Report of the RIKEN Information R&D and Strategy Headquarters Advisory Council

October 2023

Executive Summary

The first RIKEN Information R&D and Strategy Headquarters Advisory Council (R-IH AC, hereinafter “the AC”) was organized to evaluate operations and R&D activities by RIKEN Information R&D and Strategy Headquarters (R-IH) and to make recommendations to R-IH on its future operations and R&D. The AC is chaired by Professor Fukazawa and consists of global experts. (Appendix 1: List of R-IH AC Members) The AC meeting was held in Tokyo from August 8th to 9th, 2003, following AC’s site visit to Guardian Robot Project lab in Kyoto. The AC compiled this report as responses to terms of reference consulted by the president of RIKEN and the director of R-IH. (Appendix 2: Common TOR and R-IH TOR)

The AC congratulates R-IH on the impressive progress made over the period of the 4th Mid- to Long-term Plan. This success has been fostered by the organizational restructure bringing together Information Systems Division (ISD) and Infrastructure Research and Development Division (IRDD) in 2018 and the later restructure to include the Guardian Robot Project (GRP) and Advanced Data Science Project (ADSP). These restructures have been executed atop a clear and communicated plan, pivoting R-IH toward collaborative and proactive research and development. This new structure has seen the delivery of innovative research, and the collaborative development of a fledgling set of common IT infrastructures. Progress to date aligns well with the Transformative Research Innovation Platform of RIKEN Platforms (TRIP) concept and positions RIKEN to support the Society 5.0 vision. The leadership of Minoh-sensei has been instrumental in shaping and driving this restructure and accompanying change in approach. The AC further notes that this progress has been made atop the backdrop of the COVID-19 global pandemic, and calls for dramatic changes in researcher and organizational culture.

R-IH notes the rapid progress in the following areas:

- The data-driven approach through a variety of robots taken by the GRP, including autonomous, interactive, and wearable robots is impressive. A constructivist approach to understanding the human cognitive process has been taken and has focused on real-world applications. The AC deems this research direction to be in line with the next-generation of AI.
- The achievement of ADSP taking an AI-driven approach to identifying and predicting various diseases. They launched a start-up company with this output and started collaborations with hospitals. It makes ambitious proposals for next-generation AI based on first-person models.
- The planning and deployment of a common computational, storage and research data management systems (HOKUSAI-SS, HOKUSAI-SR, RIKEN Research Information Management System(R2DMS)), and a clear drive

toward a common infrastructure to support open access to data are key foundations in the future success of RIKEN.

- The work around open science particularly the number of data sets being made available and the impressive work on the RIKEN Meta-Database.
- Unification of authentication, authorization, file sharing and communication systems was critical in facilitating the move to remote work, and will be foundational to increasing automation and efficiency into the future
- The collaborative planning and development of an infrastructure to manage controlled access and confidential data (HOKUSAI-SR).

The activities of R-IH during the 4th Mid- to Long-term Plan period have centered around ambitious research and development, and the delivery of new or consolidated IT services and infrastructures. Moving into the 5th Mid- to Long-term Plan these activities must shift toward greater coherence and integration of the research initiatives underway, and the promotion and maintenance of the IT services and infrastructures. The AC has made a number of recommendations herein which, in the experience of the AC, are key to ensuring the achievements to date can be fully leveraged, remain sustainable at scale, and continue to deliver benefits to RIKEN as a whole.

Internal and External Drivers

Ther are key drivers internally and externally which have informed and shaped the report and recommendations of the AC.

Increasing Scale of Data and Computational Analysis

As the scale of computation and data expands in research organizations, the deployment and efficient usage of common resources become paramount. The complexity and volume of data generated in modern research necessitate centralized infrastructure that can handle substantial computational workloads. Shared resources, such as high-performance computing clusters and cloud platforms, not only provide the necessary processing power but also streamline collaboration by offering standardized environments for researchers to work within. By pooling resources, research organizations can avoid redundancy, optimize resource allocation, and reduce costs associated with maintaining individual, siloed setups. This approach fosters a collaborative environment where researchers can access the required tools and data without constraints, accelerating scientific breakthroughs and innovation across diverse domains.

AI, Deep Learning and Machine Learning

The 21st century has witnessed an unprecedented rise in the fields of Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning, most recently with the rapid adoption of Large Language Models (LLMs) and Generative AI (GenAI). Fueled by advancements in computing power, data availability, and algorithmic innovation, these technologies have transformed research. Supporting leading research at the forefront of these technologies requires substantial hardware, accompanied by the infrastructure and tooling to support them. Careful capacity and infrastructure planning are key to ensuring organizations have access to the resources required to support them.

Controlled Access Data

Controlled access data presents a unique set of challenges to security within research organizations. These datasets, often containing patient or other sensitive information, are essential for conducting in-depth studies. However, the very nature of controlled access data requires a delicate balance between accessibility and security. Research institutions must implement stringent authentication and authorization mechanisms to ensure that only authorized personnel can access the data. Encryption and secure storage protocols become imperative to prevent unauthorized breaches. Yet, maintaining this heightened security can potentially hinder collaboration and hinder the free flow of information, impeding the advancement of knowledge. Striking the right balance between safeguarding sensitive data and fostering open research is a complex task that demands well defined data management practices, supported by a well-designed and computational and storage infrastructure.

Open Data and Open Science

The importance of open data and open science cannot be overstated in today's rapidly advancing research landscape. Open data involves making research findings, methodologies, and datasets accessible to the public, promoting transparency, reproducibility, and collaboration. Open science encompasses a broader philosophy of sharing research processes, results, and even failures openly, which not only accelerates scientific progress but also fosters trust among researchers and the wider public. As the scale of research grows as does the challenge of storage and providing this data openly, careful planning of storage infrastructures and data sharing mechanisms is essential to ensuring scalability.

Equality, Diversity and Inclusion

A major societal momentum is recognizing the need to diversify organizations to ensure that all voices are represented. Research has found evidence that a higher proportion of women on a team increases collective intelligence (Riedl et al., 2021; Woolley et al., 2010), and that gender-balanced teams lead to the best outcomes for group process (Bear and Woolley, 2011; Carli, 2001;).

Hybrid Working

Response to the Coronavirus dramatically accelerated the transition to hybrid working. Most organizations were forced to rapidly adapt to support their users to work remotely, transitioning to cloud services, enhancing remote connectivity to the office and bolstering mobile device management practices.

Increasing Prevalence and Severity of Cyber Security Incidents

The escalating risks of cybersecurity attacks pose a growing concern for research organizations. As these institutions rely heavily on the storage, processing, and sharing of open and sensitive research data, they become attractive targets for malicious actors seeking to exploit vulnerabilities. Sophisticated cyberattacks, ranging from ransomware to data breaches, can not only disrupt critical operations but also compromise the integrity of research. The potential loss of intellectual property, confidential findings, and personal data can severely undermine the reputation and trust of the organization. Mitigating these risks demands a comprehensive approach involving robust cybersecurity measures, ongoing training, and a proactive stance spearheaded by a Chief Information Security Officer (CISO) with clearly defined roles and responsibilities.

Response to TOR 1: SWOT Analysis of R-IH

Strengths

ISD & IRDD

1. The placement of GRP and ADSP within R-IH has served as a successful incubator for service development in this early phase.
2. Placing ISD and IRDD together has created synergy, and enabled rapid progress on the common IT service and infrastructures.
3. The planning and deployment of common IT infrastructures for research data storage, computation and management have progressed quickly.
4. The drive toward unified IT services for authentication, authorization and communication supported the rapid transition to remote work and places RIKEN well for the future.
5. The level of inter-relationship of the data held in the Meta-Database is very impressive.
6. The information security awareness program is mature and focus is given to ensuring users are trained.
7. The model of working with key champions within research teams to bridge the gap between R-IH and the team is effective.

ADSP

8. In short time period (2 years), ADSP has published multiple research papers for identifying and predicting various diseases and has launched a start-up company with through these activities.
9. ADSP has made ambitious proposals for next-generation AI based on first-person view and dynamical systems.
10. ADSP has started collaborations with hospitals.

GRP

11. In a short time period, GRP has published multiple research papers (Inter speech, Computer Speech and Language RA-Letter, etc.), and several groups are working together to develop several real robots and demonstrate them effectively.
12. GRP is unique in terms of building live demo systems on multiple, diverse robot platforms that could also be used for data collection and evaluation.

13. For conversational AI, GRP has identified a set of core, important problems to tackle towards enabling natural interactions, which is also unique.
14. GRP's exoskeleton research is advanced and critically important, especially for an aging population.

ADSP-GRP Interactions

15. Design Team in ADSP and Behavior Learning Team in GRP are planning interactions through a Care Center.
16. Transfer of information on use of GenAI learning systems

Weaknesses

R-IH

1. There was no gender diversity among the presenters to the AC. All presentations were by men. All the highlighted research appeared to be that produced by men only. Women researchers are reported to be 33% of the research staff, but they were not represented at the meeting.

ISD & IRDD

2. The CISO and the Information Security Incident Response Team (CSIRT) should cover cybersecurity measures at multiple locations in Japan.
3. Information security awareness training is mandatory but no penalties exist for failure to complete it.
4. There is no clear model to fund the growth of the common IT infrastructures, and most critically staffing, as storage and computational usage grows.
5. The distribution of local IT teams at each site may create challenges in standardization and service delivery and communication.

ADSP

6. There is a problem of data expansion through collaboration with medical systems.
7. Applications of AI methods to medical data are highly significant but not highly innovative. Closer collaborations with RIKEN Center for Advanced Intelligence Project (AIP) may lead to creative AI architectures that solve complex problems particularly around multi-modal data integration with considerations of time series information. Also closer collaborations with RIKEN strategic research centers will provide domain depth for major advances in domain areas.

GRP

8. There is a challenge in how to bring together diverse researchers on robot development. Hardware design for certain applications should be considered.
9. Current research areas are extensive, but not sufficient. Additional research areas can be identified and prioritized according to the most beneficial use cases.
10. Current research efforts are highly modular with little effort to integrate the modules under a unified framework.

11. Component evaluation is useful, but not sufficient, end-to-end evaluation should be prioritized to track progress towards the overall mission.

ADSP & GRP

12. The number of researchers and engineers is insufficient. A new training system for researchers and engineers is needed.

ADSP-GRP Interactions

13. Human-robot interface can be advanced through interactions between ADSP and GRP with plans to feed robots bio-sensory data from humans but these concepts appear to be underdeveloped.

Opportunities

R-IH

1. Data-driven R&D is becoming a trend in diverse fields. The joint ADSP and GRP results here could provide important insights that can be shared more broadly within RIKEN and with other diverse research institutions.

ISD & IRDD

2. Increased research output, research quality, collaboration and operational efficiency through increased uptake of the common IT infrastructures and services already established.
3. Greater stakeholder input through the establishment of user groups and communities of experience at each site and virtually across RIKEN, further driving adoption of the common services and infrastructures
4. Transparent allocation resources via the establishment of committees charged with making recommendation on resource allocation based on usage metrics, ensuring the perception of fairness among users
5. Closer collaboration between ISD and IRDD will better shape the future direction of IT services and infrastructures.

ADSP

6. Leveraging Japan's universal health insurance system, it may be possible to collect large biomedical data with the establishment of a national registry in collaboration with National Institute of Informatics (NII) and medical centers. Large biomedical data assets are critical for advancements using deep learning.

GRP

7. Robotics is an area in which Japan has a global advantage, and collaboration with diverse companies and external research teams could enable the development of new applications to meet social needs.
8. Robots is a crucial element in the aging society; exploring opportunities for implementation science in Japan can be meaningful.

Threats

ISD & IRDD

1. Grant funding cycles are highly variable, this may affect the ability of research teams to maintain Meta-Database quality.
2. The frequency and severity of cyber-attacks is growing, RIKEN is an attractive target.
3. Inability to rapidly leverage public cloud providers owing to regulatory restrictions
4. Limited power capacity in existing facilities and data centers despite increasing power demands from applications such as GPUs
5. The placement of GRP and ADSP within R-IH could create the perception that they receive preference over other users of the services and infrastructures provided by ISD and IRDD.
6. Insufficient staffing as usage of the common IT services and infrastructures grow could lead to poor services and operational issues.

ADSP & GRP

7. Advanced AI systems such as LLM and AlphaFold are being developed at Big Techs in the US.
8. The same is true of robotics as well, with projects like Google's RT-1 & 2 project, Tesla's Optimus, and NEO by 1X (OpenAI) in recent years.
9. ADSP needs to partner with NII and medical centers to establish a national registry data with de-identifiable patient data as a necessary research resource to best meet the needs of the Japanese people and to be competitive on the international stage.

Response to TOR 2: Evaluation

All R-IH

- R-IH's future vision is considered to be in line with the direction of RIKEN's 5th Mid- to Long-term Plan, such as the TRIP concept.
- Close collaboration between the departments that develop and operate the ICT infrastructure and the information-related research departments such as ADSP and GRP is highly valuable.
- Careful consideration should be given as to how to avoid the placement of GRP and ADSP within R-IH creating the perception that they receive preference over other users of ISD and IRRD's services and infrastructures.

ADSP

- Applying unique AI and information science to integrate life sciences and medical sciences research; this is an important intersection that is often overlooked in AI discussions.
- Enhancing dynamic AI models for diagnosing and predicting diseases, by integrating first-person view and dynamical principles, into creative computational concepts across different domains, with awareness of the time-recorded events and the aging process.

GRP

- Creating robots that respond to real-world cues by considering both user context and surroundings. They aim to achieve this through autonomous decisions, emotional interactions, and aiding physical actions.
- Bridging the gap between AI's cyber-world progress and its application in the physical world to contribute to RIKEN's research goals.

Response to TOR 2: Recommendations

All R-IH

1. The broad use of R-IH's services and infrastructures will increase the computational power and storage capacity available to researchers, streamline collaboration, and reduce costs associated with maintaining siloed infrastructures. Researchers will leverage these services and infrastructures only where they believe the organization is committed to ensuring their ongoing stability. RIKEN must commit to scaling R-IH resources, especially technical staffing, in line with the proliferation of usage of the common IT services and infrastructures (such as HOKUSAI compute and storage). Clear top-down commitment by RIKEN to this model will accelerate the uptake of the services and infrastructures, delivering the benefits and efficiencies sooner.

2. The need to scale staffing in line with that of common resources is common to all research organizations, but is rendered critical at RIKEN by the prevalent practice in Japanese research institutions, where the researchers within IRDD are actively involved in the design, implementation, and maintenance of the research IT infrastructures. This practice can create a tension between the desire to conduct cutting edge development of infrastructures and their long term sustainability and maintenance. R-IH and RIKEN as a whole are encouraged to assess and acknowledge the efforts of these researchers who devote their time to developing foundational research infrastructure that benefits their peers, and to consider the balance between research and operational support staff.

3. R-IH should focus first on simple IT infrastructures that are easier to maintain and have more universal appeal. The adoption of simpler services will be faster, and once the majority of users have adopted the common IT infrastructures, then more focus can be given to more complex services. R2DMS for example is an impressive platform, but most research users may need only a persistent link to their data atop a simple storage service such as Amazon S3.

4. R-IH should consider hiring dedicated data archivists or data librarians to set data management policy, and audit data management practices. This will ensure researchers are managing data in alignment with contractual obligations, especially where controlled access or sensitive data are in use.

5. Placing GRP and ADSP within R-IH has created an incubator environment that has allowed for the integrated development of infrastructures. Careful consideration should be given as to how to avoid the placement of GRP and ADSP within R-IH creating the perception that they receive preference over

other users of ISD and IRDD's services and infrastructures. The structure should be re-evaluated as the broader use of the HOKUSAI infrastructure grows.

6. R-IH should develop and share simple, transparent metrics to measure IT service and infrastructure usage and indicative costs to help control resource usage and guide resource allocation.
7. R-IH should establish user groups and communities of experience at each site and virtually across RIKEN, further driving adoption of the common IT services and infrastructures it provides.
8. R-IH should establish committees charged with making recommendation on resource allocation within its infrastructures based on usage metrics, ensuring efficient usage, and the perception of fairness among users across RIKEN.
9. R-IH should track carefully the collaborative work between R-IH and research teams, ensuring expectations are managed and that the boundary of responsibility between R-IH and research teams regarding development and maintenance is completely clear now and into the future.
10. In the case of R-IH, 33% of the research staff are women, but it appears that there are no women in leadership positions. No women researchers gave a presentation at the AC meeting. In order to ensure the future of R-IH missions, it is critical to advance women into leadership positions. Women will strengthen the organization with their diverse perspective and serve as a role model to younger generations of women, demonstrating that there is a successful path for women researchers in R-IH to have fulfilling and impactful careers.

ISD

11. The uptake of the common IT infrastructures and services is critical to enabling efficient and effective usage of resources as the volume of data, frequency of cross-disciplinary research and the call for open data increase into the future. RIKEN should look from the top-down at how the uptake of the services and infrastructures of R-IH can be more actively driven and promoted in line with the TRIP concept, and ensure researchers understand benefits that R-IH services and infrastructure can provide.
12. The CSIRT system at bases other than Wako headquarters should be strengthened.
13. The CISO structure of RIKEN is aligned with national requirements. However, given the scale of RIKEN and the highly attractive resources it operates the placement and structure of the CISO function should be

periodically evaluated to ensure responsibility is appropriately assigned and operations sufficiently streamlined so as to place RIKEN to respond quickly and decisively to coordinated organization wide cyber attack.

14. The communication, training and delivery of R-IH services would benefit from selecting an IT service management framework. (e.g. ITIL) that could be used to support continuous service improvement and change management across R-IH service portfolio.

15. The AC could not accurately determine the level of coupling between ISD and the IT support local to each site, though there was some mention of potential inconsistencies by users. In the experience of AC members poor coupling between central and local IT teams can lead to fractured and inconsistent IT support. The structure and reporting lines of local IT groups should be reviewed to ensure that ISD can deliver consistent and quality IT services across RIKEN.

16. ISD has created a replacement program for the multiple High Performance Computing (HPC) clusters it manages. The AC endorses this forward planning and recommends that the number of clusters be gradually reduced to a minimum in order to simplify operation and create a larger pool of common resources.

17. Though fully functional, the HOKUSAI-SS OpenStack version is now quite old. A plan should be developed to reduce the impact of future upgrades on users, and make upgrades a scheduled and routine operation.

18. R-IH has developed a tiered model for data storage, defining high, medium and low cost options. At present the HPC clusters and public data sharing services share storage infrastructure. As the usage of the infrastructures and services grow this shared usage poses performance and security challenges. Consideration should be given to creating an independent and highly scalable storage infrastructure to support public data sharing and the coming explosive growth in open access data.

IRDD

19. Research data management plans and data lifecycle management have become standard practice in many countries and are required by many funding agencies as part of grant proposals. R-IH should investigate how the R2DMS or other tools could aid researchers to track and control the data lifecycle.

20. In serving a wide range of researchers, scientists and technologists, R-IH should focus on onboarding as many research teams as possible by providing low level tools that can scale dramatically, such as S3 storage.

ADSP & GRP

21. Deepen, and share the concept of the next AI which could include a first-person view and dynamical systems principle, predictive coding, etc. It could bridge the various research targets of both GRP and ADSP.

22. In GRP, enhancing the body (hardware) functions, such as manipulation with tactile sensing, and self-hardware monitoring, could be important for considering embodied AI. They could collaborate with other projects and other research groups outside of RIKEN.

23. Recommend a review of RIKEN Data Science for Society 5.0 with a joint evaluation of R-IH, and related efforts in AIP, RIKEN Center for Computational Science (R-CCS), RIKEN Interdisciplinary Theoretical and Mathematical Sciences Program (iTHEMS) and other such groups throughout RIKEN. Otherwise, there is a risk that major advancements will not be realized due to siloed efforts. For example, to realize the full potential of ADSP, assess their alignment with investments in R-CCS, RIKEN Spring-8 Center (RSC), RIKEN BioResource Research Center (BRC) and AIP. In addition, it will be highly productive to pursue integration of data science and life science research to understand human biology that addresses health goals through precision medicine initiatives. Along these lines, it can be powerful to establish closer collaborations with RIKEN strategic research centers which can provide deeper domain knowledge to the AI experts in ADSP, ensuring meaningful and impactful biomedical advances. For example, developing a campaign to establish deeper collaborations with the Center of Integrative Medical Sciences (IMS) may ensure heightened use of the integrated -omics databases.

24. GRP teams would benefit from user experience research that could identify the most beneficial use cases. The targeted research areas could be further prioritized according to these use cases, and maybe even additional areas could be identified to help with those. For example, although these are still very hard problems, social interactions with the elderly (for example, conversations about family, etc.) or interactions that mainly require navigation and verbal interaction can result in quicker success in comparison to task completion interactions which may require execution in the real physical world.

25. A broader effort towards building multi-modal models would be useful to both projects. To do that, large multimodal datasets, a large compute infrastructure (GPUs and other similar processing units optimized for tensor computations), and broadening the team of experienced researchers would be important.

26. A challenging topic related to interactions with machines is the end-to-end evaluation of the proposed framework. In the literature, human evaluation has been the accepted approach, due to the lack of alignment between human evaluation and automated metrics, however human evaluation is expensive and could also be subjective. There are some further research and innovation opportunities on this topic that could be possible at R-IH.

27. Assemble an advisory council to advance efforts on establishing a national health registry that combines patient and research data. Convene international experts who can share their experience and knowledge on how to effectively collect and share this data for open science research purposes, while protecting privacy and ensuring security. This council can also advise on how to best learn across multiple health care entities by leveraging protected health care data through federated learning systems.

Feedback from ISD & IRDD User Discussions

The following is a summary of user feedback sessions with the end users of the IT services and Infrastructures.

- Conversations with several IRDD researchers illuminated that the transition to the new cloud-based services occurred seamlessly to the best of their knowledge, partly due to their familiarity with these services (e.g., Slack, Zoom).
- Many of these services were introduced at a crucial juncture when the onset of the COVID-19 pandemic compelled numerous individuals to shift to remote work.
- The timely introduction of these services across RIKEN was made possible by prior decisions by R-IH and the subsequent implementation efforts by ISD
- Several users stressed that further training in the use of the new cloud based services would have eased migrations and would allow them to more effectively leverage them.
- Further insights gleaned from the discussions underscored the potential advantages of harnessing the centralized infrastructure, with Hokusai being of utmost importance.
- A number of users stressed that they are looking forward to increased access to GPU resources within the renewed HPC infrastructures
- Nonetheless, the researchers we engaged with still tend to rely on their lab-specific infrastructure.
- Some expressed concerns regarding potential latencies between their robotic systems and the distant cloud.
- On the contrary, lab-level infrastructure often grapples with limitations in capacities due to factors like power supply or physical space availability.
- Establishing and overseeing a shared infrastructure capable of accommodating these diverse requirements will play a pivotal role in steering successful data- and AI-centric research in the future.

Conclusions

The R-IH AC would like to thank RIKEN for the opportunity to serve and the insights gained through participation in this advisory council. The committees would in particular like to thank all members of the R-IH for their hard work in preparing for this Advisory Council, and their tireless support throughout.

The committee was impressed by the level of transformation already undertaken toward a common resources model by the ISD and IRDD. This model can deliver increased research output, research quality, collaboration and operational efficiency. The success of this model will depend not only on the work of the R-IH, but most crucially the commitment of RIKEN to its success. In the experience of the committee senior researchers are often reluctant to embrace a common resources model as they perceive it as a loss of control. Clear top down support and ongoing resourcing for this model will be crucial to driving adoption and delivering its benefits.

Appendix 1: List of R-IH AC Members

Yoshiaki FUKAZAWA, Chair
    Professor, School of Fundamental Science and Engineering, and Director, Institute of Open Source Software, Waseda University

[Subcommittee 1]

Tim DYCE, Vice-chair and Chair of Subcommittee 1
    Head, Infrastructure Services, European Molecular Biology Laboratory's European Bioinformatics Institute (EMBL-EBI)

Jenn STRINGER
    Vice President and Chief Digital Officer, J. Paul Getty Trust

Rin-ichiro TANIGUCHI
    Executive Vice President, Director General of University Libraries, and CIO, Kyushu University

Kenjiro TAURA
    Director and Professor, Information Technology Center, The University of Tokyo

[Subcommittee 2]

Tetsuya OGATA, Vice-chair and Chair of Subcommittee 2
    Professor, Department of Intermedia Art and Science, School of Fundamental Science and Engineering, Waseda University

Dilek HAKKANI-TÜR
    Senior Principal Scientist, Amazon Alexa AI

Sylvia K. PLEVRITIS
    Professor, Biomedical Data Science and Radiology, Stanford University

Jun SESE
    President and CEO, Humanome Lab., Inc.

Appendix 2: Common TOR and R-IH TOR

R-IH AC Terms of Reference (TOR)

TOR 1 (Common TOR 1 consulted by the president of RIKEN)

Based on the results of the Center's self-analysis, evaluate operations and R&D activities for the Fourth Mid- to Long-term Plan period (FY2018–2024).

R-IH TOR 1.1

Has it been beneficial to RIKEN's research and development that RIKEN reorganized its ICT-related structure into its current form (i.e., the integration of the division responsible for building, maintaining, and operating the ICT infrastructure and services and the research divisions for information science and technology)? What is the significance of incorporating information-related research divisions into the R-IH, but not the other research centers?

[For Subcommittee 1]

R-IH TOR 1.2

Are the ICT infrastructure and services, information security measures, and IT governance provided by the Information Systems Division appropriate?

R-IH TOR 1.3

Is the research and development conducted by the Infrastructure Research and Development Division appropriate from the perspectives of maximizing RIKEN's research results, its management policy, and the greater convenience of researchers?

R-IH TOR 1.4

Does the Infrastructure Research and Development Division contribute to RIKEN's research innovation in applying information technology, such as the promotion of open science and research digital transformation (DX)?

[For Subcommittee 2]

R-IH TOR 1.5

Will the goals and strategies of the ADSP and the GRP lead to academic transformation and technological innovation? Are the research results of these research projects internationally competitive?

R-IH TOR 1.6

Have the ADSP and the GRP generated synergy between them? Have the ADSP and the GRP fostered collaboration with other research centers of RIKEN?

TOR 2 (Common TOR 2 consulted by the president of RIKEN)

Evaluate the policies of the Fifth Mid- to Long-term Plan period (FY2025-2031) and recommend new directions for operations and R&D that should be implemented and promoted.

R-IH TOR 2.1

Would the continuation of the current organizational structure (i.e., the integration of the division that develops and operates ICT infrastructure and the information-related research divisions) contribute to the implementation of RIKEN's Fifth Mid-to Long-term Plan? Also, is the future direction of the R-IH in line with the direction of the Fifth Mid- to Long-term Plan, such as the Transformative Research Innovation Platform of RIKEN platforms(TRIP) concept?

[For Subcommittee 1]

R-IH TOR 2.2

With regard to the operation of information infrastructure and systems, the provision of information services, and utilization support in research and development, are the goals and direction of information-related measures and its governance suitable for RIKEN's management policy for the next Mid- to Long-term Plan and to the promotion of the TRIP concept?

R-IH TOR 2.3

Based on the TRIP concept, what kind of research and development and efforts should the Infrastructure Research and Development Division conduct in the future, especially in promoting inter-organizational and inter-disciplinary use of data by RIKEN researchers?

[For Subcommittee 2]

R-IH TOR 2.4

In the midst of major social changes on a global scale, will the respective directions of the ADSP and the GRP respond to emerging challenges and provide effective solutions in a flexible manner? Also, have the ADSP and the GRP presented visions in line with the TRIP concept that link RIKEN's leading-edge research platforms and create new areas of knowledge?

RIKEN 4th Mid-to-Long Term Plan Excerpt (Provisional Translation)

I. Maximization of R&D achievements and improvement in the quality of other operations

1 Set up/operation of a system at RIKEN to create innovation

(5) Enhancement and implementation of digital research infrastructure for information and data science

By establishing RIKEN Information R&D and Strategy Headquarters (R-IH), RIKEN will promote the creation of innovation as well as the maximization of R&D results using ICT, based on the RIKEN Information and Communication Technology Strategy (ICT Strategy). Specifically, R-IH will establish research data infrastructure that enables the appropriate management of research data within the institute and the utilization of research data both within and outside the institute to promote open science. We will also advance research in information science, proceed with making cross-organizational and cross-disciplinary efforts using information science knowledge, and promote research in next-generation robotics to realize digital transformation.

- **Promotion of Open Science**

R-IH will build and manage an informational environment where research data is collected, managed, and utilized in a strategic manner for the creation of innovation through data science. This organization will build and operate research data infrastructure that can respond to changes in research methods, as well as enhance the data collection and management functions within RIKEN. In addition, we will promote research and development to establish metadata standards in cooperation with domestic and international organizations.

- **Promotion of research in information science and cross-organizational and cross-disciplinary efforts using knowledge of information science**

R-IH will promote research in information science and, as a hub for data science within RIKEN, promote cutting-edge and original research across organizations and fields using knowledge of information science.

- **Promotion of next-generation robotics research**

In order to realize a human-centered “super-smart society,” R-IH will promote next-generation robotics research that computationally elucidates the mechanisms of the human mind, especially cognitive functions, and structurally demonstrates them through application to robotic technology.

R-IH's Future Plan for 5th Mid-to-Long Term Plan

- In order to maximize RIKEN's research activities, R-IH aims to develop and maintain the following three functions:
- Construction and operation of information infrastructure and systems
    a. Development of fundamental information technologies
    b. Cutting-edge information science research
    c. R-IH will enhance collaboration with R-CCS, AIP, iTHEMS, and RQC, as well as other RIKEN research centers.
- R-IH will actively carry out "High-quality data acquisition," "Pioneering prediction science with AI x mathematics," and some Use Cases of TRIP.
- R-IH is to provide information systems for effective administrative work.