

## Sector Governance to Support Transdisciplinary Study in Japan: Focusing on Cases of Government Sector, Profit Sector and Non-Profit Sector\*

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### ABSTRACT

The purpose of this study is to investigate the sector-by-sector governance of Japan for support of transdisciplinary study, focusing on the cases of government sector, for-profit sector, and non-profit private sector. The research method of case study is applied to an example of the government sector, the Japan Society for the Promotion of Science's 'World Premier International Research Center Initiative (WPI)', the 'Beyond AI Institute' by SoftBank Group Corp. as an example of the for-profit sector, along with the support of a research project by the Foundation for the Fusion of Science and Technology as an example of the non-profit private sector. Then these cases were analyzed particularly in terms of coherence, flexibility, and intensity. Using forms such as consortiums, which are irrespective of the existent university ranks, the advancement of support system for the commercialization of corporate-laboratory links and securing diversity of targets for convergence support and integrated management, it was concluded that the coherence, intensity, and flexibility of governance in support of transdisciplinary study could be increased as a result.

## 1. Introduction

In the context of solving social issues, enhancing social acceptance of advanced technologies, enhancing the value of advanced products, and predicting the future of society, the importance of convergence of science technology, humanities and society is increasing day by day. On the other hand, even though the importance of convergence is recognized, the lack of R&D support systems, institutions, and infrastructure for its promotion are also pointed out as tasks to be resolved. The overall expansion of transdisciplinary study is being requested accordingly for the nation, corpo-

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rations, and ordinary citizens to receive the benefits of the 4th industrial revolution.

The General Center for Convergence Research support the convergence researchers' needs to modify its roles and functions in line with ever-changing requirements and demands of the convergence researchers by continuous monitoring and full reflection to find ways to effectively support convergence research of the researchers (Noh et al., 2019, p. 91). And it is important to further expand the research stage to create and support industrial performance (Noh et al., 2018). But the previous research on transdisciplinary study appear to be biased towards government support.

Sectors supporting transdisciplinary study can be largely divided into specifically in terms of merits, the government sector, for-profit sector and non-profit sector. The government sector is characterized by a structure in which priorities are determined within the scope of the budget and the organization of public officials who are 'Servers for the whole', the for-profit sector is characterized by the principle of pursuing profits, and non-profit organizations differ in that they are formed around the voluntary participation and cooperation of civil society. Such sector-by-sector characteristics are also reflected in support for transdisciplinary study.

The purpose of this study is to examine the cases of transdisciplinary study supported by the government sector, for-profit sector and non-profit private sector in Japan, in attempts to derive implications for Korea. This study would examine the cases of the Japan Society for the Promotion of Science 'World Premier International Research Center Initiative (WPI)' as an example of the government sector, the 'Beyond AI Institute' by Softbank Group as an example of the for-profit sector, and research projects supported by the Foundation for the Fusion of Science and Technology as an example of the non-profit private sector.

## 2. Review of previous studies and case analysis framework

First, Lim (2020, p. 170) provided guidance with the suggestion of a system that coordinates the relationship between various policy implementers, and that it can be evaluated based on three criteria: coherence, flexibility, and intensity. In reference to this, it is possible to analyze transdisciplinary study support based on three perspectives: coherence, flexibility, and intensity.

A governance system with high coherence promotes cooperation among actors by creating situations with high degree of interconnection between governance elements. In addition, high flexibility governance can increase the possibility of mutual cooperation among policy implementers, especially on policy issues with high future uncertainty. Intensity refers to the impact or influence of changes in the specific element of governance. Under the governance system with high intensity, situations with various actors and policy areas that have great mutual influence will be created, which will then increase mutual interactivity between actors and allow the formation of close partnerships (Lim, 2020, pp. 177-178).

Concerning the efficiency of transdisciplinary study projects undertaken by research institutes under the jurisdiction of the National Science and Technology Research Association based on R&D expenses, there were several accomplishments of publications, patents, and etc in the year when the institution was established. Cho (2019) conducted a comparative analysis between the donated general R&D

projects and transdisciplinary study projects as part of this. As a result, Cho proved the superiority of the transdisciplinary study project performance in comparison to the general R&D project performance of science and technology, and in addition, revealed that the longer the establishment year and the more research institutes in the manufacturing industry, the greater the transdisciplinary study capability. The reasoning from the analysis presented the know-how accumulated over the years and the wide and firm network among the recently established institutes also having high transdisciplinary study capabilities in the case of life and nano fields that require joint research.

On the contrary, it is also important to emphasize how transdisciplinary study takes place not only between science and engineering fields or between science, engineering, humanities and social sciences, but also between humanities and the society (Yanagawa, 2020). An example is a joint program between the Faculty of Law and the Faculty of Economics, and on the premise that there is a disagreement between law and economics in legislative-administrative-judicial and consumer-business judgments, there is an example of developing research and education programs where both fields can cooperate. As both perspectives are necessary in actual corporate activities, there follows an expectation for nurturing human resources with such abilities. From this perspective, convergence has the potential to be created in a wide range, not just in limited fields.

Accordingly, this study examines the outlines and achievements of each sector-by-sector transdisciplinary study support case, and in particular, compares the support institutions, support amount, number of selections, application period, characteristics, and strengths and weaknesses, in attempts to draw reference for Korea. And in terms of merits among them, this study specifically attempts to analyze it in relation to coherence, flexibility, and intensity of the governance.

### **3. Cases of sector by sector transdisciplinary study support in Japan**

Case study as a research method is applied to an example of the government sector, the Japan Society for the Promotion of Science's 'World Premier International Research Center Initiative', and the 'Beyond AI Institute' by SoftBank Group Corp. as an example of the for-profit sector, and research project supported by the Foundation for the Fusion of Science and Technology as an example of the non-profit private sector. These institutions were analyzed particularly in terms of coherence, flexibility, and intensity.

#### *3.1 Government sector*

Currently, there are four types of research promotion projects conducted by the Japan Society for the Promotion of Science, which corresponds to the Korean Research Foundation. That is, there are ① Grants-in-Aid for Scientific Research, ② Topic-Setting Program to Advance Cutting-Edge Humanities and Social Sciences Research, ③ Program for Constructing Data Infrastructure for the Humanities and Social Sciences, and ④ World Premier International Research Center Initiative. Among them, an overview of the World Premier International Research Center Initiative and the current most representative support projects is as follows.

### 3.1.1 Outline

The World Premier International Research Center Initiative, which is a project started in 2007 by the Ministry of Education, Culture, Sports, Science and Technology, aims to establish a ‘visible international research-based institution’ with an excellent research environment and high standard for the world’s most advanced researchers. It started with the background that Japan needed a research-based institution to become an ‘international brain circulation hub’ that attracts top-notch research talent from all over the world in the scientific realm, where competition for excellent brain acquisition continues to intensify.

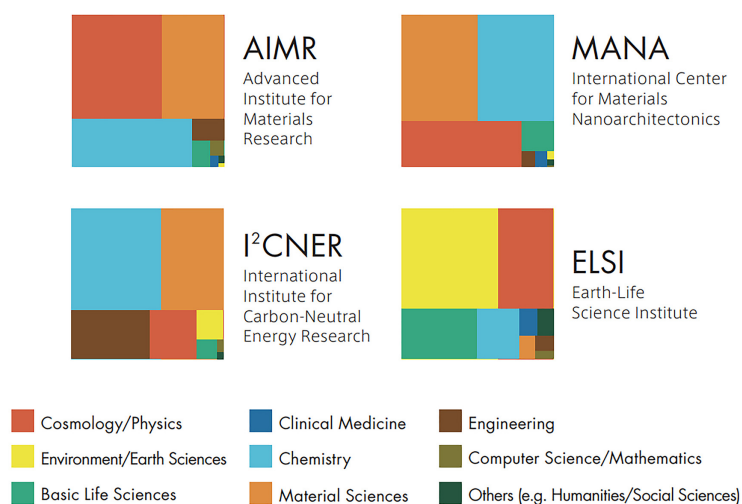
For the selection of projects, WPI selects projects that are expected to yield great results among projects proposed by universities and research institutes nationwide, and the government provides funding for the establishment of an international research-based institution (in principle, 10 years, about 0.7-1.4 billion yen, working as a WPI Academy from the 11th year).

### 3.1.2 Achievements

WPI has been generating results in four areas. The four areas are world-class research achievements, creation of convergence areas, establishment of an international research environment, and organizational reform. Each specific achievement is as follows.

First, for the world’s best research achievements, the percentage of papers published in the top 1% international journals (based on Web of Science 2007-2015) includes MIT 5.9%, Stanford 4.8%, Harvard 4.7%, etc., and WPI (7 bases selected in 2007) ranked 7th with 3.9%.

Second, the distribution of thesis fields emerging from each base is interdisciplinary as shown in the following figure by creating a convergence area.



Source: Japan Society for the Promotion of Science ([https://www.jsps.go.jp/english/e-toplevel/19\\_pamphlet.html](https://www.jsps.go.jp/english/e-toplevel/19_pamphlet.html)).

**Fig. 1.** Distribution by field of papers produced by each WPI center (Based on the date of paper issued by each center during the period from its establishment to 2018)

Third, in terms of creating an international research environment, the average ratio of foreign researchers at WPI in 2018 was 41% (the average of national universities in Japan in 2017 was 7.8%).

Fourth, as a leading research hub and university organization reform, the English-based research environment-office, strengthening leadership, acquisition of donations from private foundations and companies, sharing know-how of forming various bases (Web WPI Forum), and environmental maintenance (having teatime among researchers in different fields and open mix labs) are being promoted to increase transdisciplinary study in the field.

As of 2019, there are 13 WPI bases as shown in the following table.

**Table 1.** WPI centers

Host organization	WPI Name
Tohoku University	Advanced Institute for Materials Research (AIMR)
Tokyo University	Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU)
Kyoto University	Institute for Integrated Cell-Material Sciences (iCeMS)
Osaka University	Immunology Frontier Research Center (iFRec)
Substance-Material Research Organization	International Center for Materials Nanoarchitectonics (MANA)
Kyushu University	International Institute for Carbon-Neutral Energy Research (I2CNER)
Tsukuba University	International Institute for Integrative Sleep Medicine (IIS)
Tokyo Institute of Technology	Earth-Life Science Institute (ELSI)
Nagoya University	Institute of Transformative Bio-Molecules (ITbM)
Tokyo University	International Research Center for Neurointelligence (IRCN)
Kanazawa University	Nano Life Science Institute (NanoLSI)
Hokkaido University	Institute for Chemical Reaction Design and Discovery (ICReDD)
Kyoto University	Institute for the Advanced Study of Human Biology (ASHBi)

### 3.2 For-profit sector

Compared to other sectors, the for-profit sector has a strong tendency to link transdisciplinary study results to profitability. In particular, the case of joint studies between the SoftBank Group and Tokyo University is examined here.

#### 3.2.1 Outline

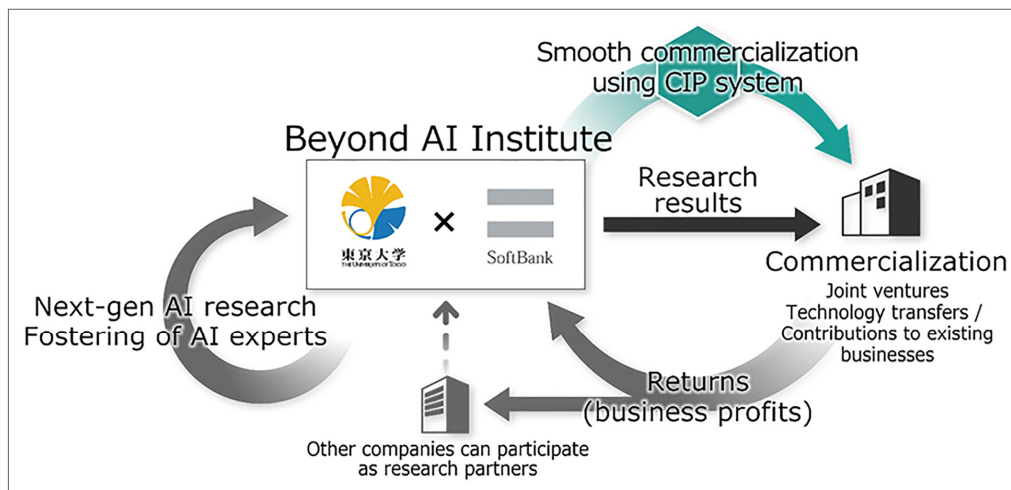
SoftBank Group Corp. and the University of Tokyo established the ‘Beyond AI Institute’ as the world’s best AI research institute, and this joint research began on July 30, 2020.

The ‘Beyond AI Institute’ has selected 10 mid to long-term research topics and 10 research leaders initiated the pursuit of cutting-edge AI, such as the evolution of AI itself and convergence with other fields to perform joint research. In addition, they aim to commercialize 10 cases and create 3 new academic fields in the next 10 years based on the research results, and in order

to set basic numerical targets, SoftBank is conducting research activities that assume commercialization from the initial stage in accordance with the 50-person commercialization promotion team.

The research promotion organization promotes research in two directions: high-cycle research aimed at commercialization based on medium to long-term research, and achievements in cutting-edge AI research conducted by researchers at the University of Tokyo and other leading universities overseas. Furthermore, it holds the characteristic of building an ecosystem by allocating the commercialization profit obtained through business to educational activities for expanding research activities and nurturing AI talent. From the Softbank Group side, it will contribute up to 20 billion yen over the next 10 years.

They plan to establish a high-cycle research infrastructure and start research in 2020, then using the achievements and intellectual property produced by the medium to long-term research, they would promote rapid commercialization using the CIP (Collaborative Innovation Partnership) system<sup>1)</sup> in the fields of medical-healthcare, smart city, and MaaS (Mobility as a Service).



Source: Softbank ([https://www.softbank.jp/en/corp/news/press/sbkk/2019/20191206\\_02/](https://www.softbank.jp/en/corp/news/press/sbkk/2019/20191206_02/)).

Fig. 2. Concept Diagram of Beyond AI Institute

### 3.2.2 Mid to long-term research topics

The ‘Beyond AI Institute’ is a project started in July 2020, and it is still in early stages of evaluating its performance. Meanwhile, the medium to long-term research topics are organized as follows.

1) The Collaborative Innovation Partnership (CIP) is a research promotion system established by the Ministry of Economy, Trade and Industry, and it is a system that allows universities and companies to quickly form a R&D organization and commercialize a joint venture established based on research results as a stock company.

**Table 2.** Medium to long-term research topics of the ‘Beyond AI Institute’

Category	Research Topics	Pursuit Value	Research Leader Affiliation
The evolution of AI itself	Automatic construction of high-precision prediction models from the data of small number of teachers	Development of predictive model learning technique from limited number of teacher data and its automatic construction technique	Advanced Science and Technology Research Center
	Problem solving technique using complex AI	Complex-multilevel AI development using ultra-large-capacity small particle experiment	Elementary Particle Physics International Research Center
Brain science and AI convergence	Brain function expansion by AI	Decode brain information with AI and apply the brain with undetectable perception and excellent cognitive ability	Graduate School of Pharmacy
	Exceptionally reliable AI development using brain activity data	Development of stubborn and flexible artificial intelligence that reproduces information processing in the brain on artificial functions	Neuro Intelligence International Research Organization
	AI using the knowledge acquisition mechanism for young children	Used for AI development by interpreting communication between children and others and clarifying the benefits of knowledge acquisition for children	Neuro Intelligence International Research Organization
Convergence of physics and AI	Elucidation of brain function using artificial brain tissues	Creating bio-AI with higher-order functions by efficiently learning self-made artificial brain tissue	Production Technology Research Center
	Decryption of quantum properties of matter using AI	Quantum signal decoding AI is used to demonstrate the use of quantum fingerprints of materials and develop them in non-classical computational resources.	Graduate School of Engineering
	Next-generation AI device that achieves ultra-low power consumption that learns from living body fluctuations	Creation of ultra-low power consumption devices based on the overall spin wave using the information processing principle based on the probability resonance field	Graduate School of Engineering
AI and society	Norms-ethics-practical research for realizing a true gender equal society in the AI era and guaranteeing the rights of minorities	‘Beyond AI society’ discovering possibilities and problems, realizing and solving them, appropriately identifying mitigation measures, and planning a desirable society	Information Science Building
	Presence of cognitive personality using AI	Systematic understanding of the principle of cognitive personality by convergence of research on artificial functions and on people with developmental disabilities	Neuro Intelligence International Research Organization

Source: Division of University Corporate Relations, The University of Tokyo ([https://www.u-tokyo.ac.jp/focus/ja/press/z1702\\_00002.html](https://www.u-tokyo.ac.jp/focus/ja/press/z1702_00002.html)).

### 3.3 Non-profit private sector

Among the foundations promoting academic support projects as a non-profit private sector, apart from the government sector or the for-profit sector, the support project of the ‘foundation for the Fusion of Science and Technology’, includes the term ‘convergence’ or ‘fusion’, as in the following table, but it is mainly composed of content related to simulation or gaming. This is in line with the foundation’s aim to get convergence of science and technology such as simulation and gaming research.

### 3.3.1 Outline

The following table exhibits the types of research projects supported by the foundation.

**Table 3.** Types of support for research projects by the Foundation for the Fusion of Science and Technology

Category	Content
Research Project A	International relations, national economy/social regional planning, urban planning, regional activation, etc. Simulation/gaming research on ‘economy-management’ such as business games Simulation/gaming research that supports group decision making, problem solving, policy evaluation, etc. Simulation/gaming research supporting collaboration-collaborative work, organizational learning, etc. Simulation/gaming studies for understanding of different cultures, self-realization, and task discovery Other simulation/gaming research
Research Project B	Beginning of learning software by simulation/gaming research applied information technology and network technology Research on games useful to the society
Research Project C	Research on advanced and original techniques of simulation/gaming (for supporting young researchers)

Source: foundation for the Fusion of Science and Technology (<http://www.fost.or.jp/subsidies.html>).

The research projects selected in 2019 are shown in the following table.

**Table 4.** Research projects selected by the Foundation for the Fusion of Science and Technology (Type A, B)

Category	Recipient's Title	University	Research Project	Amount Supported (yen)
1	Quasi-professor	Hokkaido University of Science Junior College Department of Automotive Engineering	Research on efficient learning method of gaming simulation development process through ISAGA Summer School 2020	1,400,000
2	Visiting professor	Broadcasting University Kanagawa Learning Center	Implementation of ‘Development of Business Games Unnecessary for Programming’ to expand the gaming simulation population	480,000
3	Special assistant	Noto SDGs Lab Kanazawa University Noto Rio SDGs Research Department	Promotion of mutual learning and regional activation activities through the development and implementation of the ‘理山理海 SDGs game’	760,000
4	Professor	Information Culture Division, Faculty of Media Communication, Edogawa University	Development of information education curriculum and gaming textbooks that foster problem solving skills with data analysis	750,000

Category	Recipient's Title	University	Research Project	Amount Supported (yen)
5	Visiting researcher	Keio University Graduate School of Business Administration	Proposal of analysis and evaluation method for the third-party convergence of business game-agent simulation-case method	1,125,000
6	Professor	Department of Information Science, Faculty of Curriculum, Tsudajuku University	Started entertainment app using independent restriction of body movements	980,000
7	Lecturer	Osaka Shoin Women's University Faculty of Curriculum Cosmetics and Fashion Department	Performance of exhibition use to preserve game development data	1,050,000
8	Quasi-professor	Akita University Industry-Academic Cooperation Promotion Organization	Research on social understanding in e-sports events based on local creation and global perspectives	845,000
9	Quasi-professor	Doshisha University Faculty of Cultural Information	Gaming simulation development to support prehistoric cultural proliferation research	552,500
10	Quasi-professor	Hokkaido University of Education Graduate School of Teachers	Development and implementation of 'anger management', a gaming simulation—establishing an Internet learning site for children, teachers and guardians—	845,000
11	Quasi-professor	Durham University Department of Economics and Finance	Economic experiment on self-control resources and collective decision-making under a social dilemma	620,000
12	Quasi-professor	Tokyo Agricultural University Faculty of International Food Science and Technology Department of Food and Environment Economics	Game development using the knowledge of the elderly (vegetable disposal game)	860,000
13	Quasi-professor	Nagoya University of Economics Faculty of Economics Department of Modern Economics	Developing a card game based on the location of renewable energy facilities	500,000
14	Quasi-professor	Joetsu University of Education Graduate School of School Education	What does digital local currency empower? Study on the relationship between local currency form and empowerment	680,000
15	Special quasi-professor	Meisei University Meisei Education Center	A review of the impact of face-to-face puzzle games on social-affective skills	380,000
16	Assistant	Fukui University Academic Researcher Engineering Division	Development of a game system that supports the prevention of crowd accidents in the event of a disaster	470,000
17	Researcher	Digital Hollywood University Graduate School Demere Science Institute	Is it possible to take countermeasures for birds (鳥獣) by crowdsourcing? Research and prototyping of functional games with the theme of harmony of understanding and continuous coexistence with human society from the perspective of crows	700,000
18	Emeritus professor	Rikkyo University	Developing functional games that increase individual and team resilience potential	570,000

Category	Recipient's Title	University	Research Project	Amount Supported (yen)
19	Quasi-professor	Kyushu University Graduate School of Science researcher Biological Sciences	Developing a community ecosystem to maintain sustainable environmental conservation activities using ecosystem simulation	660,000
20	Assistant	Hiroshima University Diversity Research Center	Common basis for information sharing	660,000
21	Lecturer	Autonomous Medical College Information Center IR Division	A Study on Escape Game Education Utilization: Review of Practice Cases Based on Instructional Design and Application in Medical Education	390,000
22	Professor	Graduate School of Human Development and Environment, Kobe University	Debriefing design using game learning experience for post-learning in social studies education	215,000
23	Professor	Faculty of Applied Biological Chemistry, Gifu University	Gaming simulation to support policy-making regarding seedling release and fishing	195,000
24	Full-time professor	Meiji University Faculty of Comprehensive Mathematics Department of Advanced Media Science	A Study on Educational Application of VR Role-Playing System for Speech and Hwa-ye (話芸)	430,000
25	Professional researcher	Ritsumeikan University OIC Research Organization	A study on simulation gaming to improve self-help during tourism	190,000
26	Lecturer	Osaka Medical University Medical Education Center Medical Function Simulation Room	Development of a functional game based on education in response to sudden changes through collaboration with medical workers in multiple jobs	179,000
27	Professor	Department of Information Systems, Faculty of Information, Bunkyo University	Establishment of urban space simulation system based on game engine and open data	513,000
Total				17,000,000

Source: foundation for the Fusion of Science and Technology (<http://www.fost.or.jp/subsidies.html>).

**Table 5.** Research projects selected by the Foundation for the Fusion of Science and Technology (Type C)

Category	Recipient's Title	University	Research Project	Amount Supported (yen)
1	doctoral course	Ritsumeikan University Graduate School of Policy Science Graduate School of Policy Science	Development of full-area controlled gaming simulation for shelter support training	300,000
2	master's course	Waseda University Graduate School of Creative Science and Engineering, Management System Engineering	Suggestion of techniques to support restoration of ruins using Hololens—Diagnosis of conformity of parts by puzzle gaming—	255,000
3	doctoral course	Hokkaido University Graduate School of Literature Human Science Major	Veil of ignorance in the process of social decision-making: Effectiveness and limitations: A gaming study based on the problem of the location of sheltered facilities	240,000

*Sector Governance to Support Transdisciplinary Study in Japan*

Category	Recipient's Title	University	Research Project	Amount Supported (yen)
4	doctoral course	Ritsumeikan University Graduate School of Advanced Comprehensive Research	How does the game design-symbol-interface reflect social norms? Focusing on dating simulation games for women	197,000
5	master's course	University of Tokyo Graduate School of Humanities and Social Sciences Social and Cultural Studies Major	'Only the same people are acting—reviewing the mechanisms that lead to inequality in the volunteer dilemma	225,000
6	doctoral course	University of Tsukuba Intelligent Functional System Major	Elucidation of the effect of point-of-view sharing on player situational awareness-space awareness in cooperative virtual reality games with a first-person perspective	211,500
7	Researcher	Meiji Gakuin University Faculty of Economics Department of Economics	The dilemma of exploration and extraction in the AI era: design and understanding of finite time environment systems that promote the purchase of valuable things through gaming	210,000
8	master's course	Hokkaido University Graduate School of Literature, Behavioral System Science Lecture	Is the use and learning of 'group reputation' adaptive? —Theoretical review using evolutionary game simulation	210,000
9	doctoral course	Yokohama National University Faculty of International Social Sciences	A Study on the Factors of Social Network Formation Using Gaming Simulation	195,000
10	doctoral course	University of Tokyo Graduate School of Cultural Studies Major in Wide Area Science	The process of creating a two-way coupled decision-making model in cooperative decision making	180,000
11	doctoral course	Department of Advanced Science and Technology, Graduate School of Advanced Science and Technology, Hokuriku	A study on the effect of directing on player behavior when video game fails	48,000
12	master's course	University of the Ryukyus Graduate School of Agricultural Sciences Department of Agriculture, Forestry and Environmental Sciences	Improving awareness of sustainable eco-tourism at the local level using simulation games	180,000
13	master's course	Nagaoka University of Technology and Science, Faculty of Engineering, Major in Basic Engineering, Knowledge Society	Experimental analysis of knowledge transfer process in group conversation using multimodal information and verification by multi-agent simulation	133,500
14	master's course	Fukui University Graduate School of Engineering, Major in Basic Engineering of Knowledge and Society	Estimation of palatability of VR-HMD users based on brain waves for improving learning efficiency	120,000
15	doctoral course	Tokyo Institute of Technology Graduate School of Comprehensive Science and Engineering, Intelligent System Science Major	Development of player play behavior identification technology to realize real-time measurement of concentration for game players	120,000
16	1 yr of graduate study	Hokkaido University of Education Graduate School of Education, Advanced Teaching Practice Major	Development of home and gaming textbooks that foster the power of living using ICT	105,000
17	doctoral course	Graduate School of Policy Science, Ritsumeikan University	How to Use Gaming in Classes— the Case of Refugee Problems in Europe—	70,000
<b>Total</b>				<b>3,000,000</b>

Source: foundation for the Fusion of Science and Technology (<http://www.fost.or.jp/subsidies.html>).

#### 4. Result and Implication for Korea

As examples of supporting the transdisciplinary study by the government sector, for-profit sector, and non-profit private sector in Japan, the ‘World Premier International Research Center Initiative’ by the Japan Society for the Promotion of Science, ‘Beyond AI Institute’ by Softbank Group Corp., and research project support by the Foundation for the Fusion of Science and Technology were briefly reviewed. The size, period, number of selected institutions, and characteristics of each support amount are summarized in the table below.

**Table 6.** Cases of support for transdisciplinary study by the government sector, for-profit sector, and non-profit private sector in Japan

Category	Government sector	Profit sector	Non-profit private sector
Representative Case	World Premier International Research Center Initiative	Beyond AI Institute	Simulation-gaming Research and research support
Supporting organization	Japan Society for the Promotion of Science	Softbank Group	Foundation for the Fusion of Science and Technology
Support amount	0.7-1.4 billion yen per case	20 billion yen	1.5-0.15 million yen per case
Number of selection	13	1	44
Application period	10 years	10 years	1 year
Characteristic	Leading cutting-edge research by publishing the top 1% in international journals and recruiting foreign researchers	Revenue circulation structure based on performance and commercialization, the University of Tokyo alone	Specialized in simulation-gaming research, small-scale support, target-based expansion
Advantages	Character of national policy support (strong intensity)	Massive intensive support (strong coherence)	Selection opportunity for many researchers (strong flexibility)
Disadvantages	Existing university ranking	Only for the University of Tokyo	Limited research field, small support
Implications for Korea	Consortium formation regardless of university rank	Development of a commercialization incentive system linking companies and laboratories	Expansion of small-scale support for convergence in wider fields

First, as an example of the government sector, in the case of Japan Society for the Promotion of Science’s ‘World Premier International Research Center Initiative’, characterized as a national policy, its main content is to be the world’s best by publishing in the top 1% of international academic journals and recruiting foreign researchers. In terms of governance, it is characterized by strong nation-led intensity. On the other hand, this is also a disadvantage at the same time because the targets of support are limited to the existent university rankings. In this regard, they are also seeking the use of consortiums, irrespective of university rankings.

As a representative example of the for-profit sector, the ‘Beyond AI Institute’ by Softbank Group and the University of Tokyo takes up most percentage out of these three cases’ budget of 20 billion

yen over 10 years, and this would be due to their focused partnership with the University of Tokyo, which is based on research results and commercialization. However, as a company amid the intensifying international competition, it is expected that this would be an urgent matter in the near future. In terms of governance, it is characterized by strong coherence in the context of seeking profit. To expand this coherence to other universities and research institutes, it is possible to propose an advanced supporting system that induces commercialization in connection with different companies and laboratories as an alternative.

Lastly, in the case of ‘simulation-gaming research support’ by the Foundation for the Fusion of Science and Technology as the case for non-profit private sector, projects are supported regardless of the university rankings. And although the scale of support is small, it is wider, even open to graduate students. Flexibility is strong in terms of governance. However, in this case, the research field to be supported is limited to gaming-simulation. Therefore, as an implication, it is possible to accentuate the necessity of expanding the scope of the research field.

Sector governance supporting transdisciplinary study in Japan is kind of a hybrid among the government sector, profit sector and non-profit sector. In Korea, the National Research Foundation of Korea mainly supports transdisciplinary study, but profit sector and non-profit sector have more room to develop their unique role as in Japan’s cases.

Therefore, in reorganizing the implications for Korea, the government sector and the for-profit sector could adopt forms of consortiums that disregard the existent university ranking in order to expand opportunities of more collaboration between companies and universities by developing a supporting system that promotes the commercialization of business-laboratory connection. In case of the non-profit private sector, it would be helpful to induce wider application to graduate students by securing the diversity of convergence and providing small-scale supports. In conclusion, it would be efficient to build an integrated information system for clear checking of the projects by the academic support groups, which are currently dispersed.

In addition, the three cases above are composed mainly of science and engineering, while the humanities and social sciences realm tend to remain in a peripheral position. However, the convergence of the digital field, humanities and social fields is leading the way today. In other words, it could be said that the opportunity to receive transdisciplinary study support in Japan is somewhat overly concentrated in certain areas. Nevertheless, in consideration of the diversity of disciplines, it is expected that the potential for convergence can be demonstrated in a wider range. It will be important to establish and induce opportunities to introduce and communicate research content with each other between science, engineering, humanities, and social sciences within each university. Furthermore, compelling critical thinking practices are more important than allowing research for responses, and not dividing topics for pro and con discussions (Taylor et al., 2020).

Yet in this manuscript, only few examples of various support policies for transdisciplinary study were just briefly introduced. The Japan Society for the Promotion of Science support project is expected to bring more support for convergence, but in this study, only the most representative cases have been presented in terms of time and width. To draw more detailed implications, the compare and contrast of similar support projects and similar research projects selection in both Korea and Japan would be significant for the future.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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