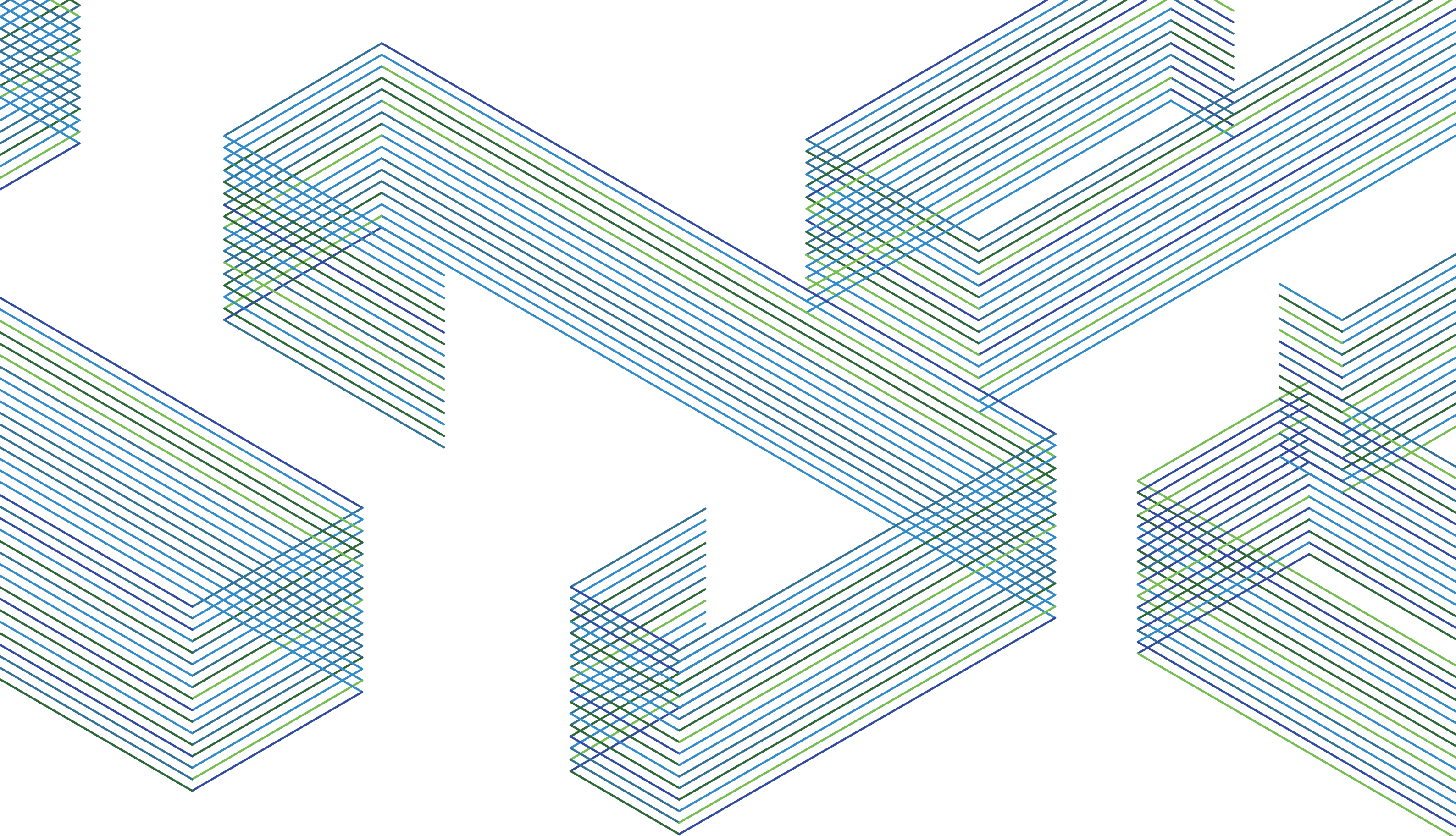




TOYOTA KONPON RESEARCH INSTITUTE INC.
Toyota Commemorative Museum of Industry and Technology,
1-35, Noritake Shinmachi 4-chome, Nishi-ku, Nagoya City, Aichi 451-0051 Japan
Tel : 052-551-6330 Fax : 052-551-6340
URL : <https://konpon.toyota>



TOYOTA KONPON RESEARCH INSTITUTE INC.

ANNUAL REPORT 2025

Passing on our origins so we can continue flying over “knowledge watersheds”



In 2026, Toyota Konpon Research Institute celebrates the 30th anniversary of our establishment. To mark this milestone, we held a talk with the aims of taking a fresh look at the Institute's origins and roles, as well as discussing how we can pass on our founding vision and build research themes that will help us move toward the next era.

Former Representative Director Takeshi Uchiyamada, who has a deep understanding of the Institute's founding philosophy and played a key role in shaping its direction, spoke with Soichiro Okudaira, the newly appointed Representative Director who will lead the Institute's evolution under the new organizational structure. They discussed three themes— “Passing on our origins”, “Reaffirming our PVMV(Purpose/Vision/Mission/Value),” and “Identifying and creating research themes.”

1 “Passing on our origins”— Reinterpreting Our Founding Philosophy

Toyota Konpon Research Institute was established as somewhere to research the needs of future society, irrespective of the business of today. This philosophy has been handed down over almost thirty years, but it has also been repeatedly re-examined amid changes in our research environment and social conditions. During this discussion, they explore how the Institute's founding philosophy can be reinterpreted and carried forward into the next era.



To be honest with you, it's not easy for a small-scale research institute to attract people, narrow down themes, and conduct research on its own, and it's not possible to produce outstanding research results entirely on your own.

As I understand it, this is exactly the reason why, after probing deeply into its purpose, the Institute decided to emphasize an approach of creating environments in which new research can emerge, rather than holding onto the research projects itself.

Uchiyamada : That's exactly right. Unless we go back to our origins, there will be no point to the Toyota Konpon Research

Institute as an independent research institute.

The question then becomes, “Could another research institute or company play this role instead?” The answer, of course, is that they would find it very difficult. It wouldn't be easy for them to think beyond the direction of their current business or research and fill the role of searching for completely new themes. This is the very reason why the Institute was established in the first place.

Okudaira : Through my involvement over the past year, I have gained a strong impression that the fundamental questions are no different today than those of thirty years ago.

“What is going to happen to the planet?,” “What makes people happy?”— in fact, the Institute's founding theme of “contributing to the happiness and progress of humanity” appears to be even more urgent now than when the Institute was first established.

The Institute has changed its roles and methods over the years in an attempt to answer these questions, but it has also remained true to its ultimate destination.

In this sense, while the initiatives the Institute is currently pursuing are a “new challenge,” I also feel that we are passing on our origins through these activities.

Uchiyamada : The challenges we thought up thirty years ago have started to feel more real now.

This is exactly why we have been able to look back on our origins at the right time and in the right way.

Uchiyamada : During my time working with the team at the Toyota Konpon Research Institute, I learned a great deal about the Institute's thirty-year history.

My understanding is that when the Institute was first established, its purpose was to search for what will be needed in the society of the future, irrespective of the business the Toyota Group is currently involved in, and to identify the themes the Toyota Group needs to tackle.

At the time, the Group's financial footing was not necessarily as solid as it would have liked. Despite this situation, it launched a research institute to examine questions about the future for the benefit of society, including in fields that were different from its current business. Looking back now, I can see that taking that decision was a bold challenge.

At the same time, as time has passed, the Institute has started to turn more of its attention and energy to current research than to its founding purpose of thinking about “what we should research.” If I'm being honest, this felt a little uncomfortable to me.

Okudaira : I have been involved with the Institute since 2025. Over the past year, I have held numerous discussions with staff, external directors, research coordinators, and professors in academia.

During these discussions, I came to learn that the Institute's current position of looking back on its origins while trying to reinvent its role was an approach it had arrived at after significant trial and error.

“Reaffirming our PVMV (Purpose/Vision/Mission/Value)”

As part of its efforts to “go back to its origins,” Toyota Konpon Research Institute has made a point of putting its philosophy into words in the “PVMV.”

In particular, we see our vision of to fly over “knowledge watersheds” as something that symbolizes the very purpose of the Institute.

Uchiyamada: We did not have a fixed answer from the outset to the question of how to identify research themes for the future.

Toyota Central R&D Labs and Toyota’s group companies are more than capable of observing current business and research and thinking about “what we will need in the future.” Instead, Toyota Konpon Research Institute set out to consider “what the themes are that will be truly relevant to society in the future.” We came to believe that this is precisely why Toyota Konpon Research Institute exists.

However, how we should go about pursuing answers to that question was far from clear.

This was why we decided to set down our thinking before we set out our methods, and to clarify this anew in the Purpose, Vision, Mission and Value.

Okudaira: At the time I first became involved with the Institute, everyone seemed to be really struggling with the question of how we would find themes in the future. The PVMV seems to have been created as part of an attempt to build a shared framework to address this uncertainty.

Uchiyamada: In a way, our purpose of seeking to contribute to society and contribute to people is something that we share with many other organizations. However, the unique nature of Toyota Konpon Research Institute is most easily seen in our Vision, Mission, and Value.

Of these, it was the Vision— Fly over “knowledge watersheds”— that struck a chord most with me.

In the world of academia, researchers conduct a wide range of research in the pursuit of truth. The Institute flies over these knowledge watersheds to the other side, identifies the “practical applications that need to be developed for the benefit of society” and the “areas of research that need to be further developed,” and brings them back to our own side.

In other words, we play the role of changing the very flow of knowledge itself. Through these discussions, it was concluded that this is the role the Toyota Konpon Research Institute needs to play.

Okudaira: Initially, people felt that flying over “knowledge watersheds” was an obvious thing to say. However, as we become more involved we came to see

this as an extremely difficult challenge, whilst also being a crucial role.

Uchiyamada: That’s right.

Flying over knowledge watersheds does not mean creating something that nobody knows anything about from scratch. Nor does it mean pursuing research that people are already focused on.

There are times when a new movement is occurring in academia but industry has yet to recognize it. Becoming a bridge between this type of research and society is a role that other organizations would find difficult to play, and this is where the value of Toyota Konpon Research Institute lies.

Okudaira: I feel that clarifying the PVMV in this way has made it possible for us to share the reasons we are here and what we are aiming to achieve, even when research coordinators or other team members change. Precisely because the Institute is a place where people from different specialisms and backgrounds come together, having a shared language becomes particularly meaningful.

Uchiyamada: This is really important. The PVMV is not just a slogan. It is there to get everyone on the same page.

The team members discussed the PVMV down to the finest detail, including values such as “think from the perspective of foundational elements, be more open, and enjoy exploring a frontier.” This very process is something I feel helps to build on the uniqueness of Toyota Konpon Research Institute.



Identifying and creating research themes

We asked how the Institute’s vision of “flying over knowledge watersheds” can be translated into concrete activities, and how research themes can be identified, nurtured, and carried forward even before they are formally selected.

Uchiyamada: When it comes to identifying research themes, I always believe it is better to avoid deciding on the methods too rigidly.

Toyota Konpon Research Institute’s original mission is to “research what to research,” and the “research methods” are actually something that needs to be explored on an ongoing basis.

If we decide from the outset that we are going to use a particular process, new research themes might not arise. This is why we have valued an approach of continuing to ask if our methods are acceptable and whether we might need to try things a different way.

Okudaira: During my visits to laboratories, I’ve felt just how difficult, but also exciting, that approach is.

There are no easy answers to how you should evaluate or explain something, and I get a genuine sense of just how much effort is being put into grappling with these questions.

Uchiyamada: When you are focusing on extensions of current projects or research, you are able to analyze trends or gaps and decide on the next theme. However, the Institute does not need to do this.

Instead, we need to become deeply involved in areas where things are happening in the world of academia, but which have yet to be picked up on by industry. We also need to identify areas of research to develop for the benefit of society, and to build bridges that will allow them to be brought over to this side.

Okudaira: I understand that one specific example of this is an exploratory program the Institute is currently promoting to fuse different fields of endeavor.

Uchiyamada: Researchers from different fields come together to hold discussions and create new themes. Not only is this something new for the Toyota Group, it is in fact a new challenge for academia. Initially, we were concerned about whether new themes would actually be created by fusing different

fields. However, there have been cases when the project has progressed to become a national government-led research project, or group companies have expressed an interest and become involved. We feel encouraged by the progress we have seen so far.

Okudaira: When researchers come up with a promising idea, I feel a strong responsibility to consider how we can help it grow and develop.

We have limited personnel and resources, so we need to focus on truly meaningful themes rather than spreading ourselves too thin. In order to achieve this, we need a strong framework to support our research coordinators, as well as the ability to clearly communicate the significance of our work to external stakeholders.

Uchiyamada: Fusing different fields is not the only way to find new themes.

Potential themes include areas in which progress is being made but in which Toyota Group has yet to get involved, as well as themes we are already involved in but where academia is starting to take different approaches. As we move forward, we need to continue studying and improving our approach to discovering new research themes, including these perspectives. At the same time, we need to remember that it is impossible to do everything at once. This is exactly the reason why we need to start out by working diligently using the current approach, produce results and learn lessons within a fixed timeframe, and link this to the next steps. It’s important that we repeat this cycle.

Okudaira: I’ve gained a keen sense of how discussions between researchers across different fields can create new links and new ideas. We need to avoid creating rigid formats, keep things fluid, and move projects forward a little at a time while learning as we go. I would like the Institute to remain a place that embraces experimentation and nurtures research themes through ongoing dialogue.

Toyota Konpon Research Institute has clearly set out its role as going back to our origins of “researching what to research” and linking knowledge beyond the watershed to society. As we carry forward the philosophy that has been cultivated over the past three decades, we continue to take steady steps toward creating the research themes that will shape the next five years and beyond.

The role of the Toyota Konpon Research Institute

Moving forward resolutely in a diversifying and changing society—PVMV

With a firm understanding of our origins rooted in both the Five Main Principles of Toyoda and our founding purpose, the Institute continues to pursue our meaning. In the hope of “making things better,” we have repeatedly asked questions, acted, and evolved our activities through trial and error. The steady accumulation of these efforts will change the future shape of the Institute. By becoming more open to academia and fusing diverse knowledge, we are gradually expanding into an organization that jointly explores new research topics. We will continue to create new value alongside colleagues who possess the same aspirations. Toyota Konpon Research Institute will continue to cherish this philosophy as we step toward the future.

PURPOSE

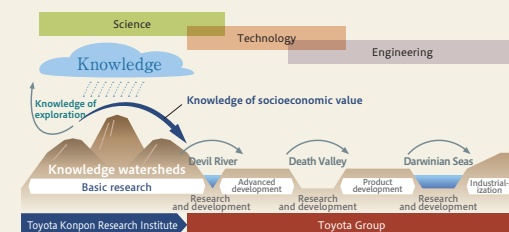
Contribute to the happiness and progress of humanity and to the harmony with the Earth and all living things

Using an approach that is driven by dreams, we will paint a picture of a future built on the aspirations of each individual and increase options in an age of uncertainty. In order to achieve this, we will continue to examine things from a fundamental perspective and take on the challenge of as yet unseen possibilities. We will continue to move forward by picturing a future in which diverse fields of research come together and create new value.

VISION

Fly over “knowledge watersheds”

As we fly over “knowledge watersheds” we will travel across the “mountain pass of science” and create research themes that give rise to new value that links these themes to society and industry. In addition to creating individual themes, we will draw paths to the future by tying themes together as a story that can be told to society, and by fusing diverse knowledge.



MISSION

Research what to research

Remaining true to our origins by continuing to “research what to research,” we will continue to ask questions and look for better ways forward while facing up to changes in society and industry. Through this process, we will open up new possibilities for knowledge by thinking through not just the research themes but also their background and significance, as well as how they link to society.

VALUE

Think from the perspective of foundational elements, be more open, and enjoy exploring a frontier.

We view our values with great importance. Moreover, we want researchers involved in our Institute to empathize with the values. With this in mind, we defined our values so that researchers from around the world choose to carry out research alongside us. To “think from the perspective of foundational elements” means adopting an approach of questioning the fundamental questions while breaking free from conventional thinking. “Being more open” is a way of thinking that involves connecting with diverse colleagues to expand our knowledge. Finally, “enjoy exploring a frontier” means enjoying taking on challenges even when things do not go well, and acting in a way that links us to the next steps as a solid platform. Toyota Konpon Research Institute will continue to move forward alongside colleagues who empathize with these values.

Three pillars which are our core activities

Toyota Konpon Research Institute’s activities are developed along three main pillars. Having built a solid platform through initiatives developed thus far, in 2025 we embarked upon a phase of further elevating and evolving these measures.

The first pillar

Explore and investigate future research projects

The second pillar

Increase interest in science and enhance scientific literacy

The third pillar

Develop human resources who can connect with diverse researchers

We will continue to take on new challenges in a constantly changing society, while inheriting our founding concepts. Diverse knowledge coming together, building new links, creating new questions, and setting us in motion towards the future—continuing to build this process is the true role of Toyota Konpon Research Institute. We will continue opening up new options for the future while returning to our origins by “researching what to research.”

Improving and advancing processes for cultivating curiosity-driven exploratory research topics through collaboration with academia

This program launched in 2022 by inviting active academic researchers from various fields to serve as research advisors (RA). Interdisciplinary projects were researched based on cutting-edge research results. In 2025, the fourth year of the program, improvements were implemented based on the “framework” built thus far.

Framework of research project creation

Which mountain should I choose from the mountain range?

Activities that look across the vast mountain range [research field] and discover an unexplored, cutting-edge, and interdisciplinary mountain [research project]



Search

Exploration

Are there any precious gemstones in that mountain?

Activities to verify, evaluate, review, and determine research projects identified through exploratory efforts

The search and exploration of research themes require broad insight, deep expertise, and diverse perspectives. There are limits to activities that rely on the abilities of individual researchers. In our Search Program, we invite researchers engaged in cutting-edge research from a variety of fields. Through discussions with these researchers, we work to discover unexplored research projects from many standpoints.

Results and challenges until now

Through the Search Program implemented up to 2024, we steadily established “opportunities” to create research themes. The feedback received from participating RA has been largely positive, and we believe a certain amount of value was created in terms of opportunities for researchers from different fields to hold discussions. However, to further increase value, it is hoped that interdisciplinary investigations will be

carried out while making greater use of the specialist knowledge of each RA, thereby giving concrete shape to research themes and further deepening concepts. We hope to create themes linked to social impact and achieve public benefits rooted in the intrinsic interests of RA. For this reason, we investigated our policy for 2025 with the aim of allowing research coordinators to co-develop concepts and support measures.

Evolution in 2025

■ Involvement of research coordinators

With the aim of improving the quality of proposal themes, we prioritized the inclusion of the “thoughts and concepts” of research coordinators in reference to information gained from interviewing staff and RA involved in the Search Program until now.

■ Using the Search Program itself as a phase of experimentation

We decided to take on the challenge of conducting science by using the Search Program itself as an opportunity for experimentation. Professor Imai (The University of Osaka, third year on the program) gave guidance from the perspective of meta-science, and we asked all RA to take part in creating data on the perceptions of interdisciplinary fusion before and after taking part (such as the levels of interest in other RA) and reflect this immediately in planning for the Search Program.

Research Advisors 2025

*Affiliations and positions as of March 31, 2026.



Selected projects

In 2025, ten themes were proposed. Three themes were selected through a combination of peer voting selection among research advisors after a contest held in September, and theme selection by Toyota Konpon Research Institute. After formulating research plans, researchers will begin exploratory research for the selected projects.

Exploring the Final Frontier for Novel Antimicrobial Discovery



Nina Yasuda Professor
The University of Tokyo



Kaori Sugihara Associate Professor
The University of Tokyo

Early detection of pre-disease conditions and autonomous health management using multimodal data



Satomi Yoshida Professor
University of Tsukuba



Kaoru Ota Professor
Muroran Institute of Technology

Investigating the Artificial Self



Masaaki Imaizumi Associate Professor
The University of Tokyo



Koji Ota Associate Professor
University of Tsukuba



Tomoki Ozawa Professor
Tohoku University

Prospects for 2026

■ Giving concrete shape to proposal theme planning

The activities carried out in 2025 increased the quality and commitment to proposal themes. Looking ahead, in order to launch exploration programs successfully we will incorporate objective advice by utilizing the perspectives of research coordinators and other researchers, while also building further opportunities to give concrete shape to research planning.

■ Creating research coordinator-initiated themes

In addition to activities promoting the creation of proposal themes initiated through the curiosity of RA, we will promote new activities creating proposal themes initiated through the ideas of “research coordinators” who understand the background to the Toyota Group and possess previous experience in exploratory activities. These activities will be promoted with the cooperation of members of the Toyota Konpon Academy.

Inauguration of Toyota Konpon Academy and hosting of First Academy Meeting

(March 5, 2026, at Toyota Commemorative Museum of Industry and Technology)

In 2025, the Search Program marked its fourth year since launching in 2022, and around fifty RA now have experience of the program. For this reason, we decided to inaugurate the Toyota Konpon Academy as an opportunity for RA from different phases to come together and exchange ideas. The First Academy Meeting was held, instigated by Associate Professor Momo Nakanishi (The University of Tokyo), Professor Taisuke Imai (The University of Osaka) and the research coordinators. On the day, the Academy Meeting was attended in person by 25 participants and online by 10 participants, despite the participants' busy schedules as the end of the academic year approached. The meeting was a great success, with participants giving updates and sharing progress with exploratory research. As we move forward, we will promote the evolution of Toyota Konpon Academy from a place where former acquaintances can catch up into a forum for co-creating themes together.

Continuing Collaboration with Top Global Universities to Become a Research Institute Uniting Researchers Worldwide

Imperial College London

Objective

To explore "what to research" together with researchers from Imperial College London (hereafter, Imperial), we held two workshops in London and Japan this year with the Imperial team, led by Vice Provost (Research and Enterprise) Prof. Mary Ryan with the program co-designed by Dr Jing Pang, Prof Ricardo Martinez-Botas, and Toyota Konpon.

Activities

Building on last year's workshops, we conducted ideation sessions based on "biological phenomena" and the theme "What kind of company will Toyota be seen as in 50 years?" Researchers from diverse backgrounds gathered and experienced Imperial's ideation process — generating ideas in a single day and deliberately leaving them without a designated owner.

Details

At the London workshop, 35 researchers from Imperial participated in ideation sessions. At the Japan workshop, a total of 13 Imperial members visited Japan and held discussions with participants from the Toyota Group.

Workshop in Japan

Day 1 Dinner

Expand Ideas



Open exchange of ideas at each table. Icebreaker activities in a relaxed atmosphere to bridge distances and broaden perspectives.

Day 2 Morning

Generate Ideas



Free-thinking discussions on future vision beyond current business domains. Three ideas were selected and presented.

Idea Selection



All participants voted. Ideas for the afternoon workshop were chosen not by votes alone, but with diverse perspectives in mind.

Day 2 Afternoon

Develop Pathways



Teams were reshuffled from the morning session and discussed 50-year pathways to realise the selected ideas.

Professor **Mary Ryan** Vice-Provost (Research and Enterprise), reflected

"Bringing together researchers from different disciplines and sectors, away from their 'business as usual' environment, creates the space to think more ambitiously about the future. The exciting discussions over these two days demonstrated the value of sustained collaboration in shaping long-term research directions."



Representative Director **Soichiro Okudaira**, reflected

"It was inspiring to see many ideas emerge during the two days of discussions as we looked ahead to the next 50 years. We strongly believe that close collaboration between researchers from Imperial and the Toyota Group will shape future research directions and lead to meaningful, tangible outcomes."



FY 2026 Outlook

Through four workshops to date, we have generated a wide range of research ideas and concepts. Going forward, we aim to elevate and expand our activities, working together with Imperial to shape the broader direction of our research.

Okinawa Institute of Science and Technology (OIST)

From January 2026, the OIST Science Foresight workshop was launched to create research themes in partnership with OIST, which continues to produce pioneering research.

Objective

OIST is well known for researchers who conduct interdisciplinary research themselves. The workshop fully leveraged OIST's unique character and will be used as a platform for generating research themes from unique perspectives.

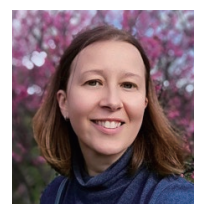
Details

Research themes will be created through four workshops organized by a steering team, which is being led by Professor Nakayama. Studio 1 and Studio 2 were held in 2025.

Studio 1 – Foresee
Studio 2 – Forge1
Studio 3 – Forge2
Studio 4 – Formulate



Naomi Nakayama
Professor



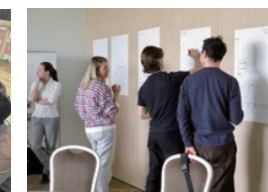
Natalia Koshkina
Project Manager

Studio 1

Creating a future vision based on the Bicycle Exercise*1



Using an S-curve*2 to self-reflect on a research career



Studio 2

Discussing themes based on the ideas contributed by each participant



*1 Bicycle Exercise: Exploratory work discussing the recycling of three perspectives— future, present, and transitions.

*2 S-curve: An analytical system for visualizing the trajectory of an individual's research career and interests in the shape of an "S."

EXPLORATION

Exploring and Evaluating the Potential of Emerging Research Themes

Framework of research project creation

Which mountain should I choose from the mountain range?

Activities that look across the vast mountain range [research field] and discover an unexplored, cutting-edge, and interdisciplinary mountain [research project]



Search



Exploration

Are there any precious gemstones in that mountain?

Activities to verify, evaluate, review, and determine research projects identified through exploratory efforts

In this phase, Toyota Konpon Research Institute will partner with universities through commissioned research. This collaborative approach allows us to verify the core value of our exploratory research themes while working as a unified team to accelerate their development.

Exploratory Research Projects Launched in 2025



Masanori Toyofuku
Associate Professor
University of Tsukuba

Asa Ito Professor,
Institute of Science Tokyo

Rina Takagi Associate Professor,
The University of Tokyo

Kaori Sugihara Associate Professor,
The University of Tokyo

— Between Life and Death

Rather than viewing life and death as a binary dichotomy, our aim is to elucidate the continuous state that exists between them—the “realm between life and death.” Using “zombie bacteria”—organisms in a state where it is difficult to distinguish between life and death—as our research subject, we will conduct a multifaceted analysis of their physiological, genetic, and mechanical characteristics, with the goal of developing metrics that conceptualize the states of life and death on a continuum. Further, by investigating state changes induced by external stimuli and their behavior within populations, we aim to gain insights that lead to a new understanding of life and death, while also exploring what a society that embraces the borderland between life and death might look like.

Exploratory Research Projects Launched in 2024



Miho Yanagisawa
Associate Professor
The University of Tokyo

Kosuke Fujishima Associate Professor,
Institute of Science Tokyo

Ayaka Sakata Associate Professor,
Ochanomizu University

Kiyoshi Kanazawa Associate Professor,
Kyoto University

Ken Hiura Assistant Professor,
Yamaguchi University

Hajime Koike Assistant Professor,
Kyoto University

— Exploration of Universal Structures in Multi-component, Polydisperse Systems

In 2025, we advanced collaborative research integrating theory, experimentation, and machine learning, with a focus on Report 24, which aims to extract universal structures from ultra-multicomponent and ultra-polydisperse systems, centering on the development of a mathematical framework. We experimentally verified polydispersity in polymer solutions and RNA systems, exploring universal laws governing phase separation and rheology. We also conducted theoretical analyses of self-distillation and fairness learning as multicomponent, polydisperse systems, thereby deepening our understandings of noise robustness and typical behavior. We formulated social phenomena as polydisperse systems within mean-field games, and advanced the elucidation of universal structures through analytical solutions for phase transitions.



Asa Ito
Professor
Institute of Science Tokyo

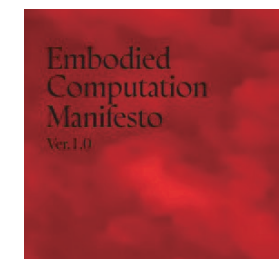
Kohei Nakajima Associate Professor,
The University of Tokyo

Tomoko Isomura Associate Professor,
Nagoya University

Yuko Ikkatai Associate Professor,
Kanazawa University

— Artificial Embodied Intelligence

By endowing AI with the “leakage characteristics” inherent in internal organs—that is, by opening up AI’s computational processes to the outside world—we aim to imbue AI’s decision-making with a sense of the “here-and-now” similar to that experienced by we humans, with our physical bodies. This year, researchers from engineering, biology, philosophy, and science communication collaborated to draft and publish a manifesto outlining the concept of “visceral AI.” We fostered interdisciplinary discussions and social dialogue through study groups, workshops, and public events. Additionally, we conducted fundamental research on computational dynamics—including untapped computational dynamics within computers and those arising from external disturbances—thereby laying the groundwork for future research.



Manifesto



Hitoshi Matsui
Associate Professor
Nagoya University



Kosuke Fujishima
Associate Professor
Institute of Science Tokyo

Asano Ishikawa Associate Professor,
The University of Tokyo

Yuka Iwasaki Team Director, RIKEN

Atsushi Nagano Project Professor,
Keio University

Ayuko Hoshino Professor,
The University of Tokyo

Kyoko Miura Professor,
Kyushu University

Yuko Ikkatai Associate Professor,
Kanazawa University

— Designing the Future of the Earth’s Environment

This project aims to establish a new framework that simultaneously addresses the global environment and ecosystems by linking climate geoengineering strategies with research that enhances biological resilience to global warming. In climate control, we used numerical models to evaluate the cooling effects mediated by clouds and aerosols. Concurrently, focusing on plants and fish, we analyzed the genetic expression and metabolic responses that determine survival and growth under high-temperature conditions, identifying candidate common factors involved in warming tolerance. These findings hold significant promise for future applications in agriculture and ecosystem conservation.

Exploratory Research Projects Launched in 2023



Tomoko Isomura
Associate Professor
Nagoya University

Atsushi Nagano Professor,
Nagoya University

Yoshio Ishiguro Associate Professor,
The University of Tokyo

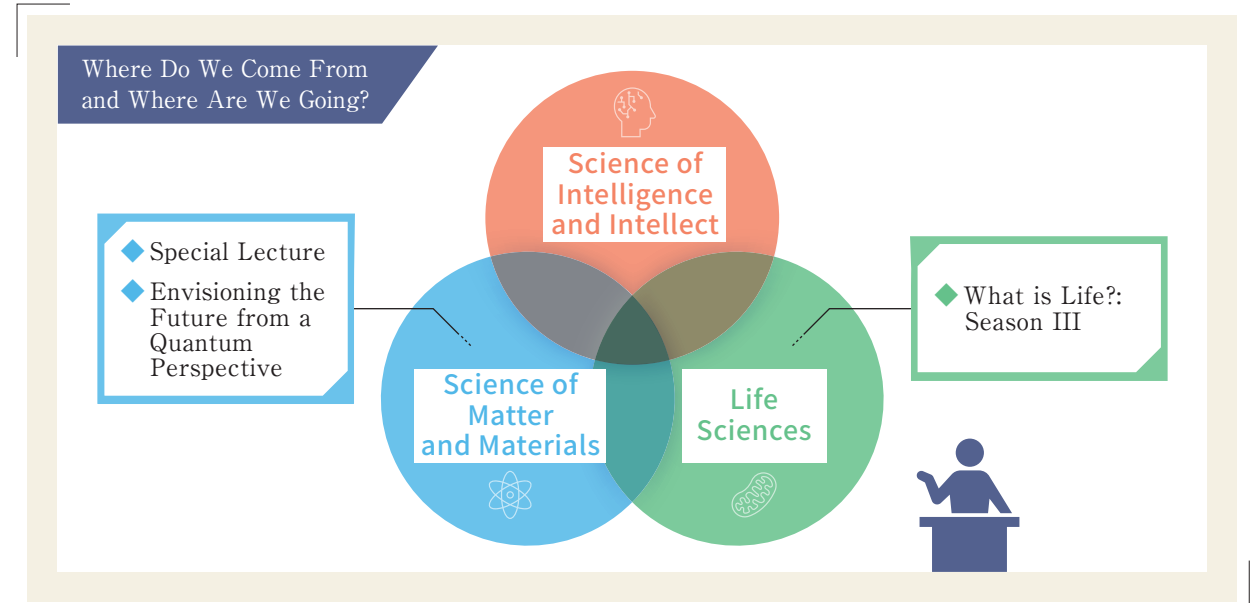
— Multi-Dimensionality of Nonverbal Communication

We aim to clarify how interpersonal distance and positioning during face-to-face communication affect physical movement and psychological states. It also seeks to determine which substances released from inside the body (visceral organs) drive these effects. This year, through experiments with unacquainted pairs, we successfully identified the optimal distance at which participants felt closest to each other with minimal tension or discomfort. Further, we confirmed that the bodily sway of the two individuals tended to synchronize at this distance, highlighting the crucial role of spatial arrangement in supporting seamless dialogue.

Where Do We Come From and Where Are We Going?

For scientific knowledge to cross the “knowledge watersheds” and develop in a way that benefits the public good and yields economic value, it is essential that we—as the audience—possess a basic literacy in the fundamental sciences. How did the fundamental sciences evolve to their current state? How will they develop in the future? And how will they interact with our daily lives and technology? Through comprehensive and fundamental (Konpon) lectures by a diverse panel of speakers, we aim to help our audience gain new perspectives, a broader outlook, and a higher vantage point.

In 2025, we held a total of six lectures focusing on the “Science of Matter and Materials” and “Life Science”—two of the three pillars of the Toyota Konpon Research Institute, which also includes the “Science of Intelligence and Intellect.”



The Science of Matter and Materials: Special Lecture

Exploring the True Nature of Dark Matter

Dark matter is an unknown substance in our universe that is not made of the atoms that form everything around us. Observations of stellar and galactic movements reveal that a substance invisible to telescopes exists, and accounts for over 80% of all matter in the universe. On the other hand, it has also become clear that no known substance can explain dark matter. Yet, without dark matter, stars, galaxies, and even we would not exist. In this lecture, the speaker discussed the cutting edge of research into how dark matter is being investigated, including the technologies used for detection and the challenges involved in launching such research.



Hitoshi Murayama
Professor, UC Berkeley/The University of Tokyo.
Organizer: Toyota Physical and Chemical Research Institute (Toyota Riken Konwakai)
Co-organizer: Toyota Konpon Research Institute
Date: July 28, 2025
Venue: Toyota Physical and Chemical Research Institute





Tetsuya Kobayashi
Professor
The University of Tokyo

Atsushi Nagano Professor,
Nagoya University

— Principles and Limitation of Frontier Exploration

We define discovering “something” that lies beyond our current knowledge as “frontier exploration,” and we have been working to clarify its principles and limitations. To date, we have held workshops featuring researchers from the fields of information science, mathematics, and life sciences, and have engaged in extensive discussions on the theories, algorithms, and methodologies related to uncharted exploration. The insights gained from this project have been carried forward into Academic Transformation Project A, “Principles of Life Function Creation through Evolutionary Information Assembly,” which began this year. Moving forward, we will continue to build on this work with the goal of elucidating the principles and limits of evolution.



Kei Hirose
Professor
The University of Tokyo

— Syntheses of Iron Polyhydrides under Extreme Conditions

Our objective is to explore new substances formed when iron combines with large amounts of hydrogen under extreme conditions of ultra-high pressure and high temperature, and to elucidate their functionality. This year, we identified the iron polyhydride FeH₆ under a pressure of approximately 1.6 million atmospheres and demonstrated that it exhibits high ionic conductivity, with hydrogen ions moving extremely rapidly in the moderate temperature range of 200–400°C. Moreover, at a pressure of approximately 2.25 million atmospheres, we successfully synthesized a new, more hydrogen-rich phase, which is expected to have applications in energy materials and research on deep-Earth materials.



Ayuko Hoshino
Professor
The University of Tokyo

— Elucidating Exosomal Trajectory in Aging and Age-related Disease

Focusing on exosomes that transport information between cells, this project aims to discover a novel metric for assessing healthy longevity by quantifying age-related systemic changes. This year, we analyzed differences across 23 distinct mouse organs based on age and sex, revealing that the pace of aging differs significantly from organ to organ. Notably, we demonstrated that skeletal muscle-derived exosomes exert a powerful effect on immune cells, uncovering crucial insights for understanding and preventing frailty* (a condition characterized by a combination of muscle weakness and persistent fatigue).

*Frailty: A state of vulnerability that represents the intermediate stage between robust health and the need for nursing care, where physical and mental vitality decline due to aging or illness.

Prospects for 2026

In 2026, several exploratory research themes will enter their final year. To facilitate the transition and expansion into the next phase, we will promote active exchange and dialogue between academia and research coordinators.

We are currently entering the era of the Second Quantum Revolution. The theories of quantum mechanics established in the early 20th century gave rise to powerful technologies such as semiconductors, lasers, and nuclear magnetic resonance (NMR)—this was the First Quantum Revolution. While the industrial world reveled in these achievements, quantum science steadily matured, and today, a new horizon has

opened up. We have arrived at the dawn of the Second Quantum Revolution, an era where we directly harness unique quantum phenomena such as quantum tunneling, quantum entanglement, and quantum superposition. The quantum realm is no longer just a “mysterious world” to us. As we set sail under the quantum banner, how will you navigate the rough seas of this new era?

Session
1

Large-Scale Optical Quantum Computers Using Quantum Teleportation



Akira Furusawa

Professor, The University of Tokyo
Deputy Director, RIKEN Center for Quantum Computing

> Organized jointly by: Toyota Physical and Chemical Research Institute
Date: June 9, 2025
Venue: Toyota Physical and Chemical Research Institute

In this lecture, the speaker introduced the current state of world-leading research and development into optical quantum computing, centered on quantum teleportation as its core technology—a unique approach originating right here in Japan. Unlike conventional digital quantum computing, it was demonstrated that an analog method directly handling superposition states enables highly efficient, low-energy computation with fewer physical components. The talk also highlighted the excellent scalability derived from building upon existing optical communication technologies, as well as the absolute forefront of the fierce international race to commercialize these systems by combining them with classical computing.

> Date: July 9, 2025
Venue: Toyota Commemorative Museum of Industry and Technology

In this lecture, the speaker shared the core concepts of quantum mechanics from the perspective that the quantum realm is no longer just a “mysterious world,” but an indispensable foundation for understanding future technologies. The presentation demonstrated how classical mechanics assumptions break down at the quantum scale, explaining a framework for understanding nature based on observation and probability. Building on this, Dr. Matsuura asserted that adopting a quantum mechanical worldview—and using its unique characteristics to spark and materialize new ideas—is the precise starting point for the next generation of technological innovation.

Session
2

What is a Quantum?



So Matsuura

Professor, Keio University

> Date: August 22, 2025
Venue: DENSO Advanced Research and Innovation Center

This lecture highlighted how semiconductors—one of the greatest success stories of quantum mechanics—are once again becoming central to society and industry. The speaker explained that, following the era of home appliances, PCs, and smartphones, a “third phase of growth” has arrived in which the real world and virtual space are converging, and that semiconductors are gaining increasing importance as both social infrastructure and strategic materials. Further, against the backdrop of power constraints, the speaker emphasized that technological innovation—including not only miniaturization but also packaging technologies and energy-saving processes—is required, and that semiconductors are evolving in tandem with the development of AI.

Session
3

The Future of Semiconductors: A Changing Society and the Future of Technological Dominance



Tadahiro Kuroda

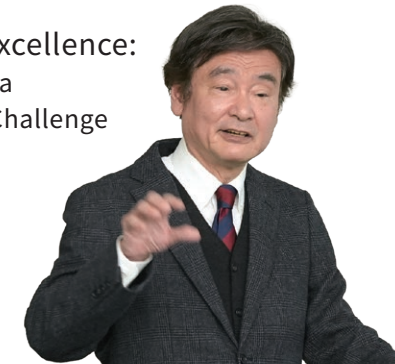
University Professor, The University of Tokyo
Chancellor, Prefectural University of Kumamoto

Our society is facing the limits of resources and the environment, forcing a shift away from the traditional model of mass production and mass consumption. The key lies in the “mechanisms of sustainability” that life has built over billions of years of evolution. This series explores life as a system, unraveling its design

principles at the molecular level, the mechanisms of energy conversion, and the essence of life that freely manipulates information and function. Cells, genes, energy, information—now is the time to draw our future from the design concepts revealed by life sciences.

Session
1

Redefining Excellence: A Keio Tsuruoka Bio-Venture’s Challenge to Shape Japan’s Future



Masaru Tomita

Director, Tsuruoka Science Park
Professor Emeritus, Keio University

> Date: December 17, 2025
Venue: Toyota Commemorative Museum of Industry and Technology

Through practical experience at the Tsuruoka Science Park, it was demonstrated that a data-driven approach to life sciences—one that thoroughly embraces “what is not usually done”—enables the simultaneous pursuit of world-leading research and the creation of local industries. The presentation argued that the ability to establish world-class research hubs in regional areas without concentrating them in Tokyo, and the direct return of research outcomes to the local community in the form of jobs and income, are the driving forces behind sustainable knowledge creation. Moreover, it emphasized that shifting away from the conventional view of talent—the “model student” ideal that has contributed to Japan’s stagnation—and embracing “mavericks” who immerse themselves in questions that truly captivate them, is what will pave the way for the future. This lecture offered an opportunity to consider how to design a structure in which research, talent, and the local community mutually enhance each other’s value.

> Date: February 9, 2026
Venue: Toyota Physical and Chemical Research Institute

In this lecture, the speaker systematically presented RNA from its scientific essence to its real-world implementation, positioning it at the very center of life sciences and medical innovation. As a molecule that possesses both information and function, RNA is not only shedding light on the origins of life but is also seeing rapidly expanding applications in vaccines, drug discovery, and regenerative medicine. In particular, cell sorting and control technologies utilizing MicroRNA and RNA switches have opened up a new path to overcoming safety and quality challenges in iPS cell therapies. It was further demonstrated that the design of functional RNA molecules integrated with AI is ushering in an era where we can design biological functions themselves. This lecture provided a valuable opportunity to understand a future where basic research seamlessly connects to medicine and industry.

Session
2

Designing and Evolving RNA Sequence Structures via Synthetic Biology



Hirohide Saito

Professor, The University of Tokyo
Professor, Kyoto University

In-depth exploration of lecture topics in books



Is the Universe Really One?
An Introduction to the Latest Cosmology
Kodansha
Hitoshi Murayama (Author)



Optical Quantum Computers
Shueisha International
Akira Furusawa (Author)



What Is a Quantum?
The Ultimate Mechanism Governing the Universe
Kodansha
So Matsuura (Author)



The Theory of Semiconductor Super-Evolution:
The Future of Technology That Will Rule the World
Nikkei BP
Nikkei Publishing
Tadahiro Kuroda (Author)



How to Escape the Conventional Mindset
Hayakawa Publishing Corp.
Masaru Tomita (Author)

INTERNATIONAL SEMINARS

Mapping the Future with Insights from Leading Global Universities

We connect directly with the strategic liaison offices of leading top global universities to drive unique initiatives that leverage each institution's strengths. This academic year, we partnered with the University of California, San Diego (UC San Diego) and Columbia University to host a series of lectures featuring world-leading researchers from both institutions. In addition, we held dynamic panel discussions and talk sessions that included Japanese researchers, fostering highly active global dialogue.

University of California, San Diego

On October 8 and 9, we held a seminar on ocean and climate topics, entitled "UC San Diego Days". This seminar was co-hosted by WPI-AIMEC* and Toyota Konpon Research Institute. The event featured panel discussions that brought together global and Japanese researchers, sparking dynamic and active dialogue.

*Tohoku University & Japan Agency for Marine-Earth Science and Technology (JAMSTEC), World Premier International Research Center Initiative (WPI), Advanced Institute for Marine Ecosystem Change (AIMEC)

Keynote Lecture | 『Ocean Challenges and Opportunities』



Professor
Margaret Leinen

Professor Margaret Leinen (Former Director of the Scripps Institution of Oceanography) delivered a lecture covering a broad range of topics, including the critical importance of ocean observations, changes in ocean chemistry, biodiversity, and perspectives for the blue economy and sustainability.



Fumio Inagaki, Vice Director of WPI-AIMEC*, Professor (center)
Satoshi Mitarai, Dean of Research, Okinawa Institute of Science and Technology (OIST), Professor (top right)
Toshio Suga, Director of WPI-AIMEC*, Professor (bottom left)
Hirofumi Inoue, President, Advanced R&D and Engineering Company, Toyota Motor Corporation (bottom right)

Panel Discussions |

Participants exchanged views from a broad perspective on topics such as how to predict and prepare for tipping points in the ocean, how to strike a balance between use and conservation, and our responsibility to future generations.

Keynote Lecture | 『Ocean: A Climate Pacemaker』



Professor
Shang-Ping Xie

Professor Shang-Ping Xie of the Scripps Institution of Oceanography and Principal Investigator of WPI-AIMEC* presented a lecture on the impact of past El Niño events on the climate of East Asia, the relationship between global average temperature rise and sea surface temperature, the mechanisms behind marine heatwaves off Japan, and long-term impacts of regional climate change to future net-zero carbon emission scenario.



Swadhin Behera, Director of Application Laboratory, JAMSTEC (center)
Nina Yasuda, Professor, The University of Tokyo (top right)
Gerald Pao, Assistant Professor, Okinawa Institute of Science and Technology (OIST) (bottom left)
Namal Rathnayake, Researcher, WPI-AIMEC* (bottom right)

Panel Discussions |

Participants exchanged views on the use of data and AI in ocean science, including Digital Twins of the Ocean, on-site data collection and utilization, and the development of a sustainable blue economy.

● We are working in close collaboration with Ms. Waga, Office of Research and Innovation, to advance joint initiatives with UC San Diego.



Our collaboration with the Toyota Konpon Research Institute—which is guided by the unique philosophy of exploring “research that bridges the gap between fundamental research and real-world applications”—is a challenging yet rewarding endeavor that cannot be achieved without delving deeper into the research activities at the University of California San Diego and reexamining them from new perspectives.

Miwako Waga, Senior Director, International Innovation Outreach, Office of Research and Innovation

Columbia University

On October 27 and 28, we hosted a two-day seminar on climate, environment and natural resources titled “Columbia Days.” The event featured dynamic talk sessions that brought together global and Japanese researchers, fostering highly active and engaging dialogue.

Keynote Lecture | 『Stewarding Planetary Resources: Sustainably Managing Climate, Earth and Environment (and How Universities Can Help)』



Professor
Jeffrey Shaman

Professor Jeffrey Shaman (Senior Vice Dean of the Columbia Climate School) delivered a comprehensive lecture on environmental pollution and its impacts, the importance of waste management, health resilience, global warming and its effects, and the role of the Columbia Climate School.



Talk Sessions | Professor Shaman and Associate Professor Kosaka

Associate Professor Yu Kosaka (The University of Tokyo) also joined the stage to engage in a dialogue with Professor Shaman, diving deeper into the insights from the lecture. They exchanged views on critical topics, including the relationship between health resilience and the circular economy, as well as the pros and cons of geoengineering (climate engineering).

Keynote Lecture | 『Geological Resources of Rare Earth Elements, Nickel, Cobalt & Hydrogen』



Professor
Peter Kelemen

Professor Peter Kelemen, Thomas Alva Edison/Con Edison Professor, Lamont-Doherty Earth Observatory, delivered a lecture providing a geological overview of the critical importance of geological resources—such as natural hydrogen, rare earth elements, nickel, and cobalt—as well as the formation of mineral deposits, global production trends, and potential reserves in Japan. Additionally, he shared valuable insights regarding the economic viability and commercial aspects of these resources.



Talk Sessions | Professor Kelemen and Professor Hirose

Professor Kei Hirose (The University of Tokyo) also joined as a speaker for a dialogue with Professor Kelemen, where they delved deeper into the content of the lecture. Opinions were exchanged on various topics, including technical challenges in geological resources, the current state of resource exploration in Japan, and future prospects.

● We are working closely with Ms. Sputz, Research Initiatives and Development, to advance our initiatives with Columbia University.



Our partnership with Toyota Konpon provides a unique lens to explore Columbia's breadth and depth of research and brings thought-provoking new insights about our impact on the future of the earth we share. It's been an enriching partnership and a rare privilege.

Sharon Sputz, Associate Vice President, Research Initiatives and Development

Prospects for 2026

These seminars provided an invaluable opportunity to gain holistic overviews and specialized expertise in oceans, climate, environment, and earth resources from world-leading researchers. It also served as a meaningful platform for fostering networking and engagement among domestic and international researchers, alongside Toyota Group affiliates. Moving forward, we intend to sustain and expand this initiative, leveraging these insights to foster the creation of new next-generation research themes.

Where Diverse Knowledge Comes Together and New Research Takes Shape

Research coordinators do more than form “bridges” between researchers and organizations. They design the environments and processes through which diverse knowledge can come together and generate new ideas through dialogue. Working alongside promising academic researchers and experts from multiple fields, they continue to ask “what to research” and link unexplored research themes to society while conducting repeated dialogue, experimentation and improvement. By planning and managing exploration and investigation activities, they draw upon the specialist knowledge and curiosity of each researcher and create new questions and seeds of research amid an exchange of perspectives between different fields. A research coordinator’s role is to hone this process. Over the past three years, efforts to create research themes have evolved from individual challenges into reproducible “formats”. Research coordinators link this knowledge to the next challenge, while opening up the possibilities of future research by supporting Toyota Konpon Research Institute’s science activities, both internally and externally.

Main activities

- Planning and management of Research Exploration Program
- Planning and promotion of exploratory Projects
- Collaboration with overseas universities
- Planning and management of lectures

Introducing research coordinators

■ Members seconded from Toyota group companies



■ After completing my secondment

Column 01

Yusuke Hongo

The past three years have felt almost like I have been running across an untamed wilderness. However, looking back I can see that a “path” built with my colleagues in academia has started to become faintly visible. Through the secondment, in addition to sowing seeds for the future of the Toyota Group by researching “what to research”, I learned what management is through direct personal experience. I would like to express my deep gratitude to everyone who has supported me, including the researchers.

Column 02

Akihiro Suzuki

The two years were a good reminder for me of how incredibly vast the world of science research is. Conversations with members of academia and the coordinators helped me to develop the ability to see things from a broad perspective, as well as the ability to produce inspirational thinking that gives new ideas by changing perspectives. One of these inspirations helped me bring home what I hope will be a pioneering research theme for Toyota Industries, and I plan to work on this further during 2026. It was an incredibly valuable experience that I am very grateful for.

Prospects for 2026

2025 was a year during which we steadily built a platform for exploration and investigation activities. By blending new perspectives with those accumulated so far, we have further deepened our involvement in concept-building and dialogue during the research theme creation process. In 2026, we will build themes based upon the ideas of research coordinators themselves, strengthen collaboration with members of Toyota Konpon Academy, add more details to proposal themes, and further improve our ability to get things done. Through dialogue and practical implementation, we will continue to cultivate pathways that lead to the next generation of research.

KONPON SPACE:

A New Hub for Collaboration and Exchange

We recently carried out an office extension and created a new collaboration zone called “KONPON SPACE” to encourage co-creation both internally and externally. We named the space after soliciting ideas from members of the Institute and decided on the name through a vote. KONPON SPACE has a flexible layout with spaces for discussion and collaboration. It is equipped with curved sofas to allow for relaxed dialogue, and has various areas including booths, etc. for concentrating on work. We hope this space will inspire new ideas, collaborations, and activities.



Company name	Toyota Konpon Research Institute Inc.	Shareholders	Toyota Motor Corporation Toyota Industries Corporation Aisin Corporation Denso Corporation Toyota Central R&D Labs., Inc. Aichi Steel Corporation JTEKT Corporation Toyota Auto Body Co., Ltd. Toyota Tsusho Corporation Toyota Boshoku Corporation Toyota Motor East Japan, Inc. Toyoda Gosei Co., Ltd.
Established	June 11, 1996		
Capital JPY	100 million		
Location	Nishi-ku, Nagoya City Inside the Toyota Commemorative Museum of Industry and Technology		
Representative Director	Soichiro Okudaira		
President	Noboru Kikuchi		
Directors	Hiroyasu Watanabe Tetsuro Toyoda Hiroyuki Wakabayashi Morito Oshita Hirofumi Inoue	History	June 1996 Established the Genesis Research Institute in the Toyota Commemorative Museum of Industry and Technology in Nishi-ku, Nagoya May 1997 Opened the East Tokyo Laboratory in the Cluster Research Laboratory of the Toyota Technological Institute, Ichikawa City, Chiba Prefecture March 2023 Closed the East Tokyo Laboratory July 2023 Changed the company name to Toyota Konpon Research Institute with the aim of becoming a research institute where leading researchers from diverse fields around the world come together
Auditors	Hiroataka Takeda Takashi Shimazu		
Business details	1.Research, investigation, and provision of technical information regarding future social predictions 2.Research, testing, and investigation of humanities and social sciences, natural sciences, and comprehensive technologies based on those sciences 3.Research, testing, and investigation regarding the development and use of science and technology, and the resulting effects and impacts 4.Research, testing, surveys, and the training and development of researchers and engineers conducted through mutual contracting or jointly with countries, administrative agencies, organizations, and research institutions		

Message from the Editor

Thank you for reading our Annual Report 2025. Toyota Konpon Research Institute has continued to value its founding aspirations and its commitment to “research what to research” while cultivating research seeds that will link to the future through dialogue with diverse fields. In June 2026, we will mark the 30th anniversary of our establishment. Moving forward, we will continue to focus on the earliest stages of change in society and science, while taking on the challenge of creating new value alongside colleagues who share our aspirations.

