

National University Corporation Tokyo Institute of Technology

Designated National University Corporation scheme

Statement

*Fostering minds that envisage and enable the unknown
Embracing the vanguard, potential, diversity
Sharing knowledge to create value and well-being
Believing in bright minds that create a brighter future.*

Tokyo Tech

1. Introduction

Tokyo Institute of Technology (hereinafter Tokyo Tech, the Institute) has set the long-term goal of being globally recognized among the top ten science and technology universities by 2030, a year shy of its 150-year anniversary, and has correspondingly initiated a variety of recent vigorous reforms in education, research, and management.

Looking ahead to the Japan of 2030, the working-age population (ages 15-64) will have decreased approximately 17% compared to 2010, while the over-65 population will have grown by some 25%.¹ Faced with this notable change in population structure, it is essential for Japan to fully utilize the contributions of women and the elderly, as well as boost its productivity through more highly skilled human resources and technical competitiveness to ensure growth. Global-scale economic, societal, and technological advances must be in harmony with the natural world, and Japan, ranked 18th in the United Nations' goals of the 2030 Agenda for Sustainable Development (SDGs), faces significant challenges, particularly gender equality, clean energy, climate action, and other environmental issues.²

Tokyo Tech envisages itself commanding a key role in overcoming these challenges. Against a backdrop of the Institute's achievements in research-based practical science education, its advanced efforts as a Japanese national university to implement a world-standard governance system, its awareness of Japan's changing population structure, and its expected role at a time of global-scale economic, societal, and technological changes, this scheme outlines Tokyo Tech's plan to establish an environment of excellence and diversity in education and research—one created by outstanding faculty, researchers, and students from around the world. While fulfilling the responsibilities of a research university at the highest level, Tokyo Tech intends to autonomously and proactively execute a virtuous cycle of innovation that creates new fields of scholarship, and returns the findings from those fields back into society.

2. Tokyo Tech's Virtuous Cycle

For a Designated National University Corporation (DNU) to function as an international hub that meets world standards in education and research, it must execute a virtuous cycle of "confronting in earnest the problems the world faces, proposing new societal and economic systems, and returning the results to society in order to be both evaluated and supported," while fulfilling the duty of continuously creating knowledge. As shown in Figure 1, Tokyo Tech's Virtuous Cycle features the following duties of a research university serving the public (light blue):

- Fulfill obligations of a research university by providing the public with knowledge, human resources, and solutions to SDGs and other societal issues in line with the Institute's outstanding, diverse track record
- Optimize public funding to generate scientific and technological achievements in response to societal needs that garner higher evaluations and extended public support
- Create new knowledge and human resources—the source of future societal impact—through revitalized education and research

In addition, the following efforts will generate increased resources, creating added impact and further enhancing the Institute's efforts in education and research to complete Tokyo Tech's Virtuous Cycle (dark blue):

¹ Regional Population Projections for Japan: 2010-2040, National Institute of Population and Social Security Research, Tokyo, Japan (<http://www.ipss.go.jp/pp-shicyoson/j/shicyoson13/6houkoku/houkoku.pdf>).

² Bertelsmann Stiftung, SDG Index and Dashboards (<http://www.sdgindex.org/>).

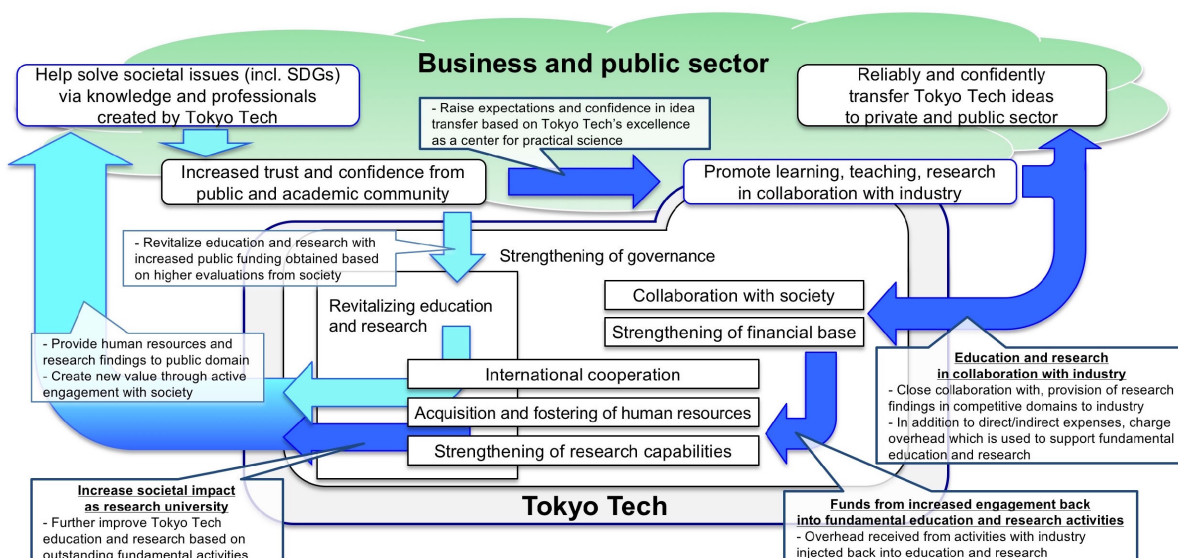


Figure 1. Tokyo Tech's Virtuous Cycle

- Promote learning, teaching, and research in collaboration with industry based on Tokyo Tech's excellent performance as a center for research-based practical science and the trust and confidence the Institute has earned from society
- Transfer Tokyo Tech ideas to the non-academic community to create innovation and increase societal impact, working in a competitive environment that values ingenuity
- Inject funding from external sources into fundamental education, research, and international activities

Tokyo Tech will execute this Virtuous Cycle under a university management system on par with the most discerning world standards.

Based on past outstanding research findings and the full confidence placed in the researchers responsible for them, Tokyo Tech strives for discoveries and breakthroughs in fields yet unknown that will lead to idea transfer and innovation creation. FY16 offers examples of big changes to facilitate these efforts. The new education system transcends traditional academic borders, allowing students, faculty, and researchers to connect across a broader range of specializations. The Institute for Liberal Arts has been established to help students gain a richer sense of humanity, boost their creativity, and learn the social skills to bridge their specialized knowledge with the wider community. The Institute of Innovative Research (IIR)—consisting of Research Laboratories and Centers with missions focused specifically on solving contemporary societal issues rather than being restricted to defined academic fields, and Research Units tasked to dynamically accelerate emerging, interdisciplinary fields—has been formed to act as the central engine of Tokyo Tech idea cultivation.

While fully utilizing increased collaboration with industry, the Institute aims to boost the societal benefit it creates through active Tokyo Tech idea transfer. Portions of increased external funding will be invested in fundamental education, forefront research, and the nurturing of “science as a core of cultural activity.”³ The new knowledge and human resources created in this way will serve as a source of positive societal impact for future generations, creating a sustained trust and confidence from society, and completing the Virtuous Cycle that Tokyo Tech sees as essential to the duties of a DNU.

3. Goal setting

3.1. Self-evaluation—a prerequisite to setting goals

Self-evaluations of Tokyo Tech's education and research, international collaboration, engagement, management, and financial status are continuously carried out to inform and establish the goals articulated in this scheme.

³ From the Nobel Lecture of Honorary Professor Yoshinori Ohsumi, recipient of the Nobel Prize in Physiology or Medicine in 2016, who said, “It is truly my hope that society is able to nurture not only purpose-oriented science but also science as a core of cultural activity.”

3.1.1. Education and research

Approximately 90% of Tokyo Tech students who graduate from bachelor-level programs continue to further education at the graduate level. To provide students with a seamless transition from one academic level to the next, the Institute implemented the *Tokyo Tech model*, combining its undergraduate and graduate programs into new Schools with appropriately aligned curricula in April 2016. An enhanced liberal arts program, applied at all levels of study, helps students formulate a clear personal vision to complement their specialized technical skills. All courses now follow a coherent and logical numbering system rendered in syllabi published in both Japanese and English. Together, these enhancements create a system that enables and encourages students to learn more proactively. Tokyo Tech's four Research Laboratories and two Research Centers, integrated under IIR, have distinct and clear missions that focus on finding solutions to societal problems and laying the foundations for future industry. IIR's Research Units, which are organized and established rapidly in collaboration with faculty from Tokyo Tech's Schools, carry out research in emerging, interdisciplinary fields. As a result of these efforts, Tokyo Tech's academic and research activities are highly regarded.

3.1.2. International collaboration

Tokyo Tech strongly supports the systematic exchange of students and faculty with numerous overseas institutions. As of May 1, 2016, the Institute had university-wide cooperation agreements with 101 overseas institutions and school-to-school agreements with 112 partners. It is a founding member of the Asian Science and Technology Pioneering Institute of Research and Education (ASPIRE) League, which also includes the Hong Kong University of Science and Technology (HKUST), Korea Advanced Institute of Science and Technology (KAIST), Nanyang Technological University (NTU), and Tsinghua University. Tokyo Tech is a member of a variety of consortia promoting international exchange and joint degree programs, including the Asia-Oceania Top University League on Engineering (AOTULE), which includes the University of Melbourne, the University of Auckland, Tsinghua University, National Taiwan University, HKUST, Bandung Institute of Technology, KAIST, the University of Malaya, NTU, Chulalongkorn University, Indian Institute of Technology Madras, and Hanoi University of Science and Technology. Tokyo Tech is also a member of CAMPUS Asia Plus, a consortium with Tsinghua University, KAIST, and NTU, and the creator of Japan's first graduate-level dual degree program with an overseas university. With research hubs such as the Earth-Life Science Institute (ELSI), a part of the World Premier International (WPI) Research Center Initiative, Tokyo Tech actively pursues broad international collaboration in research. While maintaining these collaboration efforts, the Institute continues to actively advance initiatives within the program for promoting the enhancement of research universities and the Top Global University Project.

3.1.3. Engagement

As of April 1, 2015, Tokyo Tech had research alliance programs with 13 corporations and non-profit organizations, which are managed via the Office of Industry Liaison (renamed Office of Research and Innovation on April 1, 2017). In FY14, 468 collaborations brought a total of USD14.3 million (USD1=JPY118) in external research funding to Tokyo Tech. Such engagement has a corresponding benefit to the development of intellectual property. During the same FY14, the Institute submitted 199 applications and received an income of USD486,000 in license fees. A total of 61 startup companies born from Tokyo Tech research—and therefore designated as Tokyo Tech Ventures—existed as of April 1, 2015. To promote startups based on students' ideas, various entrepreneurship programs are underway, and a student startup system supported by the Tokyo Institute of Technology Fund (Tokyo Tech Fund) to help convert these ideas into prototypes is under development.

3.1.4. Management

Tokyo Tech is already the front-runner among Japanese national universities in its implementation of a world-standard governance system. The Institute has strengthened the leadership of the president, whose discretionary resources have been increased, and who now appoints the Institute's deans and directors. All faculty positions are centrally managed. The Strategic Management Council, a centralized decision-making body, has been established to rapidly and accurately manage education, research, international activities, engagement, finances, and facilities by effectively utilizing institutional research across all units. While the new School system transcends traditional borders between academic fields, a competitive environment is ensured by granting the heads of Schools and research institutes discretionary powers to manage their own budgets. Under the leadership of the president, the Human Resources Committee deliberates faculty and instructor needs aligned with the vision of each School or research institute. Domestic experts in the President's Advisory Board, and leading figures in international

academia and business making up the Tokyo Tech Advisory Board, all offer regular advice regarding the development of a university management system on par with global standards.

This new system resembles the structure of, for example, the Office of the Provost at Stanford University. However, to successfully execute Tokyo Tech's Virtuous Cycle, the authority of the management body led by the president also requires further strengthening. Another aspect requiring attention, pointed out by members of the Tokyo Tech Advisory Board, is the need for increased student participation in the management of the Institute.

3.1.5. Financial status

In FY15, Tokyo Tech received approximately USD182 million in management expense grants from the government. The Institute also received roughly USD46.6 million in tuition and fees, and some USD155 million in external funding. In the same fiscal year, the Institute's ratio of external funding (incl. sponsored and collaborative research, grants and gifts, Grants-in-aid for Scientific Research overhead) to total ordinary revenue was the highest among Japanese national universities at approximately 31%. The education and research activities made possible with the government's direct funding, in addition to the economic activity of current students and faculty, had an estimated ripple effect of USD891.5 million on the Japanese economy,⁴ an amount 4.89 times higher than direct government investments for that year. An investment of USD1 therefore produced a return of investment of USD4.89.

To strengthen its financial base, the Institute must effectively implement its Virtuous Cycle to seek and obtain more external funding through joint research activities such as those mentioned in 3.1.3. above, and expand the Tokyo Tech Fund through more active engagement with society.

3.2. Setting goals after self-evaluation

As it strives to realize its long-term goal of "becoming a world-leading science and technology university," Tokyo Tech is "fostering individuals with the ability to view science and technology comprehensively and the enterprise, autonomy, and capacity to excel in the global world." On the research front, "the Institute aims to contribute to the development of industry and the welfare of human beings by examining scientific principles and creating innovative technology while preserving the environment and promoting peace." As suggested in its initial DNU scheme from 2017, Tokyo Tech's goal of "pioneering a new era through continuous dialogue with society and the discovery of hidden possibilities in science and technology" reflects its firm standpoint and commitment as a DNU. The Institute views its third important objective as "confidently taking on the role of a facilitator of science and technology that objectively provides knowledge to the public while co-designing a future vision with society."

Collectively, these goals, together with the actions outlined in this scheme, aim to enhance Tokyo Tech's education and research achievements and evaluations, bringing the Institute augmented global recognition as a top ten science and technology university by 2030, a year shy of its 150th anniversary. Thorough self-evaluation has enabled Tokyo Tech to identify the following goals in pursuit of its comprehensive outcomes.

<Goal 1: Excellence in education and research>

Achieve a top ten position in five fields considered as Tokyo Tech strengths in world university rankings, and generate outstanding knowledge and human resources in interdisciplinary fields that tackle global issues such as clean energy, climate action, and other environmental issues

Although opinions regarding university rankings vary, they remain one indicator of overall quality in education and research at the world's universities. Through the implementation of this scheme and the Virtuous Cycle described in Section 2, Tokyo Tech intends to improve its position in these rankings. While gaining a deeper trust from society and increasing collaboration with industry, the Institute seeks to invest in teaching and learning, research, and international activities that spawn creative ideas and productive professionals of the future. On this basis, Tokyo Tech commits to further strengthening its fundamental education and research activities in all the fields where it excels, continuing to promote fundamental research and forefront scholarship in those fields. As a result, the Institute expects to boost its reputation and citations of its published work to ever higher standards.

Additionally, Tokyo Tech will take full advantage of the permeable academic boundaries in its revitalized

⁴ Calculated based on FY15 internal data, student attributes, consumer behavior predictions, and 2011 industry data from the Ministry of Internal Affairs and Communications.

education system, amplifying interdisciplinary collaboration among faculty in newly established Research Units. By doing so, the Institute will generate knowledge and human resources that will help solve global issues in new fields, issues concerning human and industrial well-being in an advanced cybersociety, issues in life science, clean energy, climate action, and other environmental issues highlighted in the United Nations' SDGs for 2030.

<Goal 2: Societal impact>

Through excellence in education and research, improve graduates' evaluations by society and rank in the top ten in various employability rankings

The most important mission of national universities is to serve society by providing outstanding human resources. The Institute acknowledges that improving the quality of its graduates, as assessed by society, is critical. Although Tokyo Tech's graduates have long been valued by society, the Institute is dedicated to further enhancing the human resources it provides and breaking into the top ten of a number of "world employability" rankings. This mandates developing active contributors who can create new businesses and lead the manufacturing, construction, transportation, and information and communication industries, as well as academic and nonprofit research, by providing a system that encourages proactive learning. Tokyo Tech plans to renew the content of its doctoral programs to ensure that the knowledge and skills of its doctoral graduates more accurately match the needs of society, therefore providing increased value.

<Goal 3: Economic impact>

Create and nurture startups, give birth to innovations and new industries, transfer Tokyo Tech ideas to businesses and the public sector, and increase research funding from industry collaboration fivefold

Another important mission of national universities is the improvement of people's lives through enhanced economic and psychological well-being resulting from idea transfer and innovation creation. In concert with the many companies already enjoying the fruits of Tokyo Tech ideas and innovation, the Institute will continue to strengthen its Research Units, innovate new fields of study and enhanced interdisciplinary collaboration, and further promote an open research environment where emerging faculty members and researchers are encouraged and able to exercise divergent, creative thinking. Tokyo Tech has established a consulting firm to promote idea transfer based on the demands and business models of its partners, enhancing the economic value generated by these companies. Cognizant that new startup companies born of Tokyo Tech's ideas are particularly important in innovation creation and the birth of new industry, the Institute is pursuing organizational collaboration with venture capital firms, has established several gap funds, and aims to launch a startup incubation center to create startup companies and provide them with maximum support as they take root in society.

4. Details of the scheme

When planning detailed initiatives, outcomes, and goals in this scheme, Tokyo Tech has set the achievements of certain leading overseas universities—Georgia Institute of Technology (Georgia Tech), Imperial College London (Imperial), University of California, Berkeley (UC Berkeley), and the entire University of California (UC) system—as benchmarks, while evaluating its own characteristics.

4.1. Outcomes and indicators in relation to six MEXT-specified components to be addressed by DNUs

In order to confidently accomplish the aforementioned goals, Tokyo Tech has set five outcomes and relevant indicators for the period presented in this scheme while taking into consideration the six MEXT-specified components to be addressed by DNUs, namely *acquisition and fostering of human resources*, *strengthening of research capabilities*, *international cooperation*, *collaboration with society*, *strengthening of governance*, and *strengthening of financial base*.

[Development of the scheme over the 4th mid-term goals period]

Tokyo Tech was selected as a DNU on March 20, 2018, and has steadily progressed with the initiatives addressed in this scheme. In January 2022, a hearing was held by the Working Group for Designated National University, Subcommittee for National University Corporations, National University Corporation Evaluation Committee concerning the summary of the 3rd term of mid-term goals and developments planned for the 4th mid-term goals period. As a result, in March 2022, the working group compiled a report on the "development of the Designated National University Corporation scheme over the 4th mid-term goals period."

According to evaluations in the abovementioned report, Tokyo Tech has made progress in all six MEXT-

specified components to be addressed by DNUs. Particularly significant advances were acknowledged in the "acquisition and fostering of human resources" and "collaboration with society." However, points to consider, etc. in order to achieve further rapid, far-reaching progress were also highlighted. Therefore, as described in Section 7, Tokyo Tech has enhanced its "Vision for the future (image of future goals)," and has restructured its original scheme with additional and strengthened initiatives from both human-centric and society-centric perspectives of contributing to the realization of a desirable shared future.

4.1.1. Outcome 1: Reinforce student-centered learning and diversify student and faculty population

(Primary component: *Acquisition and fostering of human resources*, Secondary component: *International cooperation*)

To achieve this outcome, it is imperative that the outstanding graduates of Tokyo Tech are active on a global scale. Students must be equipped with skills that correspond to the careers they envision, which is why the curricula in the Tokyo Tech model—the new education system launched in April 2016—are student-centered, allowing all students to formulate a clear personal vision and learn proactively. This system can be refined further to address the changing needs of a more diverse student population.

With the Tokyo Tech model, the Institute continues to deliver outstanding graduate-level education based on its experience with teaching leadership and broad perspective on global issues gathered through the Program for Leading Graduate Schools. Tokyo Tech also continues to promote teaching through research in attractive interdisciplinary fields and enhanced entrepreneurship training. With the establishment of the Tokyo Tech Academy for Leadership, an Institute-wide platform that produces professional leaders with a rich understanding and appreciation of humanity, Tokyo Tech is developing graduates who possess both highly specialized knowledge and an informed, compassionate vision to lead society into the future.

To provide doctoral students with additional financial support and a more direct career path, increased education in collaboration with industry is required. As confidentiality is essential in highly competitive fields of research, a new thesis defense system has been put in place to accommodate this need, cultivating greater appreciation of, and higher evaluations of, Tokyo Tech graduates by society.

At the undergraduate level, Tokyo Tech's philosophy of proactive learning will be reinforced with the B2D Scheme, which allows motivated students to experience interdisciplinary research at various laboratories from their second year before deciding on an integrated path of rapid progress culminating in a doctoral degree. In the future, the positive effects of this program are also expected to permeate Tokyo Tech's active collaboration with high schools.

As future graduates are expected to play active roles on the world stage, creating an environment where students can engage in friendly competition with others from diverse cultural backgrounds is crucial. Utilizing resources from the Tokyo Tech Fund, a 6,000-square-meter student exchange and support hub has been constructed at a prime location on Ookayama Campus. All graduate-level lectures will be delivered in English, and dual/joint degree programs with leading overseas universities will provide a more engaging system of academic immersion for international students. The establishment of a self-sustaining scholarship for domestic and international students with financial constraints will boost competitiveness and attract outstanding students worldwide. By this strategy, international student ratios are expected to increase to 25%, as is the case at Georgia Tech, one of Tokyo Tech's comparison institutions. To supply faculty who can facilitate such a multicultural, competitive environment, Tokyo Tech aims to invite and employ prominent faculty and researchers from around the world, and eventually increase the ratio of international faculty to 30%, a level again comparable to Georgia Tech. Through these improvements, all students—domestic, international, and those already in work life—will have access to high-quality learning and teaching that correspond to their desired career paths, and graduates of Tokyo Tech can expect higher evaluations from society.

In Japan, the percentage of female researchers working in the industrial sector is comparatively low at approximately 8%,⁵ while the corresponding ratio is 24.5% in the U.S., 20.7% in the U.K., and 14.1% in Germany. Tokyo Tech believes in its capabilities to develop more female researchers in the future, which

⁵ Comparative and analytical study on social systems and human resource development in relevant countries to promote the advancement of women in science and engineering fields, December 2016, Gender Equality Bureau, Cabinet Office (http://www.gender.go.jp/research/kenkyu/riko_comp_research.html).

will contribute to diversification and enhanced vitality in society. Therefore, the Institute aims to increase the percentage of female students from 14.3% in FY16 to 20% by FY30.

Moreover, the percentage of female faculty members at Tokyo Tech was below 10% as of FY16. The corresponding ratio at Georgia Tech was approximately 25%, which clearly suggests that increasing this ratio is a continuing challenge for the Institute. Tokyo Tech's goal remains to promote the activities of women, to reflect more diverse ideas in its education and research, and to boost this percentage to approximately 20% by FY30.

[Development of the scheme over the 4th mid-term goals period]

Tokyo Tech's continuously evolving student-centered education system fosters pioneers of a desirable shared future. In order to develop global trailblazers active in universities, educational and research institutions, and the manufacturing and service industries, but also in broader sectors such as politics, administration, economics, medicine, welfare, international organizations, agriculture, forestry, fisheries, and mass media, the Institute will expand the range of its STEM education by boosting high school-university cooperation while continuing to promote liberal arts and entrepreneurship education across all levels of study. The Institute strives to provide international experience to over 90% of students by the time they complete their master's degree, motivating students to progress to doctoral programs and reinforcing Tokyo Tech's fundamental goal of developing capable, globally-minded professionals. Furthermore, efforts to expand Tokyo Tech's Doctoral Program for World-leading Innovative & Smart Education (WISE), the B2D Scheme, and doctoral program opportunities for working professionals will foster a diverse, motivated student population equipped with an entrepreneurial spirit, as will the development of a system that allows bachelor's program students to learn a variety of specializations and the employment of doctoral students as researchers. By actively promoting these features through the Tokyo Tech ANNEXes and other channels, the Institute confidently aims to recruit outstanding students from countries and regions across the world.

Continuously evolving student-centered learning to foster pioneers of future society

- A1: Recruit outstanding students from around the world
- A2: Increase students with international experience by the end of their master's degree program to at least 90%
- A3: Employ doctoral students as researchers to help kickstart their careers, provide financial support for their tuition
- A4: Innovate science and technology-related entrepreneurship education across the Institute
- A5: Expand access for working professionals into Tokyo Tech's doctoral program
- A6: Cultivate diverse professionals using a mechanism that allows students to learn a variety of specializations
- A7: Expand range of STEM education by utilizing Ookayama Campus as base for high school-university collaboration
- A8: Develop and firmly establish B2D Scheme, Tokyo Tech academies for WISE Programs (Doctoral Programs for World-leading Innovative & Smart Education)

4.1.2. Outcome 2: Enhance global recognition of Tokyo Tech research achievements

(Primary components: *Strengthening of research capabilities, International cooperation*, Secondary component: *Acquisition and fostering of human resources*)

To achieve excellence in education and research, it is essential to improve the reputation of Tokyo Tech's outcomes from an international viewpoint, and to increase citations of research papers published by Tokyo Tech investigators. The Institute can effectively accomplish this by informing the international research community of its activities, and by attracting higher evaluations from a global, mobile pool of human resources.

Through the Tokyo Tech World Research Hub Initiative, the Institute has already established a system promoting interdisciplinary exchange and international joint research by inviting and recruiting several dozen world-leading researchers to IIR. Based on the existing centralized management of posts and increased funding made available through self-sustainability in fundamental education and research activities (Outcome 5), Tokyo Tech plans to invite and recruit more outstanding researchers to innovate new fields of research. Shared research facilities will be increased and technical support by facility staff will be enhanced. Additionally, the Institute aims to sequentially establish six international education and research hubs—Tokyo Tech ANNEXes—overseas by 2030 to further accelerate collaborations with universities and companies abroad. These efforts are expected to boost the ratio of internationally coauthored papers to 50%, a percentage similar to Imperial, and the ratio of research papers in the top 1% cited and top 10% cited to 3% and 20% respectively—figures similar to those of Georgia Tech.

However, in order to truly run alongside the world's most competitive universities, Tokyo Tech cannot simply rely on the activities of its individual faculty members. It must also utilize and strengthen its organizational efforts to communicate a research vision that attracts outstanding researchers and students from around the world. To this end, the Institute has brought to the foreground three priority fields of research—next-generation element strategy, integrated energy science, digital society devices and systems—based on its ingrained strengths to strategically boost research prowess and international visibility (Outcome 2), reinforce the creation and enhancement of Tokyo Tech's outstanding graduate-level education (Outcome 1), and attract large-scale joint research partners (Outcome 4), etc.

[Development of the scheme over the 4th mid-term goals period]

In addition to highlighting the Institute's strengths through the promotion of its priority fields of research, Tokyo Tech intends to make efficient use of the European Research Council (ERC) funding philosophy to allocate stable research funds to select researchers for a certain period of time—without limiting their activities to any particular field—and, as a result, ultimately boost findings in Tokyo Tech's priority fields. The Institute expects these efforts to attract internationally acclaimed researchers and strengthen networks across borders. To ensure the sustainability of leading joint research, Tokyo Tech will support faculty members who embrace a central role in forming international joint research groups, and will foster the next generation of researchers by utilizing the know-how of these world-leading groups. Furthermore, the Institute is committed to maintaining and developing an international network of young researchers by establishing a system that supports joint research with visiting international counterparts even after these researchers have returned to their home countries or regions.

Across the Institute, the focus is firmly set on collaboration and support. On the soon-to-be redeveloped Tamachi Campus, overseas universities will be encouraged to create physical offices and engage in joint education and research, and the startup ecosystem that is planned for the central Tokyo location. In the vicinity of Suzukakedai Campus, a planned shared residence for international students and researchers who can engage in natural exchanges will create an *innovation agora*. Additionally, enhanced cutting-edge research facilities, highly skilled research support staff, and on-demand research support offered by the new Researcher Support Office will all contribute to an increase in the number of world-leading researchers selecting Tokyo Tech as their home base.

Rigorous investigation and formulation of academic principles in pursuit of the truth

- R1: Advance priority fields of research, deepen and open up new future-oriented strategic areas of research
- R2: Attract acclaimed researchers and boost level of basic research by providing research support that makes efficient use of European Research Council (ERC) funding philosophy
- R6: Establish joint research funding program for international students and researchers after their return to home countries/regions
- R7: Promote joint research and formation of global research groups

Enhanced support for Tokyo Tech's global researchers

- P1: Encourage establishment of Tamachi Campus offices by overseas universities
- P2: Prepare shared residence for international students and researchers in Suzukakedai Campus vicinity to facilitate regular natural exchanges
- P3: Enhance and share cutting-edge research facilities, attract and develop highly skilled research support staff
- P4: Provide on-demand research support via Researcher Support Office

4.1.3. Outcome 3: Opening up new, interdisciplinary fields of research

(Primary component: *Strengthening of research capabilities*, Secondary component: *Acquisition and fostering of human resources, collaboration with society*)

To achieve Tokyo Tech's goals of excellence in education, excellence in research, and sustained societal and economic impact, Tokyo Tech intends to open up new and interdisciplinary fields, while effectively informing the world of these advancements.

Nobel Prizes in the natural sciences have historically been awarded to investigators for work they conducted in their late 20s and 30s.⁶ To promote an environment that enables and encourages divergent,

⁶ FY16 MEXT White Paper on Science and Technology
(http://www.mext.go.jp/b_menu/hakusho/html/hpaa201601/detail/1371168.htm).

creating thinking, Tokyo Tech will exempt emerging researchers and faculty from teaching duties for three months each year, and will provide startup support to further promote the opening up of new and interdisciplinary fields. Additionally, on the basis of Tokyo Tech's fixed-term, annual salary system for all assistant professors hired after April 2015, the Institute plans to increase the number of assistant professors by 10%, later employing those with excellent performance as associate professors through a tenure track system. The Institute's Research Units are teams of top researchers headed by outstanding leaders focusing on new and emerging fields and earning international accolades. Recent global acknowledgements of Tokyo Tech's groundbreaking contributions include the 2016 Nobel Prize for Physiology or Medicine, awarded to Honorary Professor Yoshinori Ohsumi, and the 2016 Japan Prize, awarded to Institute Professor Hideo Hosono. The Institute remains dedicated to providing continued support to these faculty members and others engaged in cross-disciplinary collaboration in the form of increased research funding, space, and new faculty posts. Through these efforts, Tokyo Tech aims to establish 15 Research Units sustained through external funding, thereby achieving a per faculty figure comparable to UC Berkeley, one of our comparison institutions. These Research Units can be further developed and combined into research hubs focusing on new and interdisciplinary research.

In order to achieve excellence on par with world-leading institutions, strategic, simultaneous efforts to develop new areas other than the priority fields of research set in Outcome 2 are essential. With this in mind, Tokyo Tech has also set three strategic areas—Cyber Physical & Social Systems (CPS²), Sustainable Social Infrastructure (SSI), and Holistic Life Science (HLS)—at the top of its agenda. With the individual academic activities of some of Tokyo Tech's outstanding faculty members at their core, these efforts aim to open up new scholarly fields and, in the medium to long term, spearhead world-leading research in areas which the Institute considers as its strengths. In addition to creating new Research Units based on its strategic areas, Tokyo Tech will utilize the Laboratory for Design of Social Innovation in Global Networks (DLab), a platform established directly under the president, to formulate a vision of future society together with the public and create concepts for academic fields in which it can lead the world together with researchers and experts from inside and outside the Institute. These efforts will help Tokyo Tech formulate new strategic areas in the future.

[Development of the scheme over the 4th mid-term goals period]

By fully utilizing its fundamental research capabilities and extensive research support system, including on-demand research support by the aforementioned Researcher Support Office, Tokyo Tech aims to deepen its basic research, research in priority fields, and research in strategic areas. Regarding basic research, the Institute will continue to support research that adopts a long-term perspective by allocating stable research funds to select researchers for a certain period of time. The "Soaring Young Faculty & Staff Project" at the Organization for Fundamental Research aim to open doors to international collaboration by allowing young researchers to spend time at Tokyo Tech's ANNEXes, etc.

For next-generation science and technology fields strategically selected to accelerate the realization of a desirable shared future, Tokyo Tech will establish a research center where leading principal investigators and young researchers will fully devote themselves to closed research in their respective fields, and where technology will be fostered under a system through which research findings and intellectual property are managed strictly. To ensure the sustainability of high-quality international joint research, young researchers will be developed by their internationally acclaimed counterparts, and industry collaborations and intellectual property strategies will be systematically managed, contributing to the long-term reinforcement of Tokyo Tech's financial base. IIR will mainly manage Tokyo Tech's Research Units and Collaborative Research Clusters, and expanding Research Units will be further developed into Research Centers and Research Laboratories. This kind of organizational expansion will help to develop Tokyo Tech's research capabilities further, and will contribute to a stronger, more stable financial base.

Rigorous investigation and formulation of academic principles in pursuit of the truth

- R1: Advance priority fields of research, deepen and open up new future-oriented strategic areas of research
- R2: Attract acclaimed researchers and boost level of basic research by providing research support that makes efficient use of European Research Council (ERC) funding philosophy
- R3: Establish a research center for closed research in strategically selected fields
- R4: Develop young researcher talent and personnel flexibility at Organization for Fundamental Research
- R5: Establish financial independence at Institute of Innovative Research and self-sustaining Research Units

4.1.4. Outcome 4: Strengthen engagement through idea transfer from new fields

(Primary component: *Collaboration with society*)

To implement Tokyo Tech's Virtuous Cycle (Figure 1), the graduates and ideas coming from the Institute need to receive higher evaluations from both the academic and non-academic communities worldwide. Tokyo Tech will improve these evaluations through the efforts mentioned under Outcomes 1, 2, and 3. In addition, the Tokyo Tech Professional Academy will be fundamentally reinforced by reforming Tokyo Tech's personnel system, which will include use of external funding for research personnel costs and a renewed cross-appointment system, and by utilizing the marketing function of Tokyo Tech Innovation Co., Ltd. (TTI), the Institute's external consulting firm discussed below. As a result, the Institute aims to increase the number of lectures in non-degree and recurrent programs to 50 per year. Based on the initiatives highlighted under Outcome 1, Tokyo Tech will construct a mechanism to more deeply involve industry in the Institute's doctoral education programs, providing working professionals with more opportunities to obtain a doctorate. Collectively, these efforts will communicate the Institute's quality in education and research—Tokyo Tech Quality—to a broader audience, and will propel Tokyo Tech towards recognition as a world-leading innovation hub.

Therefore, while being highly aware of the need to avoid institutional conflicts of interest, as described in more detail in Section 4.5., Tokyo Tech will significantly expand its collaborative research activities with industry and actively promote idea transfer to the private and public sectors. While aiming at the establishment of new, interdisciplinary fields and global recognition of achievements in these fields (Outcomes 2 and 3), Tokyo Tech has externally established TTI, a consulting firm that will help match Tokyo Tech ideas with the demands of businesses and the public.

Additionally, the implementation of the Strategic Collaboration Research Scheme will categorize research according to aspects such as competitiveness and confidentiality, and will provide a clear framework for the management of intellectual property, direct and indirect costs, and overhead costs to facilitate large-scale joint research. Regulations regarding the compensation of faculty involved in such research based on experience and ability will also be put in place. The positioning of TTI as a research contracting agency will help avoid institutional conflicts of interest. With these activities, Tokyo Tech confidently aims to increase the revenue gained from collaborative research with industry fivefold to USD71.6 million per annum, a figure that rivals comparison institution Georgia Tech. Assuming that other external funding remains constant, a fivefold increase in income from industry would correspond to 33% of all external funding at Tokyo Tech. This is comparable to target figures at Imperial, Tokyo Tech's comparison institution in the UK, which aimed to obtain 30% of research funding from industry by 2020.⁷

Tokyo Tech is taking various steps to ensure that its ideas are transferred to create new industries. Organizational collaboration with venture capital firms began in FY16, and a gap fund has been established to support the creation of prototypes that can then be translated into real-world applications. TTI will provide consulting when required so that startups by Tokyo Tech researchers and students get the push they need, and entrepreneurship training will be strengthened to raise awareness among students. Through these efforts, the Institute plans to increase Tokyo Tech-rooted startups 1.6-fold from 61 to 100 companies, attaining the desired per faculty member level when comparing itself to the UC system, another one of Tokyo Tech's benchmarks. To help these startups take root in society, the Innovation design Platform (IdP), modeled partly after the Advanced Technology Development Center (ATDC), a startup incubator at Georgia Tech, has been established to help at least 10 new companies, or 25%, achieve an initial public offering.

Based on the Institute's third important objective of "confidently taking on the role of a facilitator of science and technology that objectively provides knowledge to the public while co-designing a future vision with society," a role that was established in line with Tokyo Tech's goal of pioneering a new era through continuous dialogue with society and the discovery of hidden possibilities in science and technology, Tokyo Tech is adjusting its position in society and reconstructing its communications and branding/image strategy. A key component of this process is DLab, which currently consists of approximately 30 members, including various Tokyo Tech alumni and professionals from within and outside the Institute as collaborators. This sounding board allows DLab members and the public to work together in examining and proposing links between science and technology and a brighter future society. More specifically,

⁷ Imperial College London Strategy 2015-2020 (<https://www.imperial.ac.uk/media/imperial-college/about/leadership-and-strategy/public/Strategy2015-2020.pdf>).

DLab draws up a vision of future society after thorough discussions with the public, shares this vision widely both at home and overseas, and proposes what kind of science and technology is required to realize this future vision. By backcasting from this future vision to the present, Tokyo Tech can design new academic disciplines required to realize the vision proposed by DLab, and can reflect these disciplines in its research activities, including in the formulation of strategic areas of research. DLab activities are also connected to educational initiatives at Tokyo Tech, allowing the Institute to share information with the world from the perspective of science and technology education while maintaining a close link with the public.

[Development of the scheme over the 4th mid-term goals period]

Amidst its efforts to transfer ideas to the public from its priority fields, the Institute has established the Tokyo Tech Green Transformation Initiative (GXI) under the broader scope of integrated energy science. GXI brings Tokyo Tech together with dozens of partner companies to conduct research and development with the aim of realizing a carbon-free society. The AI Computing Research Unit, Nano Sensing Unit, and VCSEL Photonics Unit are at the heart of applied research in the field of digital society devices and systems. In the field of next-generation element strategy, the transfer of Tokyo Tech ideas is also progressing steadily, not least with semiconducting material indium gallium zinc oxide (IGZO), which is being utilized as a transparent conductive electrode in displays across the globe.

Tokyo Tech is also spearheading efforts to transfer ideas and develop a startup ecosystem centered on the fields of deep tech and real tech, which are considered the Institute's strengths. Collaborative efforts are bearing fruit at the Startup Ecosystem – Tokyo Consortium via the Greater Tokyo Innovation Ecosystem (GTIE), which is led by Tokyo Tech, to construct a startup community together with other universities, research institutions, companies, and local governments. Tokyo Tech is also working together with venture capital firms and startup accelerators to provide more support for the creation of startup companies, and is actively developing a deep tech/real tech start ecosystem in the Asia-Pacific market. In the future, Tokyo Tech plans to establish a tech-oriented business school to foster a new type of management personnel who can create and promote business models from seeds while collaborating with researchers. In addition, the Institute is working actively to enhance advanced continuing education in growing fields. These efforts will lead to strengthened support for large-scale incubation facilities on Tamachi Campus, which will open for use in 2030.

In order to realize the shared desirable future envisioned at DLab, the research capabilities of the organization will be enhanced with the establishment of a dedicated future design research center. This center will promote sustainability research for the global environment, society, and industry by linking the social sciences and natural sciences, and science and technology and the business sciences, as shown in Figure 2. Related researchers will be united through the aforementioned GXI with the goal of achieving a carbon-neutral society. In addition, after further internal organization, Tokyo Tech plans to establish a multidisciplinary resilience research center that responds rapidly and flexibly to urgent societal issues such as disasters, epidemics, and other destructive phenomena.

Open collaboration and innovation with the public to create new industries

- I1: Develop priority fields of research and the transfer of ideas from these fields to society
- I2: Continuously develop the Open Innovation Platform
- I3: Promote collaborations with universities and venture capital firms in conjunction with Startup Ecosystem – Tokyo Consortium, create materials and informatics-focused science and technology startups
- I4: Establish tech-oriented business school to enhance training of entrepreneurs
- I5: Enrich high-quality continuing education, including in growing fields

Uncovering and solving societal issues

- S1: Establish future design research center to boost research capabilities of DLab, promote responsible research and innovation, design education, and entrepreneurship research through a continuum of social and natural sciences, science and technology, and business sciences
- S2: Establish multidisciplinary resilience research center to respond flexibly to pressing societal issues
- S3: Unite energy-related researchers through Tokyo Tech Green Transformation Initiative which aims for a carbon-neutral society

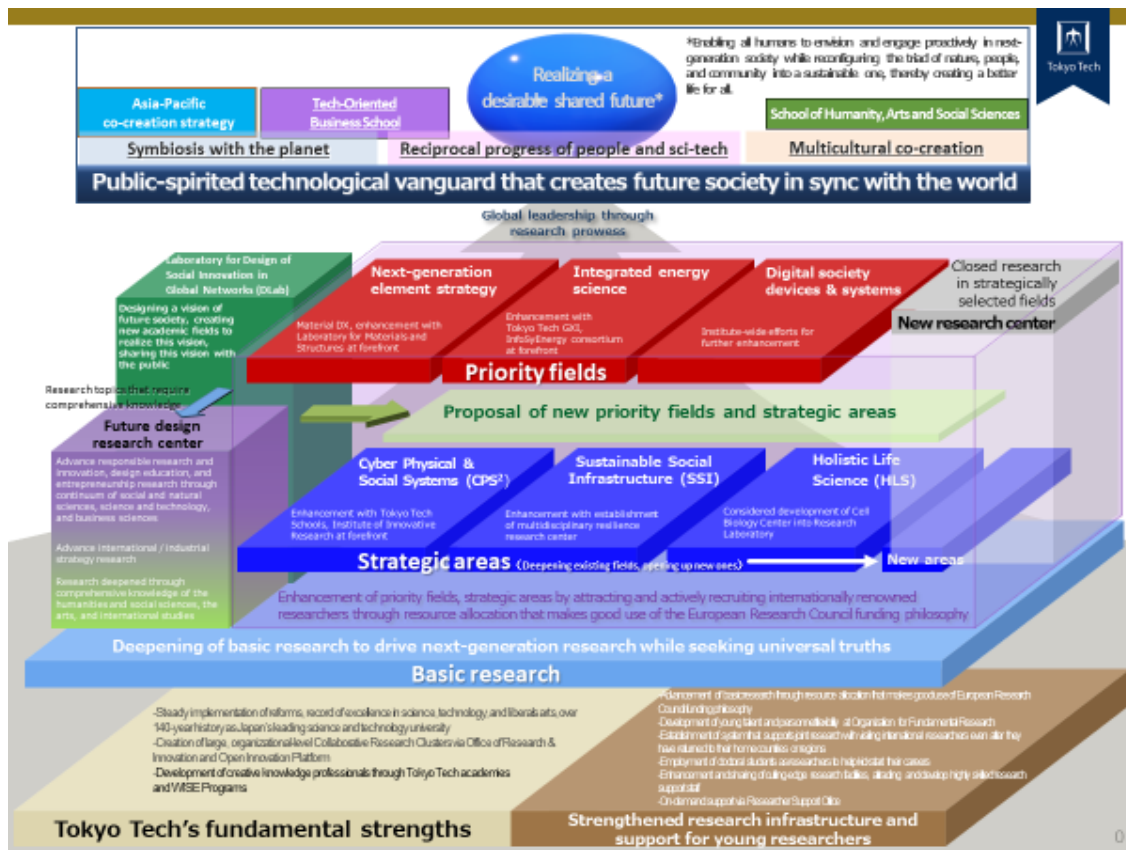


Figure. 2 Overview of Tokyo Tech's efforts to strengthen its research capabilities

4.1.5. Outcome 5: Achieve self-sustainability in fundamental education and research activities (Primary component: *Strengthening governance, strengthening of financial base*)

To keep Tokyo Tech's Virtuous Cycle (Figure 1) in motion, and autonomously develop Tokyo Tech's fundamental education and research activities and the professional staff who support them, simply acquiring resources from increased engagement (Outcome 4) is not sufficient. The Institute must also effectively utilize its campus resources and strengthen its financial base by expanding the Tokyo Tech Fund, etc. and the effects of resulting revenue. Therefore, the establishment of a university management system that facilitates appropriate strategic resource allocation is required. In creating such a system, it is important to delegate partial authority for education and research-related matters to suitable persons as instructed by the president. This allows the president to focus on strengthening Tokyo Tech's management capabilities, and to avoid concerns regarding the potential impact of his engagement activities on teaching and learning (i.e. institutional conflicts of interest).

To this end, Tokyo Tech is taking advantage of its unique position among Japanese national universities to implement a world-standard university governance system—a president-provost system—that is compliant with the rules and regulations governing Japanese national universities. In addition to the promotion of Tokyo Tech education, research, and international collaboration, the body supervised by the provost is tasked with the management of faculty efforts and other personnel factors tied to external funding use and cross-appointments, as well as the planning of student participation in the Institute's management. The management body—under the leadership of the president and secretary-general—will ensure strategic resource allocation and efficient management across the Institute, strengthen community engagement, public relations, and communications, and—under the guidance of the chief financial officer (CFO)—expand the Tokyo Tech Fund and devise strategies for campus asset management.

To expand the Tokyo Tech Fund, the Institute will collaborate with the Tokyo Tech Alumni Association to carry out strategic fundraising activities. While considering fundraising expense ratios (approx. 9%), the Institute plans to invest approximately USD1.7 million annually in professional staff and other assets to significantly expand its fundraising activities and obtain gift revenue of roughly USD8.5 million to USD17 million annually. While investing portions of this revenue into the development of Tokyo Tech education and research, the Institute aims to expand the Tokyo Tech Fund fourfold to USD127 million, a figure that

corresponds to gift revenue per faculty member within the UC system. A central figure in these efforts is the president—the face of the Institute—who is taking the lead in strengthening ties with alumni both at home and abroad, reigniting their affection for their alma mater, and as a result, increasing cooperation with these graduates in both financial and non-financial ways. Tokyo Tech is gradually increasing the programs and areas of support that are of value to individuals and companies that may be willing to give. By utilizing its alumni network and the results of its collaboration with industry, Tokyo Tech is developing its gift solicitation activities while gradually increasing the number of fundraisers to achieve its fundraising goals.

Tokyo Tech has also increased tuition in line with the ordinance of the Ministry of Education, Culture, Sports, Science and Technology. This newly acquired revenue will be used to enhance Tokyo Tech's environment for high-quality education and to upgrade educational content.

Based on the comprehensive policy for Tokyo Tech's three campuses, established in 2015, Tokyo Tech High School of Science and Technology, which is located on Tamachi Campus, will be relocated to Ookayama Campus, allowing the Institute to strengthen high school-university cooperation and collectively optimize the use of its premises. This move will maximize the land area that can be leased to third parties on Tamachi Campus, generating an estimated annual income of USD8.47 million per year and strengthening the Institute's financial base. The redevelopment of Tamachi Campus will also actively incorporate proposals from the private sector. Through these efforts, Tokyo Tech aims to secure more space for collaborations with other universities, industry-university-government cooperation, and joint international initiatives, and to create an attractive hub for deeper engagement, global business incubation and research, etc.

[Development of the scheme over the 4th mid-term goals period]

The additional income of USD8.47 million per year from land leases on Tamachi Campus was an estimate made in 2017 when Tokyo Tech's initial DNU scheme was created. However, after signing business agreements with selected business partners in February 2021, Tokyo Tech is now on track to securing USD38.1 million in annual income for 75 years starting in 2026. The Institute intends to utilize this funding by investing more heavily in the people who gather at Tokyo Tech, in the environment with the help of university bonds, and, if deregulation and other conditions allow it, confidently aims to boost the balance of the Tokyo Tech Fund to USD424 million (JPY50 billion). To realize operational transformations that strengthen Tokyo Tech's management base, the Institute is striving to clarify and visualize its operations further, share knowledge openly, and apply accumulated knowledge by making full use of digital technology. In addition, it aims to optimize the allocation of all personnel, invest in their expertise, actively increase the number of highly specialized staff, and provide stronger support for the career development of all employees with the aim of enhancing the productivity and well-being of researchers, faculty, and staff.

In terms of its Environmental, Social, and Governance (ESG) strategy, Tokyo Tech aims to promote diversity, inclusion, and the well-being of all its members (S/G) under an enhanced governance system and the leadership of the president (E/S/G). The Institute aims to increase the ratio of female board members to 30% or more by 2024. As a campus strategy, Tokyo Tech will establish the Cross-Campus Innovation Ecosystem (E/S/G) to create synergy at home while promoting the creation of a global campus that effectively incorporates Tokyo Tech ANNEXes, Thailand Advanced Institute of Science and Technology (TAIST)-Tokyo Tech, etc. (S). In terms of facilities, the Institute will strive to work towards carbon neutrality on its campuses (E). To support these campus investments, a CFO-led Office of Finance and Facilities will be established to achieve sustainable growth, and to execute strategy formulation and efficient allocation of funds (G). In addition, a strategy to enhance Tokyo Tech's presence led by the executive vice president in charge of communications, fundraising, local engagement, and alumni relations (S/G) will be implemented to gain stronger support from society.

Solid management base to sustain excellence in education and research

- G1: Utilize mobility of funds from issuance of university bonds, Tamachi Campus Redevelopment Project, etc. to secure long-term, stable funding sources
- G2: Launch initiatives that aim to boost the Tokyo Institute of Technology Fund balance to JPY50 billion
- G3: Increase the number of highly specialized staff, redefine faculty and staff roles, and provide strong career development support
- G4: Advance transformation efforts by visualizing operations and openly sharing knowledge

Comprehensive ESG approach to create synergies

- C1: Enhance leadership of president and governance system (E/S/G)
- C2: Create Cross-Campus Innovation Ecosystem (E/S/G)
- C3: Establish new Office of Finance and Facilities, execute CFO-led strategy to realize continuous growth (G)
- C4: Execute strategy to enhance Tokyo Tech presence led by executive vice president in charge of communications, fundraising, local engagement, alumni relations (S/G)
- C5: Promote diversity, inclusion, and well-being, and boost ratio of female board members to 30% or more by 2024 (S/G)
- C6: Create a global campus that effectively incorporates Tokyo Tech ANNEXes, TAIST, and other overseas connections (S)
- C7: Strive to create carbon-neutral campuses (E)

4.2. Tokyo Tech's path to success

Against the backdrop of strengthened governance and finances highlighted under Outcome 5, Tokyo Tech aims to accomplish three long-term goals, as mentioned above, through the achievement of the outcomes it has set.

<Goal 1: Excellence in education and research>

Achieve a top ten position in five fields considered as Tokyo Tech strengths in world university rankings, and generate outstanding knowledge and human resources in interdisciplinary fields that tackle global issues such as clean energy, climate action, and other environmental issues

By improving the reputation of Tokyo Tech education and attracting diverse, outstanding students and faculty through reinforced student-centered learning (Outcome 1), by growing the number of international students and faculty, and by increasing the output of internationally coauthored papers and papers in the top 1% cited through enhanced international joint research (Outcome 2), Tokyo Tech aims to achieve top ten evaluations in several fields considered to be its strengths. New frontiers of learning, teaching, and research that meet the needs of Japanese society and tackle various issues addressed in the SDGs of the United Nations—clean energy, climate action, and other environmental issues—will be established by further strengthening the activities of the Institute's Research Units (Outcome 3), and by continuing to provide an open environment where emerging researchers are encouraged and able to engage in divergent, imaginative, and creative thinking.

The transfer of ideas from fields in which Tokyo Tech engages will lead to increased income from collaborative research with industry and increased gift revenue (Outcomes 4 and 5), portions of which will be invested into the further expansion of the Institute's education, research, and international activities. This will ensure the continuity of Tokyo Tech's Virtuous Cycle and the excellence of Tokyo Tech's education and research.

<Goal 2: Societal impact>

Through excellence in education and research, improve graduates' evaluations by society and rank in the top ten in various employability rankings

Tokyo Tech's efforts to achieve this goal are based primarily on the achievement of two concrete outcomes. Through reinforced student-centered learning and a more diverse population of outstanding students and faculty (Outcome 1), and interdisciplinary education and research with international industry partners at Tokyo Tech ANNEXes (as highlighted under Outcome 2), Tokyo Tech graduates can expect improved evaluations by society and a boost in the Institute's position in various employability rankings.

To solidify Tokyo Tech's financial base and further improve the new Tokyo Tech model of education, launched in FY16, the Institute decided to implement a tuition increase in FY19. This additional revenue will be utilized to further improve both the environment and content of Tokyo Tech learning and teaching. Additional revenue obtained from collaborative research with industry and gifts (as highlighted in Outcomes 4 and 5) will be used to form a self-sustaining scholarship system for domestic and international students with financial constraints, and graduate-level students will be recruited as research assistants (RAs) in collaborative research with industry, providing increased financial support for students.

<Goal 3: Economic impact>

Create and nurture startups, give birth to innovations and new industries, transfer Tokyo Tech ideas to businesses and the public sector, and increase research funding from industry collaboration

fivefold

By strengthening engagement through idea transfer from new fields (Outcome 4), Tokyo Tech can improve and increase the number of lectures it delivers through non-degree and recurrent programs, leading to increased access, trust, and confidence from society. Against the backdrop of this confidence and its outstanding track record in practical science, the Institute can fundamentally reform its collaborative research framework while taking into consideration potential institutional conflicts of interest. Tokyo Tech is confident that this will significantly boost the Institute's idea transfer to businesses and the public, and will eventually enable a fivefold increase in revenue from collaboration with industry. A comprehensive support system for startups will ensure that this idea transfer leads to the creation of new industries.

4.3. Managing the progress of initiatives

The aforementioned initiatives are all organically related and carried out in progressive steps. The Tokyo Tech scheme is temporally divided into three terms, with progress of initiatives managed correspondingly in Phases 1 through 3. Figure 3 shows the targets for each term.

Tokyo Tech's DNU scheme will be implemented steadily in line with the separately attached National University Corporation Tokyo Institute of Technology Designated National University Corporation scheme schedule under the guidance of the Strategic Management Council, which is chaired by the president. Progress will also be reported periodically to Tokyo Tech's Management Committee, which includes both Tokyo Tech members and external experts and professionals.

[Development of the scheme over the 4th mid-term goals period]

While giving due consideration to the comments from the Management Committee and the advice from the Tokyo Tech Advisory Board, Tokyo Tech will also share a summary of the progress of this scheme in the Tokyo Institute of Technology Integrated Report, which will be published from FY21 onwards. The current status of the Institute's education, research, management, and finances, as well as a roadmap for its rapid and far-reaching progress, will be shared with industry players, students, and other stakeholders, and Tokyo Tech will continue to move forward with initiatives while taking into consideration opinions obtained through dialogue with the public.

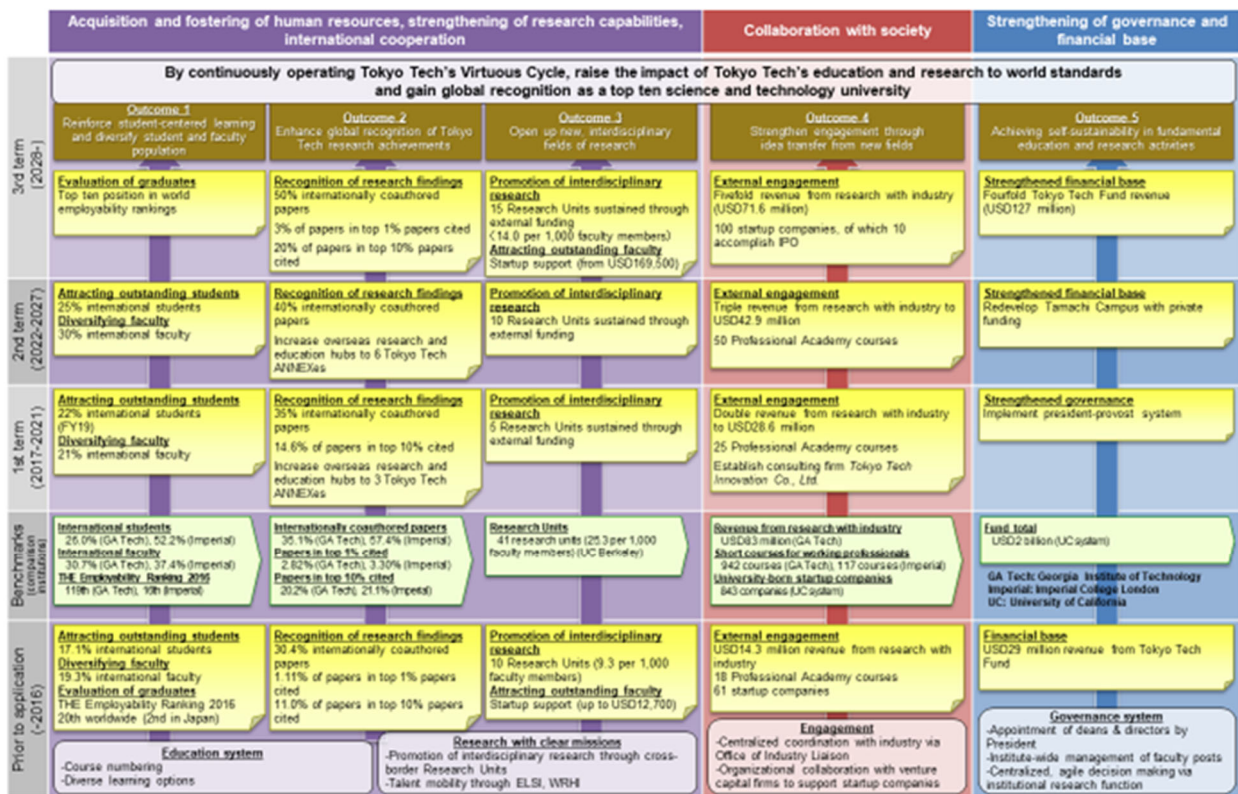


Figure 3. Tokyo Tech initiatives and indicators by term

4.4. Scale and feasibility of scheme

The outcomes of Tokyo Tech's outstanding education and research are the driving force that powers the Institute's Virtuous Cycle, and the extent to which these outcomes can be magnified is the key to the cycle's success. One of the central themes in this scheme is the expansion of Tokyo Tech's fundamental education, research, and international activities through the establishment of a designated fund using gift revenue, overhead made available from reforms to collaborative research with industry, and portions of income made available through land utilization on Tamachi Campus from 2026 onwards. As of the third term of this scheme, the scale of various new activities is as follows.

- Development of infrastructure for education and research in new academic fields and interdisciplinary areas, including management, for DLab, Organization for Fundamental Research, Tokyo Tech ANNEXes: USD4.24 million/year
- Securing outstanding faculty members / researchers who will lead new academic fields and interdisciplinary areas: 20 areas totaling USD6.78 million ((Faculty personnel costs USD169,000 + research costs USD169,000) x 20 areas)
- Faculty and staff personnel costs for business school, continuing education, strengthened community engagement: USD1.69 million (USD85,000 x 20 people)
- Self-sustaining scholarships for home and international students in need of financial aid, portions of research assistant and teaching assistant hiring costs: USD4.24 million/year
- Strengthening of institutional research and other university management infrastructure: USD1.19 million/year
- Personnel costs for highly skilled staff: USD1.69 million (USD83,000 x 20 people)

Additional income from Tokyo Tech's tuition increase (approx. USD6.78 million/year) will be used to enhance the environment for high-quality education and to upgrade educational content. By improving the quality of education and research cumulatively every year on this scale, Tokyo Tech is confident about achieving its initial objectives within the expected time frame.

[Development of the scheme over the 4th mid-term goals period]

Furthermore, Tokyo Tech will utilize the issuance of university bonds and construct a Cross-Campus Innovation Ecosystem to help create a suitable environment for generating new innovations. If the conditions allow it, Tokyo Tech will use the income generated to further boost the Tokyo Tech Fund and make strategic investments to achieve sustainable, long-term growth.

4.5. Avoiding institutional conflicts of interest

Tokyo Tech is a national university that receives significant amounts of operating funds from the government. The Institute creates knowledge and human resources, which are released to the public domain. New value is born from the Institute's educational and research outcomes and the active graduates they produce, with returns making their way back to the government in the form of paid taxes. Tokyo Tech is both highly devoted to, and aware of, its role as a public good provider, and constantly seeks to improve on this front. It also seeks to increase the societal impact of its education and research, and therefore aims to invest revenue from large, full-scale collaborative research with industry into the development of new fields of study and interdisciplinary cohorts. Through such collaborations, faculty and researchers are directly committed to private good research and development, and to the companies involved, potentially raising concerns regarding institutional conflicts of interest. The Institute needs to not only earn deeper trust and confidence from the public, but also must construct an appropriate management system to avoid such conflicts.

While disseminating its outstanding education and research achievements to the public and obtaining their understanding, Tokyo Tech has taken advantage of a world-standard governance system—a system that the Institute is a unique position among national universities to implement—to externally establish TTI. TTI will act as a research contracting agency, and to ensure transparency, will be clearly detached from the body determining the participation of faculty, researchers, and students in collaborative research—that being the executive management of Tokyo Tech. Based on reforms to the personnel system, roles of researchers in large-scale collaborative research contracted by TTI will be distinguished from university positions with a cross-appointment system, clarifying distinctions between the national university's public good activities and collaborative research with industry.

5. Positive effects of deregulation

The aforementioned efforts and initiatives have been planned according to current laws and regulations. Should deregulation occur, however, Tokyo Tech's efforts could be further enhanced and optimized. The content of this potential deregulation is described below.

5.1. Responding agilely to changes in students' intellectual curiosity: Excluding transfer students from department capacities (Standards for Establishment of Universities, Article 18, Measures to avoid exceeding department capacities)

Currently at Japanese national universities, admission capacity is specified for each department (or School at Tokyo Tech), meaning the number of students transferring between departments is also limited. Should deregulation allow the exemption of transfer students from department capacities, or apply limits on university-wide capacity only, Tokyo Tech could more agilely respond to the wishes and needs of all students, and better execute its concept of student-centered learning. Increased student mobility would not only enhance the quality of education through increased competition between Schools and departments, but would also allow Tokyo Tech to more dynamically review internal education and research structures based on the needs of students and society.

5.2. Creating a global environment through active enrollment of international students: Excluding privately funded international students from admission capacity (Standards for Establishment of Universities, Article 18, Measures to avoid exceeding department capacities)

Under current regulations, both privately funded international students and Japanese students are included in admission capacity, meaning that attracting more outstanding international students would reduce the number of Japanese students accepted into the Institute. For a national university, this decrease would be difficult to justify to the public. On the premise of preserving the quality of education, should regulations be relaxed to exclude privately funded international students from official admission capacity figures, Tokyo Tech could make strategic decisions on both admission capacity based on tuition revenue and educational efficiency based on student-faculty ratios, much like the world's leading universities do.⁸ DNUs looking to transcend domestic frameworks and achieve the standards of leading overseas universities would benefit from moving towards this policy.

5.3. Doctoral programs in collaboration with industry: Publication of doctoral theses (Degree Regulations, Article 9)

The doctoral programs Tokyo Tech aims to provide in collaboration with industry will involve research proposed by industry, and research to transfer the ideas of students and faculty members to the non-academic community, some of which may be carried out jointly with companies and other entities. In such cases, issues of intellectual property and non-disclosure are likely to arise. According to current Degree Regulations, a doctoral graduate must make public their complete doctoral thesis within one year of degree conferral. As described in Article 9 Paragraph 2, exceptions are made in case of "unavoidable circumstances," but the graduate may still have to disclose the thesis in full should such a request be made by the public. Furthermore, "unavoidable circumstances" are limited to legal restrictions such as copyright, personal information, or patent right issues. Exceptions are made rarely for "know-how" or other knowledge that is not classified as intellectual property, but *is considered extremely valuable*, particularly in science and engineering fields. As a result, technical knowledge in doctoral theses cannot be protected under the current regulations as desired by industry.

This remains a contentious issue. However, if "unavoidable circumstances" were redefined to explicitly include know-how and other content deemed unsuitable for disclosure, and if certain portions of theses could remain undisclosed for a certain period of time, doctoral students in programs planned in collaboration with industry would not only become more aware of the important link between their research and the world, but could also more efficiently provide cutting-edge solutions to societal problems. In turn, this would rapidly improve the evaluations of graduates by society and make Tokyo Tech idea transfer more effective.

6. Conclusion

Through the successful execution of this scheme, Tokyo Tech aims to raise its educational and research achievements and evaluations to the most competitive of world standards, and as a result gain global

⁸ University of California Budget for Current Operations 2016-2017 (http://ucop.edu/operating-budget/_files/rbudget/2016-17budgetforcurrentoperations.pdf), 62.

recognition among the top ten science and technology universities by 2030, a year shy of the Institute's 150th anniversary. To fully understand university management at the world's leading universities and determine what the Institute is aiming for, Tokyo Tech has spent several years establishing benchmarks with the help of top management from the UC system, Georgia Tech, Imperial College London, the University of Melbourne, and Nanyang Technological University, while candidly exchanging opinions on the management practices of national universities to discern the best direction for the Institute.

Universities, science and technology, and society itself are constantly undergoing rapid change. It is therefore likely that societal issues, forefront disciplines, and the Institute's approaches will also change. While being highly aware of this, Tokyo Tech is committed to, and united in, working towards its goals. In addition to the new education and research systems launched in April 2016, the Institute's long-term vision for 2030 was deliberated and agreed upon at numerous workshops involving management, deans, directors, faculty, staff, and students, where the opening statement of this scheme was born. By taking full advantage of the Institute's unique characteristics—its unity, its compactness, its agile decision-making ability, its vanguard of diverse students, faculty, and staff, and most importantly, its shared vision to create the future—Tokyo Tech will flexibly respond to any challenge as required by the times.

7. Vision for the future (image of future goals)

Tokyo Tech has utilized the development of its DNU scheme for the 4th mid-term goals period as an opportunity to consider the goals to be achieved by 2050. As a result of these open discussions, the Institute envisions itself as a “public-spirited technological vanguard that creates future society in sync with the world”⁹ in the near future.

By confidently executing its DNU scheme, Tokyo Tech will continue to refine cutting-edge science and technology through its priority fields and strategic areas, and will continue to share its world-leading research findings with the world. Through DLab, the Institute will create new strategic areas by backcasting from a future vision formulated together with society. To ensure the progress of these initiatives, the promotion of basic research, and the strengthening of support for young researchers, Tokyo Tech will establish a strong financial base by taking advantage of fund mobility provided by the issuance of university bonds and the Tamachi Campus Redevelopment Project. The Institute will attract outstanding researchers from around the world by effectively allocating resources in a manner that makes good use of the ERC funding philosophy. Through these efforts and well-structured Diversity, Equity and Inclusion (DEI) initiatives, Tokyo Tech will develop into a World-Class University that creates new knowledge and generates solutions to global issues while working in unity with the world.

Tokyo Tech's long-term vision aims at “realizing a desirable shared future.” In its quest to move closer to this vision, the Institute has set the three following goals.

1. **Symbiosis with the planet** - Realizing a carbon-neutral society
2. **Reciprocal progress of people and sci-tech** - Creating science and technology for human well-being
3. **Multicultural co-creation** - Designing and sharing a diverse, boundaryless future together

In order to advance towards these global goals, Tokyo Tech will continue to enhance its reciprocal, public-spirited approach to contribute to Japan, the world, and universities, institutions, and other partners at home and abroad. Through its core competencies of deep tech and real tech, and the active promotion of diversity, equity, and inclusion at the heart of this plan, the Institute will continue to forge synergistic effects based on alliances with research universities that share these intentions. As a unique entity in sync with like-minded universities and other collaborators, Tokyo Tech will design and create a better future together with the public by fostering diverse, leading professionals and opening up new academic fields with its worldwide partners.

⁹ Tokyo Tech's public-spirited existence involves not only growth of the Institute itself, but also careful consideration and determined actions that help advance other universities and sustainably develop broader society and the natural environment.