Digitalization of IT Helpdesk Operations Based on Executable Business Process Models and Artificial Intelligence Technology*

Saulius Gudauskas[1,*,†], Tomas Skersys[1,†]

[1]*Information Systems Department, Faculty of Informatics, Kaunas University of Technology, Studentu str, 50, Kaunas, Lithuania*

Abstract

The paper focuses on the basic aspects of digitizing IT Helpdesk operations by using business process execution and artificial intelligence technologies within the Camunda business process management platform. The paper overviews a common process for resolving customer IT issues performed by helpdesk personnel in a real-world, medium-sized enterprise and then introduces improvements to it. The improved business process is then digitalized using the Camunda platform and integrated with an artificial intelligence component. Early experiments have shown that the developed digital solution increases the effectiveness of IT Helpdesk operations by reducing the workload of the helpdesk personnel and speeding up resolution of IT-related issues.

Keywords

Helpdesk operations, executable business process model, BPMN, Camunda, artificial intelligence

1. Introduction

In today's business environment, IT provides essential tools for companies to ensure efficient operations, increase employee productivity, and optimize business processes [1]. In most cases, a business company would have an IT team that not only takes care of day-to-day operations but also develops the company's IT strategy as well as initiates and executes IT projects. However, there is a persistent shortage of highly skilled IT staff in the market [2], which is particularly affecting small and medium-sized enterprises. The employed IT staff have to carry out day-to-day maintenance operations as well as longer-term projects, which makes it difficult to use their competencies effectively and devote the necessary attention to all areas. Companies often lack a strategic approach, and even the most common helpdesk solutions to monitor IT processes and infrastructure. Excessive workloads and tasks related to other employees' computer illiteracy put IT professionals under negative pressure and feelings of inferiority, as they spend a lot of time dealing with tasks little related to their core competencies.

To remain competitive and adapt to an ever-changing society and rapidly evolving technologies, organizations need to use the latest technologies and change their business models and processes accordingly. While artificial intelligence (AI) is a rapidly growing and evolving field, many innovative companies work to integrate AI-enhanced solutions into their operations. Recent studies show that automated AI solutions not only help end-users but also increase work efficiency by optimizing query processing and reducing workload [3]. This means that AI-enhanced solutions can help organizations achieve better results in terms of user experience, time, and human resources optimization. While helpdesk personnel manage numerous business processes, this specific research focuses primarily on one of the most crucial ones, namely, resolving customer IT issues (Figure 1).

*IVUS 2025: Information Society and University Studies 2024, May 15, Kaunas, Lithuania

[1,*] Corresponding author.

[†] These authors contributed equally.

saugud3@ktu.lt (S. Gudauskas); tomas.skersys@ktu.lt (T. Skersys);

This research aims to automate daily maintenance tasks, improve query management, and ensure a smoother workflow for helpdesk personnel. The developed digital solution will ensure that all IT assistance requests are automatically routed, tracked, logged, and efficiently prioritized. The solution must also support timely communication among the helpdesk personnel and the IT department, which should contribute to more effective resolution of common IT assistance requests. Furthermore, common and unsophisticated issues will be solved by utilizing artificial intelligence (AI) technology - primarily, the AI component will enable one to ask IT-related questions or describe issues, and receive AI-assisted answers and instructions. Indeed, recent research highlights that integrating large language models (LLMs), such as ChatGPT, with BPM platforms has real potential of reducing response times, minimize human intervention, and improve overall service efficiency, making IT support more adaptive and scalable [4]. In our digital solution, only complex issues that cannot be processed by the AI component will be redirected to the IT department specialists who then will dedicate their time to resolve those cases.

The *objective* of this study is to validate the hypothesis that digitalizing IT helpdesk processes by integrating artificial intelligence solutions, and a knowledge base significantly enhances query processing efficiency and reduces human resource workload.

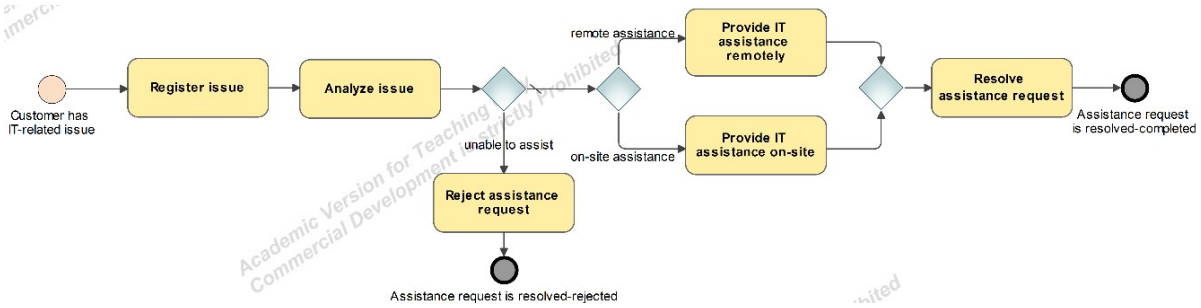

Figure 1: Generic business process for resolving customer IT issues.

2. Adoption of Executable Business Process Models and Artificial Intelligence Technology to Improve IT Helpdesk Operations

2.1. Motivation behind the Integration of Business Process Management and Artificial Intelligence Technologies

A modern business process management (BPM) platform represents an entire ecosystem of dedicated software tools for digitalizing, executing, monitoring, and optimizing real-world business processes [5]. A set of one or more digitized, *executable* business processes forms the backbone of a developed application (information system) running on the BPM platform. Dedicated visual modeling languages are used to design executable business process models. Arguably, the most popular language is BPMN, which stands for "Business Process Model and Notation" and is the Object Management Group's standard [6]. This standard supports business process execution semantics and therefore is widely used in the development of process execution-based information systems enabling efficient automation of operations and better process management [7]. All in all, BPM applications help organizations achieve their business goals and objectives by enabling more efficient distribution of work, reducing response times, and improving customer experience. Indeed, studies have shown that organizations that use BPM applications in their customer service operations can resolve problems faster and manage customer expectations more effectively [8].

In this study, we argue that integrating Business Process Management (BPM) applications with Artificial Intelligence (AI) can significantly enhance operational efficiency and support additional benefits, such as predictive analytics and intelligent automation [3, 4, 9, 10] within an organization. This integration is particularly relevant to IT Helpdesk operations, where many tasks are routine and can be addressed through automation [11, 12, 13].

2.2. The Digital Solution

In this section, basic conceptual and engineering aspects of the developed solution are presented. Section 2.2.1 introduces the overall architecture of the developed application prototype. Next, just like any other business process digitalization initiative, the development of the presented digital solution starts from the analysis and improvement of the existing (so called, *as-is*) business process to produce an improved version of it, i.e., the so-called *to-be* business process - such an improved process is described in Section 2.2.2.

2.2.1. The Architecture of the Application

As a result of a comprehensive comparative analysis of existing open-source BPM platforms, Camunda 7.22 [14] was chosen as the optimal solution for developing and deploying our digital application due to its multiple advanced features related to business process execution and automation, interoperability, strong support for BPMN standard, etc. [15]. The developed application is fully deployed in the AWS cloud infrastructure and has connections with the required third-party services (Figure 2).

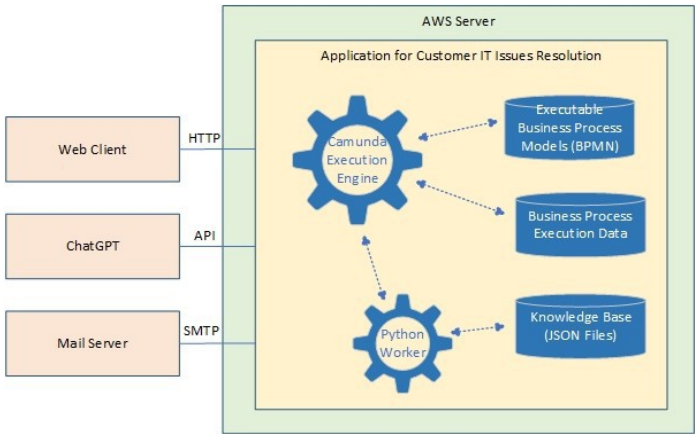

Figure 2: The basic architecture of the developed IT Helpdesk application.

Let us describe the architecture of the developed application in more detail:

- At the core of the deployment is the Camunda Engine, along with executable BPMN process models. In this application, the Camunda Engine executes, monitors, and manages business process workflows based on the BPMN standard while also interacting with other relevant software components via a REST API.
    - The primary function of the Python Worker is to execute tasks delegated by the Camunda Engine. It communicates with the Camunda Engine, checks for requests, and processes them accordingly.
    - When required, Python Worker also searches the knowledge base (JSON files) and sends requests to the external ChatGPT (GPT-4) service via API to generate responses for registered IT issues. The ChatGPT response is then retrieved by the Python Worker, allowing the Camunda Engine to continue process execution.

- In addition to ChatGPT, the application interacts with two other external components: the Web Client, which communicates with Camunda via HTTP, enabling users to access the application; and the Mail Server (SMTP), which facilitates messaging with end-users.

2.2.2. The Improved Business Process for Resolving Customer IT Issues

The improved business process for resolving customer IT issues (Figure 3) is an actual executable BPMN model, deployed in the developed application and executed at runtime by the Camunda Engine. The main objectives of the improvement were to optimize the allocation of human resources for helpdesk operations and reduce case processing times. This was achieved by automating several tasks within the process and introducing an AI assistant to provide automated, AI-based responses to certain customer issues. For each proceedings volume published with CEUR-WS, the titles of its papers should either all use the emphasizing capitalized style or the regular English (or native language) style. Check with the editors of your volume which style you should adopt.

Let's briefly describe the main execution logic of the improved business process (Figure 3):

- The case (i.e., process instance) is initiated by a customer experiencing an IT issue and seeking assistance from the helpdesk. The customer describes the issue and submits it (A1 in Figure 3).
- The system then analyzes the assistance request to determine the appropriate recipient (A2). If the issue is common or has been previously resolved in past cases, it may be directed to the AI assistant. Otherwise, it is forwarded to either the Helpdesk or the IT Department, depending on the defined category and other specifics of the issue (e.g., requests related to internal databases are always assigned to the IT Department).
- If the request is routed to the AI assistant, then an AI-enhanced sub-process is initiated (A3). Here, Camunda generates a query based on the defined category of the issue as well as other leading information. The query is then handed over to the AI component, which returns an answer. The sub-process is completed after the response is received from the AI assistant. In this sub-process, the Python Worker plays a vital role because it acts as an intermediary between Camunda Engine, AI component, and JSON database. Let's describe the algorithm of the Python Worker and the AI component interaction in more detail:
    - First, the Python Worker extracts variables from the received query to determine the category under which the corresponding JSON file (Figure 4) must be searched, and the definition of the submitted issue to be analyzed.
    - Next, the Python Worker searches for a specific JSON file associated with the defined category. If the file is not found, the Python Worker returns a negative response to Camunda, which then sends a negative result to the reviewing activity (A4). If the JSON file is found, the Python Worker loads it and searches for a record matching the issue in the assistance request.
    - The Python Worker then generates a structured query and passes it to the AI component. This query includes the submitted customer issue along with JSON data - either a single record (Figure 4) if a matching result was found in the searched JSON file, or the entire file if no matching record was found.
    - The AI component analyzes the JSON records to determine whether the submitted issue already exists in the knowledge base. If a match is found, it formulates a response based on the existing record. If the issue is new, the AI generates an optimized description of the issue along with a solution.
    - After the Python Worker has received the AI-generated response, it completes the sub process by submitting that response to the Camunda API.

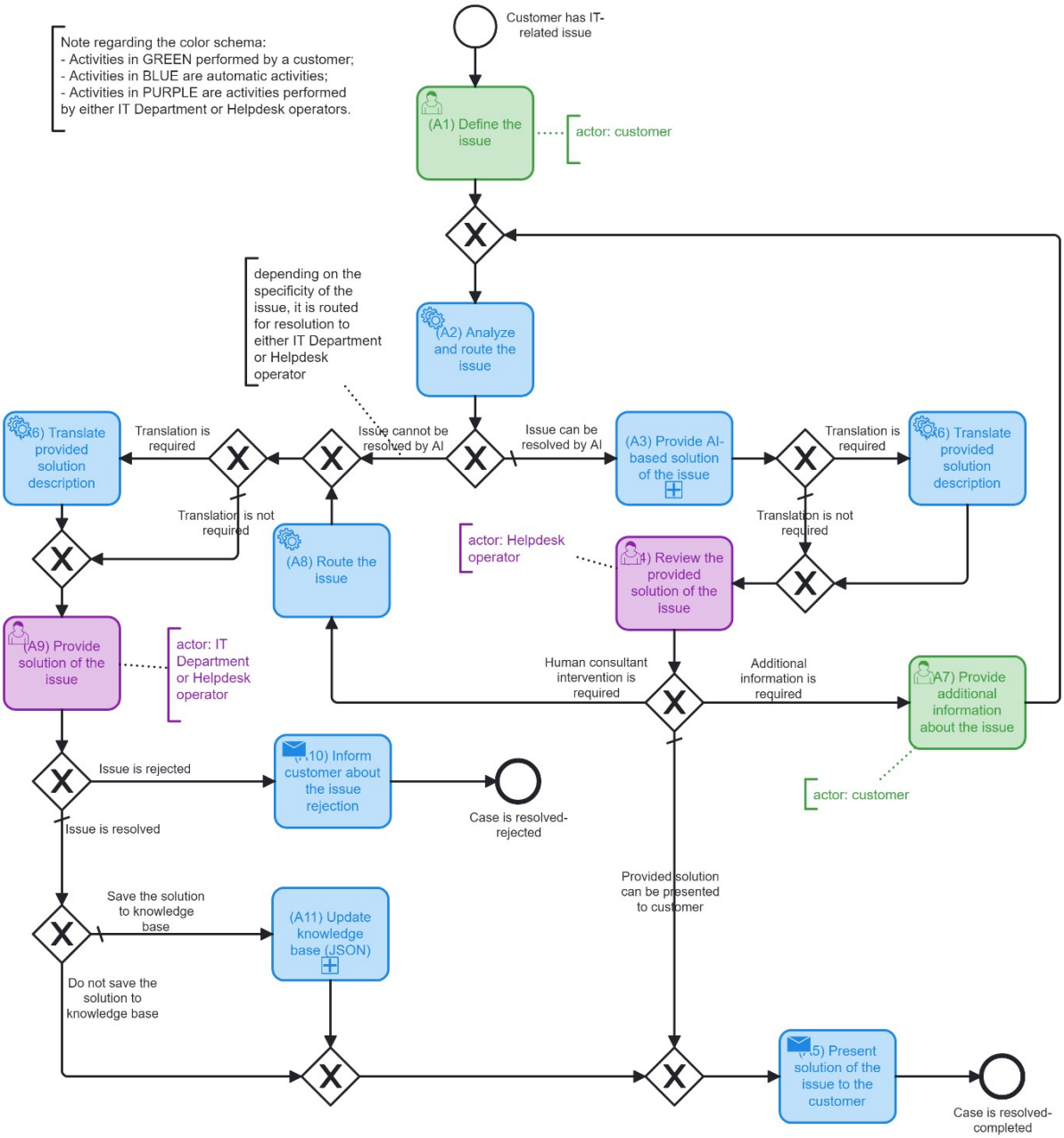

Figure 3: Business process for resolving customer IT issues (BPMN).

- Before proceeding to the reviewing step (A4), the translation service may be required (A6). The translation is performed automatically if the received response language does not coincide with the language in which the IT issue was described by the customer.
- The step of reviewing the generated solution for the presented IT issue (A4) is performed by a Helpdesk operator (Figure 5). This human interaction is essential for determining whether the solution is ready to be presented to the customer or requires further processing [16]. If the solution is deemed satisfactory, it is sent to the customer, and the case is resolved. Otherwise, the case may be escalated to the IT Department (A8) or additional information may be requested from the customer (A7).
- The left-hand side scenario (Figure 3) is triggered when issue processing is routed to the IT Department or Helpdesk operations. In this case, a human expert provides a solution to the submitted issue (A9). In some cases, issue resolution may be rejected, and the customer is informed of this outcome (A10). However, the "sunny day" scenario is that the issue is successfully resolved, meaning the customer receives a qualified response. In this case, the response may be

stored in the corresponding JSON file (A11) so that it can be accessed the next time a similar issue is submitted. Updating the knowledge base (JSON files) is a crucial part of AI training, enabling the AI component to respond to an increasing number of issues in the future.

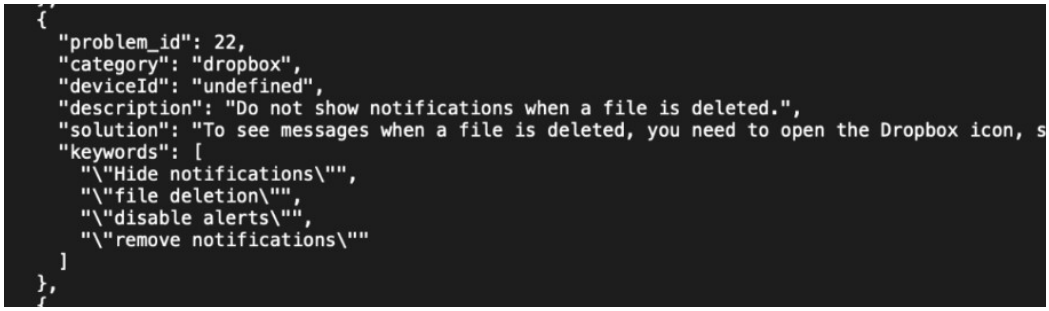

Figure 4: Structure of a JSON file.

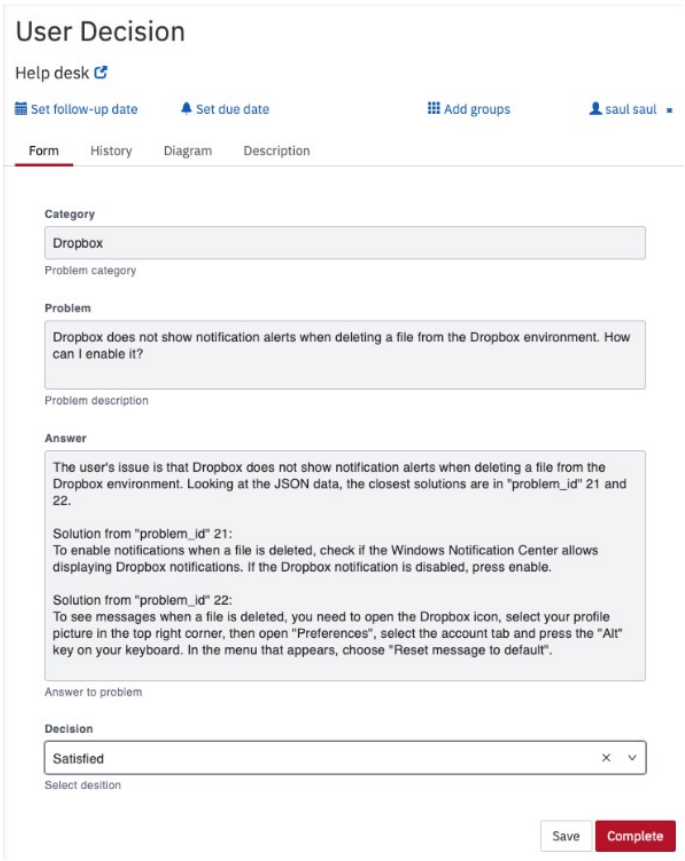

Figure 5: GUI form for reviewing AI-generated answers to submitted issues.

3. The Experiment

After deploying the IT Helpdesk application prototype in a medium-sized organization, an experimental phase was conducted to evaluate its applicability to various consulting tasks and assess the level of improvement in the digitized real-world business process. The phase consisted of two experiments, qualitative and quantitative, and an evaluation of the obtained results.

3.1. Quantitative Evaluation and Comparison of As-Is and To-Be Business Processes

The first experiment was conducted using historical data from previously resolved IT issue cases as well as artificially simulated data. In total, data from the 242 cases was collected and analyzed for

this experiment. Subsequently, all these cases were resubmitted as new cases to the developed application, and performance data was recorded. The Helpdesk and the IT department have allocated required human resources for this simulation and further assistance during the analysis of the acquired experiment results.

During the experiment, the wording of the submitted queries varied from detailed to abstract and contextually limited descriptions of IT issues.

All in all, 219 out of 242 requests (i.e., 90.5%) were routed to the AI-based processing. Based on historical data, the resolution of these cases took on average 36 minutes before the introduction of the digital solution; this duration was reduced to an average of 42 seconds after the digital solution was introduced and these issues were resolved automatically leaving only one human-required interaction, which was reviewing the AI-generated solutions to IT issues. This leads us to obvious conclusion that the introduction of the application significantly reduced issue resolution tasks for a great number of cases, at the same time, lessening the load on human resources. However, other findings need to be taken into consideration as well before drawing final conclusions:

- In 158 out of the 219 routed cases (72.1%), the AI component provided accurate and clear answers that were approved by the Helpdesk operator performing the review task (A4 in Figure 3) without further modification.
- In 9 cases (4.1%), the AI-generated answers were inaccurate or completely irrelevant to the described issues because the AI selected an incorrect JSON record while attempting to adapt it to the query. These cases were classified as false positives, as the AI system generated an incorrect answer that was mistakenly assumed to be correct.
- In other 9 cases (4.1%) the resolution of the query involved the need for clarification of the submitted IT issue. These were the cases where the acquired AI responses were identified as inaccurate during the following reviewing task (A4 in Figure 3). It was concluded that this was caused by the inaccurate description of the submitted IT issues and, therefore, requests for additional information were issued. After the additional information was provided, accurate answers were obtained from the AI component.
- In 4 cases (1.8%), the AI component was unable to find relevant answers in the JSON files due to unclear queries submitted by users. As a result, these queries were redirected to Helpdesk operators because the AI could not accurately interpret and resolve the issues. These cases were classified as false negatives, as properly formulated queries would likely have enabled the AI to generate correct responses.

Out of all 242 issue resolution requests, 23 were routed to either the IT department or the Helpdesk. 15 queries (65,2 %) were assigned to the IT department because those were database- and IT security related issues; 8 queries (34,8 %) were assigned to the Helpdesk operators because they related to technical problems. It was concluded that all routing actions were performed as expected.

Next, experimentation was carried out by simulating situations where no records corresponding to the submitted IT issues were to be found in JSON files. The goal was to determine whether the AI would be able to interpret the submitted information correctly and correctly route the queries. During this experimentation, 21 queries were submitted from different issue categories. The performance of the system was assessed by whether the AI recognized the issue and assigned it the appropriate specialist correctly. The acquired results showed that all queries were routed correctly, with 9 queries (42.9%) routed to the IT department, and 12 (57.1%) - to the Helpdesk operators, in accordance with the system's predefined routing rules.

3.2. Qualitative Assessment of the Application from the User Experience Perspective

For the qualitative assessment of the developed solution, a questionnaire was distributed to IT Helpdesk operators. The experiment evaluated the application based on its ability to provide

appropriate answers to IT-related issues submitted by respondents simulating customer behavior, as well as its look and feel from the user's perspective. IT Helpdesk operators had the opportunity to submit the most common technical issues they encounter in their daily work and assess the responses provided by the system.

In this phase of the development, the IT Helpdesk operators were asked 5 most relevant questions:

- Is the system's graphical user interface (GUI) user-friendly and intuitive?
- How well does the system route queries between automated AI-based processing and IT Helpdesk operators?
- How easy is it to understand the technical information in the answers provided by the AI?
- Are there any additional critical features the system should have to further enhance its effectiveness and usefulness?
- How would you evaluate the overall performance of the system?

After analyzing all the responses, the following main positive aspects of the developed system were identified:

- Issue processing is now handled in a centralized manner, simplifying routing of tasks, communication and reducing unnecessary live calls and emails.
- The system significantly reduces manual work, which results m much faster query processing.
- Beyond its primary application of handling IT-related issues, the system can also serve as a self-learning tool for IT Helpdesk personnel. In most cases, the answers provided by the system were not only practical but also informative, helping staff better understand how to resolve similar issues in the future. Consequently, this could further reduce the need to involve the already overloaded IT department personnel in helpdesk operations.

Few aspects for potential system improvement were also identified:

- The translation component did not always function as expected. In some cases, responses were returned in English instead of being translated into the requester's language (e.g., Swedish).
- Some answers were poorly formulated, making it difficult to understand the actual instructions for resolving the issue.

Based on the observations, comments, and recommendations for improvement, further enhancements will be made to the system before its deployment in a real-world production environment. The survey process will also continue, expanding to other groups of future users and incorporating more specific questions into the survey itself.

4. Conclusions

The improvement and digitalization of one of the main IT Helpdesk processes-IT-related issue resolution-were introduced in this paper. At the core of the developed solution is an executable business process deployed on the Camunda platform, enhanced with AI processing. This solution significantly improves the performance of the digitalized business process by accelerating case resolution and reducing the workload of IT Helpdesk operators.

The major improvement was achieved through AI-enhanced automation, which enables the system to respond to trivial and repetitive customer queries while also routing requests to the most appropriate processing entity-whether the IT Helpdesk, IT department, or AI component-using rule-

based logic. Experimental results showed that the average problem-solving time for AI processed queries was reduced from tens of minutes to less than a minute, allowing IT staff to focus on more complex, intellectual tasks. The system proved particularly effective in handling recurring, low-complexity issues. Additionally, the experiments highlighted areas for further improvement, which will be addressed in future developments of this digital solution.

Declaration on Generative AI

During the preparation of this manuscript, the authors used the ChatGPT-4 tool to assist with grammar correction and improving textual fluency. All suggestions generated by the tool were carefully reviewed and edited by the authors based on their own judgment. The authors take full responsibility for the final content of this publication.

References

[1] Kane G. C., Palmer D., Nguyen A. P, Kiron D., and Buckley N. Strategy, not Technology, Drives Digital Transformation. 2015 Jul 14; Available from: https://sloanreview.mit.edu/projects/strategy-drives-digital-transformation/

[2] Europos Komisija. Darbo jėgos ir įgūdžių trūkumas ES. Veiksmų planas [Internet]. 2024. Available from: https://eur-lex.europa.eu/legal- content/LT/TXT/HTML/?uri=CELEX%3A52024DC0131

[3] Anbiya M. I., Warsito B., Nurhayati 0. D. AI-Driven Chatbot Implementation for Enhancing Customer Service in Higher Education: a Case Study from Unversitas Negeri Semarang. [Internet]. 2024. Available from: https://www.jatit.org/volumes/Vol102No14/24Vol102Nol4.pdf

[4] Integrating Robotic Process Automation with Artificial Intelligence for Business Process Automation: Analysis, Applications, and Limitations. JSMS [Internet]. 2024 Jun 4 [cited 2025 Mar 11]; Available from: https://www.aasmr.org/jsms/Vol14/No.7/Vol.14.No.7.12.pdf

[5] 70 Top Open Source and Free BPM Tools: The Best of Business Process Management Software [Internet]. Available from: https://www.predictiveanalyticstoday.com/open-source-free-bpm tools/

[6] Object Management Group. Business Process Model and Notation (BPMN), version 2.0.1; OMG Document Number: formal/2013-09-02. Object Management Group: Needham, MA, USA; 2013.

[7] Vega-Marquez 0. L., Duarte H., Collazos V. Mapping Study on Traceability Between BPMN Models and Source Code. International Journal on Advanced Science, Engineering and Information Technology. 2022 Jan 26;12(1):218.

[8] Eckert C., Neunsinger C., Osterrieder K. Managing customer satisfaction: digital applications for insurance companies. Geneva Pap Risk Insur Issues Pract. 2022 Jul;47(3):569-602.

[9] How AI is used in Business Process Management. [Internet]. 2024. Available from: https://weaver.com.co/blog/bpm/ai-powered-bpm/

[10] Kalluri K. Artificial Intelligence in BPM: Enhancing Process Optimization Through Low-Code Development. IJFMR. 2023 Nov 20;5(6):23396.

[11] Kumar T. P. Leveraging Conversational AI for Enhanced Decisioning: Integrating ChatGPT with Pega's Adaptive Decision Manager. JSW. 2024 May;19(2):42-51.

[12] Bitkowska A., Detyna B., Detyna J. Importance of IT systems in integration of knowledge and business process management. IIS [Internet]. 2022 [cited 2025 Mar 11]; Available from: https://iacis.org/iis/2022/1_iis_2022_117-130.pdf

[13] Feng L, Senapati J, Liu B. TaDaa: real time Ticket Assignment Deep learning Auto Advisor for customer support, help desk, and issue ticketing systems. arXiv; 2022 [cited 2025 Apr 29]. Available from: https://arxiv.org/abs/2207.11187

[14] Camunda [Internet]. 2025. Available from: https://camunda.com/platform/

[15] Camunda Compared to Alternatives. [Internet]. 2024. Available from: https://page.camunda.com/wp-camunda-compared-to-alternatives-success.
[16] Horvath L, James 0., Banducci S., Beduschi A. Citizens' acceptance of artificial intelligence in public services: Evidence from a conjoint experiment about processing permit applications. Government Information Quarterly. 2023 Oct; 40(4):101876.