

REPORT OF THE 12TH RIKEN ADVISORY COUNCIL (RAC)
16 December 2023

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EXECUTIVE SUMMARY

The 12th meeting of the RIKEN Advisory Council (RAC) was convened on 13-16 December 2023 at the RIKEN Wako Campus and the Hotel Metropolitan Tokyo Ikebukuro.

- **The RAC commends the very impressive progress that has been achieved by RIKEN since 2019.**
- **The Center AC reviews highlighted the outstanding research achievements and outcomes made by the centers.** This includes globally pioneering work in a range of fields that are extending or breaking new ground in new scientific areas.
- RIKEN's advanced scientific infrastructure remains world-leading and forms a powerful and effective basis for international collaboration, but there are concerns that some infrastructure is aging and in need of replacement or upgrade.
- The RAC applauds the positive moves that have been made by RIKEN under President Gonokami's leadership, which have extended the use of its facilities and expertise to researchers outside of RIKEN, and which are enhancing human resource and administrative policies and practices in RIKEN.
- The RAC strongly supports the TRIP initiative as a major mechanism for driving cross-organizational discussions and internal collaboration and synergies within RIKEN around a joint vision and mission. TRIP will also serve to identify and engage with partnerships that will enable RIKEN to have greater impact in key research fields, such as sustainable development and healthy aging. However, given its wide scope and complexity, the RAC has a number of recommendations on the further development and implementation of the concept.

TERMS OF REFERENCE

President Gonokami asked the RAC for its opinions and recommendations on RIKEN's research strategies, management and performance, under the following terms of reference:

1. Evaluate the responses to key recommendations from 2019 11th RAC and 2021 Interim RAC key opinions.
2. Evaluate operations and initiatives for the RIKEN 4th Mid- to Long-Term Plan (FY2018-24) in particular new initiatives from FY2022.
3. Evaluate the policies of the 5th Mid- to Long-Term Plan (FY2018-24) and recommend new directions for operations, initiatives and R&D that should be implemented and promoted.

**TOR 1: Evaluate the responses to key recommendations from
2019 11TH RAC and 2021 Interim RAC key opinions.**

1. The RAC noted the very impressive response to its 2019 recommendations. However, more work needs to be done in specific areas, such as increasing the proportion of women researchers, particularly at senior levels in the institute.
2. The new practices and innovation in human resource and organizational development introduced and implemented by RIKEN can serve as a model for other Japanese institutions and universities, and the RAC encourages that these be shared more widely within Japan.

RIKEN Innovation

3. The RAC notes that RIKEN Innovation does not currently provide incubator space, accelerator services, or venture capital. The RAC advises that RIKEN Innovation develop collaborations with well-functioning technology transfer units in Japan such as the University of Tokyo, Keio University, and OIST. Such partnerships can help accelerate the overall development of the start-up and commercialization capabilities of RIKEN.
4. While providing support for start-ups is useful, it is critical to ensure the quality of those selected for such support. Additionally, having start-ups contribute to paying for the cost of using the facilities could help manage demand and ensure that the start-ups have an appropriate stake in being successful. RIKEN can also help start-ups to access external funding sources.
5. The issue of attracting venture capital to RIKEN and Japan is complex and the RAC encourages RIKEN to work with stakeholders and partners within the Japanese system to put in place measures that would stimulate such activity in a sustainable manner. RIKEN should also leverage external funds that support the development of intellectual property assets such as AMED grants for clinical research.

Human resources

6. The RAC is concerned that the salary levels for researchers and staff are not internationally competitive. The situation is being exacerbated by factors such as the declining value of the Japanese yen.
7. Under President Gonokami, several adjustments were made to HR policy to enhance the fixed-term employment policies and maintain stability while introducing more flexibility. This included exercising flexibility in relation to the 10-year limit on fixed term contracts. The RAC commends and supports these changes as they will enable RIKEN to respond more agilely to a more complex and competitive environment while maintaining overall stability. However, the RAC advises that quality assurance mechanisms should be put in place, including input by external experts to evaluate researchers being considered for indefinite-term contracts, with due consideration to issues related to gender diversity and career breaks e.g. for maternity leave.
8. These initiatives by President Gonokami are commendable given the decision-making limits a RIKEN president has with regards to HR and compensation. The RAC feels that providing the President with a higher degree of flexibility in these matters will be very

important for increasing the competitiveness of RIKEN in recruiting and retaining high quality researchers.

9. The RAC suggests that RIKEN recognize the less certain long-term employment of fixed-term employees in its compensation considerations. In addition, RIKEN should provide career-development support and guidance for such employees, including formal mentoring programs for young staff.

10. The RAC supports President Gonokami's initiative to exercise flexibility in providing higher compensation packages to highly desired researchers and other employees with specialized skill sets.

11. The RAC commends RIKEN on the many measures it has implemented in the past few years to support its researchers, including increased salaries and research budgets for PhD and postdoctoral researchers and the expanded number of positions for early career researchers, which is accompanied by increased salary (to approximately mid-way between Japanese and US universities). In addition, RIKEN has further stepped-up support to help non-Japanese employees to adapt to work and living in Japan.

12. RIKEN has also put in place a comprehensive suite of measures to improve the gender balance by increasing the number of women researchers at different levels. This is critical to ensure that RIKEN taps into the entire pool of human talent and the resultant diversity would be beneficial to the effectiveness of the institution.

13. However, the RAC notes that none of the Center Directors or Advisors to the President are women, and the number of women in senior leadership positions is still very low. The RAC feels RIKEN should do more to specifically headhunt, recruit, mentor, or appoint women into senior leadership positions at RIKEN, and exercise the necessary salary flexibility and enhance RIKEN's spousal hiring policy with nearby universities, businesses and research institutions.

14. The RAC advises that when comparing salaries between RIKEN and US universities, the relative costs of living should be taken into account. In general, it is the overall package, that includes employment opportunities for spouses, housing, and schooling of children, which is important. Opportunities for career advancement are also key considerations. In this regard, the RAC feels it is important that RIKEN places sufficient emphasis on career development, particularly for PhD students, postdocs and fixed-term researchers.

15. The RAC commends RIKEN and encourages it to further expand its current outreach programs to high schools. Among other benefits, RIKEN can increase research exposure and provide role models to high school students so as to increase the overall pool of researchers in Japan, particularly women.

16. Joint recruitment and appointments between RIKEN and universities help promote collaborative research. These joint appointments also provide useful and attractive career paths for young RIKEN scientists and promote the circulation of talent within Japan. The RAC encourages RIKEN to actively pursue joint appointments as a talent-enhancement strategy.

Internationalization

17. The RAC supports RIKEN's new approach of strategic prioritization of research areas for international collaboration based on RIKEN's goals and plans, and putting in place the framework and resources to support meaningful collaborations. Such purposeful partnerships are more likely to result in impactful outcomes and mutual benefits for the collaborating parties.

18. As RIKEN works to enhance the start-up support system and culture, the RAC supports the strategy of leveraging exchanges and partnerships with international organizations that have strong track records for innovation and commercialization.

Metrics for evaluation

19. The RAC encourages RIKEN to further develop the metrics it uses internally to evaluate research performance at the individual and institutional level. The enhanced metrics should enable RIKEN to better evaluate its researchers and centers, and assess the progress of the institute itself. The improvements in the metrics could include the following:

- Use a mix of both qualitative and quantitative measures.
- Assessment should encompass evaluation and recognition of impact beyond research outputs and publications, including leadership in the scientific community, innovative applications, and other achievements that have contributed to value creation and societal needs.

20. The RAC commends the progress that has been made in developing the open science approach in RIKEN and commends RIKEN for becoming a signatory to DORA. The RAC encourages RIKEN to expedite implementation of a public library for deposition of accepted papers and to foster a culture of posting preprints across RIKEN to accelerate the dissemination of research findings, in particular in the Life Sciences domain which is currently lagging compared with practices in Europe and the US.

21. The RAC is pleased with the progress that has been made in terms of seeking and taking into account the perspectives and suggestions from young researchers, in its policy formulation and planning.

Research integrity

22. The RAC commends RIKEN on its ongoing and enhanced focus and measures to further strengthen research integrity at RIKEN. The area of research security is also becoming increasingly salient particularly in the light of the new geo-political landscape.

23. The RAC notes that strong institutional processes and emphasis on research integrity will build trust among RIKEN researchers, as well as help maintain the confidence of the public in scientific research and its contributions to society.

TOR 2: Evaluate operations and initiatives for the 4th mid- to long-term plan, especially since FY2022.

24. The RAC has 3 general observations on the current operations and initiatives for the 4th mid- to long-term plan as follows:

a. The RAC encourages continued RIKEN leadership and support of national priorities and initiatives, working more closely with Japanese institutions and with industries.

- RIKEN should contribute to national programs for developing and applying AI, including through AIST.
- RIKEN should contribute to the national semiconductor development strategy.
- RIKEN should contribute to the development of generative AI in the Japanese language.
- RIKEN should establish clearer ways for universities and other non-RIKEN researchers to easily collaborate with RIKEN (e.g. through co-creation labs).
- Regarding human health, RIKEN should increase collaborations with clinical researchers and institutions.
- For BRC, RIKEN should consider expanding collaborations with other similar centers in Japan and overseas.

b. The RAC advises that RIKEN should consider how to differentiate its work and contributions relative to other institutions and industry.

- For its drug development program, RIKEN should clarify how far RIKEN can advance drug discovery and development on its own, and which areas of this complex process will rely on external collaborations for example with big pharmaceutical companies and academic institutions.
- RIKEN should consider providing selected collaborators dedicated access to RIKEN's facilities for top-down defined research areas, as part of RIKEN's differentiation as a partner and institution.

c. While the RAC recognises ongoing efforts to promote interdisciplinary activities in RIKEN, for example through CPR and iTHEMS, the RAC encourages the implementation of practical and systematic ways of enhancing intra-RIKEN collaboration in new areas.

- A good example would be for RIKEN to establish a systematic process to help researchers and centers within RIKEN to use AI more effectively in their research as a key factor for future success.

25. The RAC has the following observations on the work of the centers, grouped under 4 thematic areas as requested by RIKEN.

a. AI, information science, computational science

- i. RAC members highly evaluate the work that RIKEN's centers have done in this area.
- ii. RIKEN should consider expanding research on AI hardware in its research portfolio. AI hardware includes the design of accelerators, the development of new computing paradigms that are specifically optimized for AI (e.g. neuromorphic and brain-inspired computing hardware and algorithms), and the development of new semiconductor devices that enable the new computing paradigms.
- iii. Today and going forward, AI will be a key driver for the use of, and technological advances of, high-performance computing (HPC). The traditional performance metrics of HPC will need to be revisited and included in the design of next-generation HPC

- because the compute workloads for AI are very different from those for fast Fourier transforms (FFT) and solving partial differential equations (PDEs).
- iv. Regarding HPC design, RIKEN should keep working with the universities in addition to the key commercial companies such as Nvidia and AMD.
 - v. The RAC was told that the current strategy for training of large language models (LLM) is to start with a foundational model and train the model for domain-specific applications. RIKEN should work to ensure the training data for the foundational model are appropriate and without bias and illegitimate data.
 - vi. Data platforms will become much more important under the TRIP promotion of collaborative data-driven research among many centers. Data acquired or created by one center would be shared by researchers in other centers. This means that the data platforms or data formats should be carefully designed so that the data can be readily used by the researchers in other centers who are in different disciplines. RIKEN should give priority to developing well-designed data platforms for its activities.
 - vii. The shift in compute workloads from traditional HPC to AI workloads should be considered in the design of the next supercomputer for AI.
 - viii. Given the importance of foundational technology such as semiconductors for both national security and economic development, as well as AI and quantum computing, RIKEN should develop the basic science research which will benefit this foundational technology, such as new materials, new metrology, and new device physics, to provide important up-stream research discoveries that will feed into downstream research and development activities in Japan such as the LSTC (Leading-edge Semiconductor Technology Center) and Rapidus. RIKEN should provide the important basic science research for semiconductors to ensure an uninterrupted pipeline of innovations.

b. Physics, chemistry, engineering, accelerator science

- i. RIKEN's physical and chemical sciences programs are world-class, covering topics of fundamental interest and with broad applied impact. Designing, building and operating world-leading research infrastructure is one of the key missions of RIKEN. They serve 15,000 national and international users and broad industrial exploitation enabling research and innovation at the highest level.
 - It is recommended that the operation of these research infrastructure be kept at the maximal capacity to optimize the scientific return on investment.
 - The RAC recommends ambitious long-term planning and implementation of upgrades of SPring-8, SACLA and of the Nishina accelerator complex with high priority in support of Japan's ambitious innovation and sustainability goals.

CEMS

- ii. The center is at the cutting edge of R&D, with outstanding productivity serving national strategic priorities. The research groups are thriving in the context of international standards. There is exceptionally high potential for impact in areas where fundamental material science and supermolecular chemistry find direct application e.g. semiconductor quantum dots, low-power spintronics and topological devices, and materials for quantum technologies.

RAP

- iii. The center has made remarkable advances in photonics research from fundamental science to strong technology development. RAC members feel there is potential for a

closer collaboration between these developments and the scientific needs at RIKEN, e.g. at SACLA, and beyond.

RNC

- iv. The center has made important and highly recognized contributions on the origin of elements in the universe and in applications with important societal impact. The topic of nuclear transmutation is an excellent choice to contribute to the TRIP platform. The successful production of isotopes for medical applications is a flagship activity. The RAC recommends:
- Full operation of the RIBF facility (or at least double from the current level of just 2 months per year) to maximize the scientific return.
 - Mitigate the lack of spares that limits the reliability of beam delivery and its quality.
 - With high priority, the realization of the RIBF upgrade project based on the stripper capability for beam production. It has not only scientific merit but will pioneer the technology to increase the ionization of heavy atoms.

RSC

- v. Japan is among the few countries that operate advanced neutron and photon sources for world-class science and innovation. RIKEN and RSC are playing a key role in designing, building and operating such facilities. SPring-8 and SACLA are very productive and serve more than 15,000 national and international users. The RAC recommends:
- Following the strategy of offering access to mission-driven research programs in addition to individual user proposals.
 - Realizing the Spring-8 upgrade while helping their large user community from academia and industry to progress with their research at the Tohoku synchrotron.
 - Immediate planning of an upgrade to SACLA to increase repetition rate and keep up with international competitors where such upgrades are already being implemented.

c. Environmental science

- i. The RAC applauds RIKEN for its plans to engage with global sustainability challenges such as climate change, food and biomass production from land and ocean, negative impacts on biodiversity, resource circulation and clean energy, human health and behavioural changes. This has the potential to generate substantial scientific synergies and innovation, while also advancing RIKEN's national and international visibility and attractiveness for talented scientists. Consequently, the RAC recommends:
- That CSRS and BRC, together with e.g. CBS, iTHEMS, AIP and CPR, collaboratively identify joint opportunities to embark on major cooperative RIKEN-wide efforts to engage with “sustainable resource science”, combining research on plants, animals, humans, and related systems, from micro to macro scales.
 - That CSRS continues its already highly successful efforts in the area of innovative catalysis.
 - RIKEN is particularly suited to engage in the One Health concept and should consider expanding collaborations among centers towards this direction.
 - That the institutions above collaboratively define specific opportunities for RIKEN to play a global leadership role in sustainability, while also identifying the most relevant international partners which can help accelerate such efforts.
 - To show leadership for the Japanese academic community, the RAC recommends that RIKEN conduct an internal due diligence process related to its own resource and energy consumption, and its carbon footprint from travel, food, and waste, with an aim to progressively reduce its own environmental impacts.

d. Life sciences

- i. The domain organization for life sciences is a positive development that should bring collaboration and synergy between the centers. The RAC makes the following comments:
- BRC and DMP should not be separate from life sciences (e.g., BRC can be joint between life sciences and environmental science).
 - The state-of-the art research tools developed by BRC should be made available to researchers in Japanese universities and other institutions.
 - The life sciences domain organization should facilitate partnerships between IMS with BDR and CBS for studying human genetics in health and disease.
 - The RAC commends the links being developed between IMS and CBS with hospitals for tissue sourcing and clinical trials.
 - The RAC sees fruitful collaborative opportunities between CBS and BDR on brain health and aging, for example structural studies on amyloids associated with brain diseases.
 - There appear to be multiple activities in drug discovery in IMS, CBS, DMP (also in CSCR) and RIKEN should develop a coherent strategy to synergise between these.
 - Succession planning for Director roles should begin early.
 - It is commendable that CBS and BDR both contain several theory groups. It will be important to strengthen collaborations between these groups and experimentalists as measured for example, by joint publications. The TRIP initiative may be a good mechanism to strengthen these ties.
 - In other countries, women are well represented in life science research at all levels, from PhD students and postdocs, to group leaders and professors. The life science institutes should be at the vanguard for increasing diversity in the RIKEN, especially at the senior levels (Director, Deputy Director).

TOR 3: Policies of the 5th mid- to long-term plan

26. The RAC's assessment of the proposed 5th RIKEN plan is that it is very exciting, future oriented, and will further strengthen the internal synergies and collaborations among different centers within RIKEN and increase the likelihood of creating high external impact. Hence the RAC strongly supports the plan.

27. However, the success of the 5th plan, and more generally, RIKEN's continued position as a leading research institution, will depend on addressing a number of critical issues. The RAC covers these in its overall, main recommendations as follows:

MAIN RECOMMENDATIONS

Recommendation #1:

The RAC strongly recommends for the RIKEN President to make a strong case that government funding for operations must incorporate adequate increases over time and be sustained over the long-term. In addition, funding for the upgrading and renewal of the advanced research infrastructure must be planned for and provided in a timely manner through a long-term capital plan.

- While RIKEN continues to produce outstanding research and its advanced R&D infrastructure remains world-leading, the RAC is deeply concerned that RIKEN cannot compete at the highest international levels if the current funding levels and arrangements continue.
- Specifically, RIKEN's core budget from the government has remained flat since 2001 in spite of research-related inflation. As a consequence, its ability to recruit and retain top talent and to pay them competitive salaries, is progressively declining.
- Japan is in the process of reinvigorating its economy and this will critically depend on cutting edge science and technology. RIKEN possesses many of the needed capabilities which could be leveraged to drive and contribute to this crucial effort. The erosion of RIKEN's strengths through chronic underfunding will therefore also undermine this major national thrust and impact Japan's overall economic competitiveness.
- It is also very worrying that the upgrading and renewal of the advanced scientific infrastructure and facilities are being funded in a piecemeal manner. The RAC strongly emphasises the importance of developing a long-term capital plan, typically over 20 years, that will enable systematic, timely and planned upgrading, advancement and renewal of such facilities.
- The RAC supports and commends RIKEN for its current focus on bidding for supplemental budgets to fund its new or revamped programmes on a time-limited basis. However, these cannot replace the need for the increases in core funding needed to maintain long-term R&D competitiveness and strengths.
- In addition, the RAC recommends that RIKEN should try to diversify its income sources, by for example, obtaining more royalties from intellectual property and strengthening technology transfer activities.

Recommendation #2:

The RAC strongly supports the TRIP initiative and makes 7 recommendations in relation to TRIP.

- The RAC recommends that the TRIP concept be simplified and made easier to understand to facilitate communication and to rally the RIKEN community and external parties around it.

RAC commends TRIP as an exciting, innovative concept to bring together researchers and research programs across centers in RIKEN, and for generating greater external impact. However, the TRIP concept is very complicated as it comprises:

- The establishment of a huge data – AI – compute platform.
- 5 new research initiatives which connect to large global challenges or complex processes such as drug development.
- The promotion of intra-RIKEN collaboration around new basic research programs, and problem-solving research programs
- 4 research domains covering different centres based on commonalities in research and which aim to promote collaborations

The RAC also recommends that some of the new TRIP initiatives should be better aligned with the major priorities of the Japanese government.

- b. The RAC strongly recommends that specific institutional and center milestones and metrics of success be developed and explicitly shared so as to further clarify the major collective goals and thrusts of the initiative over different time periods.
- c. The RAC would like to highlight that the key to TRIP's success is careful attention to selecting the best programs and use cases which will be supported with appropriate funding. The selection of these should be done based on the strategic value of the proposed programs, the strengths of the participating RIKEN parties, the ability to leverage the unique data/AI/compute platform and possible paths to external impact.
- d. The RAC recommends that RIKEN's leadership strongly prioritize its choice of areas to focus on, identify its highest priority goals, and ensure sufficient management focus and resources are allocated to these to maximize the likelihood of success. The RAC also recommends that in parallel, it would be imperative to define more specifically the areas within the global challenges which RIKEN's problem-solving programs will address.

This is because RAC observes that the agenda in terms of basic and problem-solving research is very broad, in particular the areas identified for problem-solving programs. These target global challenges such as the Global Commons and drug discovery, which are very wide ranging in their scope and are highly complex.

- e. The RAC supports the establishment of the research domains within TRIP, which can be evolved so as to provide greater organizational impetus and support for the centers within each domain to work more closely together. The RAC advises to make Drug Discovery (DMP) an integral part of the "Life Science" research domain.
- f. The RAC underscores the importance of ensuring that the data collected under TRIP are of high quality and based on a pre-defined set of parameters. RIKEN should also consider extending its data acquisition by linking with key datasets outside of RIKEN. e.g., existing databanks (such as the Tohoku Medical MegaBank, other biobanks, environmental data), which will be critical for driving application in the chosen strategic sectors.
- g. The RAC strongly recommends that RIKEN systematically identifies the critical strategic partnerships in academia, industry, health care, and government agencies needed to create the desired impact, particularly in its problem-solving research programs. Embedded in such an effort, is the clear identification of the specific role and unique value-add that RIKEN can and should bring to such partnerships or consortia.
 - The RAC recognises RIKEN's extensive basic science research collaborations within and outside of Japan, and appreciates that top scientists are often the best placed to identify the basic science research collaborations which are most useful and effective.
 - However, the incorporation of the required strategic partnerships in problem-solving research initiatives and the pathways to impact and value creation, will significantly enhance the 5th plan. It should also allow RIKEN to make an even more compelling

case for increased funding support by connecting science to practical use and impact.

Recommendation #3:

The RAC recommends that RIKEN reviews its current approaches to innovation and commercialization.

- Innovation and commercialization is a priority of the Japanese government and therefore it is critical for RIKEN to ensure that RIKEN Innovation is structured, staffed, and operated in a manner that enables it to function most effectively. To achieve this, the RAC recommends that RIKEN Innovation undergo a review by external experts.
- The RAC notes that RIKEN Innovation does not currently provide incubator space, accelerator services, or venture capital. The RAC strongly recommends that these be established or that access to them be secured. The RAC advises that RIKEN Innovation develops collaborations with well-functioning technology transfer units in Japan, such as University of Tokyo, Keio University, and OIST, as well as those overseas. Such partnerships can help accelerate the overall development of the start-up and commercialization capabilities of RIKEN.
- The RAC recommends that RIKEN work with stakeholders and partners within the Japanese system to put in place measures that would attract and stimulate venture capital activity in a sustainable manner. RIKEN should also leverage external funds that support the development of intellectual property assets such as AMED grants for clinical research.

Recommendation #4:

The RAC recommends that RIKEN continues to give high priority to reforming its talent development and human resource policies and practices in order to recruit, retain, and nurture top researchers and staff.

- These would include continuing work on ensuring talent compensation and development policies and practices that are flexible yet equitable, internationally competitive yet sustainable.
- The RAC recommends that RIKEN set internal targets to appoint excellent female researchers into senior leadership roles, and actively seek out and nurture promising candidates for these roles. The RAC suggests that for a start, more women could be appointed as Advisors to the President and as Deputy Center and Deputy Executive Directors. Additionally, active facilitation of spousal career hires within Japan should be strengthened. Establishing internal targets while maintaining quality would help focus attention and efforts on translating the many measures that have been implemented into tangible outcomes in terms of a higher number and proportion of women in leadership roles.