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# Design and Implementation of an Artificial Intelligence-Based Scientific and Technological Intelligence Analysis and Evaluation System

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**Abstract:** *To address the limitations of current sci-tech intelligence analysis, such as insufficient depth, limited coverage and low automation, this paper designs and implements an artificial intelligence-based scientific and technological intelligence analysis and evaluation system. It deeply integrates NLP, LLMs, and knowledge graph technologies to build an AI-domain knowledge graph and an advanced technology evaluation module, realizing a fully automated workflow from data acquisition to one-click report generation. The backend uses Spring Boot, and the frontend uses Vue. A Bert-CRF model is employed for named entity recognition, while LDA topic modeling and Leiden community detection enable frontier technology evaluation. This paper presents the system architecture, module design, and testing results, verifying the system's effectiveness.*

**Keywords:** *Science and technology intelligence; Artificial intelligence; Knowledge graphs; Large language models*

## 1. Introduction

The rapid advancement of artificial intelligence (AI) technologies has sparked enthusiasm and profound reflection on the application of AI across various domains, including the field of information science[1]. How to rapidly identify frontier technology directions and discern disruptive technology signals from massive, multi-source, and heterogeneous scientific and technological literature has become a major challenge facing the information science community. Sci-tech intelligence professionals often rely on their personal expertise and technical experience to evaluate and assess such information[2], which suffers from notable drawbacks including low efficiency, high subjectivity, and delayed response. Developing a lightweight, fully automated intelligent intelligence analysis and assessment system tailored for specific domains holds significant theoretical value and practical importance.

This paper aims to design and implement an AI-based scientific intelligence analysis and evaluation system. Focusing on artificial intelligence, the system provides enterprises' R&D departments and university researchers with a comprehensive suite of intelligent intelligence services, ranging from knowledge graph exploration and cutting-edge technology assessment to intelligent Q&A and report generation. It enables companies to quickly identify technology development directions and mitigate patent infringement risks, while assisting researchers in accurately pinpointing research hotspots and frontier areas.

## 2. Project research background

### *2.1. Domestic Research Status*

#### *2.1.1. Research on Disruptive Technology Identification*

Domestic research has developed rapidly in recent years. Zhao Yutong and Yang Jianlin[3], taking the field of artificial intelligence as an example, constructed a disruptive technology identification framework based on technological convergence by analyzing manual code mutations in cross-domain patents. Liu Junwan et al.[4], employing a patent weak signal detection model and a disruptive technology potential measurement system, utilized the LDA topic model and precursor function filtering to provide an effective set of methods and approaches for the early identification of disruptive technologies. Zheng et al.[5] adopted the BERTopic model to analyze multi-source data in the field of artificial intelligence, deeply revealing the evolutionary trajectories of technological topics and thereby offering a theoretical basis for strategic decision-making.

#### *2.1.2. Research on Application Scenarios of Knowledge Graph and Large Language Model Integration*

Domestic research has actively embraced large language model (LLM) technologies and explored their deep integration with knowledge graphs. Wang Yong et al.[6] designed a university research management question-answering system that integrates knowledge graphs and LLMs, utilizing the DIET model for intent classification and entity recognition, thereby effectively enhancing the intelligence level of research management. Zhan Chuan et al.[7] focused their study on high-value patents, constructing an emerging technology identification framework that integrates knowledge graphs and social network analysis. By extracting patent text features using models such as Doc2Vec, they systematically revealed the semantic and structural relationships within patent data.

This paper emphasizes the synergy between LLMs and knowledge graphs: knowledge graphs can provide factual grounding for LLMs, effectively constraining their output; LLMs can endow knowledge graphs with robust semantic understanding capabilities and natural language interaction interfaces[8].

#### *2.1.3. Research on Multi-source Data Fusion and Topic Evolution Analysis*

Scholars are committed to breaking down barriers between multi-source data such as papers and patents to conduct more comprehensive assessments of technology landscapes. Lin et al.[9], from the perspective of technological science and drawing on Qian Xuesen's theory of technological science, explored the intrinsic mechanisms of knowledge evolution in the field of artificial intelligence, providing profound insights for promoting sustainable technological development. Shan et al.[10], based on Derwent patent data, used the LDA topic model to analyze the evolution of technology topics in artificial intelligence patents, revealing a complete upgrade path from chips, perception, and algorithms to applications.

### *2.2. Development Prospects*

According to the 56th Statistical Report on the Development of China's Internet released by the China Internet Network Information Center (CNNIC), as of June 2025, China had 1.123 billion internet users, with an internet penetration rate of 79.7%. China is accelerating the implementation of the "AI+" initiative, promoting the deployment of large language models in key industries to enhance the intelligence level of various sectors. Generative artificial intelligence services are emerging in large numbers; as of March 2025, a total of 346 generative AI services have completed registration with the Cyberspace Administration of China[11]. With the in-depth implementation of the "AI+" initiative, the market demand for scientific and technological intelligence analysis services continues to grow. These data indicate that intelligent sci-tech intelligence systems have promising market prospects and broad application potential.

## 3. Functional Analysis of an AI-Based Sci-Tech Intelligence Analysis and Assessment System

This system focuses on the actual intelligence service needs of corporate R&D departments and university researchers, providing full-process intelligent intelligence analysis and assessment functions for the artificial intelligence domain.

### *3.1. Requirement Analysis*

System requirements stem from two levels. Corporate R&D needs real-time tracking of competitors, patents, risks, and collaboration opportunities to pinpoint R&D directions and avoid redundancy. University research needs rapid identification of hotspots, disruptive technologies, and breakthrough directions with visual analyses to enhance research foresight. Traditional manual methods are inefficient, subjective, and slow. This system uses AI to create an automated closed loop from

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multi-source data to intelligent insights, addressing these issues.

### *3.2. Core Functions*

The system addresses core needs in corporate R&D and university research by offering four AI-focused functions: AI knowledge graph exploration via Neo4j for quick technology and competitive landscape insights; intelligent frontier technology identification that tracks keyword evolution to detect disruptive and breakthrough directions for high-value R&D; automated report generation with built-in templates for one-click Word export to reduce manual effort; and an LLM-powered QA assistant supporting natural language queries on technology trends and patent risks. These functions significantly enhance sci-tech intelligence efficiency, enabling users to rapidly derive actionable insights from massive data.

## 4. Design Analysis of the AI-Based Sci-Tech Intelligence Analysis and Assessment System

### *4.1. System Design Framework and Approach*

This paper designs and implements an AI-based sci-tech intelligence analysis and assessment system. The system adopts a front-end and back-end separation architecture, integrating technologies such as Spring Boot, Vue, Neo4j, MySQL, LDA model, Bert-CRF model, Leiden algorithm, and large language models to complete the overall system construction.

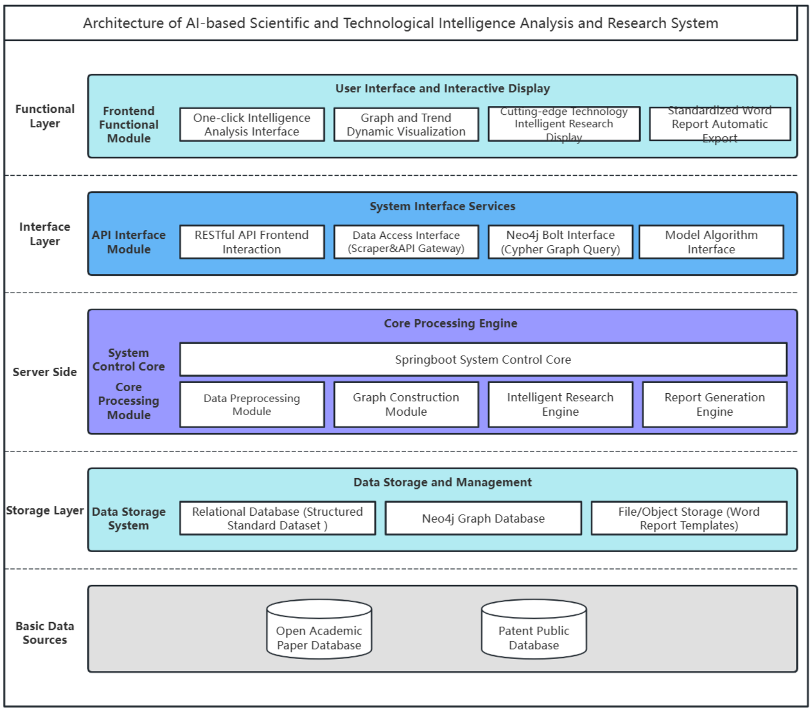


*Figure 1: Project System Architecture Diagram*

The overall architecture is divided into four layers, as shown in Figure 1:

User Interaction Layer: Built on Vue for corporate R&D and university users, providing knowledge graph visualization, frontier tech assessment, report management, and an intelligent QA assistant, with role-based access control.

Business Logic Layer: Uses Spring Boot for core logic and unified APIs, covering four modules: Knowledge Graph Construction, Frontier Technology Assessment, Report Generation Engine, and Intelligent QA.

Data Processing Layer: MySQL stores user and config data; Neo4j stores knowledge graph entity-relationship data.

System Support Layer: Includes cloud servers, object storage, and caching middleware to provide runtime environment, file storage, and performance acceleration.

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### *4.2. System Module Design and Interface Design*

#### *4.2.1. System Module Design*

To realize the core functionalities of the system, the overall system design can be divided into five main modules: the Knowledge Graph Construction Module, the Frontier Technology Assessment Module, the Report Generation Module, the Intelligent Question-Answering Module, and the User Management Module. These modules achieve close collaboration through data exchange and API calls, as shown in Figure 2.

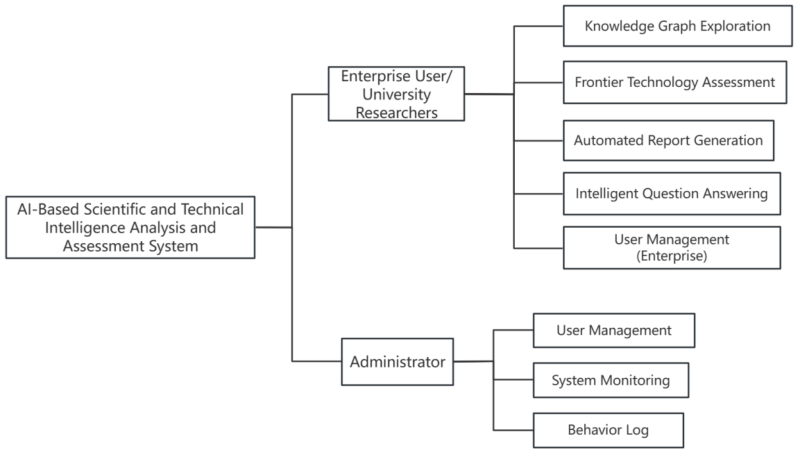


*Figure 2: System module design and interface design*

#### *4.2.2. Knowledge Graph Module*

This module supports entity recognition, relation extraction, and graph management. It integrates the Bert-CRF NER engine and a semi-supervised relation completion algorithm to enable visual query and exploration in Neo4j. Users can view entity details (research institutions, researchers, technical concepts, patents) and their relationships, with filtering by technical field and time range.

#### *4.2.3. Frontier Technology Assessment Module*

This module integrates LDA topic modeling, Leiden community detection, and disruptive technology identification. Users select a time range and dataset, then click to perform trend analysis, generating topic evolution maps and community clusters. It also supports patent citation statistics and technology diffusion index calculation to help identify key breakthrough directions.

#### *4.2.4. Report Generation Module*

This module is responsible for automatically matching assessment results with report templates. The system has built-in standardized report templates, allowing users to select a template and generate a Word-format analysis report with one click, while also supporting online preview and editing.

#### *4.2.5. Intelligent Question-Answering Module*

This module integrates large language model capabilities. Users can input intelligence queries in natural language, and the system returns precise answers based on the knowledge graph and scientific literature database, with information sources annotated, significantly improving the efficiency of intelligence acquisition.

#### *4.2.6. User Management Module*

This module provides team collaboration management functions for corporate users, supporting member invitations, role assignment, and permission control. It also offers background monitoring functions for system administrators, including system operation status monitoring, log auditing, and global user management.

### *4.3. System Interface Design*

The system interface follows the design principles of "simple and professional, data-driven, and clear functionality," adapting to the usage habits of both enterprise and university users. The main

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interfaces include the system home page, graph exploration module, intelligent assessment module, sci-tech intelligence content interface, report center module, and intelligent question-answering module.

#### *4.3.1. Home Page Interface*

The home page presents real-time data statistics and algorithm capability metrics in a data dashboard format, including the number of data sources accessed, the number of graph entities, the number of relationships, and the core functions of each module. Users can quickly grasp the overall operation status of the system.

#### *4.3.2. Graph Exploration Module Interface*

This interface provides a visual interactive interface for the Neo4j graph database. Users can explore citation, collaboration, and association relationships among technical entities through clicking, dragging, and zooming operations, and can filter and retrieve data by technical field, time range, and entity type.

#### *4.3.3. Intelligent Assessment Module Interface*

As the core functional area of the system, users can configure parameters such as time range settings and technical field selection, and perform LDA topic analysis, disruptive technology identification, and technology community detection tasks with one click.

#### *4.3.4. Report Center Module Interface*

This interface displays the user's report generation history and supports report template selection, report preview, Word-format export, and report sharing functions. The interface layout is clear and the functions are well-defined.

#### *4.3.5. Science and Technology Information Content Interface*

The sci-tech intelligence interface integrates patent and paper tracking, displaying totals in a dashboard with multi-condition retrieval. A technology hotspot ranking below shows high-interest technologies and growth trends in real time, offering one-stop query and dynamic tracking services.

#### *4.3.6. Intelligent Question-Answering Interface*

This interface provides a conversational interaction window based on large language models. Users can enter natural language questions, and the system returns answers in real time with annotated information sources. The interface supports saving of historical conversation records, question recommendations, and feedback evaluation.

## 5. System Testing of the AI-Based Sci-Tech Intelligence Analysis and Assessment System

### *5.1. System Functional Testing*

The system function test includes seven items, as detailed in Table 1.

*Table 1: System function test.*

| Test Content | Test function | Test Result |
|---|---|---|
| User Login and Registration | After entering account and password, the login function can be performed | Pass |
| Knowledge Graph Filtering, Retrieval, and Management | Filter and retrieve by technology, time, and type | Pass |
| Knowledge Graph Visual Exploration | Click on entity nodes in the Neo4j interface to view entity details and relationships | Pass |
| Frontier Technology Assessment | Select a dataset of papers in the AI field from the past five years and perform topic clustering analysis | Pass |
| Disruptive Technology Identification | Execute disruptive technology identification tasks on the patent database | Pass |
| Automated Report Generation | Select assessment results and a report template, then generate a Word report with one click | Pass |
| Intelligent Question-Answering | Input questions related to sci-tech intelligence | Pass |

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### *5.2. Demonstration of Key Functions*

#### *5.2.1. Knowledge Graph Visual Exploration Function*

This Neo4j-based function visualizes tech knowledge via a graph canvas. Users search entities to see semantic relationships, quickly revealing technology evolution, collaborations, and connections to support research and benchmarking, as shown in Figure 3.

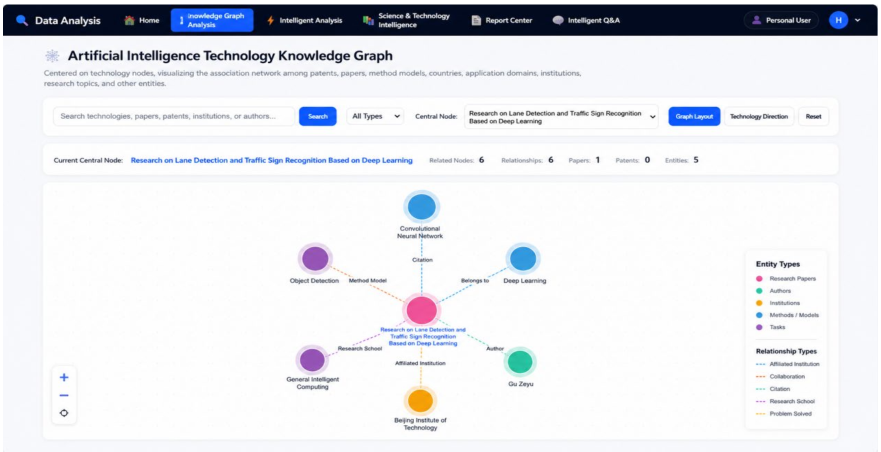


Figure 3: Knowledge Graph Module

#### *5.2.2. Frontier Technology Intelligent Assessment Function*

Users input keywords, select dimensions and time range, then click for frontier analysis. The system uses a knowledge graph and AI to generate a summary of development stage, trends, scores, breakthroughs, and recommendations—aiding research and R&D decisions, as shown in Figure 4.

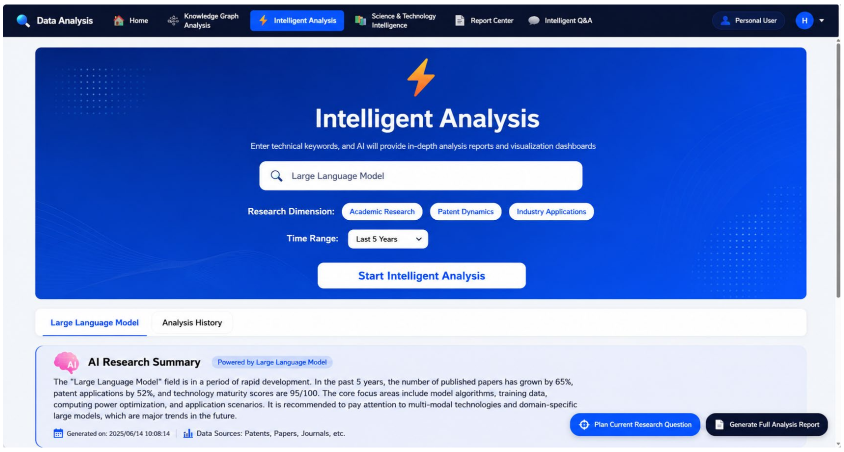


Figure 4:Frontier Technology Assessment

#### *5.2.3. Automated Report Generation Function*

The report center interface generates professional reports directly from assessment results. Users can set a title, select a template, and export a Word report with one click, also supporting online preview, editing, and export. The system automatically integrates assessment summaries, core data, trends, and recommendations, significantly reducing manual writing costs and improving output efficiency, as shown in Figure 5.

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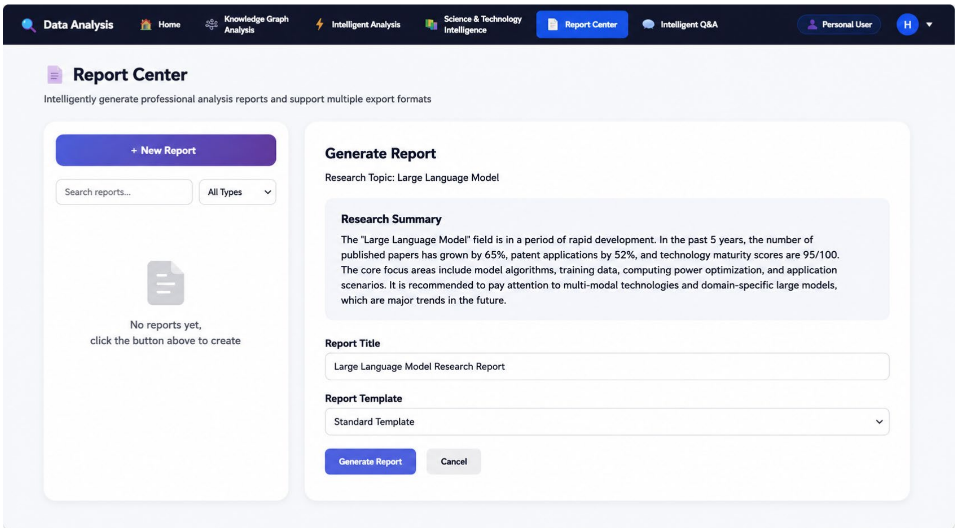


*Figure 5: Automated Report Generation*

### *5.2.4. Intelligent Question-Answering Assistant Function*

The intelligent QA interface offers LLM-powered dialogue. Users ask sci-tech intelligence questions in natural language, and the system returns structured, professional answers.It also saves and retrieves conversation history for online Q&A, as shown in Figure 6.

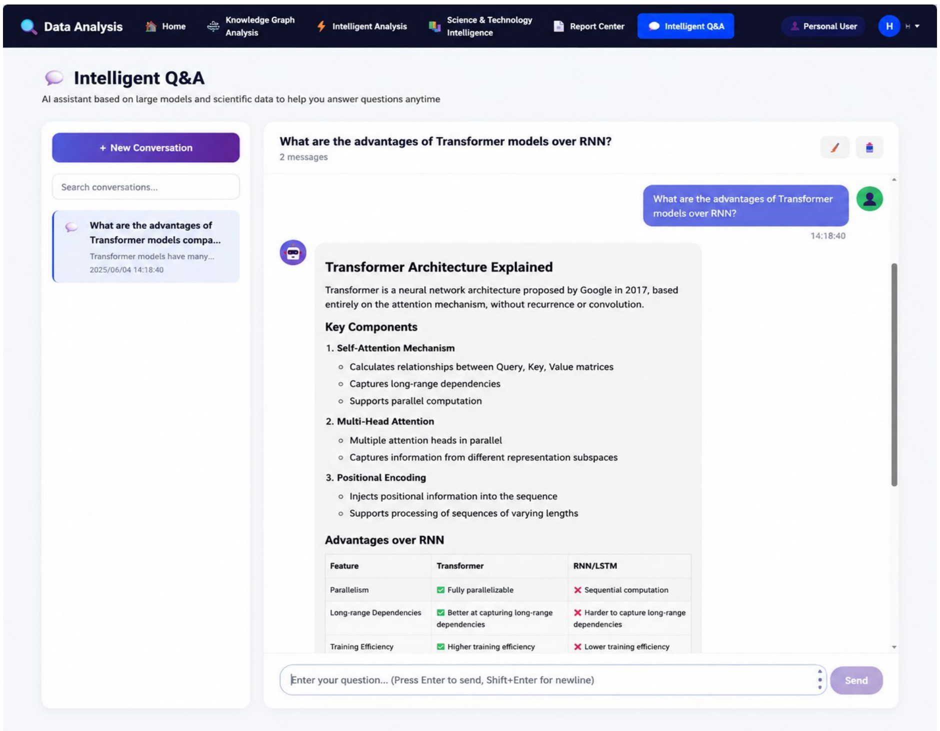


*Figure 6: Intelligent Question-Answering*

## 6. Conclusion and Future Work

### *6.1. Conclusion*

Addressing the deficiencies of current sci-tech intelligence analysis (assessment depth, data coverage, report automation), this paper designs an AI-based analysis and assessment system. It integrates NLP, LLMs, and knowledge graphs to provide one-stop services from knowledge graph exploration to report generation. Test results show the system meets targets in entity recognition, trend analysis, and report efficiency, improving analysis quality. It remedies existing systems' shortcomings and supports corporate R&D and university research.

### *6.2. Future Research Directions and Prospects*

Future work can be optimized and expanded in two aspects: (1) Extending personalized assessment modules from AI to other key national strategic areas (biomedicine, new energy, integrated circuits) to build a more comprehensive sci-tech intelligence knowledge system; (2) Exploring agent-based collaborative evolution to upgrade single analysis systems into multi-agent task-oriented systems, achieving a transition from passive response to proactive early warning.

## Acknowledgment

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## References

*[1] Li Guangjian, Pan Jiali. The Process and Current Reflections on Empowering Intelligence Work with Artificial Intelligence Technology[J]. Journal of Information Resources Management, 2024, 14(2): 4-20. DOI:10.13365/j.jirm.2024.02.004.*

*[2] Zhang Yuchen, Xuan Jia. Operation Mode of Sci-Tech Intelligence Work under the Influence of Generative Artificial Intelligence Technology[J]. National Defense Technology, 2025, 46(5): 106-114. DOI:10.13943/j.issn1671-4547.2025.05.13.*

*[3] Zhao Yutong, Yang Jianlin. Research on Disruptive Technology Identification Based on Cross-Domain Patents: A Case Study in the Field of Artificial Intelligence[J]. Information Theory and Practice, 2023, 46(3): 174-182. DOI:10.16353/j.cnki.1000-7490.2023.03.023.*

*[4] Liu Junwan, Pang Bo, Xu Shuo. Early Identification of Disruptive Technologies Based on Weak Signals[J]. Journal of the China Society for Scientific and Technical Information, 2023, 42(12): 1395-1411.*

*[5] Zheng X, Wu Q, Luo X, et al. Analyzing the evolutionary trajectory of technological themes based on the BERTopic model: A case study in the field of artificial intelligence[J]. PloS one, 2025, 20(6): e0324933. DOI:10.1371/JOURNAL.PONE.0324933.*

*[6] Wang Yong, Qin Jiajun, Huang Yourui, et al. Design of University Research Management Question-Answering System Integrating Knowledge Graph and Large Language Model[J]. Journal of Computer Science and Exploration, 2025, 19(1): 107-117.*

*[7] Zhan C, Zhou Y, Huang Y. Research on Emerging Technology Identification Methods Based on a Knowledge Graph of High-Value Patents[J]. Big Data and Cognitive Computing, 2026, 10(2): 40. DOI:10.3390/BDCC10020040.*

*[8] Wang Ping, Xu Jian, Wang Xiaodong. Construction and Optimization Method of Intelligent Knowledge Base Integrating Knowledge Graph and Large Language Model[J]. Information Recording Materials, 2026, 27(10): 119-121+148. DOI:10.16009/j.issn.1009-5624.2026.10.039.*

*[9] Lin Y, Xu C, Xu K, et al. Research on the Knowledge Structure and Sustainable Development Pathways of Artificial Intelligence from the Perspective of Technological Science[J]. Sustainability, 2024, 16(20): 9019. DOI:10.3390/SU16209019.*

*[10] Chunyi S, Jun W, Yongming Z. The Evolution of Artificial Intelligence in the Digital Economy: An Application of the Potential Dirichlet Allocation Model[J]. Sustainability, 2023, 15(2): 1360.*

*[11] Entering a New Stage of "AI+" and Sharing New Achievements in Digital Development: The 56th Statistical Report on China's Internet Development Released[J]. Information Construction, 2025, (8): 49-51.*