



## Internationalizing Japan's academia: Riding the wave of change

Japan's top universities are implementing programs to meet the goals of recent multimillion dollar government projects to internationalize their campuses and compete in the global competition for top class staff and students. **By Adarsh Sandhu**

### Reforming Japan's universities

Surprisingly, in spite of the fact that Japan has produced more Nobel laureates than any other country in Asia, there were only two Japanese universities in the top 100 of the 2014 *Times Higher Education* World University Rankings. By contrast, there were three each from China and South Korea, and two from Singapore. These facts are of concern to educators in Japan, recently prompting the Ministry of Education, Culture, Sports, Science and Technology (MEXT) to launch two 10-year, multimillion dollar projects: the Program for Promoting the Enhancement of Research Universities (hereafter "RU") in 2013 and the Top Global University (TGU) project in 2014. The purpose of these projects is to support Japanese universities with research and education reforms, enabling them to internationalize and better compete globally (1, 2). The RU program aims to improve research infrastructure, while the TGU program targets internationalization of education.

Each university received initial annual funding of US\$2 million to US\$4 million under the RU program and US\$1.4 million to US\$3.5 million under the TGU program. Both have a mid-

term assessment (after five years), with the possibility of cuts or even termination of funding for those institutes that have not achieved their initial targets. Details of the original applications are posted on the MEXT website, to enhance transparency and accountability.

These programs have generated a lot of interest in both Japan and overseas, particularly because the universities and institutes selected were chosen by an unprecedented, top-down approach based on performance metrics—such as quality of publications and patent submissions—and staff-to-student ratios.

The programs were devised to resolve two major problems facing Japanese academia. The first is the dramatic fall in Japan's birth rate, with government figures indicating that within 20 years, Japan's 780 universities will have more places available than domestic students to fill them. Currently, about 600,000 students apply for approximately 580,000 places at Japan's universities. The projected drop in enrollment will lead to mergers or the closure of less competitive institutes.

The second problem is the need to improve Japan's standing in world ranking tables. University rankings are by no means the most effective means of assessing the quality of research and education in academia, but they do highlight the importance of internationally oriented curricula and strategic outreach programs to enhance visibility. Improving global appeal may also attract international students to counteract future enrollment shortfalls.

### Attracting international students and staff

It is estimated that there are currently around 4 million international students in the world, with the United Nations Organization for Education, Science and Culture (UNESCO) predicting that this number may increase to 7 million by 2020. Japan currently has about 184,000 overseas students (approximately 3% of all students in tertiary education) with plans to increase this number to 300,000 over the next decade. By contrast, from 2013 to 2014, universities in the United States enrolled approximately 886,000 international students. Courses taught in English, the availability of scholarships, and genuine career

opportunities upon graduation are just some of the factors that attract the world's best and brightest to these universities.

Why do Japanese universities struggle to attract international students? The main reason is that the Japanese language is a formidable hurdle to overcome. When Joby Joseph, a physicist at the Indian Institute of Technology (IIT) Delhi, first visited a university in Japan, he was surprised to see that all the courses were taught using Japanese language textbooks. "There was not a single word of English in the books," he said.

To overcome language problems, universities selected for the TGU program have changed their curricula to include more English language courses and have hired bilingual support and administration staff to assist international visitors. Importantly, they have also started to send their own students abroad for short-term stays to hone their English language skills and experience different ways of conducting research and education.

### Career opportunities at Japan's top universities

Universities in Japan are now more open and dynamic in their ideas than they have been in the last 50 years, offering real opportunities for tenured positions for staff from overseas. The drive by Japan's top universities to recruit international staff and students is an unprecedented opportunity for career development for young students and faculty members from outside Japan wishing to collaborate with Japanese researchers.

All scientists, from graduate students to established academics, are encouraged to seek research opportunities in Japan. Prospective graduate students can research laboratories at Japan's top universities through their websites to find academics doing research in their area of interest. They can then contact the faculty directly via e-mail to ask about research openings and the possibility of financial support. It is worth noting that graduate school programs start in either April or October, but the precise dates for formal interviews and examinations depend on the institute. For academics, direct networking at conferences and similar events is critical for building relationships that may lead to finding openings at Japanese universities.

For international scientists, the location of an institute can be important. Prospective visitors should decide whether they would prefer a megametropolis such as Tokyo or Osaka, or less crowded cities such as Kanazawa and Beppu. The availability of English language schools for children, and of local communities and support networks for spouses, are also important factors to consider for long-term stays in Japan.

Visitors to Japan are often surprised by the safety of its cities. Personal safety and peace of mind are some of the attractions of studying or working in Japan. Another is cost, with tuition fees at Japan's national universities considerably lower than universities in the United States and certain European countries. This is an important factor when choosing universities, given the increasing number of students needing loans to pay for their university education in the United States and United Kingdom.

Many opportunities exist for short-term scholarly research in Japan, as many visiting academics will testify. For example, a three-to-nine month sabbatical can enable young researchers to form connections for future collaborations. However, there are challenges filling full-time, tenured positions at Japanese universities because of severe gaps in matching the applicants'

expectations with the realities of low salaries, heavy teaching obligations, and insufficient startup funding for setting up research labs. Furthermore, even if such issues are resolved, people with families may find it difficult to balance their careers with their children's education because of the lack of reasonably priced international schools in Japan.

---

**Universities in Japan  
are now more open and dynamic  
in their ideas than they have been  
in the last 50 years, offering real  
opportunities for tenured positions  
for staff from overseas.**

---

### Surviving Japan's educational reforms

Japan's academia is going through changes on par with those of the Meiji Restoration in the late 19th century. The Meiji movement laid the foundations for the current educational system, devised by Japanese scholars for Japanese students. But a Japanese-only study environment and curriculum has produced students who are unable to function effectively in English—the de facto global language of scholarly communication. Mastery of English is particularly important for Japanese industry, which is becoming increasingly internationalized and needs globally minded employees to run its overseas operations.

Importantly, the outcome of these two high-profile MEXT programs will have significant implications for the future of education and research policy in Japan. The next 5 to 10 years will likely see both mergers and closures of universities large and small that are unable to attract enough students and funding as government subsidies are reduced.

Japan's university administrators face unprecedented and multifaceted problems as they struggle to cope with increased international competition for students and research staff. Finding solutions to these issues will require dynamic, diverse, and global approaches. The academic institutes that survive this wave of educational reform in Japan will be those that implement bold initiatives to create borderless, multicultural, multilingual, and globally connected campuses.

*Adarsh Sandhu is a freelance science writer based in Tokyo.*

### References

1. MEXT, "Program for Promoting the Enhancement of Research Universities" (in Japanese); available at [www.mext.go.jp/a\\_menu/kagaku/sokushinhi/index.htm](http://www.mext.go.jp/a_menu/kagaku/sokushinhi/index.htm).
2. MEXT, "Selection for the FY 2014 Top Global University Project"; available at [www.mext.go.jp/b\\_menu/houdou/26/09/\\_icsFiles/safiedfile/2014/10/07/1352218\\_02.pdf](http://www.mext.go.jp/b_menu/houdou/26/09/_icsFiles/safiedfile/2014/10/07/1352218_02.pdf).



Shuji Hashimoto

## Waseda University goes global

**W**aseda University is a top, private academic institution in Japan in terms of prestige, scholarly achievements, and financial capability. The university is rapidly implementing innovative programs to create a worldwide academic network for an open, diverse, and dynamic campus.

"We have set two challenging and ambitious goals for the next 10 years under the Waseda Goes Global (W2G) plan," says Vice President **Shuji Hashimoto**. "Training 100,000 students for global leadership through research and education programs with international academic partners, and being ranked among the world's top 100 universities in 18 different areas of research."

Waseda's goals are supported by funding from the government's Top Global University Project. Waseda was one of only 13 universities selected by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) in the highly competitive Type A group when funding was launched in September 2014. The aim of the project is to help selected universities achieve reforms that will enable them to compete globally.

W2G is a ten-year plan, with approximately ¥540 million (US\$4.7 million) allocated for the first full fiscal year, 2015. The university has demonstrated its commitment to achieving dramatic results by dedicating ¥190 million (US\$1.7 million) of its own funds on top of the ¥350 million (US\$3 million) government grant.

The funding is being used to support six education and research units prioritized by Waseda to implement the goals of the W2G plan. The six units are Global Japanese Studies; Empirical Analyses of Political Economy; Health Promotion: The Joy of Sports and Exercise; Frontier of Embodiment Informatics: Information and Communication Technology (ICT) and

Robotics; Energy and Nanomaterials; and Multiscale Analysis, Modeling, and Simulation. Specific goals of the W2G plan include doubling the number of visiting researchers from 810 to 1,600 and increasing the international faculty from 760 to 1,380.

"We are also making major changes to our personnel recruitment policies to achieve the aims of the W2G plan," explains Hashimoto. "We are actively recruiting faculty from overseas, increasing the number of tenure-track positions and joint appointments."

Furthermore, Waseda is introducing an academic calendar based on quarters to synchronize with those of overseas universities. The university is also creating joint appointment chairs and cotutoring for double degree programs, as well as giving full support to visiting scholars and students studying under the Top Global University Project. The aim of these changes is to support students while they are at Waseda, and to ensure they have priority access to accommodation on or close to campus.

Hashimoto is confident that Waseda will succeed in achieving its goals and will act as a model for other universities with similar ambitions. **"Waseda is truly going global. We welcome highly motivated students and researchers from around the world to join us on this unique journey."**

### Waseda University at a glance



Okuma Auditorium

- Founded in 1882 by Shigenobu Okuma, who twice served as prime minister of Japan, Waseda University is one of the largest and most influential private universities in Japan, with more than 50,000 students and 5,500 academic staff.
- Waseda is Japan's foremost international university with more than 5,000 international students and more than 700 overseas partner institutions in 81 countries.
- International students can choose from all-English degree programs in 6 undergraduate and 12 graduate schools, and learn

over 25 foreign languages; the curriculum for Japanese language training is Japan's most extensive.

- Waseda's main campus is located in central Tokyo, with convenient access to shopping areas, international schools, embassies, and offices of major corporations.
- The university has a global network of approximately 600,000 alumni, including novelist Haruki Murakami, UNIQLO founder and CEO Tadashi Yanai, Olympic gold medalist Shizuka Arakawa, and seven Japanese prime ministers.
- Waseda University was ranked 33rd in the world and 1st in Japan in the Quacquarelli Symonds graduate employability rankings published in November 2015.

### FURTHER INFORMATION

**Waseda University**  
[www.waseda.jp/top/en](http://www.waseda.jp/top/en)

**Top Global University Project**  
[www.waseda.jp/inst/sgu/en](http://www.waseda.jp/inst/sgu/en)



# Energy and nanomaterials

## Searching for innovative means to produce, store, and use energy

**T**he Unit for Energy and Nanomaterials is one of the flagship research hubs established by Waseda University as part of the Top Global University (TGU) project funded by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT). "We want to contribute to global efforts to mitigate the daunting problems related to the production, storage, and efficient use of energy," explains **Hiroyuki Nishide**, former dean of the Graduate School of Advanced Science and Engineering, and coordinator of the unit. "We have launched several innovative international initiatives to facilitate this goal, including hiring academic staff and researchers from overseas. We welcome researchers and students from overseas to join us."

### Unit for Energy and Nanomaterials

Research and education within the Unit for Energy and Nanomaterials are driven by international collaborations, with Waseda funding joint appointments of overseas staff as well as student exchanges as part of a joint Ph.D. degree program between a group of partner universities. In 2016, Waseda University will hire full professors from universities in the U.S. and Australia. The new staff will have one-to-three-year fixed contracts and their duties will include teaching and research. Published work in peer-reviewed journals will carry the names of both universities. Salaries are competitive and the staff from the partner universities stay at Waseda for a minimum of three months per academic year.

Regular interuniversity exchanges and close supervision of students are important for the program's success. Students are carefully matched with supervisors from the partner universities and are required to take designated course credits at the partner university and to conduct research there for more than three months. Students successfully completing the program will receive a certificate under the name of Waseda and the partner university.

"Compared with students who undertake doctoral courses at only a single institution, these students will benefit by interacting with top researchers at two universities located in different countries," says Nishide.

### Innovative world-class research on batteries

Hiroyuki Nishide is internationally renowned for the development of "radical polymer" batteries that are semitransparent, flexible to the extent of being foldable, and can be charged in less than 30 seconds. "We use so-called p- and n-type redox couples of radical polymers in our flexible batteries," says Nishide. "For example, we tune radical polymers with a wide selection of molecular structures, enabling these materials to exhibit the properties of both cathode and anode materials. Prototypes show very promising properties such as rapid charging and a long shelf life."

Specifically, 0.5-mm-thick radical polymer batteries with areas of 3 cm<sup>2</sup> exhibit a battery capacity of 6 milliamp hours and a power density of 5 kilowatts/liter. These groundbreaking batteries are expected to find applications in consumer products such as smart wrist watches.

### Research institutions collaborating with the Unit for Energy and Nanomaterials



The Research Support Center

#### The Smart Energy System Innovation Center

This center for battery innovation develops high capacity secondary batteries including lithium sulfide and metal air types. Other work includes nondestructive monitoring of batteries and the development of silicon anode batteries.

#### Energy Management System Shinjuku R & D Center

This center focuses on research into next-generation energy management system responses and the development of next-generation voltage regulation technology in power networks, including power generated by renewable energy.

### FURTHER INFORMATION

**Unit for Energy and Nanomaterials**  
[www.tgu-enm.sci.waseda.ac.jp](http://www.tgu-enm.sci.waseda.ac.jp)

**Graduate Program in Science and Engineering**  
[www.leading-en.sci.waseda.ac.jp/en](http://www.leading-en.sci.waseda.ac.jp/en)

## Frontiers of embodiment informatics: Combining communications and engineering for human symbiotic robots

**R**elationships between people are fraught with difficulties. So imagine the challenges researchers face in forming mutually beneficial relationships between humans and robots. **Shigeki Sugano** has spent a lifetime of research doing just that: formulating ways of enabling robots and humans to interact with and understand each other.

"The fundamental question is whether humans and robots can coexist, and work together closely to achieve goals," says Sugano. "The answer is important for the development of robots to support human activities, particularly in aging societies such as in Japan."

Sugano and colleagues have defined safety, dependability, and dexterity as critical factors for humans and robots to be able to coexist. Extensive research based on instilling these traits in robots led to the development of TWENDY-ONE—a highly dexterous and multifunctional human symbiotic robot able to adapt to human movement and manipulate objects, such as putting bread into a toaster.

"The Graduate Program for Embodiment Informatics is funded by Japan's Ministry of Education, Culture, Sports, Science and Technology [MEXT] as one of its Leading Graduate School Programs. It aims to nurture students to meet the formidable challenges for realizing the perfect human symbiotic robot," explains Sugano. "We welcome highly motivated



Shigeki Sugano

students and researchers from overseas to join us for firsthand insights into Japan's *monozukuri* or manufacturing technology."

The MEXT funding for the Graduate Program for Embodiment Informatics reflects the long and distinguished history of robotics research at Waseda University. Sugano is following in the footsteps of his mentors Ichiro Kato and Katsuhiko Shirai, who combined their talents in mechanical and electrical engineering to develop WABOT-1, the world's first humanoid robot, in 1973. "It would not be an exaggeration to say that we are standing on the foundations laid by Professors Kato and Shirai," says Sugano.

In the program, students take on projects to build human symbiotic robots by integrating research on mechanical technology and information communications technology. The Kobo Workshop—a shared open space where students from different backgrounds meet and interact freely—is one of the unique facilities of the program.

Future research themes include the WAMOEBA Project (Waseda-Amoeba, Waseda Artificial Mind On Emotion BAse), a methodology for instilling emotion and self-preservation instincts into robots.

### FURTHER INFORMATION

#### Shigeki Sugano

Department of Modern Mechanical Engineering, School of Creative Science and Engineering, and coordinator of the Waseda Graduate Program for Embodiment Informatics.

#### Graduate Program for Embodiment Informatics

[www.leading-sn.waseda.ac.jp/en/](http://www.leading-sn.waseda.ac.jp/en/)

## Fusing science and engineering in real-world modeling of fluid dynamics

**A**ircraft, oil tankers, and nuclear power stations are critical elements of modern society. However, the average citizen is probably unaware that the design, manufacture, and implementation of these important technologies require a deep knowledge of fluid mechanics—how mixtures of gases, liquids, and solids move and interact. Furthermore, in spite of recent advances in computing and mathematical modeling, our understanding of the intricacies of fluid mechanics is still incomplete. Against this background, enhancing our knowledge of mathematical fluid mechanics is the main goal of the international doctoral program at the Research Institute of Nonlinear Partial Differential Equations (PDEs) at Waseda University.

"Our international doctoral program on mathematical fluid mechanics is focused on the analysis of real-world fluidics such as bubble formation in the cooling systems of nuclear reactors," says **Yoshihiro Shibata**, Department of Mathematics, Faculty of Science and Engineering and Research Institute of Nonlinear PDEs. "The program is part of Waseda University's Top Global University (TGU) project."

Examples of research in this program are mathematical analysis of multiscale complex phenomena, biofluid mechanics for production of biofuels using *Euglena* microorganisms, solutions to the free boundary problem of Navier-Stokes equations, and modeling of cavitation



Yoshihiro Shibata

phenomena. Notably, the decommissioning of Japan's nuclear reactor in Fukushima has focused attention on multiscale complex phenomena, including how to understand complicated interactions between molten fuels and the other structures of the reactor.

The doctoral program is evolving into a credit-based system, enabling students to transfer credits to partner institutes in Europe

and North America. Students will be supervised by faculty members at both Waseda and their overseas partners.

"Currently we are creating long-term frameworks with Darmstadt University, Germany, the University of Pittsburgh, U.S., and the Universities of Pisa and Bari in Italy," explains Shibata. "We want to nurture young minds of all nationalities capable of accurate mathematical modeling and simulations based on physics, engineering, and numerical analysis. We welcome people from overseas to join us in making physics and mathematics a driving force behind building the infrastructure of our society."

### FURTHER INFORMATION

#### Yoshihiro Shibata

Department of Mathematics, Faculty of Science and Engineering and Research Institute of Nonlinear Partial Differential Equations

#### Yoshihiro Shibata's website

[www.fluid.sci.waseda.ac.jp/shibata/](http://www.fluid.sci.waseda.ac.jp/shibata/)

#### Mathematics and Physics Unit, TGU project, Waseda University

[www.sgu-mathphys.sci.waseda.ac.jp/en/index.html](http://www.sgu-mathphys.sci.waseda.ac.jp/en/index.html)