Meta-Publishing Concepts and Platform Construction Practices for Open Science: Post-Print

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Abstract

Based on comprehensive investigation of the domestic and international open publishing landscape, this study elaborates on the driving role of open science in the evolution of academic communication systems and mechanisms, focusing on analyzing and summarizing the historical evolution, developmental transitions, and evolutionary patterns of academic publishing models. It proposes the meta-publishing concept to adapt to the demands of the open science era and the evolutionary trends and paradigm shifts in academic publishing. Grounded in the "meta-publishing" concept, a construction framework for a meta-publishing platform is presented to promote the establishment of a new open science academic publishing paradigm led by the scientific community, which integrates diverse publishing content, achieves multi-dimensional content interlinking, aggregates multiple stakeholders, and supports the re-integration of scientific achievements. Following the design philosophy of the meta-publishing platform, MetaPub—a meta-publishing platform encompassing five modules including a structured publication engine, peer review subsystem, open publishing subsystem, knowledge discovery subsystem, and academic communication community subsystem—has been constructed. The meta-publishing platform constitutes a concrete practice aligned with the development trends of open science and will play an active supporting role in the academic communication processes of the scientific community.

Full Text

Preamble

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Philosophy of Meta Publishing and Practice of Platform Construction Toward Open Science

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Abstract

Based on a comprehensive investigation of the open publishing landscape both domestically and internationally, this study examines the role of open science in driving the evolution of academic exchange systems and mechanisms, with a focused analysis and synthesis of the historical evolution, developmental transitions, and underlying patterns of academic publishing models. We propose the concept of meta-publishing to meet the demands of the open science era and to adapt to the ongoing evolution and paradigm shifts in academic publishing. Grounded in the "meta-publishing" concept, we present a framework for constructing a meta-publishing platform designed to foster a new open science academic publishing paradigm led by the scientific community—one that integrates diverse publishing content, enables multi-dimensional content association, aggregates multiple stakeholders, and supports the re-integration of scientific achievements. Following this design approach, we have developed MetaPub, a meta-publishing platform comprising five modules: a structured publication engine, peer review subsystem, open publishing subsystem, knowledge discovery subsystem, and academic exchange community subsystem. The meta-publishing platform represents a concrete practice aligned with open science development trends and will play an active supporting role in facilitating academic exchanges within the scientific community.

Keywords: meta publishing, structured data, publishing platform, open science

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1. Open Science Development Driving the Transformation of Academic Exchange Mechanisms

Open science advocates for improving research transparency and reproducibility, strengthening scientific innovation and collaboration, and accelerating the dissemination and translation of research outcomes by opening the entire research process—including methodologies, tools, procedures, results, and academic exchanges. Open science enables the flow and sharing of infrastructure, research outcomes, academic ideas, and intellectual contributions across broader contexts, making science more accessible to diverse societal groups. Driven

by open science, nations worldwide are actively introducing new academic exchange norms, platform tools, and service measures embodying innovative concepts. In August 2021, UK Research and Innovation (UKRI) announced an investment of £650,000 to develop Octopus, a new open publishing platform designed to record and evaluate scientists' latest research findings. In China, the *14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives Through 2035*, released in March 2021, includes "building a high-end platform for national research papers and scientific and technological information" as part of Chapter 4, Section 4 on "strengthening national strategic scientific and technological capabilities." This initiative aims to establish a high-level academic exchange ecosystem amid current complex economic and social conditions, thereby fostering innovation and transformation in scientific research and advancing China's progress toward becoming a global scientific and technological powerhouse.

Against this backdrop of accelerating open science evolution, the academic publishing system is undergoing dynamic development and transformation, exhibiting digital and diversified characteristics to support emerging academic exchange needs with greater openness. First, academic publication content has become more diverse and publishing methods more open. Publication types have expanded from text to include data, images, multimedia, and multi-source integrated information, while dissemination methods have gradually shifted from traditional journal articles to diversified approaches encompassing software, scientific data, and research methodologies. In 2014, Elsevier launched *MethodsX*, a research elements journal publishing methods and materials developed and used during experiments, while *SoftwareX* conducts peer review of scientific software tools and allows subsequent metadata publication and updates. Both have been indexed by major academic databases such as Scopus, Web of Knowledge, and PubMed. Second, academic exchange communities are being established and developing rapidly. Exchange channels have expanded to include blogs, microblogs, WeChat public accounts, personal websites, social networks, and online conferences. In recent years, the rise and development of academic exchange communities such as ResearchGate, Publons, and Mendeley have profoundly impacted knowledge dissemination and communication methods. Researchers establish academic profiles, publish viewpoints and findings, and track research directions and progress of relevant teams to build and expand their academic networks. However, China currently lacks open publishing platforms that effectively integrate open academic exchange, knowledge mining based on exchange content, and rapid dissemination of academic achievements. Particularly in an era of comprehensive knowledge digitization, traditional conceptual frameworks have not been fully broken through, and the potential of academic publishing to support knowledge re-creation has not been fully unleashed. Based on thorough investigation of relevant domestic and international developments, we propose the concept of meta-publishing to adapt to the open science process and have explored the development of the MetaPub platform, which integrates preprint publishing, data publishing, and structured information publishing. This paper

aims to explore the philosophy and practice of meta-publishing, examine new paradigms for open publishing, and provide researchers with new options for open exchange of academic achievements.

2. Open Publishing Philosophy Transforming Traditional Academic Exchange Models

Open science has endowed knowledge production, dissemination, and exchange with richer characteristics. Advances in digital technology not only provide new connotations for traditional academic exchange mechanisms but also create favorable conditions for meeting the diverse needs of researchers. Academic achievements are being published and disseminated in more diverse ways and at faster speeds, enabling academic peers to more quickly and accurately understand the latest research findings and engage in more open exchanges and collaborations with cross-disciplinary scholars. To meet the demands of open academic exchange and technological innovation paradigms, the forms and content of academic publishing will undergo profound transformations, with new publishing platforms continuously emerging and upgrading. Traditional journal-centric publishing models will enter an active reform and development phase with increasingly rich forms and content.

2.1 Historical Evolution of Academic Journal Publishing

As the fundamental form of academic exchange and the primary mode of academic publishing, academic journals have undergone multiple stages of development since their emergence in the mid-17th century, which established the journal-based academic exchange mechanism. Over the past 400 years, academic journal publishing forms and content have continuously evolved and innovated alongside the growth of academic societies and professional associations, the establishment of publishers, the creation of post-WWII scientific policies and institutions, the rise and application of internet technology, and the advancement of open science and open publishing. Based on comprehensive research on scholarly works analyzing changes in academic journal quantities and 梳理 of relevant major events, we have mapped the development evolution and quantity trends of academic journal publishing [Figure 1: see original paper].

The evolution can be divided into three phases: (1) **Traditional print publishing**, beginning in the mid-17th century, when over 100 academic journals were successively established worldwide, the peer review system was established, and publishers were founded and gradually grew. By the first half of the 20th century, the rapid popularization of typewriters and the advent of the electrical age significantly enhanced the efficiency and breadth of academic exchange. Article publication became the most popular form in specific disciplines such as physics and chemistry, elevating the importance of journals. Following WWII in 1945, science entered an accelerated development phase with the emergence of "Big Science" models, leading to rapid growth in both article and journal num-

bers. (2) **Digital and online publishing**, which emerged in the second half of the 20th century with the popularization of computers and development of internet technology. Electronic versions of journal articles gradually became the primary publishing and knowledge dissemination format, and a batch of purely digital journals emerged and developed. In 1957, Eugene Garfield created the Science Citation Index (SCI), enabling more efficient and comprehensive article indexing and citation evaluation, and pioneering the development of bibliometrics, journal evaluation, and scholar impact assessment. (3) **Preprints and open publishing**, which have accelerated academic achievement publication and exchange since the late 20th century. For example, the preprint platform arXiv was created in 1991, and the Social Science Research Network (SSRN) preprint repository in 1994. Entering the 21st century, as the academic publishing market locked publicly funded research literature behind paywalls, demands for free access to academic research literature from researchers and the public intensified. Open access journals and open publishing platforms emerged to meet the urgent needs of academic exchange and technological innovation.

2.2 Development and Iteration of Academic Journal Publishing Models

As the core of academic exchange mechanisms, academic journal publishing models have continuously developed and iterated under the support of information technology, driven by research paradigms, and led by the open science movement, evolving from traditional academic publishing models toward open publishing models with changes in content, methods, and forms.

2.2.1 Traditional Academic Journal Publishing Traditional academic journal publishing is dominated by publishing institutions and editorial teams with robust rules and rigorous processes, imposing high requirements on content and format. Manuscripts must undergo peer review to evaluate academic quality and innovation, and must strictly comply with professional writing standards and specific journal publication requirements. The emergence of academic publishers and their databases has significantly changed the academic publishing landscape. Leveraging substantial financial resources, technological means, and diverse marketing models, publishers have quickly become important actors in the academic publishing and exchange system. Currently, the world's five major academic publishers—Elsevier, Springer Nature, Wiley, Taylor & Francis, and SAGE—occupy more than half of the global academic journal market, wielding power to control market prices and knowledge circulation. Database aggregators have consolidated originally dispersed academic research achievements, effectively promoting research dissemination while also blocking some readers behind paywalls. From the perspective of open academic dissemination, this hinders the maximal open sharing of scientific knowledge. Overall, traditional academic journal publishing is characterized by long writing cycles, lengthy review periods, delayed publication, impeded dissemination and sharing, and complex copyright management.

2.2.2 Open Publishing Open publishing is a collective term for new academic publishing models gradually formed by stakeholders in the academic publishing field to integrate into and promote the open science movement, with open sharing as the core characteristic. Open publishing offers significant advantages over traditional academic publishing in terms of publication types, content granularity, and knowledge dissemination forms. Its publishing process is more transparent and conducive to oversight, with faster knowledge flow and broader reach. Due to its flexible forms, open publishing can cover traditional publications such as books and journals, making it inappropriate to define by traditional publishing formats.

First, open publishing features integrated publication content. Published content is not limited to strict academic papers but can also include scientific data, software tools, research questions, methodologies, and conclusions, as well as monographs systematically explaining specialized issues. Second, open publishing offers flexible publication formats. The emergence of diverse publishing formats in recent years—such as nano-publishing, semantic enhanced publishing, element publishing, and audio-video paper interpretations—has made knowledge aggregation and dissemination more convenient and enriched readers' experiences. Third, open publishing involves diversified participating institutions. In March 2021, the EU launched the Open Research Europe publishing platform, representing a typical case of research funding agencies engaging in academic publishing. The involvement of diversified publishing forces will also present different characteristics in academic publishing.

2.3 Profound Changes in Academic Publishing Models from Both Form and Content

Based on the historical evolution of academic journal publishing and the developmental transitions in academic publishing models, it is evident that with continuous scientific and technological progress and accelerated growth of scientific outputs, academic exchange demands are increasing daily. Academic publishing models, represented by journal publishing, have undergone profound changes in both form and content.

2.3.1 Historical Evolution from Traditional to Open Publishing Since the mid-17th century, journal-based academic publishing forms have evolved from traditional print publishing to digital and online publishing, and then to preprints and open publishing, effectively accelerating publication speed and greatly improving academic exchange and knowledge dissemination efficiency. *Le Journal des Sçavans*, launched in France in January 1665, and *Philosophical Transactions* published by the Royal Society of London in March 1665 are considered the earliest academic journals. France published its first specialized disciplinary journal, *Annales de Chimie-Science*, in 1789. After the 19th century, the second technological revolution spurred progress, with journals such as *Proceedings of the Academy of Natural Sciences of Philadelphia* in the United

States and *Yakugaku Zasshi* in Japan continuously advancing scientific progress and social civilization, while academic journals as communication media exerted increasing influence. China's academic journal publications began in the 19th century, initially focusing on introducing Western scientific knowledge. Between 1900 and 1919, China launched over 100 academic journals, with *Science* founded in Shanghai by Chinese students returned from the United States in 1915 representing an important milestone in early 20th-century Chinese academic journals.

In the 1990s, to facilitate more convenient and efficient academic exchange, researchers began voluntarily releasing unpublished research papers and technical reports through conference platforms or the internet, leading to the emergence of preprint publishing platforms. The preprint repository arXiv.org in high-energy physics and PubMed Central (PMC) under the public medicine center were among the first open preprint publishing platforms. Subsequently, BioRxiv, ChinaXiv, Sciencepaper Online, F1000, PeerJ Preprints, Zenodo, and FigShare were launched successively. Preprints have played a positive role in helping researchers claim priority and accelerate information exchange and sharing. Entering the 21st century, the open science concept has emerged and rapidly facilitated a new trend in academic publishing—open access to academic papers. In 2002, the Open Society Institute (OSI) released the *Budapest Open Access Initiative*. In 2003, the Howard Hughes Medical Institute in the United States and the Max Planck Society in Germany respectively announced the *Bethesda Statement on Open Access Publishing* and the *Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities*. The EU launched OpenAIRE, an open access infrastructure for European research, in 2009. In 2012, the All European Academies (ALLEA) published a joint statement, *Open Science for the 21st Century*, calling on research funding agencies to fully implement open science principles in all aspects of funded research, requiring participants to learn and embrace an open science culture, making open sharing the norm, and promoting scientific research cooperation across Europe and globally. Open science is not limited to free access to literature and data but emphasizes knowledge dissemination and application, facilitating research exchanges among scientists and even between scientists and citizens, strengthening the depth and breadth of exchanges and collaboration among various actors, thereby greatly advancing scientific development.

2.3.2 Comprehensive Improvement in Width, Depth, and Granularity of Academic Publishing Content Width of academic publishing content. With the popularization of the internet and mobile terminals, an increasing number of academic journals worldwide are publishing articles online first, including more detailed raw data, experimental methods, and process records. Some journals and authors also publish video presentations of their findings, with rich images and video materials breaking the rigid formality of traditional academic journals and becoming more attractive and readable. Academic papers have expanded into formats such as video papers and data papers, all of

which have DOIs and can be cited by other scientific research achievements. Due to expanded publishing content and the development of knowledge analysis technologies, various types of knowledge can be interconnected and recommended, providing better platforms for scientific research and making research processes more open and knowledge services more systematic.

Depth of academic publishing content. Enhanced publishing utilizes structured processing, semantic tagging, and entity linking to augment traditional paper content and improve the processing depth of fragmented information. Particularly for scientific journals, targeted marking and classification of figures, tables, and other fragmented information can enhance reading efficiency and experience. Artificial intelligence technologies (including semantic analysis, pattern recognition, data mining, intelligent algorithms, knowledge graphs, and machine learning) have greatly promoted precise capture and push of academic content, enabling deep analysis of users' reading records, temporal and spatial reading patterns, and human-computer interaction data to uncover reading needs and provide more suitable, cutting-edge, and novel academic materials.

Granularity of academic publishing content. Nano-publishing primarily uses concepts or entities as basic elements to describe scientific conclusions, facts, or experimental results from scientific literature or large experimental datasets, providing unique identifiers and contextual information such as provenance, original authors, and nano-publication creators. It represents a new form of semantic representation, organization, and publishing of scientific literature at a fine granularity. Nano-publications have smaller granularity than traditional publications and are more suitable for human and machine reading and understanding through semantic annotation of scientific conclusions in literature or databases.

In summary, academic publishing has undergone significant changes in form and content. However, continuous innovation and improvement are needed in knowledge presentation and utilization methods, dissemination speed, and exchange modes to adapt to evolving research paradigms and technological innovation demands, thereby advancing open science and open publishing.

3. Meta-Publishing Model and Platform Architecture Design and Process

Based on increasingly extensive academic exchange needs and the transformation trends in academic publishing models, our team proposes the concept of "meta-publishing" for open science. In academic research, "Meta" is a concept with broad appeal, connoting decomposition, foundation, and transcendence. Discussion of "meta" issues has become a new scientific consensus, giving rise to concepts such as "meta-media," "metaverse," "meta-symbols," "meta-cognition," and "meta-language." Currently, theoretical research specifically focused on meta-publishing is limited. Existing discussions have examined meta-publishing from a philosophical perspective, integrating "meta-issues" with pub-

lishing studies and associating meta-publishing with meta-language (linguistics) and meta-media (journalism and communication). Some platforms focus on "open access," while others merely borrow the term "meta-publishing" for unrelated content, often in game publishing. The meta-publishing discussed in this paper is a new academic publishing concept proposed based on the profound meaning of "meta," integrating publishing elements with open exchange demands, and oriented toward building high-end academic exchange platforms. Section 3 will focus on this new publishing philosophy and platform construction practice that is more open, facilitates easier publication, benefits knowledge dissemination and management, and supports knowledge organization and re-creation, to promote a new open science academic publishing paradigm led by the scientific community that integrates diverse publishing content, enables multi-dimensional content association, aggregates multiple participants, and supports the re-integration of scientific achievements.

3.1 Meta-Publishing Model for Open Science

Meta-publishing is an open publishing model that integrates current open publishing practices and concepts such as preprint publishing, data publishing, and structured information publishing. It aims to provide a ubiquitous immersive open knowledge exchange mechanism in which scientific workers are fully integrated. It represents both a development of existing academic exchange models and a transcendence of existing publishing models. Meta-publishing constructs a ubiquitous immersive open knowledge exchange system from three dimensions—deconstruction, fusion, and transcendence—to achieve meta-publishing support for broad scientific workers, open review of meta-publishing achievements, open sharing of meta-knowledge, and the use of knowledge organization, knowledge analysis, knowledge integration, and other technologies to greatly promote knowledge reproduction and open innovation.

First, **deconstruction**: Based on knowledge element module applications, research achievements can be published rapidly or in integrated form. Researchers submit content not limited to a complete, mature paper but organize research questions, methodologies, experimental processes, results, and conclusions in a modular fashion. This submission model enables structured writing, simplifies submission and review processes, facilitates reader comprehension, and simultaneously strengthens the "data" characteristics of literature to support "data" association among documents.

Second, **fusion**: Content publishing and academic exchange community development are integrated to achieve open sharing and open innovation. Emerging digital technology tools empower platform construction, enabling diversified dissemination and open sharing of meta-knowledge. Researchers can more quickly access scientific questions, achievements, and viewpoints, significantly reducing the time lag in scientific communication. The entire research chain—from topic selection and research design to implementation, output, dissemination, and knowledge reproduction—is connected, enabling cross-disciplinary

data and knowledge association and reorganization across broader disciplinary boundaries. This creates a ubiquitous knowledge dissemination and exchange open academic community that helps track scientific development dynamics, exchange cutting-edge issues, and enhance knowledge exchange and cooperation among researchers.

Third, **transcendence**: Comprehensive application of knowledge organization and big data analysis technologies establishes structured content representation, promotes efficient publication and aggregation of knowledge, and stimulates knowledge reproduction. Reading and scientific integration based on a standardized platform for meta-knowledge will be more convenient, providing more timely and effective references for parallel and subsequent scientific research and benefiting scientific progress. Over the past two decades, meta-analysis in many disciplines has developed rapidly, with increasing demand for integration research. In meta-analysis, researchers must extract, standardize, and clean data information, research questions, methodologies, and conclusions from numerous articles to establish structured knowledge identification and integrated knowledge organization, which is labor-intensive and prone to errors. The meta-publishing platform will prepare for these needs during the publication stage to support meta-analysis and integration research.

Currently, meta-publishing is in the conceptual establishment and demonstration phase, focusing on the integration of "publishing," "exchange," and "integration." In the workflow of meta-publishing, scientific achievements and knowledge are the objects of work; the process involves structured presentation of knowledge and its reorganization, reproduction, and reuse; the external forms are publication and presentation of achievements and knowledge dissemination and exchange. The scientific community will assume organizational and supervisory roles at the academic level. As members of the scientific community, researchers are both contributors and users of knowledge. By building a scientific community-led meta-publishing academic community, researchers, publishing institutions, funding agencies, R&D institutions, the public, and media can fully participate in all stages of the meta-publishing platform's knowledge innovation chain, thereby more effectively supporting academic thought generation and research innovation activities.

3.2 Design Philosophy of the Meta-Publishing Platform

Based on the meta-publishing concept, we propose a design framework for the meta-publishing platform [Figure 2: see original paper], positioning it as an environment for academic literature open publishing, knowledge organization, and academic exchange. The platform provides support for all stages of academic publishing and knowledge exchange, including paper review, processing, publication, association, dissemination, and commentary, and promotes knowledge innovation and new knowledge generation through these exchange activities. The design concept and technical route of this platform have been submitted for invention patent (patent application number CN202310341366.4).

The innovative concepts of meta-publishing are primarily reflected in new publishing objects and new publishing norms.

First, **new publishing objects**: Meta-publishing objects are elementalized and structured information, which the platform calls meta-knowledge. Through elementalization, structuring, and semantic processing of paper content, the platform supports precise expression and minimalist presentation of paper content, enabling reviewers and other readers to quickly and accurately grasp the information conveyed. Traditional paper submission requires title, author, abstract, and keywords. In addition to this information, the platform guides authors to submit paper content in structured form, including but not limited to research questions, methodologies, results, analytical conclusions, experimental tools, materials, and other content. Meta-knowledge provides relatively accurate materials for subsequent literature mining, knowledge computing, and scientific theme integration research. Additionally, beyond elementalizing paper content, the platform can provide more comprehensive information support through audio-based paper interpretations and dataset submissions.

Second, **new publishing norms**: Meta-publishing norms are structured publishing behaviors for paper meta-knowledge, which the platform calls meta-release. On traditional publishing platforms, a paper is an unstructured text containing title, author, abstract, keywords, research content, and conclusions. In contrast, the meta-publishing platform presents research questions and other content in fine granularity based on meta-knowledge, better helping experts and readers understand article content and supporting faster publication and more convenient exchange of scientific achievements. The meta-release function draws on the advantages of preprint publishing models, enabling papers that meet publication standards through domain expert review to be published immediately on the platform.

3.3 Functional Architecture and Implementation of the Meta-Publishing Platform

3.3.1 Module Design of the Meta-Publishing Platform The overall architecture design of the meta-publishing platform is shown in [Figure 3: see original paper] and mainly includes five functional modules: structured publication engine, peer review subsystem, open publishing subsystem, knowledge discovery subsystem, and academic exchange community subsystem.

The **structured publication engine** primarily conducts structured storage of researchers' academic outputs (such as scientific data and discoveries). According to the characteristics of different disciplines, it develops applicable structured publication engines for different fields, building structured publication knowledge bases and knowledge graphs. The structured publication knowledge base needs to store multiple types of data, including titles (meta-release literature names), scholars (meta-release literature authors), institutions (author affiliations), keywords (meta-release literature themes), images (attached images),

data tables (attached data including tables and parameters), etc. The structured publication knowledge graph utilizes knowledge graph construction technologies such as entity and relation extraction and entity alignment to conduct knowledge extraction, organization, and association from perspectives including research background, purpose, objects, experimental materials, methods, and results.

The **peer review subsystem** is an important tool for scientific evaluation. The system establishes a domain expert database and provides automatic reviewer recommendations based on intelligent matching technology. The process includes four main steps: (1) researchers submit structured scientific achievements to the meta-publishing platform; (2) based on these structured data, the system uses intelligent ranking algorithms to recommend the most suitable reviewers for editors; (3) reviewers conduct peer reviews and provide evaluation opinions and feedback to editors; (4) editors process and refine review opinions and feed review results back to authors for revision and resubmission.

The **open publishing subsystem** provides collaborative editing and meta-release functions. Collaborative editing includes online proofreading, typesetting, indexing, conversion, and processing of manuscripts. The meta-release function includes two modes: (1) single-article release mode, which offers more flexible publication cycles and methods compared to collection release mode, allowing domain editors to quickly publish individual papers on the platform after peer review to meet researchers' needs for rapid achievement dissemination; (2) collection release mode, where domain experts serve as editors and reviewers, and editors organize issues on a monthly or quarterly basis, similar to online electronic journal collection publishing.

The **knowledge discovery subsystem** provides personalized and precise knowledge services for academic exchange. Specifically, it utilizes knowledge reading functions to conduct comprehensive analysis of meta-release papers, provides intelligent retrieval and recommendation functions for multi-type and multi-form knowledge through information retrieval and recommendation, offers faceted navigation browsing of multi-type and multi-form knowledge through information browsing, and conducts knowledge mining on massive data including scholars, institutions, and academic achievements based on the structured publication engine. Using graph mining algorithms to build models for link prediction, community detection, and node importance judgment, it aims to detect research status and frontiers in various fields, identify academic communities, and predict scientific and technological development trends, with multi-dimensional and fine-grained knowledge panel visualization through visualization technologies.

The **academic exchange community subsystem** builds an intelligent academic exchange community subsystem by studying the forms of academic communities under open publishing mechanisms, providing researchers with more convenient and efficient academic exchange channels. Vertically, this subsystem builds domain academic exchange communities based on the structured

publication engine, integrates automatically released latest research content by robots, and incorporates domain innovation achievements to ultimately form an open domain knowledge system. Horizontally, the meta-publishing platform can also conduct information extraction and semantic enrichment calculations for meta-release content, research hotspots and cooperation relationships based on complex network analysis, and build scholar and institution profiles to promote the formation of open academic communities and facilitate more efficient and closer exchanges and cooperation within the scientific community.

3.3.3 Functional Implementation of the Meta-Publishing Platform
The meta-publishing platform is a knowledge exchange platform supporting open academic exchange within the scientific community, with the scientific community itself serving as the main actor in all process stages. [Figure 4: see original paper] presents a business process sequence diagram for researchers, including six independent services and call sequences: researcher, structured publication engine, peer review subsystem, open publishing subsystem, knowledge discovery subsystem, and academic exchange community subsystem. The eight major steps can be broadly divided into three parts: (1) academic level review based on peer review, where researchers submit structured academic achievements to the peer review system, which stores achievements in the structured publication engine and conducts peer review before submitting approved achievements back to the structured publication engine; (2) open publishing and services based on the structured publication engine, which enables open meta-publishing and provides personalized and precise knowledge services; and (3) academic exchange for the scientific community, which provides intelligent academic community exchanges for scientific knowledge discovery based on the structured publication engine.

In the MetaPub platform developed by our research team, all five module functions have been implemented: structured publication engine, peer review subsystem, open publishing subsystem, knowledge discovery subsystem, and academic exchange community subsystem. MetaPub provides scholars with an open and diversified achievement dissemination mechanism. Scholars can publish academic achievements by submitting structured meta-knowledge, including title, author, institution, keywords, discipline field, abstract, research questions, methodology, results, analytical conclusions, experimental tools, materials, images, audio, video, references, and custom fields. The system automatically recommends papers to multiple reviewers, and papers passing peer review are automatically and quickly published on the platform. Additionally, MetaPub creates a favorable open environment for online exchange within the scientific community, enabling scholars to like, forward, and comment on papers. Against the backdrop of open science, MetaPub represents a positive step toward achieving the new goals of faster research achievement publication, better academic exchange, and improved knowledge organization and integration.

4. Conclusion and Discussion

Open science has become an inevitable development trend, urgently demanding the construction of scientific infrastructure for academic exchange and technological innovation. As one of the infrastructures for scientific and technological innovation, high-end academic exchange platforms fundamentally function to aggregate high-level scientific achievements and thereby stimulate idea exchange and collision, forming a vibrant academic ecosystem.

This paper proposes the meta-publishing concept and constructs a meta-publishing platform as an exploratory effort under the open science trend. The meta-publishing platform can support open academic exchange within the scientific community and promote the transformation and upgrading of publishing models led by the scientific community from three dimensions: "deconstruction," "fusion," and "transcendence." Building upon traditional publishing models, the meta-publishing platform will transform academic publishing forms and content toward structured and fine-grained directions. Admittedly, this new publishing model also requires adaptation from researchers' publication habits and the business organization mechanisms of the publishing industry.

As a nascent phenomenon in academic publishing, meta-publishing needs to continuously enhance its advantages, improve functionality, and increase usability. To develop into a mature publishing service, it must actively leverage information technologies such as artificial intelligence and deep learning to strengthen its advantages, keep pace with the frontiers of open science development and academic exchange demands, and continuously improve systematic platform functions and researchers' recognition of and participation in this new publishing philosophy.

The meta-publishing platform will also explore and promote the development and improvement of the peer review system. In addition to anonymous review, it will incorporate new models and methods such as open peer review and post-publication peer review to promote transparency in the review process and enhance review efficiency and academic exchange quality.

The meta-publishing platform can attract the scientific community to participate more actively in the academic publishing process. In traditional academic publishing platforms, the scientific community's participation is relatively low—more involved before paper publication and less after publication. The new meta-publishing platform can support fuller participation by the scientific community in academic publishing, knowledge reproduction, and knowledge dissemination. By defining new publishing processes, establishing connections between publications and datasets, and building academic exchange platforms, supplemented by the formulation of participation rules, it provides the scientific community with fast, transformative, and process-covering achievement publication methods, introducing fine-grained and timely academic exchange methods for scientific communication, and exploring new development ideas for research li-

braries in promoting domestic open access, open data, and open science. We believe that with the promotion and popularization of open science concepts, more and more best practices in open publishing will emerge and integrate into researchers' R&D processes.

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