A Study on the Proposal for Building an Integrated Platform for Research Output Utilization

Younghee Noh*

ARTICLE INFO

Article history:
Online first 04 July 2024

Keywords:
Research performance, performance utilization, integrated platform, R&D perform

ABSTRACT

In this study, an attempt was made to propose the establishment of an integrated platform for utilizing research results as one of the measures that can increase the effectiveness of using research results compared to research investment. To this end, the study endeavored to compare and analyze the information services provided by domestic websites and platforms that provide information on the results of national R&D projects. Based on the analysis results, the derived performance utilization platform service direction and performance utilization plan are: 1) establishment of a performance integration platform that integrates the performance information, 2) specification of service users and provision of consumer-oriented services, 3) metadata for linkage of integrated information Standardization, 4) expansion of customized services using the latest technology, and 5) reinforcement of performance data-based analysis services. This study conducted an analysis of literature and about 20 domestic and foreign research performance information providing sites. In future research, there is a need to integrate a unified platform and further analyzed its performance.

1. Introduction

In the case of South Korea, R&D investment increased approximately 2.2 times from 439 billion PPP$ in 2008 to 985 billion PPP$ in 2018, and the number of research and development personnel also increased 1.6 times from 236,137 in 2008 to 383,100 in 2017. Moreover, as a result of the consistent efforts made by the South Korean government, there has been a consistent increase in the total national expenditure on research and development. In 2018, South Korea's total R&D investment accounted for 4.5% of its GDP, marking the second-highest figure among OECD member nations. Notably, the country's investment in basic research as a percentage of GDP has shown a consistent increase, rising from 0.48% in 2008 to 0.64% in 2018(Hwang Hosuk, 2020).

According to the National Research and Development Statistics of the Korea Institute of Science and Technology Evaluation and Planning (KISTEP) for 2018, the R&D investment amounts for

* Professor, Department of Library & Information Science, Konkuk University, Korea (irs4u@kku.ac.kr)

2008 and 2018 were reported as 439 billion PPP dollars and 985 billion PPP dollars respectively. Additionally, it reveals that the number of research and development personnel in 2008 and 2017 were 236,137 and 383,100 respectively. Additionally, the report indicates that in 2018, South Korea's total R&D investment as a percentage of GDP was 4.5%, and it specifically notes that the proportions of investment in basic R&D in 2008 and 2018 were 0.48% and 0.64% respectively. Such efforts will play a pivotal role in driving technological innovation and economic growth. Yet, alongside the increase in R&D budgets, there is a pressing need for adept evaluation and utilization of research strategies and outcomes. Moreover, establishing foundational infrastructure for the technological innovation ecosystem and systematically fostering skilled personnel are equally imperative.

However, while there currently exists a unified project support service centered around researchers and fieldwork, the management system for R&D outcomes is analyzed to be fragmented. In other words, while there is currently a unified project support service centered around researchers and fieldwork, it is observed that the management system for R&D outcomes is fragmented. To provide integrated project support services centered around researchers and fieldwork, various systems such as the Integrated Research Information System (IRIS), Research Fund Management System (Ezbaro, RCMS), and National Researcher Information System (NRI) are currently in place. However, when it comes to R&D outcomes, the management and distribution of research results are segregated among dedicated agencies. Moreover, technology transfer platforms are also built separately by different departments, resulting in a fragmented system for managing outcome information. For example, papers are managed by the Korea Institute of Science and Technology Information, patents by the Korea Intellectual Property Strategy Agency, full-text reports by the Korea Institute of Science and Technology Information, research facilities and equipment by the Korea Basic Science Institute, and technology summary information by The Korea Institute for Advancement of Technology. While specific case studies will be examined later, overcoming the limitations of the fragmented R&D outcome management system and addressing issues such as dissatisfaction from market demands (industry), insufficient public technology achievements perceived by the public, etc., requires the establishment of a digital technology (data/artificial intelligence)-based platform to facilitate the joint utilization and virtuous cycle of accumulated cross-departmental R&D outcome. To achieve this, there is a need for an overall analysis of the currently operational research outcome management and distribution websites, as well as the technology transfer platforms established by various departments. It is deemed necessary to comprehensively compare and analyze the information services provided on domestic and international websites and platforms, in order to identify the limitations of services provided by each institution, as well as trends in information services through the adoption of the latest technologies.

As such, this study, first, aimed to conduct an overall analysis of domestic R&D outcome-related websites and existing technology transfer platforms established by various departments, comparing and analyzing the information services provided on each institution's homepage and platform, and conducting an overall environmental analysis. Second, this research sought to explore multidimensional information service directions that can evaluate the value of outcomes, thus facilitating the eventual commercialization and practical application of the 'Integrated Performance Utilization

Platform'. Third, this study made an attempt to propose a systematic approach for promoting the practical utilization and commercialization of cross-departmental R&D outcomes, in line with private sector and market (industry) technology demands, thereby stimulating their utilization as tangible outcomes.

2. Prior Research

This study focuses on proposing the establishment of an integrated platform for utilizing research outcomes. Previous studies in this area have been examined, revealing that while there are ongoing studies on research outcome utilization and integrated platforms separately, there is a significant gap in research specifically addressing integrated platforms for effectively utilizing R&D research outcomes. This identifies a unique aspect of the current study.

They emphasized the importance of supporting basic research projects and acknowledged the need for continued investment to be understood and appreciated. While stressing the importance of analyzing the diverse ripple effects of basic research, they also noted a gap in research, particularly regarding the societal ripple effects, which encompass non-economic aspects. To overcome these limitations, this study focuses on the network formation and interaction facilitated by basic research, as emphasized by Salter and Martin (2001). In order to estimate these effects, altmetrics was utilized as an analytical framework to analyze the societal impact of government-funded basic research outcomes in South Korea The analysis targeted basic research projects within South Korea's national research and development program. The results indicate that the dissemination and sharing of SCI papers from basic research projects are relatively higher compared to the overall paper outcomes of national R&D projects. At present, the predominant method for estimating paper outcomes relies on the 'citation index'. This index, based on citation counts, offers intuitive insights derived from long-term accumulated data. However, concerns have arisen regarding the time-consuming nature of reflecting citation counts and the emergence of strategic competition to inflate citation counts. These challenges underscore the need for a shift in evaluating individual research and researchers. Furthermore, research findings suggest that there is little correlation between citation counts and the long-term value of papers (Gölitz, 2012). A study has been conducted on the establishment of a one-stop portal service for humanities and social assets from the perspective that research results are considered humanities assets (Noh Young-hee, Jung Dae-geun, Kwak Woo-jung, 2013). This study focuses on developing strategies and setting medium to long-term roadmaps for providing a one-stop portal service for humanities and social assets. To achieve this, a SWOT analysis of the Basic Academic Information Center was conducted, usability tests were carried out with 90 graduate students, and insights were derived through interviews with 8 experts. They argued that, in order for the Basic Academic Information Center to offer a one-stop portal service for humanities and social assets, first, it is necessary to adopt an approach that goes beyond solely integrating resources. It requires an approach that also emphasizes sustainable, unlimited information provision. Second, there is a need to establish a research outcome collection strategy that undergoes qualitative validation. Third, there is a demand for KRM to function as a hub for humanities and social

assets, as well as a network platform for humanities and social researchers. Fourth, its service provision should consider not only specialized research services but also education for the general public.

Upon reviewing prior research, it was found that there are no case study investigations or development studies on integrated platforms aimed at maximizing the utilization of research outcomes. In this regard, this case study research is deemed significant as it fills this gap in the literature and contributes to the field of research outcome utilization and integrated platform development.

This study proposes the establishment of an integrated platform for efficiently utilizing research outcomes. Reviewing previous research revealed a significant gap in studies specifically focused on integrated platforms for effectively leveraging R&D research outcomes, despite ongoing studies on research outcome utilization and integrated platforms independently. This research emphasizes the support for basic research projects and the analysis of their broad ripple effects, especially the societal impacts that include non-economic aspects, highlighting the need and importance of an integrated platform. It centers on network formation and interaction driven by basic research, underscoring the necessity and significance of such a platform. Additionally, this study discusses the establishment of a one-stop portal service for humanities and social assets, including the development of collection strategies for research outcomes and quality validation, as well as advocating for the Basic Academic Information Center to serve as a central hub for humanities and social assets and a networking platform for researchers. Currently, there appears to be a lack of case studies or development research on integrated platforms aimed at maximizing the utilization of research outcomes. Therefore, this case study is deemed significant as it addresses this gap in the literature and contributes to the fields of research outcome utilization and integrated platform development.

3. Research Design and Methodology

This study conducted case analysis and literature reviews to propose establishing an integrated platform through as a means to enhance the effectiveness of research outcomes relative to research investments. Firstly, the study conducted an investigation and analysis of domestic websites and platforms, comparing and analyzing the information services provided by domestic websites and platforms that offer information on outcomes produced by national research and development projects. This included platforms such as NTIS, R&D Intellectual Property Information System, ZEUS, Technology Bank (NTB), Korea Chemical Bank, and Agricultural Genetic Resources Service System.

Secondly, research and analysis on overseas websites and platforms were carried out to examine technologies and policy changes that have been implemented to provide information by R&D data-providing websites.

Thirdly, the study aimed to propose improvement measures based on the strengths and limitations of the services provided on each homepage through service analysis. The comparison and analysis points include types of information, service methods/technologies, and target users. The specific research procedure and content are as follows.

Table 1. Research Procedure and Content

Classification	Description			
Status Analysis	• Research and analyze domestic websites and platforms • Research and analyze overseas websites and platforms			
▼	▼			
Analysis of Performance Data	Analysis Target	• Investigation on the services and utilization status of the above institutions.		
		Dedicated Agency for Research Outcome Management and Distribution	Research Paper	Korea Institute of Science and Technology Information
			Patent	Korea Patent Strategy Development Institute
			Original Text	Korea Institute of Science and Technology Information
			Research Facilities and Equipment	Korea Basic Science Institute
			Technology Summary Information	Korea Institute for Advancement of Technology
			Compounds	Korea Research Institute of Chemical Technology
			Biological Resources	Korea Research Institute of Bioscience & BioTechnology
			New Varieties	National Institute of Agricultural Sciences
			Software	Korea Copyright Commission, National IT Industry Promotion Agency
			Standards	Korean Standards Association, Telecommunications Technology Association, Korea Research Institute of Standards and Science
		Classification	Responsible Ministry	Responsible Ministry
		Technology Transfer Platform	Emerging Technology Showcase	Ministry of Science and ICT
			Performance Plaza	
			Technology Bank (NTB)	Ministry of Trade, Industry and Energy
			Tech Bridge	Ministry of SMEs and Startups
			Patent Technology Market	Korean Intellectual Property Office
			nati	Ministry of Agriculture, Food and Rural Affairs
			Health Industry Technology Transfer Center	Ministry of Health and Welfare
			Defense Technology Trading Market	Ministry of National Defense
	Analysis Point	• Comparison and analysis points include information types, service methods/technologies, target users, etc.		
▼	▼			
Conclusion and Recommendations	• Propose improvement measures based on the strengths and limitations of the services provided by each website through analysis of the relevant services.			

4. Analysis Result of Information Services on Domestic and International R&D-related Websites and Platforms

To understand the status of information services on domestic R&D-related websites and platforms, the study aimed to compare and analyze the information services provided by domestic websites and platforms that offer information on achievements produced by national research and development projects. The analysis content includes the information services provided on each homepage, target users, utilization of achievements, etc. And the analysis targets include the NTIS website, research achievement management and distribution agency homepages, and technology transfer platform achievement homepages.

4.1 Types of Information Provision by Institution

Firstly, upon analyzing the types of information provided by each institution, it was found that, in general, status information on achievements in various fields such as papers, reports, patents, copyrights, compounds, and biological information predominated. Additionally, statistical information, trend information, and other related information sources were also provided. The linkage between information primarily consists of connections with R&D management systems from 18 ministries and agencies, cross-ministry systems such as NTIS and SCIENCE ON, and the Patent Office. However, in some instances, information about affiliated institutions is not available on certain websites.

Next, the level of decision-making based on provided information can be examined by distinguishing between ① the level of information acquisition and ② the level of information utilization based on the provided information. At the level of information acquisition, some websites provide only basic services where users can register information and conduct searches on the registered data. However, these platforms do not offer customized or analyzed information that could facilitate decision-making based on the collected data. Moreover, regarding the potential utilization of provided information, services facilitating decision-making based on the provided data include those that match information with user demands, offer customized services tailored to user needs, provide open services, and intermediary services.

Table 2. Comprehensive Summary of Information by Institution

Site Name	Information Type	Interconnection between provided information	Level of decision-making based on provided information
NTIS	√ Information on national R&D projects including projects, tasks, personnel, outcomes, etc. √ Scientific and technological knowledge information including papers, patents, research reports, policy trends, etc.	√ 18 Ministries and Agencies	√ Information can be utilized based on the provided information
National R&D Research Outcome Paper Management System	√ R&D research-based papers	√ Linked with NTIS, SCIENCE ON	√ Information can be obtained

Site Name	Information Type	Interconnection between provided information	Level of decision-making based on provided information
Government R&D Patent Outcome Management System	√ Status information, application and registration patent statistics, technology transfer information for patented outcomes	√ Collecting patent outcomes through collaboration between the Patent Office and NTIS √ Provision of integrated services to confirm the patent achievements of user-affiliated institutions in their respective systems	√ Information can be utilized based on the provided information
National R&D Report Registration Management System	√ R&D Reports	√ Linked with NTIS, SCIENCE ON	√ Information can be obtained
ZEUS	√ Equipment registration status and statistics, shared equipment information, research facility information, etc.	√ Reservation, sharing, and utilization based on registered equipment information	√ Information can be utilized based on the provided information
Technology Bank (NTB)	√ Technology transfer/commercialization information, technology commercialization trends, technology transfer statistics, etc.		√ Information can be utilized based on the provided information
Korea Chemical Bank	√ Compound information, data on efficacy tests utilizing provided compounds, etc.	√ Linked with Integrated Data Platform, K-DBS, and NTIS for information linkage	√ Information can be utilized based on the provided information
Life Information Research Outcome Registration System	√ Information on life science research outcomes, statistical data	√ Linked with NTIS	√ Information can be utilized based on the provided information
Agricultural Genetic Resources Service System	√ Providing comprehensive information related to agricultural genetic resources	√ Collaborating with Rural Development Administration, local agencies, universities, etc.	√ Information can be obtained
Copyright Registration	√ Comprehensive information on copyrights		√ Information can be obtained
Emerging Technology Showcase	√ Information on technology commercialization, public technology (patent) information, etc.	√ Sponsored (Research) Institutes, Universities, etc.	√ Information can be utilized based on the provided information
Tech Bridge	√ Information on technologies targeted for transfer	√ Patent Office, Korea Intellectual Property Office, Technology Guarantee Fund, Small and Medium Venture Business Administration, NTIS, etc.	√ Information can be utilized based on the provided information
nati	√ Patent information, technology transfer status, trend information, policy support projects, etc.	√ Linked with cross-ministry R&D management systems (RIPIS, NTB, NTIS, etc.)	√ Information can be utilized based on the provided information
Defense Technology Trading Market	√ Information on defense-related patent technology, support project information, etc.	√ Linked with NTIS, government-affiliated websites, and public agency technology transfer centers.	√ Information can be utilized based on the provided information

Through comprehensive analysis of the provided information, it is evident that information provision based on inter-platform linkage is being conducted across various homepages and platforms. However,

fragmentation of platforms based on subject and information type, disparity in the level of information provision across different platforms, and inadequate utilization of outcome information were observed. Therefore, the integration of fragmented information should be achieved through the establishment of an integrated outcome platform. Beyond mere information linkage and integration, there is a demand for services that utilize outcomes based on the provided information and meet user needs.

4.2 Service Functions and Technologies by Institution

When conducting investigations specific to each institution, comprehensive analysis of the technologies and tools employed on websites was conducted, alongside the examination of service functionalities, aimed at presenting information. Firstly, upon conducting an overall analysis of the service functionalities specific to each institution, the majority primarily focused on registration and search functionalities for outcomes. Additionally, there were a significant number of intermediary services for equipment rental, sharing, and technology transfer. Currently, institutions are designated as dedicated agencies for research and development outcome management and distribution, registering and donating research and development outcomes by field, thus forming the core of their services. Websites offering data analysis tools were observed in the Korea Chemical Bank and the Life Information Research Outcome Registration System. At the Korea Chemical Bank, a tool for performing three-dimensional structure-based virtual screening is provided, while the Life Information Research Outcome Registration System. offers Bio-Express, a web-based high-capacity data analysis service.

Table 3. Comprehensive Summary of Functions and Technologies by Institution

Site Name	Service Function
NTIS	√ 1) National R&D Whole Cycle, 2) Project Participation and Management, 3) Researchers and Research Institutions, 4) Research and Development Outcomes, 5) Research Evaluation Information, 6) Data Utilization, 7) R&D Plus
National R&D Research Outcome Paper Management System	√ Paper Registration, Paper Search, Statistics and Status, etc.
Government R&D Patent Outcome Management System	√ Patent Outcome Search, Patent Outcome Statistics, Education Application, Provision of Related Materials, etc.
National R&D Report Registration Management System	√ Report Registration, Report Search (Advanced Search Available), Registration Confirmation, Automatic Personal Information Verification Tool, etc.
ZEUS	√ Introduction Review, Registration Management, Equipment Reservation, Equipment Sharing, Knowledge Sharing, Statistical Information, Research Facility Registration, Search, Reservation, etc.
Technology Bank (NTB)	√ Sales Technology Registration, Demand Technology Registration, Support for Demand Technology Transfer, etc.
Korea Chemical Bank	√ Compound Donation, Compound Search, Compound Application, Provision of Research Results Data, etc. √ (Analysis Tool) Provision of a tool capable of performing three-dimensional structure-based virtual screening

Site Name	Service Function
Life Information Research Outcome Registration System	√ Life Information Research Outcome Registration, Life Information Research Outcome Search √ (Analysis Tool) Provision of Bio-Express
Agricultural Genetic Resources Service System	√ Resource Search, Resource Registration, Resource Distribution, Resource Donation, etc.
Copyright Registration	√ Copyright Registration Application, Registration Search, Transfer of Copyrighted Works, Issuance of Certificates, etc.
Emerging Technology Showcase	√ Search for Promising Commercialization Technologies, Search for Public Technologies (Patents), AI Search, Search for Demand Technologies, OPEN-API, etc.
Tech Bridge	√ Application for Introduction of Promising Technologies, Special Technology Transfer, Application for Public Technology Development, Customized Technology Search, etc.
nati	√ Patent Information Search, Technology Transfer Application, Technology Transfer Consultation, Technology Transfer Seminar, etc.
Defense Technology Trading Market	√ Technology Transfer Application, Search for Defense Patent Technologies, Technology Helper Services, etc.

When considering the limitations from the perspectives of service functionalities and technologies, current institutions have been designated as dedicated agencies for research and development outcome management and distribution. They register, donate, and manage research and development outcomes by field. However, there is a lack of awareness among researchers and research institutions regarding the system for registering and donating research outcomes. Additionally, due to complex administrative procedures, the registration and donation rates for some research outcomes are considered low. The awareness rate of the registration and donation system for public research institutions' research outcomes was at 48.6% as of 2020, largely dependent on voluntary registration by researchers or research institutions. Furthermore, factors hindering the registration and donation of research outcomes were surveyed as follows: 'Complex and unclear administrative procedures and timelines (60.5%)', 'Non-disclosure for follow-up research (37.9%)', 'Lack of perceived necessity (24.5%)', indicating the needs to address complex administrative procedures. Consequently, it will become necessary in the future to streamline the registration process for research outcomes to enhance convenience, and along with this, various information utilization services allowing users to make decisions based on outcomes and providing analysis tools should be provided.

4.3 Target Users by Institution

The target users for each homepage varied from R&D researchers to R&D personnel, R&D-related institutions, and general users. In the case of the patent outcome management system, the homepage clearly distinguished between general users and professional users, and presented what services are provided based on this distinction. However, in some institutions, the target users of their homepage were not clearly defined, or the entire homepage required logging in to access.

Table 4. Comprehensive Summary of Target Users by Institution

Site Name	Target Users
NTIS	√ R&D Researchers, R&D-related Personnel, R&D-related Institutions, General Users
National R&D Research Outcome Paper Management System	√ R&D Researchers
Government R&D Patent Outcome Management System	√ General Users, Institutional Users (Government Departments, Project Management Agencies, Research Institutions)
National R&D Report Registration Management System	√ Personnel from Task Management (Specialized) Agencies Managing National R&D Projects, Government-funded Projects (Agency-specific Projects), Project Managers Granting Report Original Submission Rights
ZEUS	√ Researchers, Research Institutions, Relevant Business Personnel
Technology Bank (NTB)	√ Researchers, Research Institutions, General Users
Korea Chemical Bank	√ Researchers, Research Institutions
Life Information Research Outcome Registration System	√ Researchers, Project Teams, Hospitals, Companies, General Users
Agricultural Genetic Resources Service System	√ Researchers, Breeders, Seed Companies, Research Institutes, Schools, etc.
Copyright Registration	√ General Public
Emerging Technology Showcase	√ Researchers
Tech Bridge	√ Researchers, Research Institutes, Universities, Companies, General Users
nati	√ Prospective Entrepreneurs, Venture Companies, Agricultural Companies
Defense Technology Trading Market	√ Defense Companies, General Companies, etc.

The limitations in terms of target users by institution are that the target users vary for each institution, and there are areas where the users are not clearly defined by each institution. Furthermore, the fragmentation of outcomes may lead to confusion among users regarding the services provided on each website. Henceforth, there is a need for a unified platform to consolidate fragmented outcomes. Through this platform, all relevant users should have access to services. In addition, it appears essential to distinctly delineate the primary user targets, sub-user targets, and specific user targets on the platform, while also outlining services by assigning a priority level to each target group.

4.4 Latest Technologies and Distinctive Services by Institution

Among the services provided by each institution, services that were provided by introducing the latest technology or that had differentiation were analyzed. Firstly, in recent times, several institutions have been offering personalized services based on AI technology. Services primarily involve summarizing and providing information using technology, analyzing usage patterns to offer preferred information to users, or providing matching and recommendation services. Especially, NTIS provides information summarization services and recommendation services based on user pattern analysis, while NTB

offers technology matching services, Emerging Technology Showcase provides AI search and demand technology matching services, and Tech Bridge conducts technology recommendation services. Cordis has developed and offers visualization maps as a new method to explore public data.

Table 5. Characteristics and Status of New Technology-Based Services by Institution

Site Name	Characteristic	Remark
NTIS	√ (Information Summarization Service) Advanced artificial intelligence and natural language processing technology for summarizing information from tasks and reports. √ (Chatbot Service) Interactive search service capable of answering natural language queries. √ (Recommendation Service) Utilizing artificial intelligence technology to analyze NTIS usage patterns and provide information that users are likely to prefer.	Utilize AI technology, Use chatbots
Government R&D Patent Outcome Management System	√ Statistics service for domestic and international applications and registrations predominates. √ Publication of the annual 「R&D Patent Performance Survey Analysis Report」 √ Operation of a separate RIPIS open service homepage.	Develop a separate integrated platform
National R&D Report Registration Management System	√ Compared to other platforms, research results and high-quality services are strong. √ Providing search services for full text, tables, and images (non-text content) within research reports √ Summary service using keyword graph	Word graph-based summary service
Technology Bank (NTB)	√ AI-based technology matching and related information provision √ Providing technical information network services √ Expansion of private technical information and provision of video services	Utilize AI technology, relationship network service
Korea Chemical Bank	√ Provide information services by developing a separate integrated data platform √ Perform 3D structure-based virtual search directly using tools provided by the platform.	Develop a separate integrated platform, Provide analysis TOOL
Life Information Research Outcome Registration System	√ KOBIC provides an analysis tool called 'Bio-Express', a web-based large data analysis service.	Provide analysis TOOL
Emerging Technology Showcase	√ Beyond providing comprehensive information, process the collected information to provide customized information services. √ AI search, demand technology matching service	AI Search Demand technology matching service
Tech Bridge	√ Customized technology recommendation through intelligent matching and recommendation service √ (Commercialization project using Tech Bridge) Utilizing the Tech Bridge platform to promote technology transfer to public technologies of small and medium-sized enterprises in the fields of materials, parts, and equipment and to improve technology and commercialization capabilities through R&D support	Utilize AI technology
Cordis	√ Provides data-based visualization maps √ Domestic companies can discover partners for business proposals for technology commercialization and additional joint research with EU R&D companies.	Visualization map Business proposal, Partner matching
researchfish	√ Customized consulting services to help interpret, evaluate and apply data for strategy development and future research decisions.	Customized consulting service to help decision making

AS AI technology is gradually expanding into the public domain, it is deemed necessary for future integrated platforms for outcome utilization to provide services such as information matching services that meet users' needs and proposals for follow-up research by linking AI technology with outcome information.

4.5 The SWOT analysis

This study compares and analyzes the status of information services provided by domestic and international research and development (R&D) related websites and platforms, highlighting various strengths. Initially, an analysis of the types of information offered by each institution revealed a predominance of information provision centered around the status of achievements in diverse fields such as papers, reports, patents, copyrights, compounds, and biological information. Additionally, statistical information, trend information, and other related information sources are also provided. In terms of information connectivity, the primary linkages include R&D management systems from 18 ministries and agencies, inter-ministry systems like NTIS and SCIENCE ON, and connections with the Patent Office. However, there are instances where some websites do not provide information about affiliated institutions.

When examining the level of decision-making based on the provided information, by differentiating between the level of information acquisition and the level of information utilization, it's observed that some websites offer only basic services allowing users to register information and conduct searches on the registered data. These platforms do not offer customized or analyzed information that could facilitate decision-making based on the collected data. Moreover, regarding the potential utilization of provided information, services that facilitate decision-making based on the provided data include those that match information with user demands, offer customized services tailored to user needs, provide open services, and intermediary services.

Through comprehensive analysis, it has become evident that information provision based on inter-platform linkage is being conducted across various homepages and platforms. However, fragmentation of platforms based on subject and information type, disparity in the level of information provision across different platforms, and inadequate utilization of outcome information were observed. Therefore, the integration of fragmented information should be achieved through the establishment of an integrated outcome platform. Beyond mere information linkage and integration, there is a demand for services that utilize outcomes based on the provided information and meet user needs.

When conducting investigations specific to each institution, a comprehensive analysis of the technologies and tools used on websites was conducted, alongside the examination of service functionalities aimed at presenting information. Initially, an overall analysis of the service functionalities specific to each institution indicated that most are primarily focused on registration and search functionalities for outcomes. Additionally, a significant number of intermediary services for equipment rental, sharing, and technology transfer were observed. Currently, institutions are designated as dedicated agencies for research and development outcome management and distribution, registering, and donating research and development outcomes by field, thus forming the core of their services. Websites offering data analysis tools were observed in the Korea Chemical Bank and the Life Information Research

Outcome Registration System. At the Korea Chemical Bank, a tool for performing three-dimensional structure-based virtual screening is provided directly using tools provided by the platform, while the Life Information Research Outcome Registration System offers 'Bio-Express', a web-based large data analysis service.

The SWOT analysis of the information services on domestic and international R&D-related websites and platforms can be structured as follows:

Table 6. The SWOT analysis of the information services on domestic and international R&D-related websites and platforms

S	• Integrated Information Provision: The consolidation of information provided by various R&D-related websites and platforms enables easier access to the necessary information for users. • Utilization of Advanced Technologies: The use of the latest technologies, such as AI, natural language processing, and big data analysis tools, to summarize information and analyze user patterns, providing personalized information. • Customized User Services: Offering services tailored to the needs and preferences of users allows for a personalized experience.	• Service Expansion: The opportunity to meet more user needs through new services such as information matching services and suggestions for subsequent research utilizing the latest technologies like AI. • Collaboration and Partnerships: Enhancing the utilization of research outcomes and promoting the commercialization and technology transfer of new technologies through collaboration between various institutions, government departments, and companies. • Connection Between Public and Private Sectors: Strengthening the role of platforms in facilitating technology transfer and commercialization between public research outcomes and private companies.	O
W	• Information Fragmentation: Fragmentation of information across multiple platforms and websites may make it difficult for users to find the information they need. • Low Awareness of Registration and Donation Systems: The low awareness and complex management procedures associated with registering and donating research outcomes can limit the utilization of research findings. • Lack of Consistency in User Experience: The inconsistency in experience across platforms with different target users and service functionalities.	• Rapid Pace of Technological Change: The risk of platforms not being able to adapt in time to the rapid development of technologies like AI, potentially failing to meet user needs. • Security Issues: The potential for data security and privacy issues arising from processing large-scale data and providing personalized services. • Complexity in Building Integrated Platforms: The time and cost involved in integrating information from various sources and providing customized services to users through the construction and maintenance of an integrated platform.	T

5. Directions and Strategies for Outcome Utilization Platform Services

In this study, to explore future service directions for the integrated outcome utilization platform, a comprehensive investigation and analysis of existing domestic and international websites and platforms was conducted. Based on this, the following future service directions for the integrated outcome utilization platform are proposed,

5.1 Building an integrated outcome consolidation platform by integrating fragmented outcome information

Currently, there are unified project support services centered around researchers and field activities, but there is a lack of platforms focusing on the utilization of outcomes. In particular, currently institutions are designated as specialized agencies for research and development outcome management and distribution, registering, donating, and managing research and development outcomes by field. However, the awareness of researchers and research institutions regarding the system for registering and donating research outcomes is low, and due to complex administrative procedures, the registration and donation rate of some research outcomes is also low. Therefore, it is necessary to establish an 'Integrated Outcome Utilization Platform' based on digital technologies (data/artificial intelligence) to promote the collaborative utilization and virtuous cycle of accumulated cross-agency R&D achievements. Existing department-specific technology transfer platform databases should be integrated with the performance information from specialized agencies for research achievement management and distribution, enabling intelligent services through search and analysis. Rather than simply converting data into a database format and presenting search results or allowing navigation within specific information, it is necessary to provide information that allows assessment of the value and level of utilization of achievements.

5.2 Concrete delineation of service users and provision of demand-centered services

To develop and provide user-centered services, it is necessary to delineate and specify the user targets and audiences, and to develop services tailored to the needs of each user. Users can be segmented into primary, sub, and specific targets, and it is essential to anticipate service usage scenarios for each user group and develop services accordingly. 주Primary user targets, sub-user targets, and specific user targets need to be established, and the service allocation for each target group on the platform should be prioritized. Users include researchers (from universities, affiliated institutions), specialized agencies of government ministries and agencies, businesses, and the general public. It is necessary to specify the target users for service utilization and provide services based on the demands of each user group.

Table 7. Service Provision Direction by Target User

User	Limitation
Researcher	√ Customized information service for each research life cycle based on the researcher's experience and interests √ Classify the life cycle according to the researcher's job and expertise, and provide necessary services according to the life cycle. √ By selecting life cycle, service demand type (support program information, employment information, education programs, qualification information, etc.), region, users receive customized services accordingly. √ Development and provision of various contents and information needed in the research field
Specialized Institutions	√ Providing centralized access to government-produced matters for establishing evidence-based science and technology policies. √ Strengthening the provision of high-quality policy and technology trend reports and analysis services.
Enterprises	√ Providing specialized services for managing technology commercialization and business portfolios.
General Public	√ Developing informational content related to societal issues that can engage citizens' interests. √ Providing mashup services that integrate heterogeneous data. √ Establishing and operating online platforms for solving social problems and offering services to the general public. √ Collecting and sharing key policies, applications, research information, and exemplary cases related to living labs, while also establishing a system for open access and utilization of research data generated during living lab projects.

5.3 Standardization of metadata for integrated information linkage.

The analysis of current metadata status revealed disparities in metadata standards across platforms. While differences exist based on the types of information provided, even metadata for the same patents or technology transfers varies among platforms, indicating a need for prioritized standardization efforts. To build a future integrated performance utilization platform, standardization of metadata should be prioritized. Below is the current metadata status for each website.

Table 8. Metadata Status by Homepage

Site Name	Metadata
NTIS	Registration number, registration date, applicant, affiliated institution business registration number, foreign application status, application/registration country, priority claim number, contribution rate, application number, application date, inventor, IPC code, CPC code, legal status.
National R&D Research Outcome Paper Management System	Paper classification, body language, publication country, paper name (Korean/English), journal name (Korean/English), journal publication year, SCI (including SCIE) classification, volume number, paper page, DOI, paper number, ISSN, ISBN, author, abstract, original text attachment, original text disclosure, reason for original text non-disclosure
Government R&D Patent Outcome Management System	Application number, country name, registration number, application number (date), registration date, invention title, applicant, rights holder, Int. CI (International Classification), publication number (date), announcement number (date), registration number (date), classification/original application right, original application number (date), Family application number, final disposition content, registration status, international application number (date), international publication number (date), request for examination (date), number of claims, representative drawing, abstract.

Site Name	Metadata	
National R&D Report Registration Management System	(Private)	
ZEUS	Manufacturer name, model name, acquisition amount, acquisition date, holding institution name, utilization scope, utilization status, standard classification.	
Technology Bank (NTB)	Patent title, applicant, inventor, application number, application date.	
Korea Chemical Bank	(Login required)	
Life Information Research Outcome Registration System	Subproject number, project unique number, research project name.	
Agricultural Genetic Resources Service System	Plant	Resource number, institution name, scientific name, crop name, resource name, place of origin, collection site, resource classification, distribution standard quantity (lip).
	Microorganism	Scientific Name, Information, Domestic Literat. on Pathog., Strains, KACC No., Type, Other collection No, History, Location of Isolation, Source, Literature using the isolates, Media, Temperature, Image, Distribution restriction, Distribution utilization
	Insect	Scientific Name, Order, Family, Common Name, Alias Adult Form, DNA Barcode, Sequence Information (Representative Individual Code, Number of Analyzed Individuals, Sequence Difference, QR Code) Ecological Information (Diet, Habitat) Distribution (Domestic, International) Specificity, Utilization of Resources, Measures for Insect Acquisition (Distribution, Purchase, Collection, Import) Utilization Status
	Plant Virus	Resource Number, Year of Donation, Family Name, Genus Name, Species Name (Scientific Name), Common Name, Isolate Name (Korean), Isolate Name (English), Preservation Method, Collection Location, Quarantine Grade
Copyright Registration	Registration Number, Type, Title, Registration Date, Author	
Emerging Technology Showcase	Int. CL (International Classification), CPC (Cooperative Patent Classification), Application Number/Date, Applicant, Registration Number/Date, Publication Number/Date, Notice Number/Date, International Application Number/Date, International Publication Number/Date, Priority Information, Legal Status, Examination Progress Status, Adjudication Matters, Classification, Original Application Number/Date, Related Application Number, Technology Transfer Desire, Request for Examination/Date, Number of Claims for Examination, Drawings, Summary	
Tech Bridge	Summary, Int. CL (International Classification), CPC (Cooperative Patent Classification), Application Number/Date, Applicant, Registration Number/Date, Publication Number/Date, Notice Number/Date, International Application Number/Date, International Publication Number/Date, Priority Information, Legal Status, Examination Progress Status, Adjudication Matters, Classification, Original Application Number/Date, Related Application Number, Request for Examination/Date, Number of Claims for Examination	
nati	IPC (International Patent Classification), Applicant, Application Number, Application Date, Registration Number, Registration Date, Publication Number, Publication Date, Representative, Inventor, Material Classification, Product Classification, Abstract	
Defense Technology Trading Market	Technology Classification, Detailed Technology Field, Registration Number, Inventor, Application/Registration Date, View PDF, Patent Technology Name, Industrial Technology Classification, National Defense Science and Technology Classification, Application Number, Application Date, Registration Number, Registration Date, Overview	

5.4 Expansion of customized services utilizing the latest technologies

With the advent of the AI popularization era, AI adoption is expanding in the public domain. In cases where repetitive tasks or large amounts of data need to be processed, AI can take over, allowing for cost and time savings. If creativity-intensive planning tasks are allocated, administrative efficiency can be enhanced, and high-quality public services tailored to user needs can be provided.

An additional aspect expected through AI adoption is the ability to make “data-driven policy decisions”. Through cross-validation via AI and establishing evidence through AI-based analysis, more rational decision-making is possible.

Some websites and platforms currently offer AI-powered matchmaking, recommendation, and summarization services. However, there is a need to expand these services to include data analysis and prediction-based services. Various policy and technology trend analysis services are provided based on the collected information, with time-series analysis (monthly, yearly) and visualization of policy and technology trends. Additionally, to enhance accessibility and usability of policy and technology trend information, classification into finer categories is carried out with applied intelligent information classification technology. Furthermore, it is deemed necessary to expand existing matching and recommendation services to continuously provide users with technology information and related follow-up project tasks that meet their interests, as well as services such as proposing follow-up projects for the technological growth of existing achievements and diagnosing the types of necessary follow-up tasks based on consumer needs.

5.5 Enhancement of analysis services based on output data

Diverse perspectives of analytical services are needed to derive insights by linking national R&D performance data. Support for exploring opportunities such as the status of major domestic and foreign institutions possessing similar technologies in each technical field is also required. In other words, these services should include providing information on key technologies, countries for overseas expansion, inventors, and major institutions holding similar technologies. Additionally, it should also offer diverse services through the integration and analysis of different types of data and provide analysis services on the current status of research and development activities in various technology fields, both domestically and internationally. In particular, it should provide quantitative research trend results, such as the status and market share of research by country in specific technology fields, the status of international joint research, and the results of level analysis by institution.

6. Implications and Future Research

This study emphasizes the need for an integrated platform to consolidate and efficiently utilize scattered information on existing research outcomes. Such a platform can offer tailored services to various user groups, including researchers, government agencies, enterprises, and the general public, thereby maximizing the value of research findings and contributing to the creation of a

sustainable research and development (R&D) ecosystem.

Firstly, there is a necessity for the construction of an integrated platform. The current situation of low registration and donation rates for research outcomes, due to a lack of awareness and complex management procedures, necessitates the establishment of an 'Integrated Outcome Utilization Platform' based on data and artificial intelligence (AI) technologies. This platform would integrate existing technology transfer platform databases with outcome information from specialized agencies for research outcome management and distribution, providing intelligent services.

Secondly, the provision of user-centered services is emphasized. This research highlights the need to clearly distinguish between primary, secondary, and specific user targets, and to develop services tailored to the usage scenarios of each user group. By offering services based on the demands of each user group, it is possible to enhance user experience and increase the utilization of research outcomes.

Thirdly, the standardization of metadata and the application of AI technologies are critical. Metadata standardization should be a priority for the integration and linkage of information. The application of AI technologies can contribute to the provision of high-quality, user-customized public services, not only in repetitive tasks or large data processing but also in creative planning tasks. This technological approach enables data-driven policy decisions, supporting more rational decision-making.

Fourthly, there is a need for the expansion of analytical services. Various analytical services are required to derive insights by linking domestic and international R&D outcome data. This involves providing information on technologies, countries, inventors, and major institutions, and offering analysis services on the current status of research and development activities in various technical fields, both domestically and internationally.

In conclusion, an integrated outcome utilization platform can play a pivotal role in building a sustainable R&D ecosystem by enabling efficient management and utilization of research outcomes. This study presents key factors to consider in the construction and service provision of the platform, providing important foundational data for exploring future-oriented directions.

7. Conclusion and Recommendations

This study comprehensively analyzed domestic R&D achievement-related websites and existing department-specific technology transfer platforms to explore multidimensional information service directions that can ultimately lead to the commercialization and practical application of an 'Integrated Outcome Utilization Platform' through case analysis and literature review methods.

First, this study made an attempt to compare and analyze the information services provided by domestic websites and platforms that offer information on outcomes produced by national research and development projects in order to understand the current status of R&D-related websites and platforms in Korea and abroad. The analysis included information services provided by each website, target users, utilization of outcomes, etc. The analyzed targets included the NTIS website, websites of dedicated agencies for research outcome management and distribution, and the outcome pages of technology transfer platforms.

Based on the analysis results, the derived performance utilization platform service direction and performance utilization plan are: 1) establishment of a performance integration platform that integrates the performance information, 2) specification of service users and provision of consumer-oriented services, 3) metadata for linkage of integrated information Standardization, 4) expansion of customized services using the latest technology, and 5) reinforcement of performance data-based analysis services.

This study conducted an analysis of literature and about 20 domestic and foreign research performance information providing sites. In future research, there is a need to integrate a unified platform and further analyzed its performance.

References

Choi, H., Lee, Y., & Lee, H. (2019). Analysis of the Social Impact of Government-funded Basic Research Outcomes: Exploration of the Applicability of Altmetrics Analysis Tools. *Social Science Research, 45*(3), 321-344.

Hwang, H. (2020). Comparative Analysis Report of Top 1% Cited Papers in Major Countries from 2008 to 2018. Daejeon: Korea Research Foundation.

Jeong, G., & Noh, Y. (2019a). Analysis of the Initiating Factors and Continuous Motivating Factors of Humanities and Social Convergence Researchers. *Journal of the Korea Contents Association, 19*(11), 619-631.

Jeong, G., & Noh, Y. (2021). A Study on Long-term Support Policies for Convergence Research Support Projects in Humanities and Social Sciences. *Korean Journal of Local Government Studies, 35*(2), 275-294.

KISTEP (Korea Institute of Science and Technology Evaluation and Planning) (2019). 2018 National R&D Statistics. Daejeon: KISTEP, http://www.kistep.re.kr

Noh, Y., Jeong, D., & Kwak, W. (2018). A Study on the Establishment of One-stop Portal Service for Humanities and Social Assets. J*ournal of the Korean BIBLIA Society for library and Information Science, 29*(1), 73-97.

Noh, Y., Lee, G., & Jeong, D. (2018). A Study on the Impact Factors of Research Outcomes in Humanities and Social Convergence Research. *Journal of the Korea Contents Association, 18*(6), 667-678.

Noh, Y., Ro, J. Y., & Kwak, W. (2021). An Analysis of the Trends in the Arena of Cooperation by the International Research Cooperation Related Experts. *International Journal of Knowledge Content Development & Technology, 11*(4), 53-86.
https://doi.org/10.5865/IJKCT.2021.11.4.053

[About the author]

Younghee Noh has an MA and PhD In Library and Information Science from Yonsei University, Seoul. She has published more than 50 books, including 3 books awarded as Outstanding Academic

Books by Ministry of Culture, Sports and Tourism (Government) and more than 120 papers, including one selected as a Featured Article by the Informed Librarian Online in February 2012. She was listed in the Marquis Who's Who in the World in 2012-2016 and Who's Who in Science and Engineering in 2016-2017. She received research excellence awards from both Konkuk University (2009) and Konkuk University Alumni (2013) as well as recognition by "the award for Teaching Excellence" from Konkuk University in 2014. She received research excellence awards form 'Korean Y. Noh and Y. Shin International Journal of Knowledge Content Development & Technology Vol.9, No.3, 75-101 (September 2019) 101 Library and Information Science Society' in 2014. One of the books she published in 2014, was selected as 'Outstanding Academic Books' by Ministry of Culture, Sports and Tourism in 2015. She received the Awards for Professional Excellence as Asia Library Leaders from Satija Research Foundation in Library and Information Science (India) in 2014. She has been a Chief Editor of World Research Journal of Library and Information Science in Mar 2013 ~ Feb 2016. Since 2004, she has been a Professor in the Department of Library and Information Science at Konkuk University, where she teaches courses in Metadata, Digital Libraries, Processing of InterSnet Information Resources, and Digital Contents.