

# Application and Scenario Analysis of Artificial Intelligence in Research Management at Higher Education Institutions

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## ABSTRACT

This paper explores the multifaceted applications of artificial intelligence in the field of research management at higher education institutions. Through the analysis of five scenarios (research data management, research team management, research output management, research evaluation management, and research support management), the paper provides a detailed examination of its intelligent support at different levels. In terms of research data management, artificial intelligence achieves intelligent processing of research data through data repositories, data knowledge graphs, and data intelligent analysis systems, providing data-driven decision support and value creation for research management at higher education institutions. In the realm of research team management, covering aspects such as project management, personnel management, output management, and funding management, various technologies like facial recognition, voice recognition, and image recognition are employed to offer comprehensive intelligent services to research teams. These applications enhance the efficiency, quality, and intelligence of research management, fostering improvements in research quality and levels. In conclusion, the application of artificial intelligence in research management at higher education institutions presents broad prospects, offering viable directions for innovation and progress in the future of the research domain.

**Keywords:** *Research management, Higher education, Artificial intelligence.*

## 1. INTRODUCTION

Artificial Intelligence (AI) refers to the intelligent behavior exhibited by computer systems or machines, encompassing capabilities such as perception, understanding, reasoning, decision-making, learning, and creativity. In recent years, breakthroughs in AI technology, spanning computational power, data resources, and algorithmic methods, have sparked a global wave of innovation, profoundly impacting and transforming various industries, daily life, and society at large [1]. AI has emerged as a crucial driver of technological advancement and industrial revolution worldwide and represents a key area in national strategic competition [2].

Research management in higher education institutions serves as a vital safeguard for academic research activities, encompassing aspects such as

research projects, research teams, research outcomes, research evaluation, and research support. It plays a pivotal role in shaping the research level, quality, efficiency, and impact of higher education institutions. With the development and application of AI technology, research management in higher education faces new opportunities and challenges, necessitating continuous innovation and optimization to adapt to changes in the research environment and enhance research management capabilities.

Hence, exploring the application areas and scenarios of AI technology in research management at higher education institutions, analyzing its impact and value on research management, and proposing application strategies and recommendations hold significant theoretical and practical significance. This paper aims to start from the characteristics and trends of AI technology,

combined with the characteristics and requirements of research management in higher education institutions, to analyze its application areas and scenarios. It explores the effects and values of AI application in research management, puts forward principles and recommendations for AI application in research management at higher education institutions, providing references and insights for the innovation and optimization of research management in higher education [3-4].

### ***1.1 Artificial Intelligence (AI)***

Artificial Intelligence (AI) refers to intelligent behaviors exhibited by computer systems or machines, encompassing diverse capabilities such as perception, understanding, reasoning, decision-making, learning, and creativity. AI technology primarily encompasses areas like natural language processing, machine learning, and computer vision. Natural language processing enables computers to understand and generate human languages (such as Chinese and English), involving technologies like machine translation, speech recognition, and sentiment analysis. Machine learning enables computers to learn automatically from data and continuously improve, incorporating technologies such as neural networks, support vector machines, and decision trees. Computer vision allows computers to comprehend and process images and videos, including technologies like facial recognition, object detection, and scene analysis. The integrated application of these technologies constitutes the core system of artificial intelligence, providing extensive technical support for its application in various domains.

### ***1.2 History of Artificial Intelligence Development***

The development history of AI can be divided into six stages: the inception and development stage, the introspective development stage, the application development stage, the downturn development stage, the steady development stage, and the flourishing development stage.

The inception and development stage, from 1943 to the early 1960s, marked the conceptualization of AI, accompanied by significant research achievements such as machine theorem proving and chess programs [5]. The introspective development stage spanned from the 1960s to the early 1970s, during which AI faced difficulties and challenges in addressing common-

sense problems and the accuracy of machine translation [6]. The application development stage, from the early 1970s to the mid-1980s, witnessed the emergence of expert systems, transitioning from theoretical research to practical applications, with notable examples like DENDRAL and MYCIN. The downturn development stage occurred from the mid-1980s to the mid-1990s, influenced by various factors such as economic, technological, and societal issues, reflected in the limitations of expert systems and the challenges faced by neural networks [7].

The steady development stage, from the mid-1990s to 2010, benefited from advancements in information technology such as the internet, big data, and cloud computing. AI witnessed innovative research and applications during this period, including the victory of Deep Blue in chess against the world champion and the concept of a smart Earth [8]. The flourishing development stage, from 2011 to the present, driven by technologies like deep learning, supercomputing, and multi-source data, witnessed breakthroughs in fields such as image recognition, speech recognition, natural language processing, man-machine gaming, and autonomous driving, exemplified by achievements like AlphaGo defeating the Go champion and passing the Turing Test [9-11].

The current development status of AI can be assessed from four aspects: technological level, application level, innovation level, and societal impact. In terms of technological level, AI has made significant breakthroughs in specialized intelligent domains, surpassing human capabilities in specific tasks such as Go, image recognition, and skin cancer diagnosis. However, in the domain of general intelligence, AI is still in its infancy, yet to achieve genuine wisdom, such as conceptual abstraction, reasoning, decision-making, and emotional understanding. On the application level, AI has been widely applied across various industries and fields, including smart manufacturing, intelligent healthcare, smart education, intelligent security, and smart transportation, positively impacting and transforming human production, life, and society. Regarding the innovation level, AI has become a global focal point and engine for technological innovation, with governments and businesses worldwide increasing investments and support for AI, forming a robust innovation ecosystem, encompassing strategies like national AI initiatives, AI startup companies, and open-source AI platforms. In terms of societal impact, AI has

triggered discussions and concerns regarding issues such as personal information and privacy protection, the ethics and responsibility of AI, AI's impact on employment and education, and the security and trustworthiness of AI. Timely solutions and regulatory measures are required for these issues. Notably, the ChatGPT chatbot model launched by OpenAI in 2023, based on large-scale pre-training language generation technology, can engage in natural, fluent, and diverse conversations with users, covering multiple tasks and domains of natural language processing, including translation, question answering, summarization, writing, code generation, and more.

In conclusion, AI stands as a hot topic and frontier in today's technological landscape, with its developmental trends, application scenarios, innovation drivers, and societal impacts warranting in-depth attention and research. Technologically, AI is advancing towards the direction of large models, big data, and high computing power, aiming to enhance model generalization capabilities and generation quality while exploring the possibilities of achieving general artificial intelligence. On the application front, AI is progressing towards natural dialogue, multi-task transfer, and task emergence, with the goal of improving user interaction experiences and satisfaction. Additionally, the use of synthetic data is being explored to overcome data bottlenecks and safeguard data privacy.

From an innovation perspective, AI is being driven by human feedback, instruction fine-tuning, reinforcement learning, and other technologies to enhance model adaptability and controllability. Furthermore, considerations are being given to the potential application of quantum computing in the field of artificial intelligence.

On the societal level, AI involves issues related to personal information and privacy protection, ethics and responsibility, employment and education, safety, and trustworthiness. Timely proposals for solutions and regulatory measures are imperative to address these concerns. Overall, Artificial Intelligence is dynamically evolving, and its trajectory in terms of technology, application, innovation, and societal impact necessitates ongoing scrutiny and study.

## **2. APPLICATION SCOPE OF ARTIFICIAL INTELLIGENCE IN RESEARCH MANAGEMENT AT HIGHER EDUCATION INSTITUTIONS**

### ***2.1 Research Project Management and Artificial Intelligence***

AI provides intelligent support for research management in higher education institutions, encompassing various stages of project declaration, review, execution, acceptance, and assessment, thereby enhancing the efficiency and quality of project management. Specifically, Artificial Intelligence demonstrates multifaceted applications in research project management. By analyzing historical data and expert evaluations, AI can offer intelligent recommendations, matching, optimization, and predictions for research projects. This functionality assists researchers in making wiser choices regarding project direction, collaborators, and funding sources, ultimately increasing the feasibility and success rate of projects.

Utilizing technologies like natural language processing and knowledge graphs, AI can provide intelligent generation, auditing, evaluation, and feedback for documents such as project proposals, midterm reports, and final reports. This contributes to improving the quality of texts, consequently enhancing the success rate of project applications and the overall quality of outcomes. Simultaneously, through machine learning, data mining, and other technologies, AI provides intelligent monitoring, early warning, scheduling, and collaboration functions during the execution phase of research projects. This ensures real-time tracking of project progress, early identification of potential issues, and ultimately improves the efficiency and outcomes of project execution.

The comprehensive application of Artificial Intelligence in research project management at higher education institutions not only effectively elevates the intelligence level of project selection, optimization, and text processing and generation but also, through monitoring and collaboration, makes research management more scientific, efficient, and precise. These intelligent support measures contribute to efficiently driving the entire lifecycle of research projects, achieving a modernized upgrade in research management.

## **2.2 Research Team Management and Artificial Intelligence**

AI provides intelligent support for research managers at higher education institutions, comprehensively covering various aspects of research team formation, cultivation, motivation, and evaluation. Its aim is to enhance the overall capability and vitality of research teams. Specifically, Artificial Intelligence demonstrates multifaceted applications in research team management. By analyzing information such as researchers' academic backgrounds, research interests, and contributions, AI offers intelligent functionalities like recruitment, matching, configuration, and optimization for research teams. This allows research managers to construct more precisely tailored and efficiently collaborative research teams.

Leveraging technologies like natural language processing and knowledge graphs, AI provides intelligent generation, auditing, evaluation, and feedback for documents such as research team proposals, midterm reports, and final reports. This enhances the quality of texts, subsequently improving the success rate of project applications and the quality of outcomes. Simultaneously, through machine learning, data mining, and other technologies, AI provides intelligent monitoring, early warning, scheduling, and collaboration functions during the execution phase of research teams. This achieves real-time tracking of project progress and issue identification.

In the realm of research team management, the application of Artificial Intelligence not only improves the overall organizational efficiency of teams but also, through personalized training and guidance, provides more targeted academic development support for team members. Through intelligent incentives and evaluations, AI assists research managers in more fairly assessing the contributions of team members, sparking their innovation and research enthusiasm, and driving the efficient operation of the entire research team. These intelligent support measures collectively build a research team that is more cohesive, innovative, and effective, further propelling the modernization upgrade of research management.

## **2.3 Management of Research Achievements and Artificial Intelligence**

AI plays a crucial role in providing intelligent support for the management of research achievements in higher education institutions, covering key processes such as the collection, organization, storage, retrieval, presentation, and transformation of research outcomes. Its aim is to enhance the overall value and impact of research achievements. Specifically, Artificial Intelligence is applied in the following aspects:

Through technologies such as natural language processing, image recognition, and speech recognition, AI achieves intelligent identification, classification, labeling, summarization, and more for research achievements. This enables research managers to swiftly and comprehensively acquire and process information related to research outcomes. Leveraging technologies like knowledge graphs, data warehouses, and cloud computing, AI provides intelligent storage, indexing, querying, and recommendation functionalities for the storage and retrieval of research achievements, enhancing data availability and retrieval accuracy.

Simultaneously, through data visualization, multimedia presentations, virtual reality, and other technologies, AI offers intelligent presentation, demonstration, interaction, and communication functionalities for the display and transformation of research achievements. This empowers research managers with more intuitive and dynamic means to showcase research outcomes, effectively improving the dissemination and promotional impact of the achievements.

These intelligent support measures collectively build a more efficient, intelligent, and interactive research achievement management system, providing research managers with powerful tools to better facilitate the management and application of research outcomes at every stage of research management.

## **2.4 Research Evaluation Management and Artificial Intelligence**

AI provides intelligent support for research managers in higher education institutions, encompassing various stages of research evaluation design, implementation, analysis, improvement, aiming to enhance the fairness and scientific rigor of research assessments. Specifically:

By analyzing elements such as the objectives, criteria, indicators, and methods of research evaluation, Artificial Intelligence offers intelligent functionalities like modeling, optimization, validation, and correction for the design of research evaluations. This assists research managers in developing more rational and scientific evaluation schemes.

Utilizing intelligent data collection, processing, computation, and output functionalities, AI provides efficient execution support for the implementation of research evaluations, ensuring the accuracy of the evaluation process and the integrity of data.

Through the analysis of the impact, effectiveness, issues, and recommendations of research evaluations, AI offers intelligent functionalities such as analysis, assessment, diagnosis, and optimization for the analysis and improvement of research evaluations. This helps research managers continually enhance the quality and standards of research evaluations.

These intelligent support measures effectively elevate the efficiency of research evaluation management, drive the continuous optimization of research evaluation systems, and empower research managers with the ability to design evaluation frameworks, efficiently execute evaluation tasks, and continually improve evaluation mechanisms.

## ***2.5 Research Support Management and Artificial Intelligence***

AI provides intelligent support for research managers in higher education institutions, covering various aspects of research support planning, coordination, services, supervision, aiming to enhance the efficiency and quality of research support. The specific applications of Artificial Intelligence in research support management are as follows:

By analyzing factors such as the demands, resources, policies, and mechanisms of research support, AI offers intelligent functionalities like prediction, matching, allocation, and adjustment for the planning of research support. This assists research managers in devising rational plans for research support.

Utilizing AI's intelligent collaboration, communication, negotiation, and coordination functionalities, research managers can more

effectively coordinate the relationships within research support, promoting collaborative success.

Through the analysis of feedback on the effectiveness, satisfaction, issues, and improvements related to research support, AI provides intelligent services, responses, evaluations, and monitoring for the service and supervision of research support. This helps research managers continually enhance the level of service and supervision in research support.

These intelligent support measures collectively build a more efficient, collaborative, and service-oriented research support management system, providing research managers with powerful tools to better facilitate the efficient operation of research support in planning, coordination, services, and supervision.

## **3. ANALYSIS OF TYPICAL SCENARIOS FOR THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN RESEARCH MANAGEMENT IN UNIVERSITIES**

### ***3.1 Scenario 1: Analysis of Artificial Intelligence Application in University Research Data Management***

In university research management, leveraging artificial intelligence technology for research data management enables intelligent processing, including aspects such as data recognition, classification, annotation, indexing, and recommendations. This is evident in the following data resource management tools:

- **Data Repository:** Serving as the platform's data storage and management center, it is responsible for organizing, storing, backing up, updating, and maintaining various types of research data, including text, images, videos, audio, tables, code, and more. Through the automation provided by artificial intelligence technology, data is structured, standardized, and normalized, improving readability, usability, and trustworthiness.
- **Data Knowledge Graph:** Acting as the platform's data retrieval and display center, it provides, displays, retrieves, queries, and browses various dimensions and levels of research data, including metadata, datasets, data samples, data relationships, and data sources. Through artificial intelligence

technology, automated processing of data, such as association, mapping, fusion, and inference, enhances data visualization, semantic understanding, and intelligence, improving data interpretability, explorability, and discoverability.

- **Data Intelligent Analysis System:** Serving as the platform's data analysis and utilization center, it is responsible for analyzing, processing, utilizing, and transforming various research data, including data cleaning, data mining, data modeling, data prediction, data evaluation, and data optimization. Through the automation provided by artificial intelligence technology, processes like segmentation, clustering, dimensionality reduction, feature extraction, pattern recognition, machine learning, and deep learning enhance data quantification, statistics, analysis, and interpretation, improving data computability, comparability, and evaluability.

The expected outcomes of this intelligent research data management system include:

- **Data Decision-Making:** By comprehensively managing and intelligently analyzing research data, it provides data-driven decision support for university research management. This includes various stages of research project application, approval, execution, acceptance, and evaluation, offering data guidance, suggestions, evaluation, and feedback, thereby improving the quality and efficiency of research projects and reducing risks and costs.
- **Data Value:** By effectively utilizing and innovatively transforming research data, it provides data-driven value creation for university research management. This includes various stages of research outcome generation, presentation, dissemination, and transformation, offering data support, recommendations, evaluation, and promotion, thereby enhancing the innovation and impact of research outcomes, and promoting their application and transformation.

### ***3.2 Scenario 2: Application of Artificial Intelligence in University Research Team Management***

University research teams, as the core of research activities, involve various aspects such as projects, personnel, outcomes, and funding. With

the expansion of research scale, diversification of fields, and increased complexity of tasks, team management faces challenges such as inefficient information flow, low collaboration efficiency, unfair evaluation, and insufficient motivation. The introduction of artificial intelligence technology can provide integrated research management services for university research teams, covering aspects such as project application, execution, monitoring, evaluation, and completion; recruitment, training, assessment, and motivation of research personnel; generation, presentation, dissemination, and transformation of research outcomes; as well as application, allocation, utilization, and audit of research funds. This facilitates standardized, transparent, collaborative, and optimized research team management. The specific contents include:

- **Project Management:** Utilizing artificial intelligence's literature search and generation technology to guide and support project application for research teams can significantly enhance the efficiency and quality of the research process. Data analysis and visualization techniques are employed for monitoring and evaluating project execution, providing feedback, and offering final reports and summarizations. Knowledge graph and recommendation technologies provide project-related information, latest developments, and suggestions for extension and innovation.
- **Personnel Management:** Leveraging facial recognition and comparison technology for identity verification and attendance records of research personnel can streamline administrative processes and improve the security and accuracy of access control within research facilities. Speech recognition and synthesis technologies offer voice communication and instructions, while emotion analysis and generation technologies provide emotion recognition, regulation, encouragement, and praise for research personnel.
- **Outcome Management:** Utilizing artificial intelligence's image recognition and generation technology for image processing and presentation of research outcomes can greatly enhance the clarity, accuracy, and visual appeal of scientific data, making it easier for researchers to communicate their findings and for audiences to understand complex concepts. Natural language processing and generation technologies handle the text processing and presentation of research outcomes. Social network analysis and

generation technologies provide analysis and optimization of the dissemination of research outcomes, as well as transformation, connection, and recommendations.

- **Funding Management:** Employing artificial intelligence's digital recognition and generation technology for the digital processing and presentation of research funds can optimize financial management, automate reporting, and ensure greater transparency and accountability in the allocation and tracking of research budgets. Rule-based reasoning and generation technologies offer rule formulation and execution for research teams' funds. Exception detection and processing technologies discover and correct funding anomalies, along with audit assessments and recommendations.

The expected outcomes of this artificial intelligence application for university research team management include:

- **Enhanced Efficiency:** Through automated, intelligent, and collaborative processing, it reduces the human, time, and resource consumption in research team management, improving efficiency and effectiveness. This enables research teams to focus on research innovation and development.
- **Improved Quality :**Through standardized, transparent, and optimized processing, it enhances the quality and level of research team management, providing more reliable, accurate, and valuable research management services, promoting the improvement of research quality and level within the team.
- **Expanded Functionality:** Through innovative, expanded, and personalized processing, it broadens the functionality and scope of research team management, providing more diverse, flexible, and personalized research management options, meeting the diverse and differentiated research management needs of research teams.

#### 4. CONCLUSION

This paper aims to explore the multifaceted applications of AI in university research management, covering five scenarios: research data management, research team management, research outcome management, research evaluation management, and research support management.

The introduction of intelligent technologies has elevated university research management to a more efficient, higher-quality, and intelligent level.

For instance, in research data management, AI is applied to processes such as identification, classification, labeling, indexing, and recommendation, leading to the establishment of a system comprising a data resource repository, data knowledge graph, and data intelligent analysis system. This system not only achieves the structuring, standardization, and normalization of research data but also enhances data readability and accessibility. Additionally, it provides data-driven decision support and value creation for university research management.

In the realm of research team management, AI encompasses aspects such as project management, personnel management, outcome management, and funding management. Intelligent processing is implemented throughout stages like project application, execution, monitoring, evaluation, and completion, offering research teams more accurate and valuable information. Simultaneously, AI facilitates efficient, standardized, and transparent research team management by handling identity verification, attendance records, emotion recognition, encouragement, outcome processing, and digital fund presentation.

Regarding expected outcomes, these applications make research management more data-supported and intelligence-driven, enhancing the quality and impact of research projects and outcomes. Through automation, the burden of research management is alleviated, and the functionalities and scope of research team management are expanded to meet diverse management needs.

In summary, artificial intelligence plays a constructive role in university research management, laying the foundation for efficient, standardized, and intelligent research management and driving continuous improvements in research quality and level. Looking ahead, with the ongoing progress of AI technology, its application in university research management is expected to evolve, bringing more innovation and progress to the field of research.

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