

Prototype of a Conversational Agent for the Management of Recruitment Processes in the Public Sector

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Abstract

The management of competitive procedures for the allocation of research grants in universities represents a complex administrative challenge, characterized not only by strict deadlines, but also by multiple stakeholders and the need to ensure maximum documentary transparency. Business process management methodologies and tools, although effective in modeling the formal sequence of phases, from the publication of the call to the appointment of the winner, provide limited support for stakeholders. The aim of this paper is to present a first prototype of a process-oriented conversational agent designed to support the entire lifecycle of the research grant allocation procedure. The agent acts as an intelligent mediator between the governing bodies, the evaluation committees, and the candidates, integrating advanced language models with the logic of university workflow processes. The main contribution of this work lies in demonstrating how artificial intelligence agents can not only monitor the state of the process, but also validate the consistency of the selection criteria and produced documents with respect to the original call. The results presented show that the hybrid approach that synergistically fuses business process management with artificial intelligence reduces the risk of procedural errors and also significantly improves the accessibility of information for all stakeholders.

Keywords

Business Process Management, Administrative Processes, Conversational Agents, Large Language Models

1. Introduction

Today's academic institutions operate within a bureaucratic framework characterized by high systemic complexity. This ecosystem is defined by the interaction of numerous actors and regulatory constraints that require the coordinated and scrupulous management of heterogeneous documentary flows and stratified decision-making processes [1].

The growing complexity of regulations and the need to manage heterogeneous documentary flows within tight deadlines place a significant strain on the efficiency of the university administrative apparatus. Specifically, the activation and awarding of research grants represent an emblematic process, where the legitimacy of administrative action depends on the correct, precise, and rigorous alignment between the decisions of governing bodies, directors, and various departments, and the complex technical procedures of selection committees.

Indeed, many processes remain difficult for users to manage despite the increasing digitalization of administrative services: this is primarily due to the fact that users are required to interpret technical documents, understand complex procedures, meet strict deadlines, and make decisions under conditions of information uncertainty, which together constitute forms of administrative burden [2].

The evolution toward a fully functional e-government, as highlighted in [3], cannot be limited to the simple digitalization of documents but must aim for an integration that facilitates semantic interaction between the different stages of the workflow.

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BPM (Business Process Management) provides established methodologies and tools for analyzing, modeling, and improving complex administrative and organizational processes. In the context of public university procedures for the approval and awarding of research grants, BPM provides a structured framework for representing the various administrative phases of the process, from the definition of the call for applications to the selection of the winning candidate [4].

The graphical modeling of processes through the *BPMN (Business Process Model and Notation)* enables a formal description of roles, activities, and decision flows, thereby promoting transparency, repeatability, and standardization of procedures such as the publication of the call, the evaluation of candidates, and the formalization of selection results [5].

Despite these advantages, process modeling alone is not sufficient to effectively support users during the administrative activities under analysis. Specifically, even when the workflow is clearly defined, the actors involved, such as members of the selection committee, administrative staff, and university governing bodies, must still consult and interpret documentation that is often complex, understand the applicable regulations, and comply with procedural constraints, thus being required to make decisions in operational contexts that are not always explicit.

In this scenario, the support provided by traditional BPM tools is often static and purely structural. Although BPM offers multiple advantages in mapping the logical sequence of phases, from the request of the proposing professor to the publication of the winner, the tools that it normally provides are not capable, for example, of helping with the documents produced during the execution of a process.

This technological gap results in a high cognitive load for the involved actors, who are required to perform manual checks to ensure, for example, that the selection criteria established in the meeting minutes are consistent with the original call. According to [6], the challenge of modern *DI (Document Intelligence)* lies in transforming documents from passive entities into active sources of knowledge capable of guiding and evaluating the entire process.

In recent years, significant progress has been made in the field of *LLMs (Large Language Models)*, fostering the widespread adoption of increasingly advanced and customized conversational *AI (Artificial Intelligence)* agents. These new agents are not only capable of understanding the context in which they operate but also of analyzing complex documents and adapting responses based on the user's role and the current state of the process in which the interaction occurs.

According to this new perspective, LLM-based conversational tools are not limited to mere text generation; they can also take on the role of true process assistants. These tools provide contextual clarifications, decision support, and interpretation of clauses and constraints within administrative documents, while also serving as an operational guide for the activities required by the procedure.

The convergence of BPM methodologies and the potential of conversational AI is outlining a paradigmatic shift in the governance of administrative flows. In this new operational architecture, the process transcends its purely prescriptive nature to evolve into a cognitive and explorable entity. Thanks to advanced dialogic interfaces, the rigidity of formal modeling merges with the flexibility of contextual reasoning, allowing for intuitive navigation of procedural knowledge and adaptive management of the exceptions occurring in the execution of processes [7].

The main motivation for adopting intelligent agents to support public selection processes lies in their procedural fragility: an error in managing deadlines or a discrepancy between the evaluation criteria and the call may expose the university to legal appeals and administrative paralysis. For example, consider a typical workflow: a call published on December 2nd, 2024 with a deadline of December 16th, 2024. Within a short timeframe, the selection committee must meet, e.g., on December 20th, 2024 to define transparent selection criteria, and publish them promptly before accessing the applications. A conversational agent is not merely a technological convenience capable of monitoring these chronological steps and validating meeting minutes in real time, but also a guarantee of administrative compliance. In addition, the understanding of complex bureaucratic terminology remains an obstacle without a specialized tool, as demonstrated by the need for domain-specific models such as *LEGAL-BERT* for processing legal texts [8]. The objective of this work is to present preliminary results on a case study of a conversational agent prototype designed to support the administrative procedure for activating and awarding research grants within an Italian public university.

To overcome the previously mentioned limitations, this study proposes the integration of a process-aware conversational agent that combines the flexibility of RAG (*Retrieval-Augmented Generation*) with an explicit awareness of the process state.

Unlike a generic chatbot, the described prototype is informed about the specific stages of the process, such as the appointment of the selection committee on December 18th, 2024, and offers the capability to answer complex compliance queries, such as verifying whether the winner was selected based on the correctly published criteria. Through this case study analysis, it is demonstrated how this architecture can support governing bodies, committee members, and candidates, thereby making the workflow more transparent and resilient to errors.

The presented case study represents an application of *PARMA* (*Public Administration Robust Management Assistant*), a cloud-based software platform currently under development with the aim of supporting administrative processes in public sector organizations. *PARMA* is conceived as a configurable and extensible framework, designed to adapt to the specific organizational structure and regulatory context of individual administrations. For each institution adopting the platform, it is possible to formally model administrative workflows and develop process-aware conversational agents designed to assist users during the execution, monitoring, and management of processes.

In the context of this work, the platform was used to model and simulate the administrative process relating to the awarding of research grants. However, the platform was not integrated with the central information systems of the University of Parma; instead, it was delivered as an experimental environment to explore the potential of a hybrid BPM–AI approach.

This approach combines several technologies: the structure and formal rigor of BPM, the reasoning flexibility of LLMs, and the document analysis capabilities of DI. The advantage of the developed prototype is that it allows users to interact with the process via an agent capable of recognizing the user's specific role among all process actors, evaluation criteria, or committee minutes, while also providing responses consistent with the procedural state of the instance at any given moment.

One of the primary objectives of this work is not to propose a definitive and fully automated solution for managing research grants assignments, but rather to demonstrate how the integration of BPM principles and conversational AI can improve not only the understanding but also the execution and transparency of complex administrative processes. In particular, the proposed approach aims to assist users through two main advantages: the reduction of cognitive load on the actors involved and support for greater consistency in the decisions made throughout the entire procedure.

The contribution of this work is twofold: on one hand, it proposes a conceptual framework that integrates BPM methodologies with conversational AI technologies; on the other, it presents a functional application prototype that concretely demonstrates the potential of this approach within the context of university research grant awarding procedures. Finally, the study shows how a process-aware conversational agent can represent an effective support tool for administrative processes characterized by high documentary complexity, interpretative ambiguities, and critical decision points, through the simulation of realistic operational cases.

The remainder of this article is organized as follows. Section 2 reviews the state of the art in the literature. Section 3 describes the developed prototype and presents the details of the experimental research grant awarding process. Finally, Section 4 discusses the results and future perspectives.

2. Related Work

Numerous recent studies have addressed multiple fields related to the case study presented in this work, including BPM, workflow modeling, conversational AI, and DI. These complementary fields, which represent important research directions, address various aspects ranging from process automation to information management. However, these domains are often studied independently, with limited integration between them: consequently, this separation becomes more problematic in administrative environments characterized by rigid procedural constraints and complex documentation, such as those found in university settings.

In general, BPM represents a consolidated paradigm not only for the analysis, but also for the design and improvement of complex organizational processes [9]. Furthermore, within institutional contexts, BPM plays a key role in increasing operational efficiency while ensuring transparency, traceability, and compliance with regulatory frameworks.

Furthermore, within the BPM lifecycle, process modeling represents a crucial activity that enables the formal representation of tasks, actors, and decision-making flows. Among the available modeling languages, BPMN has emerged as the reference standard for the graphical representation of processes, thanks to its ability to bridge the gap between technical analysts and domain experts [5]. Numerous studies have shown that BPMN models offer several advantages: they facilitate a shared understanding of organizational procedures, improve the clarity of responsibility allocation among the actors involved in a process, reduce the likelihood of errors, and facilitate process automation [10].

In the specific case of university procedures for research grant assignments, BPMN constructs, such as pools and lanes, allow for a clear representation of the roles of the various actors involved, including the proposing professor, the relevant department, the director, the governing bodies, and the selection committee. However, despite these significant advantages, research on BPM highlights a major limitation of this approach: process models are primarily used as static documentation artifacts to support both the design and analysis phases, but they provide limited operational assistance during the actual execution of activities [11].

In fact, users are still required to independently interpret complex documents and heterogeneous procedural rules. This limitation is particularly evident in university administrative procedures, where, for example, members of the selection committee must verify compliance with calls for applications, interpret regulatory constraints, and validate procedural steps. Furthermore, the rapid evolution of LLMs has led to a significant increase in the capabilities of conversational agents. Indeed, AI-based assistants are no longer limited to rule-based dialogue agents but can perform various tasks such as semantic interpretation, contextual reasoning, and adaptive interaction with users [12].

As highlighted in [13], such agents can provide personalized assistance, adapting responses based on user profiles and situational process contexts. The concept of a process-aware conversational agent has emerged precisely within this line of research. As established in the literature, a conversational agent can be considered process-aware when it is capable of identifying the current state of a process instance and providing responses consistent with procedural rules and constraints. Consequently, process-aware conversational agents are designed to effectively operate in direct connection with both the structure and the constraints of a specific workflow [14].

In contrast, however, most existing and studied applications of conversational AI focus on domains such as customer service, e-commerce, and technical support, where processes are already relatively flexible. Much less attention is currently devoted to university administrative processes, which are characterized by rigid regulations, formal documentation, and multiple decision-making actors. The work presented in this paper aims to address this limitation by integrating the formal structure of workflow models based on BPM tools with the reasoning capabilities of LLMs, in order to support the actors involved in research grant assignment procedures.

As a final area of analysis, DI represents an emerging field of research. This theme combines natural language processing, information extraction, and machine learning techniques with the goal of transforming unstructured documents into knowledge usable in automated processes [15].

In administrative contexts, these technologies enable the analysis of complex documents and support tasks such as data and clause extraction, information retrieval, and document validation [16]. In particular, natural language learning models have recently demonstrated significant capabilities both in interpreting complex textual structures and in identifying relevant information within official documents [17]. Compared to traditional keyword-based search approaches, LLMs are able to capture complex and hidden deep semantic relationships between the numerous parts of a document and provide more accurate and contextualized interpretations of regulatory texts.

Despite these significant advancements, most existing solutions are designed and studied for commercial or legal domains, such as contract analysis or procurement management. Consequently, academic administrative procedures present additional complexities, as they are governed by a combination of

national regulations, institutional rules, and specific provisions contained in calls for applications. It is therefore necessary to have agents capable not only of extracting information from documents but also of verifying consistency with the procedural constraints defined by institutional workflows.

The digital transformation of public administration in general is recognized as a central objective of e-government initiatives, whose goal is not simply to digitalize existing procedures, but to redesign administrative services to improve their efficiency, transparency, and accessibility for users. Administrative processes can be significantly supported by advanced information systems which, in addition to reducing manual labor, improve traceability and mitigate the risk of human error in complex bureaucratic environments [18]. However, several studies highlight that digitalization initiatives often fail when they are implemented through siloed systems that do not communicate effectively with each other [19]. This issue is particularly evident in university settings, where administrative procedures often involve multiple organizational units and decision-making bodies; consequently, the mere digitalization of documents does not necessarily simplify the user experience, nor does it improve the understanding of procedures [20]. In this context, there is a growing need for tools capable of assisting users in interpreting procedural rules and navigating complex administrative workflows [21].

The literature review presented reveals the absence of an integrated approach capable of combining formal process modeling, intelligent document analysis, and conversational interaction. Consequently, the prototype presented in this work aims to fill this gap, proposing a hybrid framework in which a process-aware conversational agent acts as an intelligent interface between users and administrative procedures, taking into account the workflow state, the roles involved, and the specific documentary constraints of research grant assignment processes.

Through the synergistic use of LLM and Document Intelligence techniques, the proposed agent provides proactive decision support capable of reducing the cognitive burden on administrative actors. Ultimately, the work aims to demonstrate how the convergence of formal modeling and generative AI can redefine efficiency and transparency in complex university ecosystems.

3. The Prototype Conversational Agent

The prototype conversational agent presented in this section arises from the synergy between the structural rigor of administrative processes and the operational flexibility of next-generation conversational agents. The current objective of the presented project is not the full automation of the selection procedure, but rather the creation of a conversational agent capable of acting as a mediator between regulations and the various types of users.

This approach aims to overcome the rigidity of traditional information systems by introducing a conversational agent capable of interpreting not only the data, but also the sequential logic and the legitimacy constraints that govern administrative action. In this context, the proposed agent is not limited to a mere technical support function; it is strategically configured as a robust digital governance tool with the primary aim of ensuring the integrity of the information flow throughout the entire lifecycle of the research grant awarding process. The prototype enables the investigation of the potential of a hybrid BPM-AI model applied to highly complex administrative procedures within the academic domain. In this scenario, the focus is specifically on the process of activating and awarding research grants. The agent is designed to guide various types of users, from the proposing professor to the members of the selection committee, through the chronological sequences of the workflow, facilitating the exegesis of competition documentation (calls, minutes, and criteria) and offering contextualized decision support. Such assistance is dynamically calibrated both to the prerogatives of the user's role and to the actual progress of the instance within the selection lifecycle.

The agent addresses the critical issues related to the management of documentary flows, monitoring compliance between the different phases: from the publication of the call to the definition of evaluation criteria, up to the announcement of the winner. In this way, the agent is not limited to passive information retrieval but operates as a guarantor of procedural consistency, reducing opacity and mitigating the risk of formal flaws that could compromise the legitimacy of the competitive procedure.

3.1. Process structure

The developed agent is designed to support the activation and awarding of research grants at the University of Parma. The added value of the developed prototype lies in its ability to integrate temporal deadlines and documentary constraints within a single interface. Thanks to the data stored in the process state, the agent knows exactly which stage the process is currently in and can provide contextual support. Among the various advantages offered by the agent, significant support can be observed regarding the following themes:

1. Transparency: the agent can confirm the publication date of the criteria or the specific composition of the committee;
2. Decision awareness: the agent can extract information from meeting minutes to justify the selection of the winner based on the published criteria; and
3. Reduction of uncertainty: the agent manages complex information flows, such as access to candidate applications or call deadlines, thereby reducing the bureaucratic burden on the actors.

The procedure for activating and awarding research grants has been rigorously analyzed and deconstructed into its fundamental units to establish a reliable operational framework. The analysis enabled the mapping of a rigorous sequence ranging from the approval of the call to its closure, through to the appointment of the committee and the publication of the final results. This rigor ensures that the agent operates within a defined regulatory perimeter, respecting the constraints of administrative legitimacy.

Conceived as an experimental environment, the demonstrated process can be detailed as follows, highlighting the interaction between regulations, actors, and temporal flows. The process is based on a hierarchy of responsibilities involving both academic and administrative components:

1. Proposing Professor (Principal Investigator): The initial driver of the process, who proposes the activation of the grant and guarantees financial coverage through available research funds;
2. Affiliated Department: Tasked with the formal acceptance of the Proposing Professor's request;
3. Rector: Acts as the guarantor and supervisor of the entire process, approving the issuance of the call and validating every crucial step;
4. Selection Committee: A technical body composed of three members tasked with evaluating the scientific profiles of the candidates;
5. Candidates: The participants of the procedure that submit applications;
6. Winner: Identified based on merit and consistency with the established criteria; and
7. Conversational Agent: Acts as an intelligent information mediator, designed to provide precise, concise, and exhaustive answers to queries from all involved parties.

The procedure follows a rigorous chronology that the prototype simulates to test its process-state awareness. The phases of the administrative workflow are listed below, incorporating dates and information used as a case study and practical example, as follows.

1. Issuance and Closing (December 2nd–16th, 2024): The Rector initiates the process upon the Department's request. The call for applications, concerning, for example, a study on the use of Large Language Models in Public Administration (S.S.D. INFO/01), remains open for Candidates' submissions until the deadline.
2. Committee Appointment (December 18th, 2024): Once the applications have been collected, the Rector officially appoints the members of the Selection Committee.
3. Criteria Definition and Evaluation (December 20th, 2024): The Selection Committee meets for the first time to establish the selection criteria. The relevant extract of these criteria is approved by the Rector and published on the website; simultaneously, the Candidates' documents are made accessible to the Selection Committee.
4. Conclusion and Publication (December 23rd, 2024): Following a second evaluation meeting based on the previously defined criteria, the Selection Committee identifies the Winner. The process concludes with the publication of the results following rectoral approval.

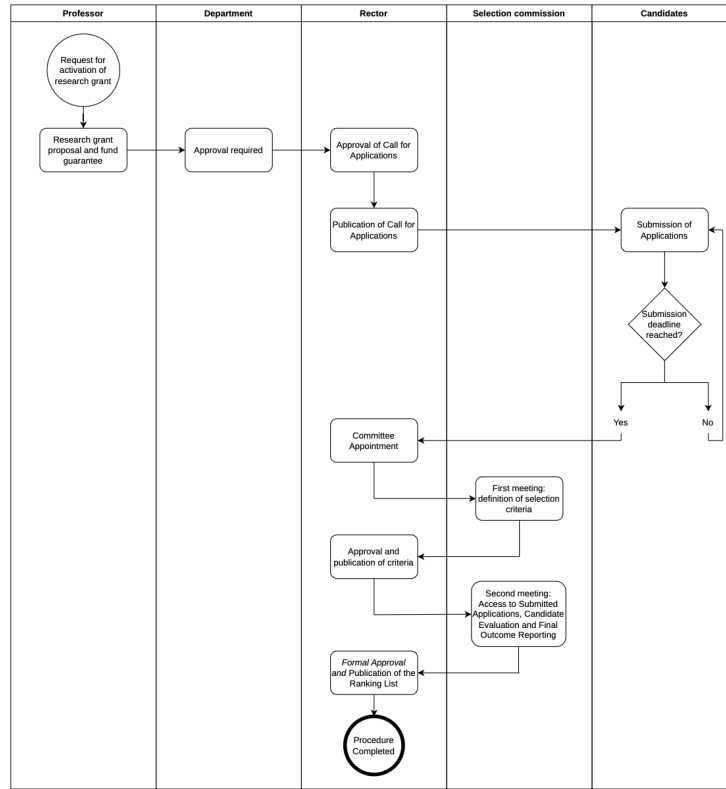


Figure 1: The BPMN model details the studied research grant assignment process and shows the interactions among the academic actors and the administrative tasks, thus providing the logical foundation for the conversational agent’s process-awareness

To provide a structured representation of the administrative workflow, the process has been modeled using BPMN. Fig. 1 illustrates the administrative workflow for the activation and awarding of a research grant through a BPMN diagram, which explicitly represents the involved roles and the temporal progression of the process. The diagram adopts a vertical layout, where the top-to-bottom direction reflects the chronological evolution of the process, while the vertical lanes correspond to the main actors: Proposing Professor, Department, Rector, Selection Committee, and Candidates.

As illustrated in the diagram, the process begins with the request for grant activation by the Proposing Professor, followed by Department approval and the Rector’s authorization, leading to the publication of the call. A central aspect of the model is the management of the application submission phase via a temporal condition. The application activity is associated with a gateway labeled “Submission deadline reached?” to regulate the transition to the next phase.

In the case study, the call is published on December 2nd, 2024, and remains open until December 16th, 2024. This interval is represented in the diagram as a loop: as long as the deadline is not reached, Candidates can continue to submit applications; once the term has expired, the process moves forward. This choice allows for the representation of temporal constraints without referring to absolute dates, making the process more flexible and consistent with real administrative practices.

Once the application phase is concluded, the process continues with the appointment of the Selection Committee by the Rector (December 18th, 2024). The Selection Committee then holds its first meeting (December 20th, 2024), during which the selection criteria are defined. These criteria are subsequently approved and published by the Rector, after which the Selection Committee is allowed to access the submitted applications to start the evaluation phase.

Finally, the process concludes with the evaluation of Candidates and the identification of the Winner during the second meeting of the Selection Committee (December 23rd, 2024). The Rector then proceeds with the formal approval and the publication of the final result, marking the conclusion of the procedure.

In addition to representing the sequence of activities, the BPMN diagram is also accompanied by the production of key documents, such as the call and the Selection Committee's minutes. This structured and process-aware representation forms the foundation for the conversational agent, enabling it to align its responses with the current state of the process and to respect the temporal and procedural constraints derived from the BPMN model.

3.2. Agent structure

The architecture of the prototype agent is based on a general-purpose LLM. The major task of the agent is to act as an assistant capable of providing concise, precise, and exhaustive answers to queries from various actors. Unlike a traditional chatbot, this agent is process-aware: it interprets user requests by recognizing their specific roles and maintaining consistency with the current phase of the process. For instance, the agent is aware of whether the call for applications is still open, if the Selection Committee has already been appointed, or if the first meeting scheduled for December 20th, 2024 has already taken place. Through a structured prompt that defines behavioral rules and role-based constraints, the agent is able to guide different types of users through the chronology of events, such as the announcement of the Winner on December 23rd, 2024.

The agent uses DI to utilize attached documents as a dynamic knowledge base. Indeed, the agent is capable of extracting relevant information from specific sources, such as extracts containing selection criteria or meeting minutes. This technology bridges the gap between abstract process modeling and documentary reality: users can ask complex questions regarding compliance (for instance, whether the winning Candidate was selected in accordance with the published criteria) and receive answers based on the actual content of the uploaded files. By integrating these two aspects into a single conversational interface, the prototype transforms static documentation into an active, real-time searchable resource.

The agent adopts an approach inspired by RAG techniques to enable the semantic querying of documents. Administrative documents, such as calls for applications and minutes, are treated as a queryable knowledge base. Specifically, these documents are subdivided into logical units corresponding to semantically coherent sections, such as evaluation criteria and scoring systems, which are then transformed into vector representations to allow for semantic information retrieval. Finally, these units are queried by the user during the interaction, with the agent selecting the most relevant passages based on the user's specific request. This approach allows the agent to provide highly accurate responses grounded in the actual content of the documents, thereby reducing the risk of errors and enhancing the overall reliability of the responses.

From an implementation perspective, the developed prototype is based on a modular architecture that integrates process modeling, state management, and LLM-based response generation. The objective is not merely to provide textual responses, but to constrain the model's behavior within a formalized procedural space. The agent is structured into three primary levels, as follows.

1. **Process Representation Layer:** The administrative flow is modeled according to the principles and rules of BPM and, consequently, encoded in a structured form. For this reason, information relating to actors, phases, and temporal transitions is explicitly defined and constitutes the logical basis upon which the agent's behavior is founded.
2. **State Layer:** The process state is represented through explicit structures managed by dedicated modules. In particular, the module named Process State in the case study contains verified chronological events, such as the call closure, committee appointment, and winner publication, while the Process Timeline module allows for the simulation of the time perceived by the user, enabling the agent to adapt responses according to the temporal phase. This separation thus makes it possible to distinguish between the actual state of the process and the state perceived during the interaction, thereby ensuring consistency and governing the generation of information.
3. **Conversational Layer:** The agent is implemented through a general-purpose LLM, appropriately instructed via a structured prompt that integrates rules such as role definitions, procedural constraints, process state, and documentary context. In this way, the model does not operate freely but functions as an agent guided by explicit constraints.

The current implementation of the prototype uses a frontend developed as a React single-page application built with the MUI component library (www.mui.com) to support the Material Design (www.material.io) guidelines. The frontend is stateless and uses the REST API provided by the backend to manage the dialogue with the user. Fig. 2, Fig. 3 and Fig. 4, shown in the next section, are screenshots of the developed frontend accessed using an up-to-date Google Chrome on a MacBook Air.

The backend of the developed prototype is implemented in Java and features a MySQL database (www.mysql.com) to manage registered users and active processes. Registered users are associated with their roles in the active processes, and the structure and state of the active processes are stored using a database schema that can accommodate processes described using a subset of BPMN.

The backend provides a secure interface to the adopted LLM, thus relieving the frontend from directly interfacing the LLM. Notably, the prompt used to query the adopted LLM is dynamically composed by the backend using the user message history, the structure of the target process, the state of the current process instance, and the documents attached to the process instance. Currently, the prototype interfaces Gemini 2.5 Flash Lite, but the backend module that interfaces LLMs can be easily customized to support other LLMs, possibly from other vendors.

Finally, it is worth noting the architecture of the prototype supports the event-based nature of business processes, as formalized using BPMN, by means of a custom-built event bus used to distribute events across the modules of the software system. This event bus interfaces each active frontend using a dedicated server push channel to allow frontends to immediately react to interesting events, thus providing an up-to-date view of process instances to users.

3.3. Prompt structure

The prompt instructing the conversational agent is configured as a complex logical architecture designed to transform a static language model into a process-aware administrative agent. The objective is not merely to generate textual responses, but also to formally constrain the model's behavior within a structured procedural space capable of reflecting the dynamics of the analyzed administrative process.

First, the prompt defines the agent's operational identity and the ontology of the actors involved in the research grant awarding process. In this context, therefore, the agent is not considered a simple chatbot, but rather an assistant whose primary task is to provide concise, precise, and exhaustive answers to the various participants in the process. The agent is thus instructed to recognize and distinguish among the different actors, each characterized by specific operational constraints and responsibilities:

1. Proposing Professor: Tasked with proposing the activation of the grant and ensuring adequate financial coverage;
2. Rector: Supervisor of the entire process and guarantor of the legitimacy of its various phases;
3. Department: Responsible for the formal approval of the request; and
4. Selection Committee: In charge of the technical and scientific evaluation of the Candidates.

A fundamental component of the prompt concerns the codification of procedural knowledge, specifically the sequential and regulatory description of the administrative procedure. The agent does not merely generate responses based on the query; rather, it follows a state logic derived from BPM principles. Specifically, the administrative process is articulated into sequential phases, which reflect the actual execution of the procedure:

1. Initial Phase: relating to the management of the Department's request and the Rector's approval for the issuance of the call;
2. Closing and Appointment Phase: concerning the monitoring of deadlines and the subsequent appointment of the Selection Committee;
3. Evaluation Phase: in which the Selection Committee defines the criteria during the first meeting and supports their publication, following the Rector's authorization; and
4. Final Phase: relating to the management of access to Candidates' applications, the evaluation based on the established criteria, and the publication of the Winner's name.

The prompt also integrates a specific module that acts as a historical and situational memory of the ongoing instance, dedicated to managing the process state. Thanks to this component, the agent is able to base its responses on verified events that have already occurred within the process. Specifically, the agent is informed about key elements such as:

1. Exact date of issuance or publication of the call (December 2nd, 2024);
2. Closing date of the call (December 16th, 2024);
3. Participation of two Candidates in the competitive procedure;
4. Definition and publication of selection criteria during the first meeting of the Selection Committee (December 20th, 2024); and
5. Identification of the Winner, which is Candidate 12345678 (December 23rd, 2024).

Alongside the state representation, the prompt introduces a temporal parameterization mechanism that enables the simulation of realistic interactions. This module allows the anchoring of the user interaction or conversation to a specific date, for instance, simulating that the interaction takes place on December 20th, 2024. This functionality is crucial as it enables the agent to modulate its responses according to the reference time window. In this way, the agent ensures that the user receives only procedural updates that have already been formalized within the chosen chronological context. Consequently, the agent avoids providing information regarding phases that have not yet occurred, such as the final selection outcome at the end of the second meeting if the simulated date precedes the event, thus ensuring full consistency with the actual state of the process and preventing misinformation.

Finally, the prompt includes a component dedicated to technical specifications and domain knowledge. Specifically, the subject of the research grant is defined, for example, the study and experimentation of the use of Large Language Models in the management of public administration processes. The agent is also instructed on technical aspects of the contract, such as its annual duration and the *Scientific Disciplinary Sector (SSD)* INFO/01, enabling it to answer not only procedural questions but also substantive queries regarding requirements and the research topic.

In summary, the prompt transforms the agent into a process guardian, capable of navigating technical documents, such as selection criteria and minutes, and respecting temporal and procedural constraints. This approach consequently reduces ambiguity for the end-user and enables a fluid interaction that is, at the same time, strictly regulated by the administrative context.

3.4. Validation and interaction analysis

To evaluate the effectiveness of the prototype, a series of interaction tests were conducted simulating the life cycle of a research grant at the University of Parma. The validation focuses on three core dimensions: state-awareness, temporal constraint enforcement, and procedural consistency.

The first test aims to verify the agent's ability to identify the current interaction within the formal BPMN model. As an example, a user query from December 18th, 2024, was simulated, representing the moment following the Rector's formal appointment of the Selection Committee, yet still prior to the definition of the evaluation criteria.

As illustrated in Fig. 2, when the user asks the conversational agent who won the selection, the agent does not produce a generic message stating the information is unavailable. Instead, it identifies the current state as Phase 3 of the administrative workflow. The agent explicitly informs the user that the Rector has just appointed the Selection Committee and provides a clear comprehensive roadmap of the four remaining mandatory steps required to reach the final result. This behavior demonstrates that the agent is effectively and consistently anchored to the process state, preventing the illusion of premature results and providing accurate procedural guidance.

A fundamental requirement for Public Administration assistants is the rigorous application of temporal constraints, which in BPMN are often represented by Boundary Timer Events. In the case study under analysis, the closing of the call for applications was formally set for December 16th, 2024. To validate the agent's ability to enforce such constraints, an interaction was conducted as shown in Fig. 3. When the agent is queried about the number of applications received, it accesses the data about the

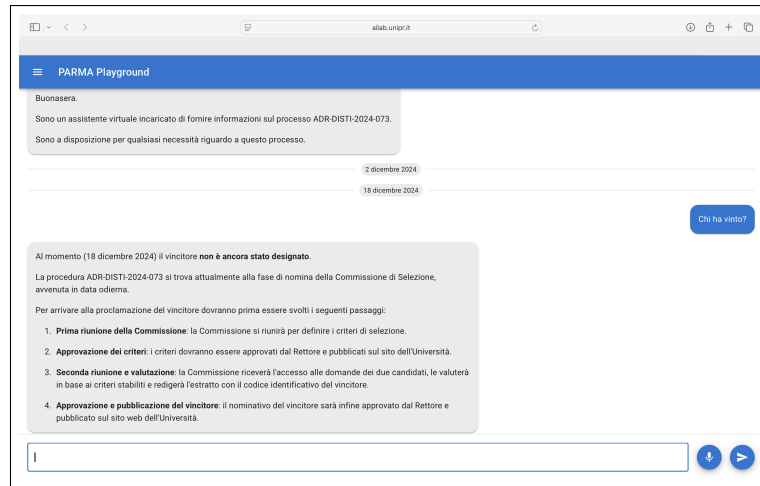


Figure 2: Validation of intermediate state-awareness: the agent identifies the active process phase and replies that the winner name is not yet available, providing a roadmap of the remaining administrative requirements, when asked “Who is the winner?”

submitted applications only after verifying that the deadline has passed. It confirms the receipt of two applications and cross-references this data with the call’s expiration date.

Furthermore, the agent maintains a high level of temporal awareness regarding the future of the process: it explains that it is not yet possible to determine a precise date for the announcement of the Winner, as this depends on the completion of subsequent evaluation phases that have not yet been initiated. This demonstrates the agent’s ability to manage complex temporal logic and historical records, ensuring that the conversational layer respects the sequence of administrative deadlines.

The final validation phase, which in this example takes place on December 23rd, 2024, focused on the consistency between various procedural documents. As illustrated in Fig. 4, the agent identifies the Winner via a unique identifier and, following a further prompt, performs an automated verification against the minutes drafted during the Selection Committee’s first meeting. The agent confirms that:

1. The selection criteria were defined on December 20th, 2024;
2. The evaluation conducted on December 23rd, 2024 exclusively utilized these criteria; and
3. The Rector formally validated the result prior to its publication.

This multi-stage validation highlights the primary contribution of the framework on the PARMA platform: namely, the ability to ensure that the conversational layer respects the sequential dependencies and the distribution of responsibilities defined in the original BPMN model. By linking the LLM’s reasoning to structured process logs, the agent provides a verifiable and transparent justification for administrative decisions, an essential element for accountability within public institutions.

4. Discussion and Conclusion

This work discussed a prototype of a process-aware conversational agent designed to support administrative procedures for the activation and assignment of research grants in a public university context. Through the case study of the University of Parma, it has been demonstrated how the integration of BPM methodologies and technologies based on AI enables overcoming the limitations of traditional business process support systems, introducing a dynamic level of interaction with processes, administrative documents, and several types of users.

From an application perspective, the developed prototype highlights how a conversational agent can operate not only as a passive informational interface, but also as a true and active mediator between users, workflows, and documentation. The results show that the combination of explicit process state representation, role management, and semantic document querying makes it possible to obtain

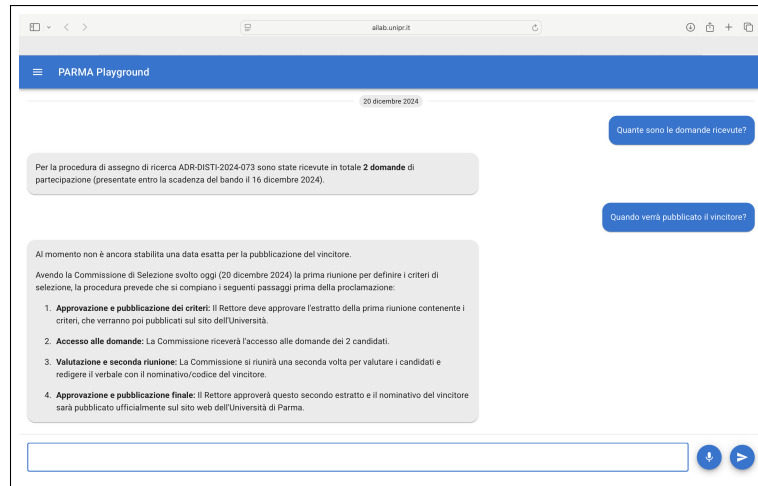


Figure 3: Validation of temporal constraints: the agent accesses application statistics only after verifying the expiration of the submission deadline, thus replying with the list of missing process phases before declaring the winner when asked “When will the winner name be public?”

highly accurate, coherent, contextualized, and verifiable responses. In particular, the agent’s ability to respect the strict and complex temporal constraints of the process and to correlate information from different procedural phases represents a significant and transformative advancement compared to general-purpose chatbots.

An additional aspect of interest concerns the methodological contribution of the proposed approach. Unlike traditional conversational agents, the developed prototype does not merely generate plausible responses, but operates on an explicit and structured representation of the process. This characteristic makes it possible to constrain the behavior of the language model to a controlled informational state, reducing the risk of hallucinations and ensuring greater reliability of the responses. In this sense, the integration of BPM modeling and natural language generation techniques does not represent a simple technological combination, but introduces a paradigm in which the process becomes the primary and indispensable central reference for interaction.

A highly relevant aspect emerging from the developed prototype concerns the significant reduction of cognitive load on the involved actors. In traditional administrative procedures, users are often required to manually consult and cross-reference complex documents, reconstruct the entire sequence of events, and interpret regulations that are not always explicit. The proposed approach instead allows these activities to be effectively delegated to the conversational agent, which provides precise and concise responses grounded in documentary evidence and procedural constraints. This directly contributes to improving information accessibility, process transparency, and the overall quality of decision-making.

Despite the promising results, this work presents some limitations that must be considered. First, the prototype was developed and evaluated in a simulated environment, without direct integration with real university information systems. This implies that the observed performance may vary in the presence of heterogeneous, incomplete, or distributed data sources.

Second, the effectiveness of the approach depends on the quality and structure of the provided documents: ambiguous, incomplete, or non-standardized reports may compromise the agent’s ability to deliver accurate responses. Furthermore, the use of real administrative data, particularly containing sensitive information about candidates, raises significant challenges in terms of security, privacy, and regulatory compliance, which have not been addressed in this prototypical phase.

Third, a critical aspect concerns the management of process evolution over time. In real-world contexts, administrative procedures may undergo changes, regulatory updates, or operational variations that require continuous alignment between the process model and the conversational agent. The lack of synchronization among these elements and the agent’s knowledge base can compromise the consistency of the responses provided by the agent.

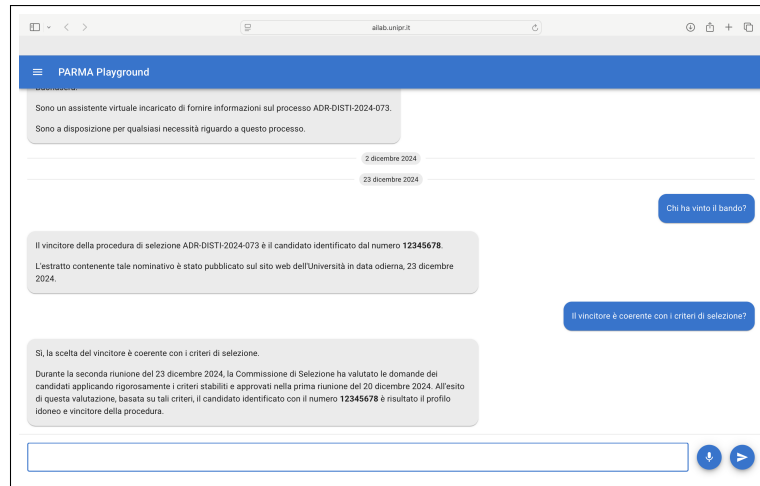


Figure 4: Final process verification: the agent identifies the winner and validates the outcome against the selection criteria defined in previous phases when asked “Is the winner coherent with selection criteria?”

Finally, another critical aspect concerns the predominantly qualitative nature of the evaluation. Although the case study clearly highlights the potential of the adopted approach, future studies will be required to quantitatively measure the impact of the approach, for example in terms of reduction of task execution time, decrease in procedural errors, or improvement in user satisfaction.

In light of these considerations, several future research directions emerge as particularly relevant. First, the integration of the agent with real administrative platforms will represent a fundamental step to validate the approach in concrete operational contexts and at scale.

Future developments will focus on implementing proactive assistance functionalities, enabling the agent to anticipate user needs by signaling imminent deadlines or potential procedural inconsistencies. This evolution aims to transform the agent from a reactive interface into a predictive administrative assistant, further enhancing the efficiency and reliability of complex university workflows. In this context, the agent will not merely respond to requests but will anticipate informational needs and signal critical events in real time.

Additionally, a further research direction concerns the adoption of specialized models for the legal and administrative domain, capable of further improving the understanding of complex regulatory texts. This development will be paired with the extension of the proposed approach to more complex and multi-actor administrative processes, characterized by asynchronous interactions and non-linear dependencies. In such contexts, it will be necessary to integrate advanced mechanisms for state management and coordination among multiple conversational agents.

The exploration of explainability techniques is particularly relevant, enabling the agent to explicitly justify its responses by indicating the documentary sources and procedural rules used. This aspect is especially important in public sector scenarios, where transparency and traceability of decisions are fundamental requirements that also drive the adoption of a technology.

From an architectural and systemic perspective, future developments will explore advanced solutions designed to ensure significantly greater levels of robustness, scalability, and security. This includes investigating the deployment of specialized on-premise models or high-performance cloud infrastructures that are fully compliant with the stringent regulatory requirements of public administration.

Another promising research direction involves the formal definition of standardized metrics and rigorous evaluation methodologies specifically tailored for process-aware conversational agents. Such a framework is essential to quantitatively and objectively compare their operational effectiveness against more traditional administrative approaches.

Finally, future research directions will need to address two crucial challenges for the effective adoption of the presented model within the public sector. First, it will be necessary to delineate a clear framework of legal and administrative liabilities in the event of formal or procedural errors committed by the

agent. Second, further investigations should assess the model's reliability and resilience when facing intrinsically ambiguous, incomplete, or constantly evolving regulations, specifically testing the agent's ability to identify regulatory conflicts.

From a broader strategic perspective, the presented prototype suggests that the convergence between BPM and conversational AI represents a transformative key element for the necessary and structural evolution of modern e-government systems.

The proposed approach does not merely aim to digitize or automate existing bureaucratic procedures; rather, it introduces a novel paradigm in which administrative processes become fully interrogable, immediately understandable, and actively supported in real time. In this sense, process-aware conversational agents can contribute significantly to transforming public administration into a more transparent, efficient, and genuinely user-oriented ecosystem, effectively paving the way for unprecedented forms of interaction between citizens, institutions, and complex information systems.

Ultimately, the proposed methodology paves the way for a new generation of intelligent information systems for public administration. In this vision, administrative processes are no longer just statically executed behind the scenes, but instead become dynamic, interactive, and queryable entities. This evolution fosters a deeper integration between operational logic and human interaction, ensuring that public services are not only more accessible and efficient but also inherently more responsive to the evolving needs of the digital society.

The integration of process models and conversational agents enables overcoming the historical and rigid separation between operational execution and information access, fostering a tighter and more intuitive integration between agents and users. This paradigm may have a truly transformative and significant impact not only in academic settings, but also in broader e-government contexts, contributing to making public services more accessible, efficient, and user-oriented.

Declaration on Generative AI

During the preparation of this work, the authors used ChatGPT in order to: Grammar and spelling check, Paraphrase and reword, Improve writing style. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the publication's content.

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