Research Article

Artificial Intelligence in Banking Internal Demand Management Systems: The Example of Vakıf Participation Bank

Büşra Tural[1*], Zeynep Örpek[2], Samet Özmen[3]

[1] Vakıf Participation Bank R&D Center, https://orcid.org/0000-0003-3645-8761, busra.tural@vakifkatilim.com.tr
[2] Vakıf Participation Bank R&D Center, https://orcid.org/0000-0001-7130-9118, zeynep.orpek@vakifkatilim.com.tr
[3] Vakıf Participation Bank R&D Center, https://orcid.org/0000-0002-8398-3107, samet.ozmen@vakifkatilim.com.tr
[*] Correspondence: busra.tural@vakifkatilim.com.tr; Mobile Phone.: (+905376945561)

(First received February 12, 2024 and in final form May 16, 2024)

Reference: Tural, B., Örpek., Z., Özmen, S. Artificial Intelligence in Banking Internal Demand Management Systems: The Example of Vakıf Participation Bank. The European Journal of Research and Development, 4(2), 130-138.

Abstract

The development of artificial intelligence and technology has accelerated the transformation of internal processes in the banking sector. In particular, Natural Language Processing (NLP) technology provides time and cost savings by automating processes such as data entry, querying, and reporting. While NLP-based systems increase customer satisfaction by understanding customer demands and providing appropriate responses quickly, they also increase operational efficiency. Classification algorithms, which are frequently used together with NLP technology, analyze text data and assign them to certain categories or classes, creating a powerful combination for the processing and analysis of text-based data. Vakıf Participation Demand Management System R&D Project has developed an NLP and classification model to be used in its internal processes. With the developed model, it was aimed to eliminate the problems encountered in workflow processes and increase efficiency by developing a language understanding model using the records of requests (demand management system) kept within Vakıf Participation and frequently used in operational processes. During this study, existing data containing in-house requests were subjected to pre-processing, and model training studies were carried out with these data. As a result of the developments, a model with 75% accuracy was developed and improvement efforts on the model continue. Thanks to the developed model, aims to shorten the response time for requests in the demand management system, reduce operational burdens, and increase internal customer satisfaction. It is planned to use the developed model in other banking internal processes as well.

Keywords: *Artificial Intelligence, Natural Language Processing (NLP), Classification, Banking Internal Processes*

1. Introduction

Technological advances are one of the main factors that trigger transformation and create a significant impact in the banking sector. In addition to enabling banks to provide better service to their customers, these advances provide opportunities in various areas such as improving operational efficiency, reducing costs, and preventing fraud. The impact of technological advances in the banking sector is becoming visible, especially in areas such as artificial intelligence and Natural Language Processing (NLP). Techniques such as artificial intelligence, big data analytics, pattern recognition, and machine learning enable banks to understand the complex structures in their databases and use this data effectively. In this context, NLP stands out with its abilities to understand, classify, and process text-based data. The banking sector stands out as one of the sectors that closely follows the advantages offered by NLP technology [1].

Demand management in banking internal processes is of critical importance in terms of correctly managing and meeting customer demands. Effective handling of customer demands increases customer satisfaction and strengthens customer loyalty. At the same time, fast and accurate demand management increases the operational efficiency of banks and ensures the effective use of resources. Carrying out demand management processes regularly and systematically strengthens banks' customer relations and allows them to gain a competitive advantage.

Integration of NLP technology into banking internal processes helps to carry out demand management more effectively. NLP technology-based systems automatically analyze customer communications and provide significant support to banks in understanding, classifying requests, and quickly providing appropriate responses. In this way, banks can respond to customer demands faster and more accurately. Additionally, the integration of NLP technology into demand management processes reduces manual workload and increases operational efficiency by minimizing human errors. These technological innovations provide the opportunity to provide a more effective and customer-oriented service in the banking sector. There are many researches and studies in the literature on the use of NLP technology, both in demand management processes and in banking internal processes. These studies address various applications of NLP technology in demand management and banking processes.

In their study, Crandall et al. (1996) examined the issue of demand management in service sectors, emphasized the importance of demand/capacity management, suggested the classification of demand management strategies, and identified the factors that may affect the selection of these strategies [2].

In their study, Sujala Reddy and colleagues examined how artificial intelligence techniques such as natural language processing, machine learning, and chat bots can be used at various stages of demand management and how these technologies improve processes such as demand capture, categorization, prioritization, workflow optimization, and resource allocation [3].

In the study of Altıntaş et al., the difficulties of manually assigning demand records in large organizations were discussed. Instead, automatic assignment with supervised machine learning algorithms has been suggested. Their proposed model is trained with pre-categorized tickets. The result of the study shows that this approach provides better service and employee satisfaction by reducing manual workload [4].

A similar study on the demand management system was carried out by Gorbunova et al. In his work, he proposes a model that aims to automatically process wireless network problems with natural language processing methods. This subsystem, integrated into the Atlassian Jira system, analyzes user requests, detects problems, and produces solutions. Information is extracted from texts using artificial intelligence techniques such as word embedding and convolutional neural networks. The article demonstrates the success of these methods applied to different text sizes [5].

A similar study on demand management and use of NLP technology was also conducted by Subbarao et al. Aiming to quickly categorize IT requests, this study proposes an effective technique for systematic demand categorization/classification using machine learning and natural language processing techniques. Supervised has developed a machine learning model that significantly predicts an incident resolution category with ML algorithms. In particular, the results obtained with LDA and NLP techniques such as TF-IDF and 3 Grams provided 96.46% sensitivity with stop word removal and lemmatization [6].

In their study, Olujimi et al. (2023) reviewed previous research on automating customer queries using NLP technology approaches using a systematic review methodology. The 73 articles analyzed provided a detailed evaluation of existing studies on the use of NLP technology techniques in business applications [7].

In their study, Yang et al. (2020) created a financial domain-specific language model called FinBERT by pre-training on a large number of financial communication texts in the financial sector. Experiments confirm that FinBERT provides an advantage in financial sentiment classification tasks over general-purpose language models [8].

In their study with Dash et al. (2023), in-depth learning was investigated for analyses related to reading and extracting the meaning of unstructured personal data in the banking sector. The research focuses on improving these methods faced by banks by using natural language processing and deep learning applications [9].

In their study, Khan et al. proposed a chatbot model based on artificial intelligence and natural language processing to provide consultancy to Islamic banking and finance

customers. The proposed chatbot model aims to help Islamic finance and banking customers interact in real-time and receive recommendations in line with Islamic finance principles based on their personal financial needs [10].

In their research, Örpek et al. suggest that it should be taken into consideration that general NLP models are insufficient to meet banking needs and that banks should develop their own NLP models. These models provide benefits such as ensuring data privacy, improving business processes, and providing customized customer service, but they must consider success, cost, and language-based challenges [1].

These studies show that the integration of NLP technology into banking internal processes helps to carry out demand management processes more effectively and increases the operational efficiency of banks. This provides the opportunity to provide a more effective and customer-oriented service in the banking sector.

2. Materials and Methods

2.1.NLP Technology

NLP technology is a machine learning technology that gives computers the ability to interpret, process, and understand human language and is a subfield of artificial intelligence. The main goal of NLP technology is to develop algorithms and models to understand, interpret, and use natural language data such as text or speech.

NLP technology combines computational linguistics, machine learning, and deep learning models to interpret human language [11].

- Computational Linguistics: It is the science of understanding and creating human language models with computer and software tools. Tools such as language translation tools, text-to-speech synthesizers, and speech recognition software are based on computational linguistics
- Machine Learning: It is a technology that increases the efficiency of the computer by training it with sample data. It helps to learn various features of human language, as well as grammar and usage exceptions.
- Deep Learning: A specific field of machine learning that teaches computers to learn and think like humans. Thanks to structured data processing nodes that include a neural network, computers can recognize, classify, and correlate complex patterns.

2.2.Classification

Classification, is generally the process of dividing objects or concepts into groups according to certain characteristics. In these groups, elements with common characteristics exist together. Classification is used to make a subject more

understandable, reduce complexity, and organize information and is used in science, mathematics, linguistics, information technology, and many other fields.

The combined use of NLP technology and classification techniques is a successful method to understand, process, and classify text data into specific categories or classes. NLP technology enables human language to be interpreted and processed by computers. Classification, on the other hand, involves the process of assigning a particular text to a set of specified categories. When NLP technology and classification techniques are used together, it is possible to analyze text data more deeply and obtain meaningful results.

The main NLP technology classification algorithms are as follows.

- Naive Bayes: It is a probability-based classification method to assign texts to specific categories.
- Decision Trees: It is a method that creates a tree structure by analyzing text data and classifies the text by assigning it to certain categories.
- Support Vector Machines (SVM): It is a method that classifies text by assigning it to certain classes using its features and separating data points with a hyperplane.
- Nearest Neighbor (k-NN): It is a method that classifies the text using its nearest neighbors.
- Logistic Regression: It is a method that classifies the text by estimating the probability that it belongs to a certain class.
- Random Forest: It is a method that classifies by bringing together many decision trees.
- Deep Learning Models: It is a method that classifies texts using the deep architectures of artificial neural networks.

These algorithms have different advantages and disadvantages. In addition to these methods, Bidirectional Encoder Representations from Transformers (BERT) is a deep learning model that has recently made a great revolution in the field of NLP technology and shows extraordinary performance in various tasks such as classification.

BERT was developed by Google and is a major revolution in the field of NLP technology. The difference between BERT and other classification methods with NLP technology is that it is learned in an unsupervised way with large amounts of text data. This enables BERT to understand complex relationships and semantic structures between texts.

BERT is a model based on transformer architecture. It has been trained to consider the word order in texts. In this way, it can better understand the meaning of texts and understand the context of the sentence as well as the meaning of the words in the texts.

BERT's success in classification tasks is related to its feature extraction and better capture of semantic relationships between texts. BERT is used to determine which category or class a given text belongs to. This has opened a new era in the field of classification with NLP technology and has created a huge impact in many industries.

2.3.Example of Vakıf Participation Bank

Solution center systems have a critical importance in the banking sector, both in customer-bank relations and in terms of the bank's internal activities. In the banking sector, where legislation and regulations are very strict, it is of great importance that the activities are carried out flawlessly. By the banking law, activities are subject to multi-stage and complex evaluation processes. In this context, free format text correspondence, e-mail correspondence, telephone, etc. are used in customer and internal communication. Methods are quite common. As a result,;

- The need for manual effort is increasing for processes to proceed smoothly.
- Since the requests, requests, and complaints submitted through the solution center concern different processes, the problem cannot be solved at once.
- In cases where complex requests submitted through the solution center cannot be resolved through the "helpdesk" system, they are resolved by going outside the system and using channels such as telephone or e-mail. In this case, the possibility of tracking the data to improve the process is eliminated. Any solution center system that does not function properly increases operational risk as it is prone to errors that may cause financial loss for the bank.
- As a result of the non-optimized solution center system, the need for extra effort emerges, resulting in inefficient use of resources.

Vakıf Participation Bank uses the Atlassian Jira Demand Management system to track the work between in-house teams. Through this system, users open requests for their problems/requests, and information such as the route the request follows until the solution, comments, and the information of the teams/units from the moment the record is first opened until the solution is found, can be followed. These requests filed by users are not always opened in the correct category, and it takes time for the request to reach the relevant unit, which delays the resolution of the request. Failure to submit requests to the relevant unit leads to loss of performance and productivity.

Extending the resolution time for a request increases operational burdens and reduces internal customer satisfaction. As a result of this R&D study, the solutions to the requests opened were classified on a subject-based basis and classified according to the relevant addressee departments.

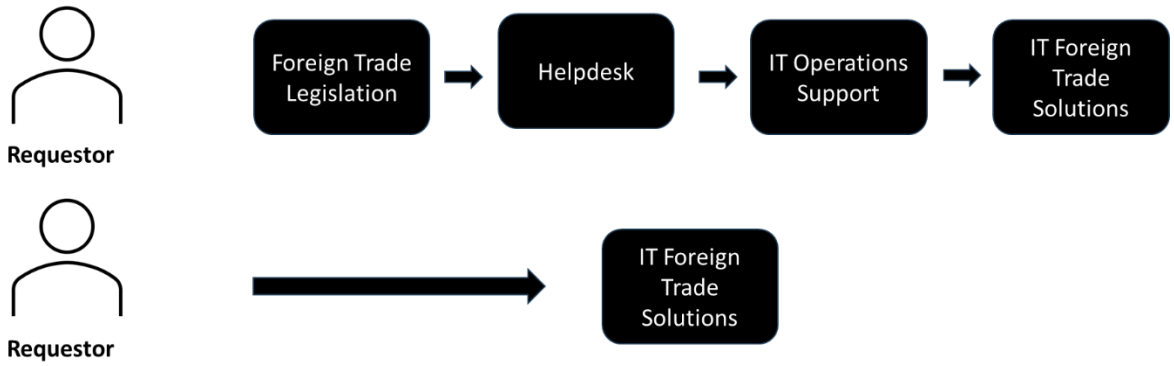

Figure 1: Sample Request Record

In the developed R&D project, the text categorization model was trained on the language model trained in Turkish. For language model training, the BERT model, which is one of the transformer-based language models, was preferred. Pre-trained/optimized language models were used as the main models in the training. Fine-tuning was carried out on the categorization model trained in the field of banking, with the data of the records in the request system. Experiments were made on the optimization of the text categorization model and the selected text categorization models were trained according to departments.

Certain success criteria have been targeted in the project. These success criteria include reducing demand resolution times by 20%, having a 90% accuracy rate in the classification model, and having a minimum Bert Score value of 0.6.

Four different models have been developed based on the BERT model, and the test results of these models according to various metrics are given in Table 1 below.

Table 1: Model Test Results

Models	Accuracy	Precision	Recall	F1-Scor	Data Count
Model 1	0.75	0.64	0.54	0.57	28604
Model 2	0.74	0.62	0.56	0.57	28604
Model 3	0.66	0.64	0.64	0.63	11953
Model 4	0.64	0.62	0.61	0.61	11953

As a result of model training, it can be seen that Model 1 and Model 2 were trained on a larger dataset, which may indicate that they may have a more general model. However, even though Model 3 and Model 4 were trained on a smaller data set, they appear to perform better than others on some metrics. As a result of the training, a model with 75% accuracy was developed, and fine-tuning studies on the model are continuing.

3. Results

Technological advancements are triggering a significant transformation in the banking sector. Especially new technologies such as artificial intelligence and NLP offer opportunities to banks to improve customer service, increase operational efficiency, and prevent fraud. Demand management not only increases customer satisfaction but also provides a competitive advantage by increasing operational efficiency. As a result of the R&D work carried out by Vakıf Participation Bank, a language understanding model specific to participation banking will be developed, and with these language models, processes such as request processes within the bank will be shortened and efficiency will be increased. This model, it is aimed to increase internal customer satisfaction by reducing operational burdens as demand resolution times will be shorter. It is envisaged that by directly transmitting the records in the Demand Management system to the relevant units, the resolution of the records will be accelerated, and thus, internal and external customer satisfaction will increase. It is envisaged that the improvements to be made in branch operation processes will reduce operational errors, increase operational efficiency, and increase customer satisfaction. At the same time, the product to be developed is aimed to be a successful model in banking terms and, accordingly, it is expected to have high commercial potential.

4. Acknowledge

This research was made possible by the working opportunities and infrastructure support provided by the R&D Center of Vakıf Participation Bank. The invaluable contributions of the Vakıf Participation Bank R&D Center significantly contributed to the successful completion of this study. We would like to extend our heartfelt gratitude to the Vakıf Participation Bank R&D Center for their support on this occasion.

References

[1] Z. T. B. &. Ö. S. Örpek, "Review on the Use of NLP in the Banking Sector.," *In Proceedings of International Conference on Engineering, Science and Technology*, p. p. 154, 2023.

[2] R. E. &. M. R. E. Crandall, "Demand management-today's challenge for service industries," *Production and operations management*, pp. 5(2), 106-120., 1996.

[3] S. R. RS, "Role of Artificial Intelligence in Request Management: A Comprehensive Review," *In 2023 IEEE 11th Region 10 Humanitarian Technology Conference (R10-HTC)*, pp. pp. 915-921, 2023, October.

[4] M. &. T. A. C. Altintas, "Machine learning based ticket classification in issue tracking systems," *In Proceeding Int. Conf. Artif. Intell. Comput. Sci.(AICS 2014)*, pp. pp. 195-207, 2014, September.

[5] A. A. T. A. S. &. V. V. I. Gorbunova, "Intelligent analysis of technical support requests in Service Desk ticketing systems," *In 2020 International Conference on Engineering Management of Communication and Technology (EMCTECH)* , pp. pp. 1-6, 2020, October.

[6] M. V. V. K. A. S. U. K. U. R. T. Y. &. S. C. Subbarao, "Automation of incident response and IT ticket management by ML and NLP mechanisms," *Journal of Theoretical and Applied Information Technology,* pp. 100(12), 3945-3955., 2022.

[7] P. A. &. A.-I. A. Olujimi, "NLP techniques for automating responses to customer queries: a systematic review.," *Discover Artificial Intelligence,* pp. 3(1), 20., 2023.

[8] Y. U. M. C. S. &. H. A. Yang, "Finbert: A pretrained language model for financial communications," p. arXiv preprint arXiv:2006.08097, 2020.

[9] B. S. S. &. A. A. I. Dash, "Evolving of Smart Banking with NLP and Deep Learning. In Enabling Technologies for Effective Planning and Management in Sustainable Smart Cities," *Cham: Springer International Publishing,* pp. pp. 151-172, 2023.

[10] S. &. R. M. R. Khan, "Artificial intelligence and NLP-based chatbot for islamic banking and finance," *International Journal of Information Retrieval Research (IJIRR),* pp. 11(3), 65-77., 2021.

[11] [Online]. Available: https://aws.amazon.com/tr/what-is/nlp/.