AMAZON KENDRA AT BANKING DOCUMENT MANAGEMENT SYSTEM

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ABSTRACT

Electronic document management systems have a great prospect of use in the banking sector, all information stored in electronic document management systems requires further analysis and processing, this involves the use of a machine learning service to build a semantic search result, which implies the presence of a search service with the thinking of artificial intelligence and the ability to provide links clearly reasoned answers. Such a service that satisfies the needs of semantic search is the Amazon Kendra service, the question of using such a service is more relevant than ever for the construction of modern banking products. Under such conditions, an important area of research is to assess the effectiveness of Amazon Kendra in the banking sector, which necessitates the development of a conceptual model for evaluating the effectiveness of banks to make management decisions aimed at improving the efficiency of individual banks and the banking system.

Objectives: The purpose of this work is to improve the work of electronic document flow in the banking sector using Amazon Kendra to design an innovative banking product and develop the banking sector of Ukraine.

Methods/Approach: Scientific research methods – both comparative and analytical – is used in the process of drawing up of this article.

Results: A semantic search system based on the bank’s electronic document flow system was designed.

Keywords: information and communication technologies, innovative technologies in the banking sphere, digitalization processes, bank activity, electronic document circulation system, innovative banking products, Amazon Kendra

JEL classification: G21; G32; O33

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INTRODUCTION

Innovative development of the banking sector in the direction of modeling the implementation of information technology to support innovative products of banks and services is extremely important. In this direction, Vadym Hetman Kyiv National University of Economics is conducting research (R&D), in particular on the topics: «Development of methods and technologies of intellectual support for the management of organizational structures in the context of digital economy» state registration number 0119 U002604 «And»
Modeling of processes of introduction of information technologies of support of innovative products of banks and services (state registration number 0122U001987 (scientific supervisor Doctor of Economics, Prof. Ustenko S.V.). Based on the current results of these works, scientific articles have been published in international monographs (Ustenko, 2020), (Ustenko, 2021), (Ustenko, 2020), (Ustenko, 2019). The relevance of the research topic is due to the fact that in market conditions, banking products, services and services play a key role in the functioning of the financial system and market. This causes an urgent need to build intelligent information systems for the interaction of banking institutions with the user, to attract artificial intelligence, including neural networks.

The main feature and innovation of such systems is that they have the property of machine learning and with each new training the system improves its performance. In information and communication systems and technologies to support information security of banking and conceptual approaches to sustainable development of Ukrainian banks on the general principles of banking education, the main of which are the principles of integrity, stability, digitization and structural and logical links elements and the banking system as a whole, which requires the generalization of approaches to model research and technologies for the use of banking systems (Ustenko, 2019). The work is devoted to the study of the conceptual foundations of the processes of information support of digital educational activities, which does not take into account the production (operational) sphere of activity of enterprises and organizations (Ustenko, 2022). Publications provide approaches, trends and factors of economic growth in the most technologically advanced countries (Tew, 2017), (Hussaini, 2020), (Dusange, 1994), (Millier, 2011). Technological development is one of the important factors of economic growth and includes the use of a set of production techniques and scientific methods that must be considered for sound analysis and evaluation of banks’ performance. At the same time, there is an urgent need to develop a general (conceptual) model for assessing the effectiveness of the bank, which can take into account key performance indicators of a number of subsystems of the bank, including operational, economic, financial, management, information technology and more (Dusange, 1994), (Millier, 2011). Implementation of the conceptual model in each bank will allow at the system level to conduct model experiments to assess the effectiveness of the bank’s operation and development, develop practical recommendations and ways to improve the efficiency of Ukrainian banks, take into account the introduction of banking services to provide customers with banking services.

Since the beginning of 2014, the banking system of Ukraine has experienced one of the strongest crises in its history. In terms of banking assets as a percentage of gross domestic product, Ukraine's banking sector was similar to Poland's. However, by 2016, bank closures and reduced lending led to a sharp reduction in the role of banks in the economy. Today, Ukraine lags far behind many European banks. As of October 2020, out of 180 banks operating at the beginning of 2014, 104 banks were declared insolvent or liquidated by the National Bank of Ukraine, which is almost 60% of the country's banks. It should be noted that the assets of some Ukrainian banks in 2014 were overstated due to the concealment of loans to related parties, but many banks,
unfortunately, did not have the opportunity to model and forecast the impact of internal and external destabilizing factors on the financial institution, which leads to the search for tools and approaches for strategic analysis, evaluation of efficiency and development of banks. Banks are at the epicenter of these changes. Technological developments and social changes have a deeper and more immediate impact on the financial industry than on most other sectors, as its primary raw materials are information and money. And money, in turn, can be dematerialized and turned into accounts, in other words, into data that can be stored, processed and transferred in real time with little cost (Ustenko, 2021), (Ustenko, 2020).

**METHODOLOGY**

Methods and materials: methods used to achieve the aims of the study are comparative and analytical methods of scientific research. Materials of the studies consists of analysis of documentations texts, scientific articles and publications, as well practical experience gained in the topic of the research

**RESULTS AND DISCUSSION**

**Amazon Kendra at banking document management system**

Banking has not yet undergone the transformation that other information sectors have undergone. This is largely due to the fact that banking has historically been a highly regulated industry subject to close supervision and control by government authorities. However, the transformation of the industry is not only inevitable, but also gaining momentum every day. The main reason is that the technological revolution introduces new ways of doing business every day and increases the potential to reduce costs, and the number of users who resort to non-traditional methods of banking continues to grow. Another reason for the transformation is that the current crisis is causing changes in different directions. Banks are perceived as the "culprit" of the recession, and rightly so, because many institutions made very serious mistakes and chose to ignore the basic principles of banking: prudence, transparency and even honesty. As a result of these mistakes, many banks faced serious difficulties, with some banks failing and others undergoing complete restructuring, usually financed by public funds.

The colossal amount of taxpayer resources invested in savings banks has caused serious damage to the reputation of financial institutions and the entire industry in the eyes of ordinary citizens. The crisis also triggered a process of radical changes in banking regulation: loan limits, increased capital and reserve requirements, the need for large investments to improve risk and compliance systems, etc. All this comes down to a decrease in income and an increase in costs, in other words, to a decrease in the current and future profitability of financial institutions. Banks must respond to the new demands of their customers and society, meet this challenge with damaged reputations, lower profits and slower pace growth of traditional banking business. Such a situation requires a radical transformation: banks must radically revise the way they interact with clients.
and make a qualitative leap in efficiency. To some extent, efficiency gains will be achieved due to the sharp consolidation of the banking sector, which has already begun. But the true transformation of the industry will be achieved through the broad and, above all, smart use of technology as part of a continuous process of innovation.

In recent decades, banks have been among the most important users of information and communication technologies, which they have adopted with two main goals: to reduce costs and optimize processes to increase profits, and to develop communication channels that are different from the usual ones. With the development of banking, the Internet has become a leading source of information, indispensable business communication and even a forum for personal relationships: now more than a billion people around the world use various social networks. The Internet is also driving the fragmentation of banks’ production chains, facilitating the outsourcing of services. Banking services offered by cloud computing are a major breakthrough in universal access to data storage and processing at very low costs and will have far-reaching consequences. The use of the Internet has also increased significantly due to the advancement of mobile phone technology. Thanks to these new devices, almost 4.5 billion people are online and have almost universal access to some level of information services, which has a huge impact on productivity (Ustenko, 2019), (Ustenko, 2018). Mobile phones are equipped with more and more powerful and diverse functions, which will gradually be included in other devices, additional services and services of banking systems ("Internet of Things", "Internet banking"). The methodology of researching the processes of functioning and development of banks is based on a general analysis and principles of bank development and takes into account a comprehensive approach to researching the processes of effective development of banks (Ustenko, 2019). A comprehensive approach to the study of bank development processes is focused on the holistic development of all processes, rather than individual processes, which contributes to the comprehensive development of the bank. This approach allows taking into account the information technology aspects of banking services, the development of new banking products and the use of modern information technologies and banking systems. The basis of the information and technological support of banks is the process of implementing digitalization as a tool for the development and scaling of the bank. Digitization is the direction of development of banks in the sense of the implementation of modern digital technologies aimed at the transition to automated digital technologies controlled by real-time intelligent systems in constant interaction with the external environment beyond the boundaries of one bank, with the prospect of unification on a global scale. the Internet of Things and Services network. Today, the first steps in the implementation of digitization are the introduction of such technologies as machine learning, blockchain systems, AR technologies (augmented reality), cloud technologies AWS (cloud technologies), systems for processing large data sets (data processing) (Ustenko, 2021), (Ustenko, 2020), (Tew, 2017).

To improve the work of the bank manager, it is suggested to use the Amazon Kendra system to obtain semantic search results. Amazon Kendra is a document search and indexing interface. Amazon Kendra can be
used to create an updatable index of various types of documents, including plain text, HTML files, Microsoft Word documents, Microsoft PowerPoint presentations, and PDF files. It has a search API that can be used from a number of client applications, including websites and mobile applications. Other services are integrated with Amazon Kendra.

For example, you can use Amazon Kendra search to power Amazon Lex chatbots and provide answers to user queries. Amazon S3 can be used as a data source for your Amazon Kendra index. AWS Identity and Access Management can also be used to manage access to Amazon Kendra resources.

**Amazon Kendra consists of the following elements:**

- **Index** provides a client-side search API. The index consists of source documents.
- Documents to be indexed are stored in the source repository.
- The data source synchronizes the documents of your source repositories with the Amazon Kendra index. You can synchronize your data source with the Amazon Kendra index to update the index with new, updated, and deleted files from the source repository.
- **Document Addition API**, which directly adds documents to the index. In recent decades, banks have been among the most important users of information and communication technologies, which they have adopted with two main goals: to reduce costs and optimize processes to increase profits, and to develop communication channels, different from the usual ones. With the development of banking, the Internet has become a leading source of information, indispensable business communication and even a forum for personal relationships: now more than a billion people around the world use various social networks. The Internet is also driving the fragmentation of banks’ production chains, facilitating the outsourcing of services. Banking services offered by cloud computing are a major breakthrough in universal access to data storage and processing at very low costs and will have far-reaching consequences. The use of the Internet has also increased significantly due to the advancement of mobile phone technology. Thanks to these new devices, almost 4.5 billion people are online and have almost universal access to some level of information services, which has a huge impact on productivity (Ustenko, 2019), (Ustenko, 2018). Mobile phones are equipped with more and more powerful and diverse functions, which will gradually be included in other devices, additional services and services of banking systems ("Internet of Things", "Internet banking"). The methodology of researching the processes of functioning and development of banks is based on a general analysis and principles of bank development and takes into account a comprehensive approach to researching the processes of effective development of banks (Ustenko, 2019). A comprehensive approach to the study of bank development processes is focused on the holistic development of all processes, rather than individual processes, which contributes to the comprehensive development of the bank. This approach allows taking into account the information technology aspects of banking services, the development of new banking products and the use of modern information technologies
and banking systems. The basis of the information and technological support of banks is the process of implementing digitalization as a tool for the development and scaling of the bank.

Benefits of using Amazon Kendra:

- Get answers in natural language: We can use simple keywords to search. It will return the best answers to your query whether your answer is in a document, FAQ, or PDF. It will also provide suggested answers rather than going through a long list of documents.
- Content Access: With Kendra, we can easily access content from various repositories like SharePoint, Amazon S3, ServiceNow, and Salesforce into a centralized index that allows you to search all questions in your data and find the exact answer.
- Fine-tuning search results: We can fine-tune search results by manually adjusting the importance of data sources or by using custom tags.
- Deploy with just a few clicks: Just a few clicks. We can set up the index, connect the appropriate data sources, and start using Kendra to find answers to our questions.
- Amazon Kendra users can ask the following types of questions or requests:
  - Factual questions are simple who, what, when, and where questions that have answers based on facts that can be given in a single word or phrase.
  - Descriptive questions are questions with a single line, section, or full text as the answer.
  - Search by keywords - when the purpose and scope of the question is unclear. Amazon Kendra can determine the user's intent behind a search query and return results that match the user's expected value.
- Amazon Kendra is a widely used service defined as an Intelligent Search (ML) service powered by machine learning. Amazon Kendra redefines business search for user websites and applications so that their employees and customers can quickly find the information they need, even if it is spread across multiple locations and content repositories within the company. Users can stop sifting through reams of unstructured data and instead find relevant answers to their queries when they need them with Amazon Kendra. Because Amazon Kendra is a fully managed service, there is no need to configure servers and train or install machine learning models. Use natural language queries in addition to your primary keywords to get the information you need. Whether it's a text snippet, an FAQ, or a PDF document, Amazon Kendra will provide the exact answer from it. Instead of searching for exact answers in huge lists of documents, Amazon Kendra offers suggestions in advance. Amazon Kendra is also defined as a service that offers intelligent search capabilities for websites and applications. With this service, employees can easily identify the material they need, even if the data is stored in multiple locations, and get the right answers to their queries when they need them.
- Amazon says goodbye to browsing long lists of links and browsing articles in the hope of finding something that will help users. Natural language search capabilities, unlike traditional search technologies, provide the
answers users are looking for quickly and accurately, regardless of where the material is stored in their company, so they find relevant answers quickly. Amazon Kendra easily aggregates content from content repositories such as Microsoft SharePoint, Amazon Simple Storage Service (S3), ServiceNow, Salesforce, and Amazon Relational Database Service (RDS) into a centralized index using Amazon Kendra. This allows users to quickly search all of your enterprise data and find the most accurate answer, thus centralizing access to knowledge. The deep learning models used by Amazon Kendra have been pre-trained in 14 industrial domains, helping to produce more accurate answers in a variety of commercial use cases. Users can also fine-tune search results by directly prioritizing data sources, authors, or recency, or by applying custom tags, thus customizing search results. Compared to traditional search solutions, Amazon Kendra is quick to set up, allowing users to access Amazon Kendra's advanced search capabilities more quickly. Without any programming or machine learning skills, users can simply create an index, link relevant data sources, and launch a fully functional and customizable search interface with just a few clicks of the mouse, and thus it deploys with just a few clicks of the mouse.

As with any data discovery tool, metadata is king. We will use the S3 databases and tables available in the AWS Glue data directory. To make this information searchable through Amazon Kendra, I needed to prepare the metadata (that is, the database and table names in the AWS Glue Data Catalog) in a format that could be indexed in Amazon Kendra. It’s very easy with boto3’s AWS Python SDK. See the example below (see Fig. 1):

```python
def get_all_glue_tables():
    """
    Function to get all tables in AWS Glue Data Catalog
    """
    glue_tables = []
    kwargs = {}
    response = glue.search_tables(**kwargs)
    glue_tables.extend(response['TableList'])
    while 'NextToken' in response:
        token = response['NextToken']
        kwargs['NextToken'] = token
        response = glue.search_tables(**kwargs)
        glue_tables.extend(response['TableList'])
    return glue_tables
```

Fig.1. The example
With metadata added as documents to Amazon Kendra, it's time to experience data discovery. Our first query was to find user session data. To do this, Amazon Kendra returned the correct results along with a suggested answer that matched what we were looking for. In addition, based on the metadata and Facet configuration in Amazon Kendra, it is possible to filter the columns I am interested in or the types of tables (views or external tables, see Fig.2).

**Fig. 2.** Search for data about user sessions

After examining the session data, our task is to review the data available for conversion. So we simply ask Amazon Kendra, "Where's the conversion data." Voila, the result, as seen in Fig. 3.
Finally, we want to see the tables with the eventId column so we know which tables or views to join for analysis (see Figure 4):

**Fig. 3.** Data available for conversion

**Fig. 4.** of the table with the eventId column
Search allows you to ask questions in natural language, such as "where is eventid used?" or "where is the conversion data?". This capability makes it easier for anyone to find the relevant data they need for analytics. Thus, the time required to search for data is reduced.

Amazon Kendra document attributes can be used as filters, in this case column names, providing an intuitive user interface for filtering.

The architecture of the electronic document management system using Amazon Kendra is presented in Fig. 5.

**CONCLUSIONS**

The article presents the use of the Amazon Kendra service to improve search results and work with the electronic document management system. Such an improvement will make it possible to build an innovative banking product to provide better service to the client of banking services. This will make it possible to significantly improve the service for the client of banking services.

Using the Amazon Kendra service in the banking sector is an innovative approach that will provide a significant market advantage to the banking institution and satisfy the client's needs.
Such an architectural solution still has no analogues in the banking sector of Ukraine and can be recommended for implementation in the banking sector.

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All authors have read and agreed to the published version of the manuscript.

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**Conflict of interests**
The authors declare no conflict of interest.

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