-line"** tool for handling appeals; however, their implementation strategies differ in terms of scope and system architecture. In particular, in the United States, chatbots are typically introduced at the level of individual agencies (for example, in the fields of immigration, healthcare, or state services), whereas in Singapore and Estonia more centralized or interoperable systems are applied (in Singapore, multiple agencies operate under a single brand, while in Estonia a network of interoperable chatbots is used). Nevertheless, these practices have collectively contributed to the formation of several shared best practices.

Starting small and gradual scaling

A phased approach is considered the most optimal strategy for implementing NLP technologies. Initially, agencies focused on narrow functions, such as

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automated responses to frequently asked questions or the classification of incoming emails. Success in these limited areas later generated confidence for advancing to larger-scale projects. U.S. experts, in particular, emphasize the importance of selecting tasks that do not cause public concern and demonstrating that NLP technologies serve to assist, rather than replace, human labor. Estonia and Singapore similarly followed this approach by first implementing pilot projects in specific sectors before scaling them nationwide.

Integration with human activity

The experience of all three countries demonstrates that NLP systems should not operate in parallel with existing workflows but must be directly integrated into them. For example, in Estonia, the automated classification system does not merely generate statistical reports but directly routes appeals to the responsible official. In Singapore, the "Ask Jamie" chatbot transfers complex inquiries to a human officer. This integration enables a seamless transition from artificial intelligence to human involvement where machine capabilities reach their limits, thereby ensuring continuity and quality in the handling of appeals.

Use of multi-channel and multilingual platforms

In order to maximize citizen engagement, governments deploy NLP solutions across websites, mobile applications, social networks, and voice platforms. The United States and Singapore, for instance, utilize platforms that are widely used in daily life—such as Amazon Alexa and Facebook Messenger—for managing public appeals. At the same time, in multilingual societies, supporting national languages alongside English is regarded as essential for ensuring inclusive access for all segments of the population.

Centralization of knowledge and data

The effectiveness of NLP technologies in public administration is directly dependent on the availability of high-quality knowledge bases and data repositories. Singapore's centralized knowledge base containing over 42,000 question-and-answer pairs, as well as Estonia's open data exchange systems, clearly demonstrate the substantial benefits of transforming government

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information into machine-readable formats. This enables not only precise automated responses but also the generation of analytical insights based on appeals (for example, identifying complaint trends). At the same time, it is essential to ensure data relevance, consistency, and compliance with data protection and confidentiality legislation.

Ensuring legal and ethical foundations

The introduction of NLP systems into public administration raises issues related to transparency, accountability, and the protection of privacy. Comparative analysis indicates that leading countries strive to align technological solutions with legal norms. For example, in Estonia, mechanisms for appealing automated decisions are under discussion, while in the United States strict requirements for data protection and transparency are observed in the deployment of chatbots. Principles such as clearly informing users that they are interacting with artificial intelligence, ensuring the secure storage of communication records, and obtaining user consent are regarded as advanced best practices. Based on these experiences, Uzbekistan should also develop legal mechanisms that fully protect citizens' rights and ensure public trust.

CONCLUSION

International experience demonstrates that the application of NLP technologies to public appeals management systems makes it possible to significantly enhance the speed and efficiency of public administration. The rapid resolution of repetitive issues, the identification of critical problems through text analysis, and the reallocation of human resources toward strategic tasks yield the most effective results. The highest level of effectiveness is achieved where NLP technologies complement the human factor, are supported by a well-designed strategic framework and solid legal safeguards, and are subject to continuous improvement. These conclusions may also serve as a robust scientific and practical basis for the modernization of the public appeals processing system in Uzbekistan.

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