



Design and Implementation of an AI Agent-Based Workflow Automation System for Scheduling and Information Dissemination in Oil Palm Plantations

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ABSTRACT

Purpose – Oil palm plantation operations in Indonesia require coordination across multiple divisions; however, meeting scheduling and information dissemination are often managed through separate, manual processes. This may cause communication delays, scheduling conflicts, and inconsistent information deliveries. This study aims to design and implement an AI-based workflow automation system that integrates meeting scheduling and information dissemination into a centralized platform to support the automated coordination and information management across organizational units.

Methods – This study employed the Design Science Research (DSR) approach, covering problem identification, literature review, system design, implementation, testing and evaluation. The proposed system integrates Gemini AI, Natural Language Processing (NLP), Telegram Bot, Zoom API, Google Calendar API, and Google Sheets to automate meeting scheduling, information dissemination, and document management.

Findings – The implemented system successfully automated meeting scheduling, calendar synchronization, information dissemination, and documentation management within an integrated platform. Functional testing confirmed that the core features operated as intended in the scenarios evaluated. The system also supports information classification based on public and private access.

Research implications – The system was evaluated through functional testing in a simulated oil palm plantation context and depends on third-party API services, which may limit its generalizability. User acceptance, organizational effectiveness, and efficiency were not evaluated. Nevertheless, the proposed architecture can be adapted to other organizational settings that require automated coordination and centralized information management.

Originality – This study proposes an AI-based workflow automation architecture that integrates communication and productivity services to support the end-to-end automation of meeting scheduling and information dissemination in oil palm plantation operations.

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INTRODUCTION

Oil palm plantations represent one of Indonesia's strategic sectors and play a crucial role in the national economy. This industry contributes significantly to economic growth through export activities, job creation, and the development of downstream palm oil-based industries [1]. According to data from the Secretariat General of the Ministry of Agriculture (2024), this sector also supports regional development, enhances export value, and strengthens the supply chain of natural resource-based industries in Indonesia [2]. However, despite its large-scale operations, oil palm plantation management still faces various challenges, particularly in information management, operational coordination, activity monitoring, and reporting processes, which are still conducted manually in several operational activities [3]. This condition results in limitations in communication efficiency and data integration between the field units and management levels.

The development of digital technologies has driven transformations across various sectors, including agriculture and plantation industries. Digital transformation enables organizations to integrate data, automate business processes, and improve operational efficiency through the utilization of information technology [4]. In this context, workflow automation has emerged as a relevant approach to address operational coordination complexity. Workflow automation enables processes that were previously performed manually to be executed automatically through the integration of interconnected digital services, thereby improving the speed, accuracy, and consistency of the information flow within organizations.

Previous studies have shown that the implementation of workflow automation and business process management can enhance organizational operational efficiency by reducing manual activities, improving process consistency, and integrating various digital services into a structured workflow [5]. Workflow automation has also been widely applied to support organizational activity coordination involving multiple data sources and heterogeneous communication platforms [6], [7]

With the advancement of Artificial Intelligence (AI), the capabilities of workflow automation have significantly improved through the utilization of Large Language Models (LLMs) and Natural Language Processing (NLP). AI technologies enable systems to understand user instructions in natural language, generate contextual responses, and support automated decision-making processes [8]. Recent studies indicate that the integration of AI into workflow automation enhances system flexibility and supports more effective orchestration of digital services compared to conventional automation approaches [9], [10]

In addition, several studies have developed the concept of AI-assisted workflows, which utilize AI to manage and coordinate various operational processes within digital organizational environments [11]. This approach enables the integration of communication services, scheduling systems, document management, and online collaboration tools to support structured coordination of workflows. Although previous research has demonstrated the potential benefits of workflow automation and AI integration for organizational process efficiency, most existing implementations still focus on specific task automation or the limited integration of a single service type [6], [11]. Research integrating communication services, meeting scheduling, virtual conferencing, and information dissemination into a fully coordinated end-to-end automated workflow remains limited.

Furthermore, most existing studies have been conducted in the general business, digital services, or healthcare sectors, while the application of AI-based workflow automation in oil palm plantation environments remains underexplored in the literature. In fact, the operational characteristics of oil palm plantations, which involve multiple divisions, geographically dispersed working locations, and high coordination requirements, necessitate a system capable of integrating various digital services in an automated and centralized manner [3]

Based on these conditions, a research gap exists in the development of AI-based workflow automation systems capable of integrating communication services, meeting scheduling, virtual

conferencing, and information dissemination within a unified architectural framework to support oil palm plantation operations.

To address this gap, an approach that can connect various digital services into an integrated workflow is required. AI-based workflow automation offers the capability to automate coordination processes, reduce manual intervention, and enhance the consistency of information exchange among departments. By integrating communication services, meeting scheduling, virtual conferencing, and data management into a unified ecosystem, organizations can achieve a more efficient, structured, and traceable coordination process for their work.

This approach is also aligned with the digital transformation needs of the plantation sector, which demands improved operational efficiency and real-time information management. Therefore, the development of an AI-based workflow automation system is relevant for supporting operational coordination and information dissemination within oil palm plantation environments.

This study aimed to design and implement an AI-based workflow automation system that integrates communication and productivity services to support the automation of meeting scheduling and information dissemination in oil palm plantation environments. The proposed system is expected to reduce manual processes, improve interdepartmental coordination structures, and support more organized information management by integrating various digital services into a unified automated workflow.

METHOD

Research Design

This study used the Design Science Research (DSR) approach as the main methodological framework. DSR was chosen because it systematically guides the process of designing, developing, implementing, and evaluating innovative and solution-oriented technological artifacts. The artifacts developed in this study are in the form of an AI-Based Workflow Automation system to support meeting scheduling and information dissemination in the oil palm plantation management environment. This approach is considered the most appropriate considering that the purpose of research is not only limited to producing theoretical knowledge, but also to produce technological solutions that can be directly applied to solve real problems in the field, especially in the aspects of coordination, communication, and information management between divisions in an integrated manner [12], [13].

Research Subjects

The subjects in this study consisted of nine undergraduate students who participated as simulated users of the proposed system. The use of simulated users was considered appropriate because the primary objective of this study was to evaluate the functional performance and technical feasibility of the AI-Based Workflow Automation system rather than to assess its operational effectiveness in a real oil palm plantation environment. All participants possessed basic experience in operating digital communication and collaboration platforms, enabling them to execute the predefined workflow scenarios during the testing process [14].

The participant involvement was divided into two stages. During the requirements analysis stage, three participants contributed to identifying the system requirements and validating the workflow scenarios within the simulated environment. Subsequently, six participants were involved in the system evaluation stage by executing predefined test scenarios and verifying whether each system function operated as expected. This approach enabled a systematic evaluation of the developed artifact from both the requirements validation and functional testing perspectives [15].

Notably, the participants were not plantation managers, field supervisors, administrative personnel, or operational staff within oil palm plantation organizations. Therefore, the evaluation conducted in this study represents a controlled, simulation-based assessment of the system functionality. Validation involving actual plantation stakeholders remains an important direction for future

research to assess user acceptance, practical usability and organizational effectiveness in real-world operational settings.

Table 1. Distribution of Student Participation

Research Stage	Participants	Role
Requirements analysis	3	Simulated users involved in validating workflow scenarios
System evaluation (Black Box Testing)	6	Simulated users executing testing scenarios
Total	9	Undergraduate students

Population and Sampling Method

The population in this study comprised undergraduate students who were capable of operating digital communication tools and participating in workflow simulation activities. Given the exploratory and artifact-oriented nature of the research, purposive sampling was employed to select participants who understood and could execute the predefined system workflows. Participants were selected based on the following criteria: (1) willingness to participate in the simulation activities, (2) familiarity with digital communication and collaboration applications, and (3) ability to execute the predefined testing scenarios. A total of nine participants were selected to represent simulated end users within the controlled evaluation environment [16].

Because the objective of this study was limited to functional testing of the developed artifact, the selected participants were not intended to represent actual users in oil palm plantation operations. Consequently, the findings should be interpreted as evidence of functional feasibility rather than as validation of user acceptance or operational effectiveness in real plantation environments.

Instrument

The research instruments used in this study were designed to support each stage of the research systematically and comprehensively. These included:

1. Observation Guidelines were used to identify and document problems in the existing meeting scheduling and information dissemination processes, thereby providing a comprehensive understanding of the actual conditions represented in the simulation environment.
2. System Requirements Analysis Documents served as the basis for designing the system by defining both functional and non-functional requirements in a structured manner based on observational findings and participant input.
3. Black Box Testing Scenarios were used to evaluate the success of each system function based on predetermined inputs and expected outputs without considering the internal structure of the software. Black Box Testing focuses on verifying whether the observed system behavior conforms to the specified functional requirements and expected outcomes [16] [17].

The validity of the instruments was ensured by aligning the assessment indicators with the system requirements and the research objectives. Instrument reliability was evaluated through the consistency of participants' responses during the testing phase, enabling the measurement results to be used reliably as the basis for drawing conclusions.

Procedures and Time Frame

The research was conducted through a series of structured and mutually continuous stages. The first stage is problem identification, which is carried out through direct observation of the coordination process and scheduling of meetings in oil palm plantation operations to obtain a comprehensive picture of the problem. The second stage is a literature study, including an in-depth study of the concepts of AI-based workflow automation, Natural Language Processing, and relevant supporting

technologies as the theoretical basis for system development. The third stage is the needs analysis and design of the system architecture, which integrates the Gemini AI Agent, Telegram API, Zoom API, Google Calendar API, and Google Sheets API into one cohesive ecosystem. The fourth stage is the implementation of the system based on the prepared architectural design. The fifth stage is the thorough testing of the system using Black Box Testing to evaluate technical functionality. The sixth and final stage is the evaluation and analysis of test results to assess the effectiveness and feasibility of the system in supporting meeting scheduling and information dissemination in the operational environment of oil palm plantations [18], [19].

Analysis Plan

The data analysis in this study was conducted descriptively, based on the results of the system implementation and functional testing. The Black Box Testing results were analyzed by comparing the outputs generated by the system with the expected outcomes specified in the testing scenarios. This testing approach evaluates software functionality through input-output verification without considering the internal structure of the software [20], [21]. Each test scenario was classified as successful or unsuccessful according to predefined criteria, providing an assessment of whether the implemented system functions operated as intended under the evaluated conditions. The analysis focused exclusively on verifying the functional correctness and technical feasibility of the developed system.

No User Acceptance Testing (UAT), usability assessment, workload analysis, productivity measurement, or quantitative efficiency evaluation was conducted in this study. Therefore, the results should not be interpreted as evidence of user acceptance, ease of use, organizational effectiveness, or efficiency. Instead, the findings demonstrate the functional capability of the proposed AI-Based Workflow Automation system to automate meeting scheduling, information dissemination, and related workflow processes within the simulated evaluation environment.

Scope and Limitations

This study focuses on the development of an AI-Based Workflow Automation system specifically designed to support the process of meeting scheduling, information distribution, and information dissemination in the operational environment of oil palm plantations. The scope of development includes the integration of various external services, namely Telegram API, Zoom API, Google Calendar API, Google Sheets API, and Gemini AI Agent, as the main components that make up the overall ecosystem of the system [22].

There are several limitations that should be considered when interpreting the results of this study. First, system performance is highly dependent on the availability and stability of the external services used; therefore, a disruption to one of the services could potentially affect the overall performance of the system. Second, the evaluation of the system was carried out in a specific operational environment, namely oil palm plantations; therefore, the results of the study have limitations in terms of generalization to other industrial sectors. The application of the system in different contexts requires adjustments to the functional needs and applicable business processes, so the validity of the findings needs to be re-verified through further research in different domains [23], [24].

Furthermore, the system evaluation was conducted using undergraduate students as simulated users instead of actual oil palm plantation personnel. Consequently, the findings primarily demonstrate the functional feasibility of the proposed system and cannot be generalized to real-world operational environments. Future studies should involve plantation managers, field supervisors, administrative staff, and other relevant stakeholders to evaluate user acceptance, usability, organizational impact, and operational effectiveness in real-world conditions.

RESULTS AND DISCUSSION

RESULTS

This section describes the information distribution workflow implemented in the AI Agent-based Telegram chatbot system. The workflow starts with the process of managing schedules and materials by administrators, which includes collecting material data, validating schedules, and determining information distribution categories. Based on the categories that have been determined, the system automatically sends notifications or materials via Telegram, both public and private. The process flow is presented in the form of a workflow diagram to illustrate the interaction between the system components in support of a scheduled, structured, and targeted distribution of information. In this workflow, users do not manage data but only receive information distributed by administrators via Telegram.

Global Telegram Trigger

The workflow in Figure 1 shows the main process of managing meeting schedules through the Telegram Bot. The process begins when the administrator sends the meeting information through the Global Telegram Trigger, which serves as the main entry point of the system. The received message is then forwarded to the Master Router to identify the type of process to run. The system then verifies access rights through the Is Admin module to ensure that only administrators can manage the meeting schedules and information distribution.

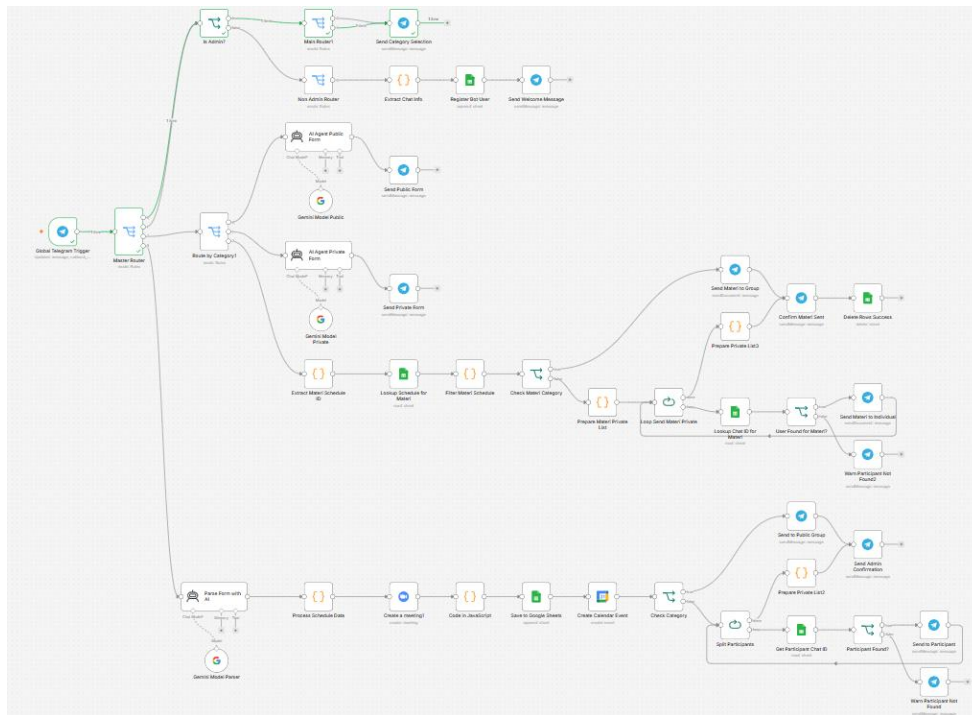


Figure 1. Workflow Global Telegram Trigger

In addition to managing meeting schedules, this workflow handles the user registration process. The system retrieves user identity information through the Extract Chat Info module and saves it to the database using the Register Bot Us module. The stored data include the user's identity and Telegram Chat ID, which will later be used as a reference in the information distribution process. After the registration is successful, the system sends a notification via Send Welcome Message as a confirmation that the user has been registered in the system.

For the meeting scheduling process, administrators fill in the meeting information consisting of the implementation date, start time, meeting duration, meeting title, host, and meeting agenda. The

information is then directed through Route by Category to determine the type of meeting to be created, namely the public or private category. This categorization is used to determine the mechanism for distributing information and meeting materials at the next stage.

In the public category, meeting data are processed by the AI Public Agent, which is integrated with the Gemini Model Public. Meanwhile, the private category is processed by the Private AI Agent connected to the Gemini Model Private. The two AI Agents are tasked with extracting and validating meeting information from the format sent by the administrator to produce structured data that are ready for use by the system.

The processing results are then stored in the Meeting Schedule Sheet as the main database of the meeting schedule. The stored data include the identity of the schedule, date of implementation, meeting time, duration, meeting title, host, agenda, meeting category, and other information needed in the system's operational process. Storing data on a schedule sheet allows the system to search, update, and manage the schedules centrally.

After the data is successfully saved, the system conducts a validation process through the Extract Meeting Schedule ID, Lookup Schedule for Material, Filter Meeting Schedule, and Check Material Category modules. This stage aims to ensure that the stored schedule is valid and ready for use in the information distribution process. In this workflow, administrators act as managers of schedules and meeting materials, while users only act as recipients of information who will automatically receive notifications, meeting invitations, and meeting materials via Telegram, based on predetermined public and private categories.

The processed data were then integrated with Google Sheets and Google Calendar for data storage and activity schedule management. The system is also connected to Zoom for automatic meeting creation and Telegram for distributing information to users. The integration of these platforms enables communication, scheduling, notification, and material distribution processes to be executed automatically within a centralized workflow, thereby reducing the need for manual intervention across these functions in the tested scenarios.

Meeting Schedule Notification Monitoring and Execution Workflow

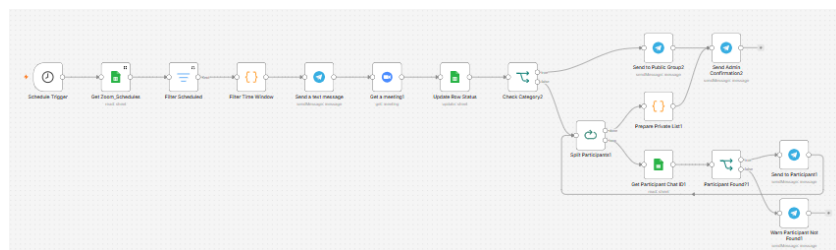


Figure 3. Meeting Completion Monitoring Workflow and Data Cleansing

The workflow in Figure 3 shows the process of monitoring the completion of the meeting, which is carried out automatically every minute. The process begins with Every 1 Minute, which is in charge of checking the entire meeting schedule on the Meeting Schedule Sheet. The schedule data are then retrieved through Get Zoom Schedule and filtered using Filter Schedule and Filter by Time Window to identify meetings that have passed their execution time.

If a completed schedule is found, the system validates it through Check If Empty and processes each meeting data using Loop Over Result. Furthermore, the meeting that has ended is deleted through the Delete a Meeting module and the schedule status is updated in the database using the Update Sheet Stopped as a marker that the meeting has been completed.

Once the data update process is complete, the system sends a notification to the administrator via Send Zoom End Notification to confirm that the meeting has ended. The notification also serves as a

marker for administrators to distribute meeting materials to participants, if needed. After the entire process is completed, the unused schedule data are deleted from the Meeting Schedule Sheet so that the database is maintained and only the active schedules are stored.

Through this mechanism, the system can automatically manage the meeting cycle, starting from monitoring schedules, completing meetings, providing notifications, and cleaning data, thereby reducing the need for manual management by administrators.

Implementation Results

a. User registration implementation

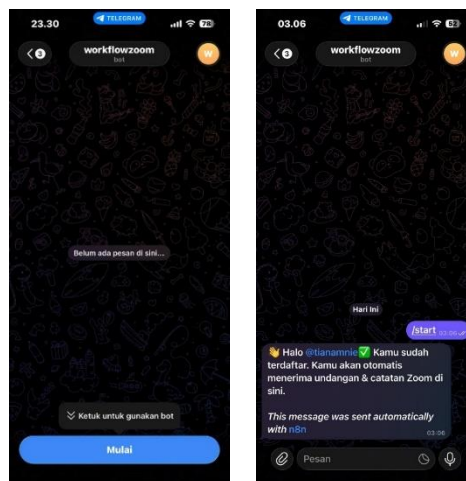


Figure 4. User Registration

User registration is performed via Telegram by pressing the /start button. Once the command is received, the system automatically processes and stores the user's data and sends a confirmation notification that the registration was successful. The stored data were then used as the basis for information distribution so that users could automatically receive notifications of meeting schedules, Zoom links, and meeting materials via Telegram.

b. Implementation of admin registration

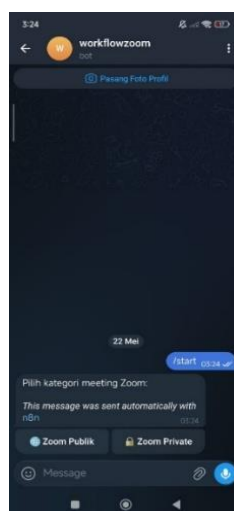


Figure 5. Admin Registration

The meeting agenda is managed by the admin via Telegram by running the /start command. The system then displays a selection of meeting categories, namely Zoom Public and Zoom Private, which are used to determine the method of information distribution. In the **Zoom Public** category, meeting schedules, links, and materials were sent to Telegram groups. Meanwhile, in the Zoom Private category, meeting information was distributed personally to participants registered in the system. Once a category is selected, the system resumes the process of scheduling and distributing information automatically.

c. Implementation of system management by admin



Figure 6. System Management by Admin

After selecting the meeting category, the system automatically displays the meeting data filling form through Telegram. The form is used to input information, including the date of the event, start time, duration of the meeting, meeting title, name of the host, activity agenda, list of participants, and meeting materials to be shared. All data that have been input are then processed and stored in the Meeting Schedule Sheet as a meeting scheduling database.

After the storage process is successfully completed, the system automatically creates a Zoom meeting schedule based on the information provided. Meeting information, including the implementation schedule, meeting details, and Zoom links, is then used to distribute notifications and meeting materials to participants according to the predetermined categories.

d. Notification to start a meeting to admins



Figure 7. Admin Start Notifications

When the meeting time is in accordance with the schedule stored in the system, the admin receives an automatic notification via Telegram containing meeting information, such as the meeting title, date, time, and Zoom link to start the meeting as the host. The system gives admins a 10-minute time limit to start meetings. If the meeting does not start within this time range, the meeting schedule is automatically removed from the scheduling list so that it is not reprocessed by the system.

e. Notification to start a meeting to participants

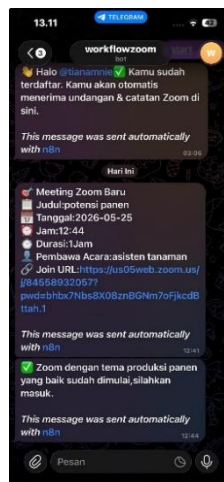


Figure 8. Participant Start Notifications

When the meeting time is in accordance with the specified schedule, the system automatically sends notifications to the participants via Telegram. The notification contains meeting information, including the meeting title, date of the meeting, meeting time, duration of the activity, name of the host, and Zoom link to join the meeting. Notifications are sent based on participant data registered by the admin so that meeting information is only received by predetermined participants.

f. The process of completing the zoom meeting on the admin

After the Zoom meeting process is completed, the system automatically sends a notification to the admin via Telegram. In the notification, the system displays the *"Send Material"* button that the admin uses to distribute the material files resulting from the meeting discussion to the private participants. When the admin presses the button, the system automatically sends attachments or material files to participants who have previously registered in the private meeting based on the username of the participant that has been entered in the meeting form.

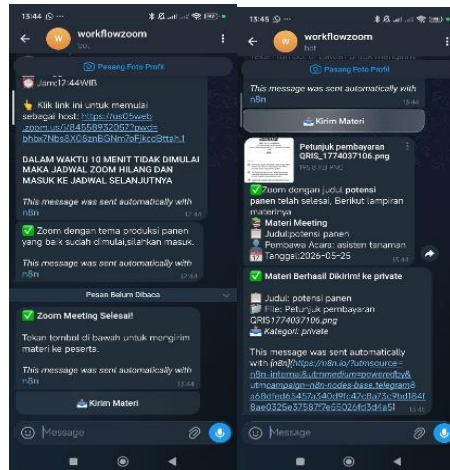


Figure 9. Admin Notification of Meeting Completion

The process of distributing materials was carried out via Telegram so that participants could immediately receive the meeting discussion file after the meeting activities were completed.

g. Notification of the end of the meeting to participants



Figure 10. Participant Notification of Meeting Completion

After the meeting is over, the system automatically sends a notification to the participants via Telegram that the activity has ended. Along with the notification, the system also distributes the meeting materials uploaded by the admin through the Send Materials button. Using this mechanism, all registered participants can receive meeting discussion materials and supporting documents directly via Telegram.

System Testing

Table 2. Black Box Testing Results.

N0	Tested Features	Testing Process	Expected Results	Test Results	Status
1	Telegram User Registration	The user presses the /start command on the Telegram bot	The system successfully registers the user and sends a registration confirmation message	Successful	Valid
2	Admin Access Rights Validation	Admin accesses the system management workflow	The system is able to recognize admin access rights to manage workflow and information distribution	Successful	Valid
3	Zoom Schedule Distribution	Admin sends meeting schedule distribution commands	The system successfully sends the schedule and Zoom link to the user	Successful	Valid
4	Public Information Distribution	Admin selects the public category in the information distribution process	The system successfully sent information to the Telegram group	Successful	Valid
5	Distribution of Private Information	The admin selects the private category in the information distribution process	The system successfully sends information to a specific user via a private message	Successful	Valid
6	Automated Material Delivery	Admin sends material delivery order	The system successfully distributes the material according to the delivery category	Successful	Valid
7	Creating a Zoom Meeting	Admin runs the meeting scheduling process	The system successfully created a Zoom meeting automatically	Successful	Valid
8	System Data Storage	Workflow runs the data logging process	The system successfully saves schedule and activity data on Google Sheets	Successful	Valid
9	Automatic Notification Delivery	The system runs the process of sending notifications, schedules and information	Users receive automatic notifications via Telegram	Successful	Valid
10	Google Sheets integration	The system runs the process of recording meeting schedules	The schedule data is successfully temporarily saved in Google Sheets and deleted after the meeting is completed	Successful	Valid
11	Telegram Bot Menu Management	Users access menus on Telegram bots	The system successfully displays menus and responses according to the user's commands	Successful	Valid

System testing in this study employed the black-box testing method to verify whether the core functionalities of the system operated according to the predefined requirements. The testing focused on the main features of the AI agent-based meeting management and information dissemination system, including Telegram user registration, administrator access validation, schedule and

information distribution, material dissemination, Zoom meeting creation, data storage, automated notification delivery, Google Spreadsheet integration, and Telegram bot menu management.

Based on Table 2, all the testing scenarios were successfully executed and achieved a valid status under normal operating conditions. These results confirm that the primary system functionalities produced the expected outputs in the evaluated scenarios, including user registration through the Telegram bot, dissemination of information and meeting schedules, automated Zoom meeting creation, and data storage in Google Spreadsheets. However, it should be noted that all scenarios represent ideal-condition tests; no failures, invalid inputs, or service disruptions were introduced during the evaluation.

Although all testing scenarios yielded valid results, the evaluation was strictly limited to verifying the system behavior under normal operating conditions with expected inputs. The testing did not include negative test cases, boundary condition testing, handling of invalid or malformed inputs, partial failures of third-party service integrations, or assessments under network disruptions and high-system workloads. Consequently, the findings should not be interpreted as evidence of the system's robustness, reliability, or fault tolerance. The results demonstrate that the implemented functions produced the expected outputs within the scope of the defined scenarios, and claims regarding system performance must remain bounded by these tested conditions.

Overall, the test results provide evidence of basic functional feasibility, confirming that the core features of the proposed system operated as intended under the evaluated normal-condition scenarios. These results are sufficient to establish proof of concept; however, further testing, including negative cases, boundary conditions, and resilience testing, is required before characterizing the system as robust or reliable beyond these conditions.

DISCUSSIONS

The results of Black Box Testing indicated that all 11 functional scenarios in the AI-Based Workflow Automation system were executed successfully. These results demonstrate that the core functions of the system—including user registration through Telegram, access validation, meeting schedule distribution, information dissemination, automatic Zoom meeting creation, notification delivery, and data recording in Google Sheets—operated in accordance with the expected outputs. This finding suggests that the proposed system is functionally capable of supporting meeting coordination and information distribution workflows in the operational context of oil palm plantations.

The successful implementation of the system also reflects the effectiveness of integrating multiple digital services into unified workflows. The architecture combines the Gemini AI Agent, Telegram Bot, Zoom API, Google Calendar API, and Google Sheets to support end-to-end meeting management activities. In this regard, the present findings are consistent with Harman and Sklar [25], who emphasized that agent-based approaches can reduce coordination complexity by automating task allocation and workflow execution in agricultural settings. Although the present study did not quantitatively evaluate organizational efficiency, the functional success of all tested scenarios indicated that the system architecture could perform the intended coordination tasks in a structured and automated manner.

A central component of the proposed system is the use of Natural Language Processing (NLP) within the Gemini AI Agent to transform unstructured administrator input into structured scheduling data. This capability is particularly relevant in operational environments where coordination processes are often dependent on repeated manual inputs across multiple platforms. The findings are aligned with Rao et al. [7], who reported that AI-based information structuring can improve the handling of data-intensive workflows. In the system developed in this study, the AI Agent serves as an intermediary layer that translates conversational input into executable workflow actions, thereby enabling scheduling and information distribution processes to be handled through a single interaction channel. This interpretation is also supported by Bienefeld et al. [10] who highlighted the role of human-AI collaboration in facilitating structured knowledge management and operational coordination.

Another important aspect of the system is the implementation of public and private information categorization methods. This mechanism allows information to be distributed based on the communication scope, which is particularly relevant in plantation operations involving multiple divisions and different levels of access. This feature extends the role of the system beyond meeting scheduling by incorporating controlled information dissemination into the workflow design. This is in line with Zhang et al. [26] who highlighted the importance of structured agentic workflows for improving synchronization across organizational units. In addition, the automatic deletion of completed schedules from Google Sheets contributes to maintaining data relevance and reducing the accumulation of outdated coordination records, which is important for preserving operational data consistency.

Despite these positive results, the findings of this study should be interpreted within the scope of the evaluation. The system evaluation was limited to Black Box Testing, which focused on verifying whether each functional component produced the expected output under normal operating conditions. Therefore, the results primarily indicate functional feasibility rather than overall system robustness under all possible operational scenarios. This study did not examine error handling for invalid input, boundary conditions, unstable network environments, or partial failures in third-party service integrations. Furthermore, the system remains dependent on the availability and stability of external services, including Telegram, Zoom, Google Calendar, Google Sheets, and Gemini, which means that disruptions in these services may directly affect system operation.

Overall, the findings indicate that the proposed AI-Based Workflow Automation system is functionally feasible for supporting meeting coordination and information distribution in oil palm plantation operations. The successful integration of AI Agent capabilities with multiple communication and scheduling platforms demonstrates the potential of workflow-based automation to support operational coordination in agricultural environments. Within the limits of functional testing, this study contributes an implementation model for integrating conversational AI, meeting scheduling, and information distribution into a single, coordinated workflow.

CONCLUSION

Based on the results of this study, an AI-Based Workflow Automation system was successfully designed and implemented to support meeting scheduling and information dissemination activities in the operational environment of oil palm plantations. The system integrates Gemini AI, Telegram Bot, Zoom API, Google Calendar API, and Google Sheets API into a unified workflow platform. Through the application of Natural Language Processing (NLP), administrators can interact with the system using natural language via Telegram, enabling meeting management processes to be carried out more systematically and with reduced manual interaction in the tested workflow. The integration of these technologies facilitates the automation of communication, coordination, scheduling, and information distribution processes within a centralized system.

The implementation results indicate that the system is capable of supporting user registration, administrator access validation, meeting scheduling, participant management, material distribution, and storage of scheduling data in Google Sheets. In addition, the system can automatically monitor meeting schedules, distribute notifications to administrators and participants, provide meeting information, and facilitate the delivery of meeting materials after the meeting concludes. Based on the Black Box Testing results, all main system functions operated in accordance with the specified requirements. These findings indicate that the developed system is functionally capable of supporting coordination and information management activities in oil palm plantation operations.

From a methodological perspective, this study demonstrates that the Design Science Research (DSR) approach can be effectively applied to the development of AI-based workflow automation systems within the agricultural informatics domain. The resulting artifact contributes a practical implementation model that integrates artificial intelligence and digital collaboration services to address the coordination and information-sharing challenges in plantation management.

Despite these achievements, several limitations must be acknowledged. First, the system evaluation was conducted using undergraduate students as simulated users rather than actual plantation managers, field supervisors or administrative personnel. This design decision was appropriate for assessing technical feasibility; however, it means that the findings cannot be considered evidence of user acceptance, practical usability, or operational effectiveness in real plantation environments. Validation involving actual organizational stakeholders remains an essential area for future research. Second, the evaluation was limited to functional testing using the Black Box Testing method under normal operating conditions. User Acceptance Testing (UAT) and quantitative assessments related to efficiency, productivity, user satisfaction, and coordination effectiveness were not performed. Therefore, the findings of this study are limited to demonstrating the functional performance of the system and do not provide empirical evidence regarding its impact on organizational performance. Third, the accuracy and reliability of the Gemini AI Agent in extracting and structuring administrator input have not been formally evaluated. Because the AI Agent serves as a central component for transforming natural language input into executable scheduling data, errors in extraction or misinterpretation of ambiguous inputs could propagate through the entire workflow. Future studies should assess the extraction accuracy, failure modes, and consistency of the AI Agent under diverse and edge-case input conditions. Fourth, the system handles sensitive organizational data, including private meeting schedules, participant Telegram IDs, and distributed meeting materials. The current implementation relies on administrator-level access control to distinguish between public and private information categories. However, no formal security audit, data encryption verification, or access control testing has been conducted. The system's dependence on third-party platforms, including Telegram, Zoom, Google Sheets, and Gemini API, also introduces potential risks related to data sovereignty, unauthorized access, and service-side privacy policies that are outside the direct control of the system developer. These security and privacy considerations should be addressed in future implementations, particularly when deploying the system in contexts that involve confidential organizational data. Fifth, implementation and testing were conducted specifically within the context of oil palm plantation operations, which may limit the generalizability of the results to other sectors.

Future studies should focus on several directions. First, the evaluation should be extended to include actual plantation personnel through User Acceptance Testing (UAT) and quantitative performance measurements to assess real-world usability, coordination effectiveness, and organizational impact. Second, the accuracy and robustness of the Gemini AI Agent in handling diverse and ambiguous natural language inputs should be formally evaluated, including error rate measurements and failure case analyses. Third, a dedicated security and privacy assessment covering data encryption practices, access control mechanisms, Telegram ID storage procedures, and compliance with applicable data protection regulations is recommended. Fourth, the development of advanced features, such as automated meeting minutes generation, meeting transcription, and AI-based discussion summarization, would further extend the functional scope of the system. Collectively, these directions would contribute to a more comprehensive validation of the system's practical value, reliability, and security for deployment in real organizational environments.

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AUTHOR CONTRIBUTION STATEMENT

SEA compiles and designs research, designs and implements Multi-Agent Automation systems, conducts system tests, analyzes research results, and prepares manuscripts. AP contributed to the research design, oversaw methodologies, validated system implementation results, assisted in the interpretation of research results, and reviewed and revised the manuscript. RMS contributed to research supervision, provided input for system development, evaluated research findings, and reviewed and approved the final versions of the manuscripts. All the authors have read and approved the final manuscript.

AI DISCLOSURE STATEMENT

The authors used ChatGPT, developed by OpenAI, during the preparation of this manuscript for language editing, grammar improvement, and script refinement. After using this tool, the author carefully reviewed, revised, and validated all content to ensure its accuracy, originality, and scientific integrity. The author is solely responsible for the content of this manuscript.

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