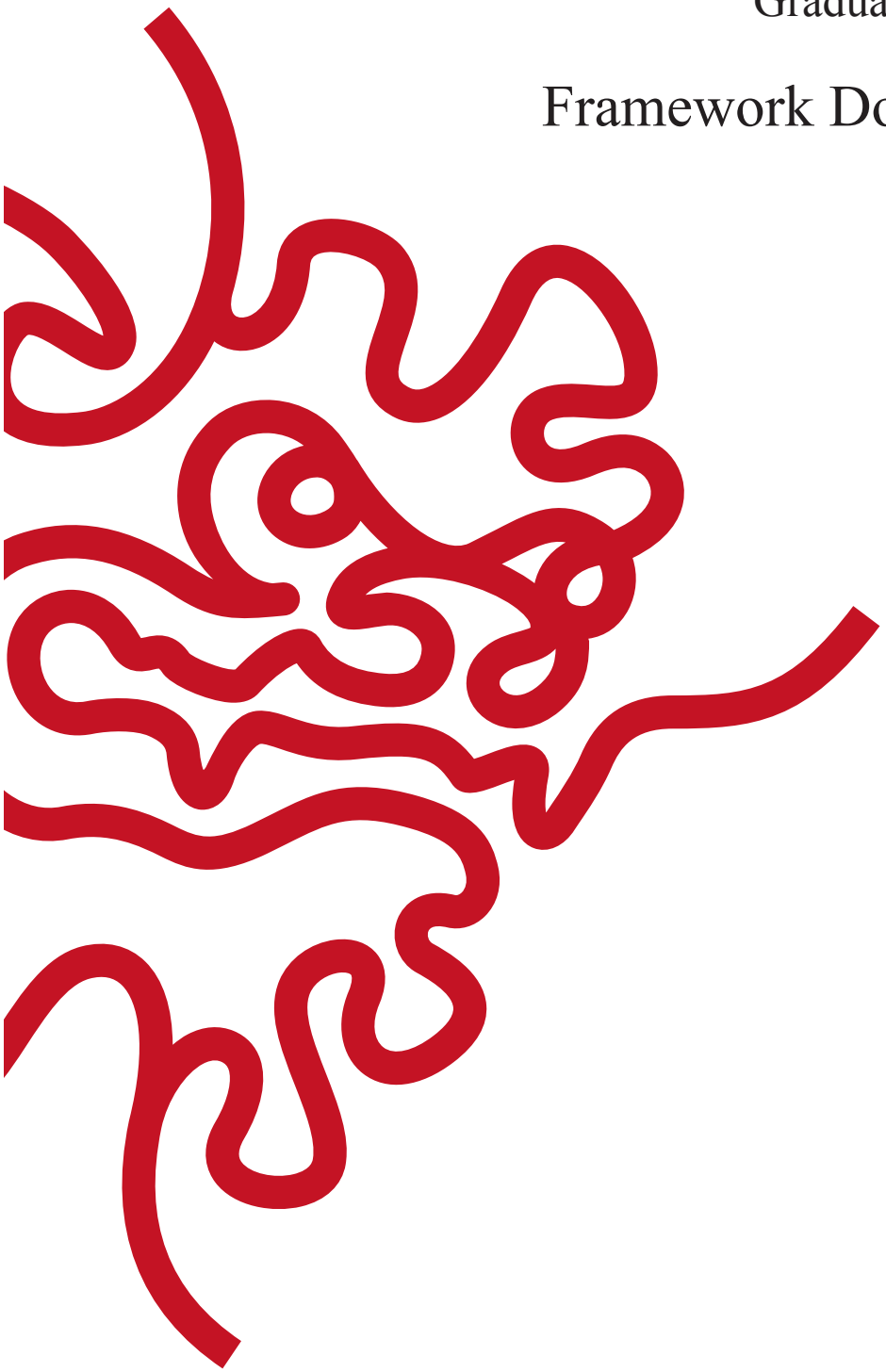
Okinawa Institute of Science & Technology
Graduate University

Framework Document II

July, 2014



OIST OKINAWA INSTITUTE OF SCIENCE AND TECHNOLOGY
GRADUATE UNIVERSITY

Table of Contents

Executive Summary 1

Chapter 1. Vision, Foundational Concepts, Legal Basis, and Governance 2

1.1 Objectives and Aspirations of the University 2

1.2 Basic Concepts that Underpin the University 3

1.3 Institutional Legal Basis and Governance 4

1.3.1 OIST School Corporation Act and Private Schools Act *4*

1.3.2 Autonomous Oversight by the BOG and BOC *4*

Board of Governors *4*

Board of Councilors *6*

1.3.3 Organizational Chart *7*

Business Plan *9*

Organization Performance Review *10*

Chapter 2. Current Status of OIST Graduate University 11

2.1 Research and Education 11

2.1.1 Current Status of Research at OIST *11*

2.1.2 Current Status of Graduate Education *15*

2.1.3 Faculty and Academic Organization *17*

2.1.4 Support Structures for Research Programs *19*

2.2 Physical Infrastructure 21

2.2.1 General Site Status and Conditions *21*

2.2.2 Upper Campus *23*

2.2.3 Lower Campus and Village Zone *26*

2.2.4 Seaside House and Faculty Houses *27*

2.3 Financial/Business Status 29

2.3.1 Budget: Subsidy Funding *29*

Annual budget planning and budget requests *29*

2.3.2 Budget: Procurement and supplies *31*

2.3.3 Budget: PPP Funding *32*

2.3.4 Budget: External Funding *33*

Activities of Sponsored Research Section *33*

Activity of the Business Development and Technology Licensing Sections *34*

Donations *35*

2.3.5 Budget: FY2013 Spending by Division *35*

2.3.6 Business Development *36*

Business development and collaboration with industry *36*

Dedicated resources *37*

Outreach activities for business development *37*

Entrepreneurship *39*

2.3.7 Development of an Intellectual Property Portfolio *40*

Building a portfolio of intellectual property to share with commercial partners. *40*

Contractual and legal support 42
2.3.8 Sponsored Research **43**
Responsibilities of the Sponsored Research Section 43
Activity of the Business Development Section in sponsored research 45
2.4 Administration and other Support Functions **46**
Executive Leadership and Administration 46
Governance 46
2.5 Welfare Functions **48**
2.6 Current Achievements as Measured Against the Primary Mission Goals **49**
2.6.1 Leading-edge Science, Technology, and Education **49**
Leading-edge Science and Technology 49
International Networking 52
Workshops 52
Innovative Education 53
International Program 53
Independent Student Research 54
Interdisciplinary 55
2.6.2 Sustainable Development of Okinawa **55**
Timeline and Milestones 55
Startup 56
Establishing the patenting procedures 56
Intellectual Property management system 57
Maturing Patents 57
Marketing and Networking 57
Motivating OIST researchers and local talent toward commercialization 57
Campus Visits 58
Academic Programs 58
Cultural Programs 58
2.6.3 A Great Impact on Japanese Universities **59**
International 59
Interdisciplinary 60
Leading management style 61
Chapter 3. Expansion of the Graduate University **62**
3.1 Expansion of OIST Graduate University: A Compelling Need **62**
3.2 Development of an Intellectual & Industrial Cluster **70**
3.2.1. Technology Transfer and Development: Putting Innovation to Practice **70**
Short-term (FY2014-FY2015) Build R&D infrastructure, services, and networks 70
Medium term (FY2020) Develop OIST incubator and expand applied R&D research capability in Okinawa 71
Long term (FY2025 and beyond) Develop Fully Equipped Technology Transfer Center 72
3.2.2. Technology Transfer **72**
Short term (FY2014-FY2015) Implement policies and procedures covering

inventions, patents, copyrights, and other intellectual property (IP) 72
Build a network of external IP experts 73
Create a visible structure for business development 73
Medium term: (FY2020) Explore feasibility of spinning out technology transfer functions 73
Network with other business development organizations 73
Long term (FY2025 and beyond) Recruit industry research sponsors 74
3.2.3 Regional Strategic Development **74**
Short term (FY2014-FY2015) Create an R&D cluster Promotion Organization 74
Develop tools to measure the socio-economic impact of S&T innovation 74
Medium term (FY2020) Assume leading stakeholder role in guiding the efforts of the R&D cluster Promotion Organization 75
Long term (FY2025 and beyond) Network with other emerging centers of innovation in Okinawa 75
Attract large Japanese and multinational corporations to locate R&D in Okinawa 75
3.2.4. Entrepreneurship **76**
Short term (FY2014-FY2015) Promote entrepreneurial events, competitions and educational programs 76
Formulate guidelines and incentives for staff participation in entrepreneurial activities 76
Accumulate "intraprenurial" support mechanisms 76
Medium term (FY2020) Build an OIST business park and incubator facility on or near campus 76
Partner with the University of Ryukyus to develop a joint entrepreneurship education program 77
Pilot test a university-managed venture capital fund 77
Long term (FY2025 and beyond) Set up an "OIST Innovation Venture Fund" 77
3.3 Areas of Scientific & Technology Emphasis for OIST Graduate University **80**
3.3.1 In the Next 10 years (~ 100 Faculty) **80**
3.3.2 Toward the Final Growth Phase (~300 Faculty) **85**
3.4 Evolution of the Graduate Education Program **87**
3.4.1 Quantitative aspects **88**
3.5 Physical Infrastructure Needs **89**
3.5.1 Education and Academic **89**
3.5.2 Research **89**
3.5.3 Administration **91**
3.5.4 Technology Transfer, Incubation, and Industry Collaboration **92**
3.5.5 Housing for Short-term Visitors, including a Guest House **94**
Guest House 94
Users Office 94
3.5.6 Welfare Support, including Recreation **95**
3.5.7 Education of OIST Children **95**
3.5.8 Housing for University Employees and Students **95**

3.5.9 Site Modifications to Support the Items Above *97*
Chapter 4. Construction and Operational Budget Estimates **100**
4.1 Construction Timeline and Associated Budget Estimate **100**
4.1.1 Implementation Timeline for construction (by function) *100*
4.2 Estimation of Near-term Funding Needs, Including Construction Funds **104**
Chapter 5. Anticipated Achievements of the Next Decade **108**

Executive Summary

In November, 2003, a document outlining, "The Proposed Framework of the University" was published. It established the structure and major aims of a new Graduate University in Okinawa.

Barely a decade later, this report, Framework Document II, reviews the progress made since the publication of the first Framework Document, takes stock of the current state of the University, and anticipates its continued growth and development.

The central vision expressed in the 2003 Framework Document was:

"*The new university will be a graduate university in science and technology that will conduct and provide "best-in-the-world" quality research and doctoral education with an emphasis on integrative work.*

The University aims to:

- *Contribute to the advancement of science and technology in the world*
- *Make Okinawa into the leading intellectual cluster of the Asia-Pacific region*
- *Make the University a "success story" and provide a model for the reform of Japanese universities.*"

OIST has, by all measures, been very successful in the first phase of realizing this vision. All the critical elements that comprise a mature research and educational institution have been put in place and are operating effectively. The University has achieved its initial goals while insisting on excellence as the standard for all its endeavors.

Yet as successful as OIST Graduate University has been, the limitations of its current size are already apparent and it is time to begin the process of expanding the University. This expansion can be undertaken with confidence, knowing that the base from which the University will grow is fully formed.

Accordingly, Framework Document II is divided into 5 Chapters. Chapters 1 and 2 describe in detail the current state of OIST Graduate University and some of its accomplishments to date, whereas Chapters 3, 4, and 5 cover future planning.

Framework Document II was first presented to the OIST Board of Governors during its meeting in Okinawa in May, 2014.

Okinawa
June, 2014

Chapter 1. Vision, Foundational Concepts, Legal Basis, and Governance

1.1 Objectives and Aspirations of the University

The Okinawa Institute of Science and Technology Graduate University (OIST) aspires to become one of the world's premier research universities within its first decade of operations. OIST's mandate is to achieve excellence in research and science education so as to meet global challenges for which science and technology can provide solutions. It further aspires to be a catalyst for the economic renaissance of Okinawa and all of Japan.

To achieve these aspirations, OIST must support both basic and applied research in fields ranging from physics and chemistry to genomics, cell biology, neurobiology, and ecology. The level of excellence that OIST expects to attain can only be accomplished by interdisciplinary and collaborative approaches. To facilitate such efforts, OIST intersperses research units without regard to scientific specialty. Faculty members and other research personnel are expected to collaborate among themselves and with counterparts throughout the world, to contribute to science and technology globally. Likewise OIST graduate students spend one of three compulsory rotations in fields other than those in which they desire to work, hopefully enabling them to cross disciplines and to solve complex problems more readily than students trained more narrowly in traditional departments.

Its exceptional facilities notwithstanding, OIST recognizes that its human capital is its most valuable resource. OIST embraces all cultures, giving capable scientists the same opportunities to succeed without regard to social demographics. While OIST is already international, with 41 nations represented among its faculty and staff, and 23 among its students, it seeks to become more inclusive still, as large sections of the globe are still poorly represented. To live up to its ideals, OIST must develop young scientists not only intellectually, but also socially and ethically. OIST strives to create an environment in which all feel valued and are supported in reaching their individual potentials.

OIST hopes to become everything virtuous and praiseworthy that any research university could possibly attain. It has an almost unprecedented opportunity to achieve the academic equivalent of Camelot. Its physical location, high above the turquoise and sapphire waters of the East China Sea is spectacular. It has exceptional economic support from the Japanese Government. Its existing physical facilities are superbly designed, and other key structures, engineered to the same high standard, are under construction. Equipment is state-of-the art and research funding is exceptional. These attributes provide the most fertile environment possible for scientific creativity to flourish. In the original plan for the OIST Promotion Corporation, the Board of Governors proposed to expand OIST from its current 48 professors to 300. While this plan greatly expands existing opportunities, it also presents great risks. To actually accomplish its lofty, espoused goals on a vastly larger scale, more than rhetoric will be required. If OIST is to fulfill its mandate to achieve the zenith of research and graduate education, it must earn and maintain the public trust, and its productivity must be as exceptional as its generous funding. Each phase in its growth and development must be executed without losing sight of its ideals for the sake of short-term political expediencies.

What will OIST become? This document articulates its vision and plans for the future.

1.2 Basic Concepts that Underpin the University

Essential attributes of OIST include:

- World-class, in science and scholarship
- Cutting-edge
- Interdisciplinary
- International
- Globally networked
- Flexible

At OIST, education and research are conducted entirely in English, although it functions administratively in both English and Japanese. The five-year academic program is customized for each student through a flexible curriculum that includes three laboratory rotations. These occur in the first year and expose students to at least one field outside their preferred disciplines. Through its unique Ph.D. program, OIST Graduate University hopes to provide the next generation of scientists and researchers with the ability to think creatively, reason scientifically, and collaborate effectively across traditional academic boundaries. OIST does not have departments and its interdisciplinary research spans a range of scientific fields, including life sciences, physical sciences, chemistry, and mathematics. At 4 pm on Thursdays, an open teatime brings the OIST community together. In the ensuing cacophony, new projects and partnerships are conceived across disciplines and between laboratories. This weekly event symbolizes many of OIST's core values.

A new Okinawa development policy was implemented by the Japanese government in FY2012. In addition, the Government's "Basic Policies for Economic and Fiscal Management and Reform" call for development of an R&D cluster in Okinawa, in which OIST will play an important role. OIST Graduate University will promote Okinawa's self-sustaining development through strong academia-industry-government partnerships to achieve one of the objectives stipulated in the OIST SC Act. In addition, OIST will work closely with academic institutions in Okinawa, such as the University of the Ryukyus and the Okinawa National College of Technology. Also, OIST will continue to enhance collaboration and communication with the local community and local schools to develop the OIST campus as a center for cultural and community activities.

Echoing Okinawa's historical status, carved on the bell at the Ryukyu Kingdom's Shuri castle, OIST endeavors to restore Okinawa as "Bankoku Shinryo," "a bridge between nations," by recruiting and educating excellent scientists without regard to nation or culture and sending them throughout the world.

1.3 Institutional Legal Basis and Governance

As a Japanese educational institution, established with special legislation, and supported by Japanese taxpayers, the University is required to meet the highest level of transparency and accountability to the general public.

1.3.1 OIST School Corporation Act and Private Schools Act

In June 2001, former Minister of State for Okinawa and Northern Territories Affairs and Minister of State for Science and Technology Policy, Koji Omi, first announced a plan to establish a new international graduate university in Okinawa.

On September 1, 2005, the Okinawa Institute of Science and Technology Promotion Corporation (OIST PC) was established by an Act of the Diet. It received legal status as an Independent Administrative Institution, in order to prepare the way for an international graduate university dedicated to science and technology, pursuant to the Independent Administrative Institution Okinawa Institute of Science and Technology Promotion Corporation Act (Act No. 26 of 2005).

Following the successful establishment and operation of OIST PC, the OIST School Corporation Act (Act No. 76 of 2009) was enacted on July 10, 2009, to provide the corporate and institutional basis for the University and to establish a framework for transitioning from a research institute to a fully functioning graduate university. The Private Schools Act (Act No. 270 of December 15, 1949) was officially designated as the governing legal structure by the passage of the OIST SC Act.

On November 1, 2011, in recognition of the autonomy and the management flexibility of the school, the Okinawa Institute of Science & Technology School Corporation (OIST SC) received accreditation from the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) to establish an independent school corporation to operate OIST Graduate University. In accordance with Chapter II, Article 4 of the Bylaws of OIST School Corporation, the graduate educational institution was named the "Okinawa Institute of Science & Technology Graduate University."

1.3.2 Autonomous Oversight by the BOG and BOC

Board of Governors

In compliance with the mandate of the OIST School Corporation Act, OIST School Corporation (OIST SC) and OIST Graduate University (University) present a unified management structure. Ultimate authority and responsibility for management and operation of OIST SC are vested in its Board of Governors (BOG). The BOG consists of world-renowned scientists and high-level professionals.

The BOG is comprised of no more than 20 and no fewer than 10 Governors, including the President/CEO and the Provost/Vice CEO. The BOG includes a majority of members who are not officers or employees of OIST SC at the time of appointment. The Chairman and Vice Chairman are elected by the Governors, excluding the President and Provost.

BOG meetings comprise two types: Regular and Extraordinary. Regular meetings are convened in May, September, and February every year, and Extraordinary meetings are convened as necessary. All BOG meetings are called and chaired by the Chairman.

In particular, the BOG makes decisions on items concerning management and operation of OIST SC and the University, pursuant to OIST SC Bylaws and Rules of Operation for the BOG, including:

- *Determination of management policy and determination or amendment of corporation activities*
- *Appointment and dismissal of Governors*
- *Nomination and dismissal of Auditors*
- *Appointment and dismissal of the President and the Provost*

  The BOG selects a CEO for OIST SC who also serves as President of the University. The President nominates, and the BOG appoints, a Provost for the University, who also serves as Vice CEO of OIST SC. Additionally, Vice Presidents of the University are nominated by the President and approved by the BOG.
- *Appointment and dismissal of Councilors*
- *Establishment and revision or abolition of Bylaws and rules for management of OIST SC and the University established by OIST SC*
- *Merger or dissolution of OIST SC*
- *Establishment, revision, or abolition of the Graduate School*
- *Important items regarding the organization, career ladders, human resources management, salary, and working conditions of OIST SC*
- *Business plans, budget plans, and financial plans*

Each fiscal year, the BOG is required to review and approve the annual budget and the Business Plan for OIST SC prepared by the President, Provost, and Vice Presidents, in consultation with University faculty and staff members. The BOG also oversees budget execution of OIST SC and decides budget allocation.

- *Acceptance of new obligations and releases of rights outside the budget prescribed in the Article 33 of the Bylaws*
- *Loans*
- *Restrictions on disposal of important assets*
- *Institutional performance and settlement of accounts*
- *Items regarding solicitation of donations in money or in kind*
- *Other items upon which the CEO has requested the judgment of the BOG.*

Except for items prescribed above, the BOG delegates decision-making regarding operations of OIST SC, to the CEO.

The BOG establishes the following standing committees: Steering, Business and Finance, Research and Academics, Audit and Compliance. The Steering Committee is chaired by the Chairman of the BOG, while the President/CEO and the Provost/Vice CEO attend the Committee as ex officio members. The responsibility of the Committee is to expedite obligations of the BOG. The Business and Financial Committee is responsible for business and financial policies of the University, including review of long-term planning, capital expenditures budgets, annual operating budgets, building project cost estimates, and investments. The Research and Academics Committee has responsibility for reviewing

research and academic affairs, including selection and promotion of faculty members. The Audit and Compliance Committee has powers and duties with respect to financial statements of the University, internal and external audits, risk management, compliance, reporting, and other matters as specified.

Board of Councilors

The BOC provides opinions to Governors and Auditors regarding the state of OIST SC's operations and assets, and the execution of operations by the Governors and Auditors. It also responds to inquiries from Governors and Auditors, and solicits reports from Governors and Auditors.

The Board of Councilors (BOC) is comprised of no more than 41 and no fewer than 21 Councilors, including the CEO and Vice CEO. The BOC Chairman and Vice Chairman are selected by the BOG from the BOC membership, excluding members of the BOC who are executives of OIST. Councilors are also selected and appointed by the BOG, pursuant to the OIST SC Bylaws. Councilors serve for three years, subject to reappointment.

The BOC must prepare opinions and reports on the following matters and submit them to the President/CEO before every BOG meeting:

- *handling of budgets and loans, disposal of endowment assets, and disposal of real estate and reserve funds that are operating assets*
- *operations plans*
- *acceptance of new obligations or release of rights outside the budget*
- *changes to the Bylaws*
- *mergers*
- *dissolution caused by inability to achieve OIST SC's target purposes*
- *items regarding solicitation of donations in money or in kind*
- *other important items regarding OIST SC's operations as deemed necessary by the BOG*

1.3.3 Organizational Chart

In keeping with the mandate of the OIST School Corporation Act, OIST SC and the University present a unified management structure (Figure 1.3.3.1).

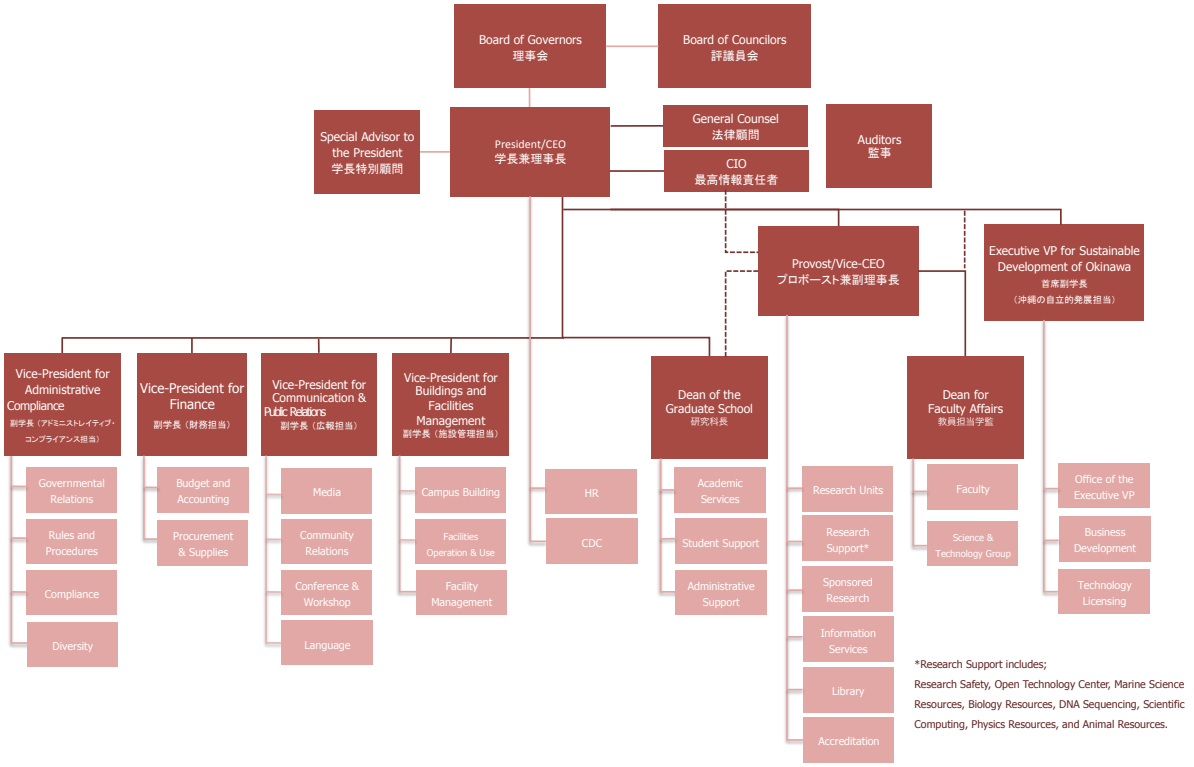


Figure 1.3.3.1. OIST Graduate University Organization, 20 July, 2014.

The Officers of the Corporation consist of: the CEO, the Vice-CEO and the Auditors. The Corporation presently operates only one entity, the Graduate University. The President/CEO, in consultation with the BOG, establishes a management structure for the University. The managers that populate these positions are tasked with effectively and efficiently executing the mission of the University. The managers also must ensure administrative and fiscal accountability and provide transparent oversight regarding the use of government and private funds. The organizational chart for the Corporation and the University reflects their two core mission elements: research and education, and sustainable development of Okinawa.

The Provost's Office oversees all elements of the research program, including individual research unit budgets, sponsored research, and extensive research support services (including information services). Each research unit is headed by a faculty member. While the Faculty Affairs Office handles recruitment, promotion, and collective actions of faculty members, the hiring and administration of research unit personnel is the responsibility of the Provost. The research program is by far the largest budgetary element of the University, which places very large financial and personnel management responsibilities upon the Provost.

Graduate students are admitted into the Graduate School, which, under the leadership of the Dean, is responsible for all aspects of student life at OIST. This includes recruitment of students, curriculum and teaching, research rotations, placement of students in research units

(including thesis proposal preparation and advancement to candidacy), and evaluation of the thesis as a requirement for the Ph.D.

As head of the Office for Sustainable Development of Okinawa, the Executive Vice President is responsibility for the mission of transforming research innovation into economic development of Okinawa, including the development of an R&D Cluster. Key elements that support this mission are technology transfer and business development. Technology transfer involves the stewardship and protection of intellectual property, licensing of intellectual assets, and guiding the interactions between university R&D operations and the industrial entities that seek to commercialize innovation assets developed by the University. Business development involves establishing relationships with local, national, and international industries and academic partners, implementation of agreements with industrial partners, the creation of start-up companies or similar spin-offs spawned by OIST, and the raising of funds that support all of these objectives.

The Vice President for Administrative Compliance bears the critical responsibility to ensure that all University administrative functions conform to the applicable national laws and regulations, as well as to University Policies, Rules, and Procedures (PRP). The Office of Administrative Compliance is the interface with government ministries, most importantly CAO and MEXT. Administrative Compliance administers the internal audit and oversees the diversity policy.

The Vice President for Finance is responsible for the key administrative functions of budget, accounting and procurement.

The Vice President for Communication and Public Relations (CPR) oversees all internal and external communications, community and academic outreach, visitors to the campus, and the scientific workshop program. CPR provides CAO with information and communication materials that support CAO's interface with the Diet, other ministries, and the public. CPR handles translation services for the University and operates a professional training program for science-writing interns.

The Vice President for Buildings and Facility Management is responsible for all aspects of construction and for operation and maintenance of all OIST facilities.

1.3.4 Budget Cycle, Business Plan and Performance Review

Annual Budget Cycle

OIST SC's fiscal year runs from April 1 to March 31 (Table 1.3.4.1).

April	Start preparing Budget Request draft
May	Presentation of Budget Request draft to the BOG (as required)
June	Communication with the Cabinet Office (CAO)
July	Submission of Budget Request from OIST to the CAO Approval of ceiling for Budget Request and budget (quota)
August	Submission of budget request from CAO to the Ministry of Finance (MOF)
September October November	Communication with MOF
December	Notification of the MOF & CAO Budget Plan for OIST (draft)
	Approval of Budget Plan (draft) by the Cabinet
January	Start preparing Business Plan draft
February	Presentation and confirmation of Budget draft to the BOG Negotiation for approval of Business Plan draft from CAO and MOF
March	Approval of Business Plan by CAO and MOF

Table 1.3.4.1. The OIST budget cycle.

Business Plan

Every fiscal year, the President works with other executive officers of the University to compile and propose the annual Business Plan. The Business Plan is prepared to promote the autonomous development of Okinawa and is compatible with comprehensive plans for economic promotion and social development in Okinawa. Based on the Bylaws of OIST SC, Article 9, the draft Business Plan is submitted to the BOC for its review and to the BOG for final approval. Pursuant to Article 9, the Business Plan is then submitted to the Prime Minister for approval before the commencement of each fiscal year. The Government provides financial support to OIST SC on the condition that OIST SC implements the approved Business Plan appropriately.

The Business Plan is composed of the following five chapters, in accordance with the Cabinet Office Ordinance (Ordinance for enforcement of the OIST school Corporation Act (Cabinet Office Ordinance No. 59 of 2011)):

Chapter 1. Education and research
Chapter 2. Governmental and administrative transparency and efficiency
Chapter 3. Finance
Chapter 4. Contribution to self-sustainable development of Okinawa
Chapter 5. University campus and community development; safety and environmental protection.

Each chapter has subchapters consisting of goals and a list of action items to achieve the vision described, as follows:

- *Excellence in research*
- *Best opportunities for students*
- *Contribution to enhancing the competitiveness of Okinawa and Japan*
- *High flexibility, efficiency, and transparency.*

For successful implementation of the Business Plan, the BOG is responsible for overseeing its implementation by the President, while the President is responsible for executing daily operations and reporting the implementation status of the Business Plan to the BOG. In addition, the Auditors of OIST SC conduct independent and rigorous auditing of every aspect of operations.

Organization Performance Review

A high level of transparency is a statutory requirement for OIST SC. OIST SC is responsible to implement the Business Plan, to comply with pertinent laws and regulations, and to demonstrate accountability to the general public.

Organizational performance is reviewed within 2 months of the end of each fiscal year. The review, in the form of a Performance Report containing goals, actions, metrics, and achievements, is prepared by the University as the result of an extensive self-audit, as measured against the expectations of the Business Plan. The review is reported to and evaluated by the BOG and BOC at the Regular Board Meeting held in May, shortly after the close of the fiscal year. After the Performance Report and the associated letter grades are ratified by the BOG, the Report is provided to the CAO.

Performance evaluation results are utilized in planning and in executing business for the next several years. To ensure transparency, the Business Report and the Performance Report are posted on the OIST public web site by the end of the first quarter of the new fiscal year.

Chapter 2. Current Status of OIST Graduate University

2.1 Research and Education

2.1.1 Current Status of Research at OIST

OIST has established an extraordinary research facility in a remarkably short time. There are 48 active research units, each directed by a faculty member, and more than 360 researchers, including students, postdocs, and technicians. Many research areas are represented, including cell biology, neurobiology, developmental biology, evolutionary biology, genomics, structural biology, and systems biology in the life sciences; and in the physical sciences, nanotechnology, novel 2D materials and heterostructures, organic and inorganic functional materials, interface science, photocatalytic and energy materials, quantum optics, quantum materials, and surface science. Two world-class research laboratories have been completed and equipped with excellent instrumentation. Faculty members and researchers have been recruited from leading laboratories around the world.

All this was created in an environment in Okinawa that had limited ability to support cutting edge research on this scale. The buildings and facilities had to be built and staffed far from urban centers usually associated with research-intensive institutions.

But the effort has been successful. In the last year, nearly 150 refereed articles were published in international scientific journals and more that 260 presentations were made at scientific conferences and symposia. Many articles attracted attention from the research community and scientific press. Over 20 patent applications were filed. It is important to recognize, however, that most of the research units are still not functioning at full capacity. Twenty-four research units have existed only for 1-3 years, 10 from 4-6 years, 10 from 7-9 and only 2 for 10 years. Because the Graduate University is only in its second academic year, only two of the five graduate classes that will comprise the fully operational university have been admitted to date. Furthermore, postdoctoral recruiting is only now starting to expand with a full Postdoctoral Scholarship program.

Key characteristics of the OIST environment envisioned in the original Framework Document were the lack of borders between research areas and emphasis on interdisciplinary interactions. The open, integrated design of the laboratory buildings, the lack of departmental administrative boundaries, and an emphasis on shared equipment and resources have created an environment and support structures that arguably are unique in their effectiveness in promoting the crossing of traditional disciplinary borders. With the arrival of the students and initiation of the student laboratory rotation program, another powerful driver of cross-disciplinary interactions has blossomed. The students now are an independent catalyst for communication between research units. It important to emphasize that at OIST, cross-disciplinary studies cover the extreme range from quantum mechanics to behavior, and genetics to robotics. This expansion of range has not occurred at the expense of strength in core expertise. OIST's faculty members and researchers have knowledge and experience in their specific areas of research equal to those of leaders in traditional fields at other universities.

Arguably, however, the most novel and powerful success in the OIST research environment is the integration of experimental and theoretical approaches in a manner that transcends disciplinary perspectives. The immediacy of combining outstanding experimental access with sophisticated theoretical analysis has enabled a new level of insight and discovery. At OIST, experimentalists have access to sophisticated analysis and interpretation of their results, and theoreticians can guide and design experiments to provide the data they need without the familiar barriers of space, administration, and social isolation that normally impede the melding of experimental measurement with theoretical understanding.

But does this remarkable opportunity to cross traditional disciplinary borders at OIST actually produce the anticipated synergism, combining experimental data and theory from different fields, so as to yield new breakthroughs? Figure 2.1.1.1 clearly illustrates the high degree of interconnectedness of OIST faculty members and underscores the extent to which cross-disciplinary science is now occurring at OIST. Despite OIST's short existence, important scientific insights are already reflected in many high-impact publications (Table 2.1.1.1), and the development of novel applications is manifested in many successful patent applications (Table 2.1.1.1).

Examples include:

1. Neuroscience. Investigations have ranged from control of cell-specific neuronal gene expression, neuronal signal transduction, pharmacological modulation, subcellular structural specialization in axons and dendrites, anatomical connectivity in the brain, development of the nervous system, degeneration, regeneration, therapeutic design, animal and human behavior, decision making, computational analysis, modeling, and robotics. As this list confirms, the field of neuroscience is itself fundamentally multidisciplinary. Collaboration of neuroscientists with physicists has led to new methods of analyzing neuronal structure, and importantly of modifying neuronal function by introducing therapeutics with localized and controlled release.

2. Marine and environmental science. Sequencing at OIST of the genome of the most common Okinawan coral species and its associated symbiotic microbial partner has provided a basis to understand the massive environmental crises impacting corals worldwide. Analysis of current flows in the Okinawan and Ryukyu marine environment, carried out in cooperation with the Japan Coast Guard, has begun to explain relationships in the distribution of both oceanographic and biological factors of the local marine environment. The Okinawa Coastal Ocean Observatory System, created by OIST in cooperation with Woods Hole Oceanographic Institution, provides new capability to collect simultaneously, in real time, a wide range of physical, biological, acoustic, and image data on a coral reef during the full range of weather-related, biological, and environmental perturbations. A similar system of terrestrial environmental monitors is now being assembled and installed in Okinawa under OIST's scientific direction.

3. Biological and physical structure. In both biological systems and condensed matter science, new understanding of properties and function of molecular structure at the single-molecule level have been provided by state-of-the-art optical and electron microscopic facilities, including both "cryo" and "environmental" transmission

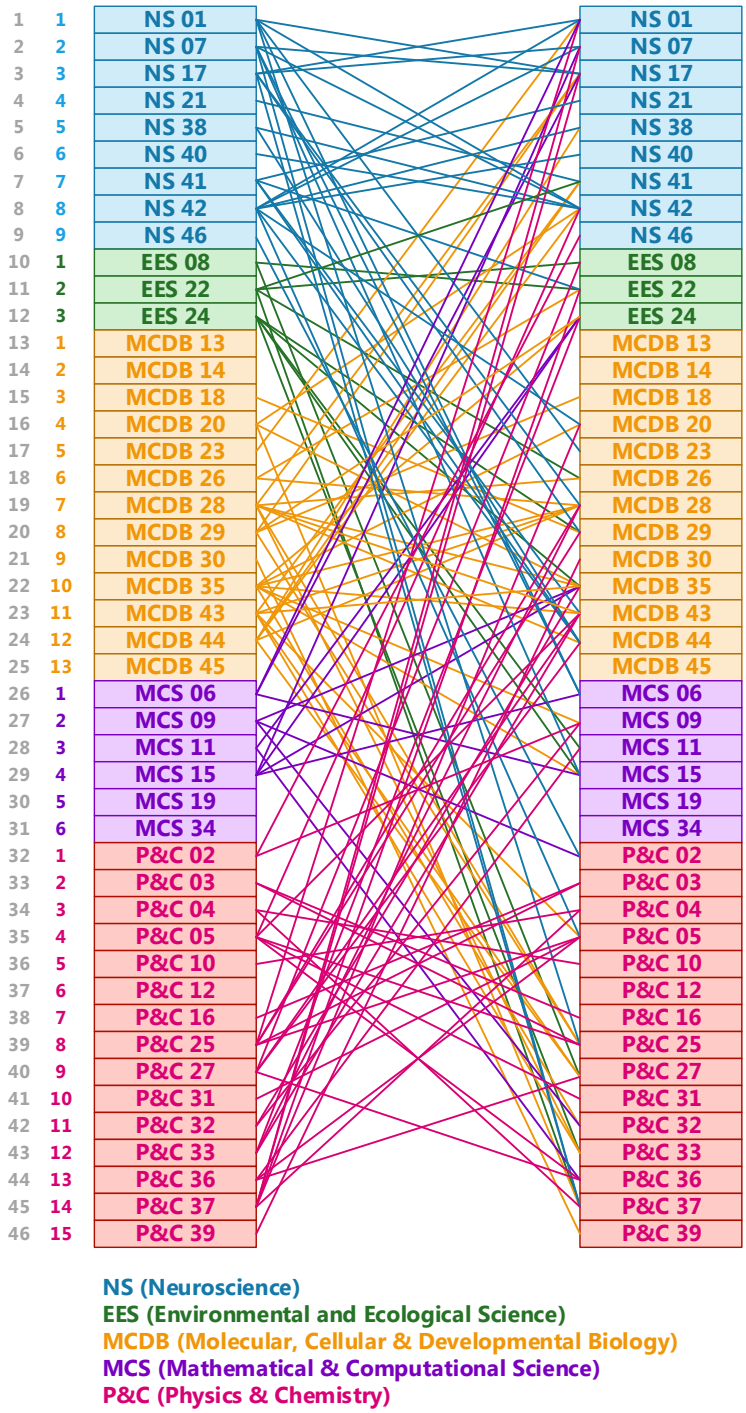


Figure 2.1.1.1. Representation of collaborations between OIST faculty members, illustrating the cross-disciplinary nature of research fostered by the OIST environment. Forty-five faculty members were asked to identify the colleagues with whom they have significant collaborations. If both faculty members independently identified one another, a link was created, joining the two professors. Each professor is identified by a numeral, and different colors represent traditional scientific disciplines.

electron microscopy on world-class instruments. This includes, for instance, cryo-TEM analysis of protein conformational changes during binding of antibodies and receptors and environmental TEM analysis of newly created nanoparticles with novel properties. As an example of possible independent, future innovations, fundamentally new electron microscopic and light microscopic imaging techniques are being

developed at OIST, which if successful, will provide powerful new modalities for atomic and molecular structural analysis.

4. Imaging. In both biology and physics, scientists at OIST have installed a series of new electron microscopes, confocal and two-photon optical microscopes, and associated computational methods for analysis of atomic, molecular, macroscopic, and even whole animal images. This has enabled visualization and characterization of subcellular organelles, single nanoparticles, novel solar cell materials, and discrimination of animal species. Such high spatial and temporal imaging generates massive data sets that must be analyzed, stored and shared in the OIST scientific computing facility.

5. Chemical dynamics and quantum systems. As the ability increases to produce and study materials and chemical systems at smaller dimensions and shorter times, remarkable new properties that exhibit quantum mechanical behavior have been discovered. This has provided profound insight into how matter and light are structured and interact, and importantly has provided an opportunity to explore information storage and manipulation at a quantum level.

6. Energy production and optimization. Investigation of mechanisms of photo conversion in organic and mixed-composition solar cells and harnessing of ocean currents for electrical generation are being explored for cost-effective production of energy from renewable sources. In cooperation with a corporate partner, an on-campus study in the OIST faculty residential village is determining conditions for optimal production and sharing of locally generated, renewable electrical power and optimization of power use with micro-grid analysis.

7. Material science, soft and hard condensed matter, fluid dynamics, and turbulence. The production of new materials with unique properties takes advantage of both the powerful, shared instrumental analysis and nano- and macro-fabrication clean-room facilities that have been built. Design and construction of world-leading technology for generating and characterizing multi-element nanoparticles has already produced novel materials with exciting new properties for both semiconductor and medical applications. Experimental characterization and mathematical analysis of fluid dynamics and turbulence have provided improved understanding of turbulence, promising many practical applications.

8. Advanced medical devices. This area is just getting started, but it will play an increasingly important role in the OIST research portfolio. The focus is on new particle beam accelerators, for example for carbon, that have great promise for therapeutic intervention in cancer. Associated with this is basic research on the "radiobiology" of the system that is urgently required to understand and optimize safe and effective delivery of high-energy particles in living tissue.

9. Cell biology, systems biology, and metabolomics. The use of new genetic tools at OIST to produce organisms with modified development and function is unlocking

understanding of normal development, aging, degeneration, and cancer initiation. The subtle, but powerfully informative changes in "metabolomic" composition in these different conditions from microorganisms like yeast to humans are now being investigated with high precision with new mass spectrometric and other analytical techniques. The outstanding capacity of the OIST scientific computing center has enabled powerful computational analysis of normal and pathological systems during manipulation of conditions biologically or pharmacologically. Capability is in place to do robotic high-throughput screening of biological activities, which supports efforts to find bioactive substances from the extremely diverse marine and terrestrial ecosystems in Okinawa.

10. Mathematical analysis. The quality and precision of new data about biological and physical systems provides quantitative constraints and numerical properties that powerfully enhance the development of new mathematical descriptions and analysis. This includes regulation of genetic expression, complex biological systems, such as whole cells and organisms, as well as quantum mechanical, quantum optical, and nonlinear fluid dynamics and other turbulent systems.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Conference Presentations	61	45	41	98	109	171	223	260	455	548	**2,011**
Dissertations	0	0	2	3	4	0	1	1	2	3	**16**
Software	0	0	0	0	0	0	0	0	7	9	**16**
Journal Articles, Book Chapters	11	15	20	44	39	52	65	107	146	174	**673**
Books	0	3	0	2	1	1	0	1	1	2	**11**
Patents (Pending)	0	0	0	0	0	0	0	1	9	14	**24**
Patents (Granted)	0	1	0	3	2	0	5	0	0	0	**11**
Total	**72**	**64**	**63**	**150**	**155**	**224**	**294**	**370**	**620**	**750**	**2,762**

Table 2.1.1.1. Historical progress of scientific productivity at OIST.

In each of these areas, OIST has made cutting edge contributions that rival those of far larger institutions. This confirms that OIST already has implemented successfully the key elements of the original Framework Document concept for creating an engine of scientific innovation. The future OIST program can be built with confidence on the novel research and academic foundation that has been established.

2.1.2 Current Status of Graduate Education

OIST has established an individualized Ph.D. program providing a solid foundation in each student's field of study, with unparalleled opportunities for cross-disciplinary research. Students are treated as unique with individualized programs of study that allow them to fulfill their potential within their chosen fields and also to learn to communicate with researchers in other fields. In addition to about forty established courses, OIST offers independent study with world-class faculty members who teach at the most advanced levels. Students also study special topics of current interest and participate in world-renowned OIST international workshops, as part of their graduate program.

Student recruitment involves a global search. OIST has successfully recruited two classes of excellent students in its first two years of operation and expects to recruit at least 20 more students per year in future classes. Selection is based on a series of five interviews with faculty members, student academic transcripts, a personal statement, and confidential letters of recommendation. An efficient process for selection of students has been established and applied in a transparent manner. After screening, shortlisted applicants are invited to an admissions workshop where they have face-to-face interviews with faculty members and are given an explanation of the OIST graduate program, aspects of student life in Okinawa, a tour of facilities, and an opportunity to meet informally with faculty members at a number of events. The excellent standard of the students who are selected, is evident in high scores based on one-on-one interviews with OIST faculty members. Students selected by OIST often receive competing offers from other top universities.

There are currently 52 students in the OIST Ph.D. program. Thirty-four students from 19 countries were admitted in 2012 and 21 students from 14 countries in 2013. Three students of the original 55 have left the program. Of the current two classes, only 15 (29%) are female, and 9 (17%) are Japanese; however, OIST is making a special effort to recruit more female and Japanese students.

Students from the class of 2012 have been assigned to the thesis laboratories of their choice. In coming months they are expected to produce a thesis proposal and prepare for their qualifying examinations. Students from the class of 2013 have been assigned to rotation labs and their first rotation is in progress.

All OIST Ph.D. students receive an internationally competitive support package and subsidized on-campus housing. A Research Assistantship provides financial support and tuition. The assistantship ensures that students are able to concentrate on their research activities while living at a standard comparable to those of the best universities in the world. Students are provided with a laptop computer and travel support to attend a scientific conference and an educational visit to their home country each year. Upon admission, students attend a welcome ceremony and a week-long orientation program to provide course advising, necessary information about life in Okinawa, as well as the support needed to complete immigration procedures and to secure necessities of life, such as banking and purchasing.

Students are admitted to the graduate program rather than to an individual laboratory. The program includes pre-thesis research training and laboratory rotations, under the guidance of an academic mentor, who is independent of the eventual Ph.D. thesis supervisor. In the first year, students rotate through three different research units, before making their choices of thesis labs. Thus, from the beginning, students work side-by-side with world-class faculty members and researchers in well-equipped laboratories, learning research by doing research. During the first and second year, students take courses in their field of study. In the second year, students start research in their Ph.D. thesis laboratories, and toward the end of the second year, they take a qualifying examination for progression to their thesis research.

In parallel with the individual program, OIST provides a required Professional Development course for all students, which helps them to develop knowledge and skills important for leadership in scientific research and education. This includes weekly seminars covering basic principles of research conduct and ethics, scientific communication, including presentation and writing skills, and aspects of science in society. In addition, students complete a cross-disciplinary group project. Visiting speakers, who are able to contribute to the program by virtue of their leading roles in science or science communication, are invited each month to meet and discuss various topics with the students.

The academic year runs from September through August. Students whose studies permit, may be admitted during the period from March-September to take part in intensive immersion training in English or Japanese in conjunction with laboratory placements appropriate to their interests.

A Curriculum and Examinations Committee has been established and meets three times per year to review individual student progress. Procedures for progression to thesis research are now being implemented for the 2012 class, as they come to the end of their second year of study.

In addition to OIST Ph.D. students, the Graduate School hosts visiting students in different categories. About twenty Special Research Students are completing degrees at other universities, providing continuity for students of newly recruited faculty members. On the order of fifty short-term Research Interns visit OIST for periods of three to six months, during which they are hosted in specific laboratories. Interns are regularly received from Oxford and Harvard, and an agreement with the University of Tokyo promises increased numbers of Japanese Research Interns in the future.

The Graduate School provides an administrative structure that supports the Ph.D. program in matters related to the full degree-cycle of our students, including recruitment, admissions, course advising, academic mentoring, curriculum and examinations, monitoring of individual student progress, graduation, and professional development toward careers as independent researchers. The Graduate School also provides an interface with other divisions for financial support, housing, and continuing support to ensure student welfare. The Graduate School organizes education-related travel for OIST Ph.D. students, candidates for admission, and different categories of visiting students, including Special Research Students and Research Interns. In addition the Graduate School maintains student records, liaises with MEXT in relation to educational matters and faculty accreditation, and handles agreements with other universities concerning students. Individual accreditation of faculty members is an ongoing process as new faculty members assume positions at OIST.

2.1.3 Faculty and Academic Organization

The University has the objective of achieving leading-edge status in those areas of research that it chooses to pursue, and this requires the appointment of internationally outstanding faculty members. OIST also aims to be a truly international graduate university, with at least half (currently about two-thirds) of its faculty members from outside Japan, and a similar mix of graduate students.

There are currently 48 faculty members, including 14 Full Professors, 12 Associate Professors, 15 Assistant Professors, and 7 Adjunct Professors, 15 of whom have tenure. In addition, there are 3 Visiting Academic Advisors to the President, the Provost, and the Dean of the Graduate School.

Each full-time faculty member leads an autonomous research unit, pursuing a program with allocated resources. The research unit is the administrative entity for managing research. Faculty members are expected to maintain a program of excellent research and publication, and to seek external funding.

Research is currently concentrated in five broad domains: 1. Neuroscience, 2. Molecular, Cell and Developmental Biology, 3. Environmental and Ecological Sciences, 4. Physics and Chemistry, and 5. Mathematical and Computational Sciences. Because there is no grouping of similar activities into departments, there is no advantage in co-locating them in the laboratories; thus a heterogeneous cohort of staff and students can mingle and develop innovative interdisciplinary projects. This approach is reinforced by graduate school training, which requires students to undertake one of three rotations in disciplines unrelated to their preferred fields.

Research units may appoint Staff Scientists, Research Specialists, Research Technicians, or Postdoctoral Scholars as fixed-term employees, but continuing appointments can only be made by the Continuing Staff Appointments Committee. A postdoctoral scholarship is always a fixed term, normally for 3 years. Administrative personnel are appointed according to the needs of the research unit, and may be shared.

Faculty members contribute to the teaching program of the Graduate University, supervise graduate research projects, and assume appropriate responsibilities in the University academic community. The Dean of the Graduate School administers the OIST Graduate School, and the Deanship rotates among the faculty. A three-year term, renewable at the discretion of the President is standard. The overall ratio of faculty to students is about 1:2. All teaching is in English.

The Faculty Assembly is the self-governing body of the professoriate, advisory to the President. The Assembly deliberates on policy matters, strategic direction, and educational philosophy, addressing academic, research, resource, and welfare matters, as well as recruitment, promotion, and tenure. The Assembly can bring issues that warrant attention of the University management directly to the President. The Chair of the Assembly is elected for a two-year term, renewable once. The Assembly elects a Council under the leadership of the Assembly Chair, which acts as the Executive Committee of the Assembly. The President, Provost, Vice Presidents and Deans are ex officio members, and attend meetings of the Assembly and the Council by invitation. The Faculty Affairs Office provides the Secretariat. The Secretary to the Assembly works with the Chair as the Executive Secretary to the Assembly and the Council, with responsibility for preparing agendas, preparing or commissioning papers for meetings, serving any sub-Committees created by the Assembly or Council, and coordinating with the President, the Provost, the Vice Presidents, and the Deans.

The OIST Graduate School needs to be able to respond flexibly to opportunities to extend and complement its research portfolio and to pursue activities in support of the wider development of Okinawa. In addition to its research functions, the Science and Technology Group helps to promote educational and cultural activities, in collaboration with other local institutions. There are currently ten members of the Science and Technology Group.

The Provost is responsible for the administration and management of the research portfolio and the Dean of Faculty Affairs is responsible for the administration and management of academic affairs.

2.1.4 Support Structures for Research Programs

Several factors have contributed to the extraordinary level of success in OIST's research efforts. The leadership of the Board of Governors and experience of the founding faculty and administrators have brought a level of expectation and performance that matched the aspirations of the founders, as expressed in the original Framework Document. The Japanese Government has provided generous and steady support in making the kinds of investment needed. The functionality and quality of the research buildings are extraordinary. The laboratories were designed by an outstanding team of architects who had decades of experience in designing and constructing world-class research facilities. The design focused on a key element of the OIST community, multidisciplinary research. Every aspect of the fundamental laboratory design creates opportunities for researchers to meet and interact outside of the usual disciplinary boundaries, thereby promoting collaboration. As a feature to enhance the multidisciplinary environment, research labs and offices for theoreticians are distributed on the periphery of the buildings with the central services and shared spaces located in the building interiors, which facilitates access and further encourages interactions among the researchers.

A second key element is the implementation of a shared resource environment for the whole university, independent of disciplinary boundaries or conventions. This intention, incorporated into the design by the architects, results in greatly increased access and efficiency of use. Many common instruments and resources are housed, as appropriate, in localized centers and distributed service areas. Some types of equipment such as mass spectrometers, confocal microscopes, electron microscopes, DNA sequencing, protein preparation, X-ray spectrometers, and special areas such as clean rooms are located together in centralized space. Other more local resources such as centrifuges, freezers, autoclaves, high-purity water, cold rooms, culture rooms, etc. are distributed locally by floor or area. Access to the extensive range of equipment is facilitated by an online database that enables researchers to find any piece of equipment at OIST, get full specifications, contact information, training requirements, and to make reservations. All service contracts are centralized and vendors provide umbrella support service that is faster and higher quality than individual research units could offer.

Outstanding scientific computing resources have been established, including high-performance computing clusters, high-speed memory, very large data storage, high-speed

optical networks that allow consolidation in well maintained server rooms, high-speed access off site, and an excellent campus-wide wireless network with secure and public domains.

Animal resources are excellent and include transgenic rodent facilities, *Drosophila*, *Caenorhabditis*, aquatic species including zebrafish, and others. OIST is close to completing certification that would make it only the second AAALAC-accredited university facility in Japan (Association for Assessment and Accreditation of Laboratory Animal Care International).

The scientific staff provides training and direct service, as well as maintenance of common resources. Scientific staff members generally have Ph.D.s and postdoctoral experience. Section leaders all have prior experience in directing laboratory groups. OIST's Research Support Division oversees eight sections and one center.

- Animal Resources Section
- Biology Resources Section
- DNA Sequencing Section
- Marine Science Resources Section
- Open Technology Center
- Physics Resources Section
- Research Safety Section
- Scientific Computing Section
- Sponsored Research Section

2.2 Physical Infrastructure

2.2.1 General Site Status and Conditions

The OIST campus is located in the Tancha district of Onna Village, Okinawa Prefecture. The site consists of two tracts of land: a 214 ha area of forested hillside on the west slope of Mt. Ishikawa, and a nearby 8 ha coastal property on the sea side of Route 58 (Figure 2.2.1.1).

The hillside tract is largely public land administered by Onna Village, which has been made available free-of-charge to OIST on a leasehold basis for an initial period of 10 years (automatically renewing). However, a number of small, privately held land parcels within this site have been purchased by the university. These parcels total 5.5 ha. The seaside site, which is located in Okinawa Quasi-National Park, is owned freehold by OIST.

The main site extends roughly 2.5 km east-west from the Onna Village Akama Sports Ground to the Self Defense Force Road leading to a military facility on the summit of Mt. Ishikawa. In the north-south direction the site extends about 1 km from the Route 58 Bypass up the slopes of Mt. Ishikawa to the ridge running along the center of the island.

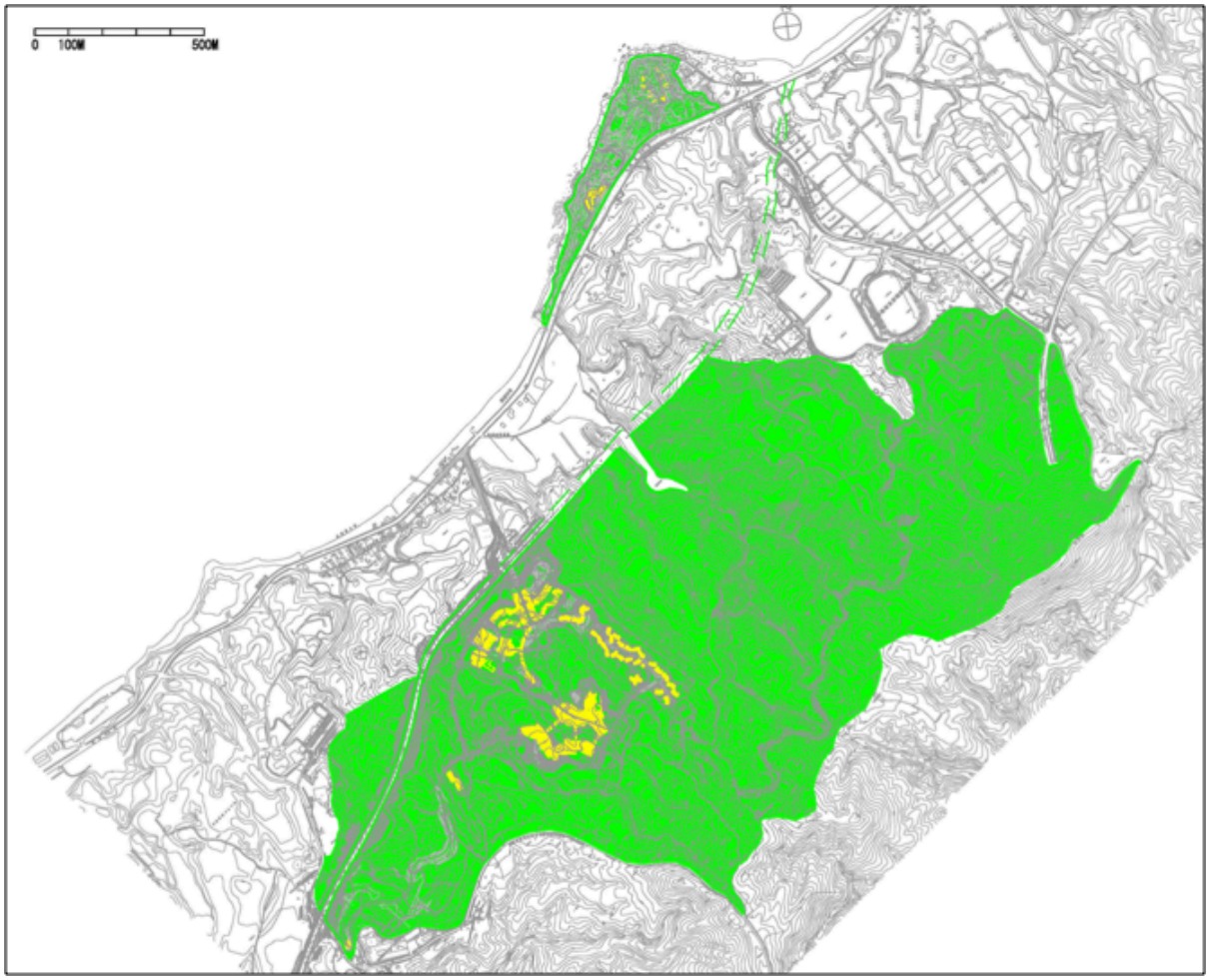


Figure 2.2.1.1. Overall site map of the main OIST campus.

In terms of terrain and natural environment, the main site is deeply wooded and cut transversely by a series of short, steep ravines that drain the seasonal heavy rainfall to the sea.

There is little flat land between these ravines, so the site is, in effect, a repeating series of steep ridges and valleys aligned generally perpendicular to the coast. This severely restricts the amount of buildable land available for campus construction (Figure 2.2.1.2).

Part of the site at an elevation of 50~60 m above sea level was occupied previously by a botanical garden. The pond and car parking area remaining from this project were utilized as the lower campus area, which primarily houses support facilities for the university.

There was insufficient flat land at this lower level to also accommodate the academic facilities of the university, so these were constructed 30 m higher on the hillside in what is now the upper campus area, with the lower and upper parts of the campus connected by a 100 m pedestrian tunnel and an intersecting vertical shaft housing elevators to the Central Building.

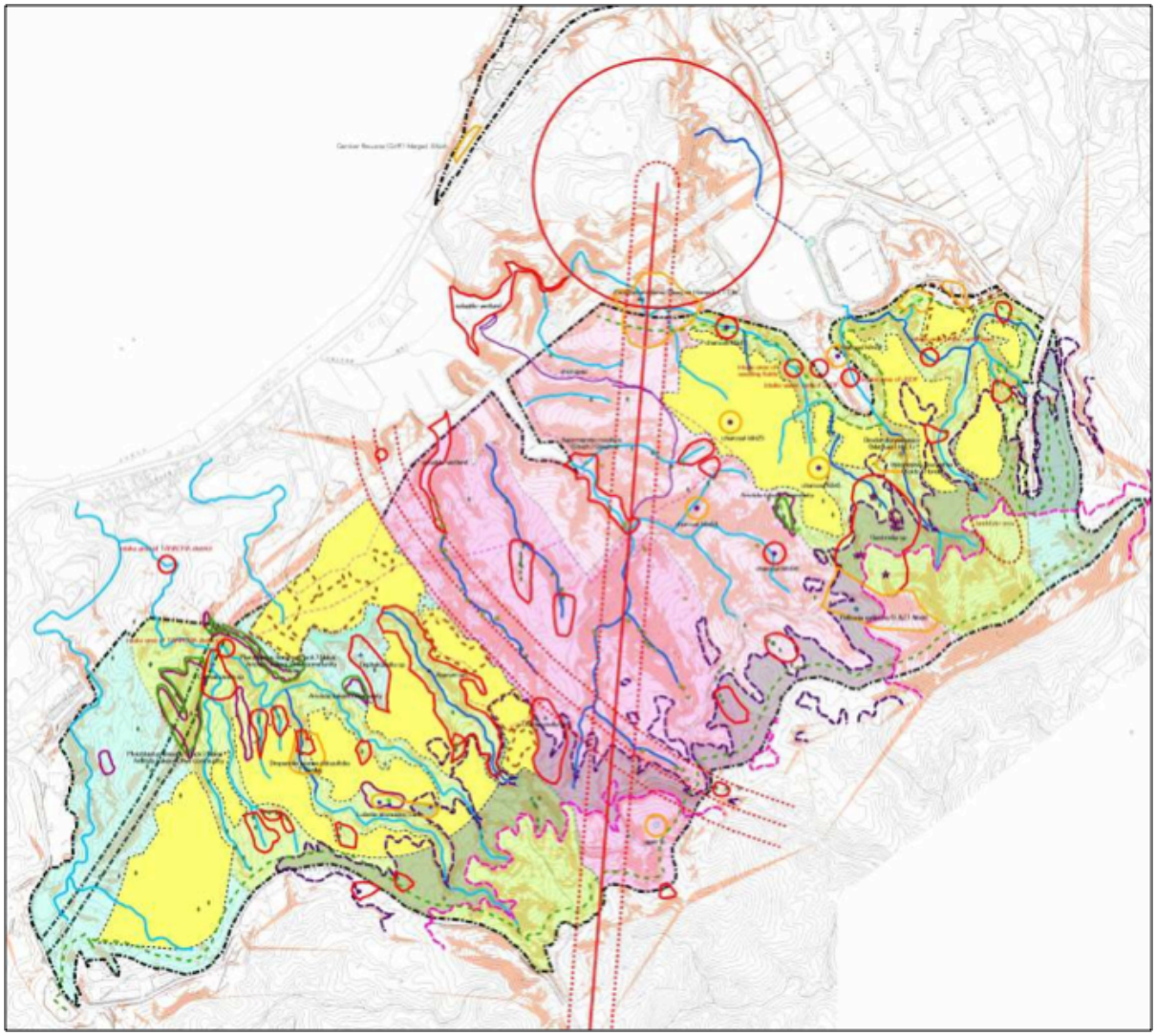


Figure 2.2.1.2. Environmental impact diagram showing restricted and buildable areas of site in yellow.

Further complicating the building of a university campus on this site is the presence of a number of protected species of flora and fauna. An Environmental Impact Assessment carried out before development of the university began, identified many areas of the site that

should not be disturbed by construction. In particular, the streams running in the valleys are the habitat of an endangered species of newt. As a result, a stipulation for campus development was that these streams be left undisturbed (Figure 2.2.1.2).

The site is subject to the typical, subtropical climate of Okinawa, characterized by a hot, humid summer and mild to cool conditions for the rest of the year. It is exposed to northerly winter winds, and also to the typhoons that frequent the Ryukyu Archipelago between June and October. Being close to the sea, the impact of salt-laden cyclonic winds from the west is severe, as these damage vegetation and result in a particularly corrosive environment for building materials.

The main site is located in an area not subject to urban planning constraints. A local government ordinance does, however, limit building height to 11 stories. There are building restrictions on the seaside site, due to its location in a quasi-national park. These principally restrict the total floor area buildable, and prescribe an involved and time-consuming building approval procedure.

2.2.2 Upper Campus

The OIST Phase 1 laboratories and the Campus Center Building have been constructed on two ridges of the hillside site at an elevation of roughly 80 m (Figure 2.2.2.1). This is 20~30 m above the level of the lower campus area described in the following section.

Figure 2.2.2.1. Upper campus buildings before construction of Lab 3.

The buildings constructed in Phase 1 were designed to accommodate 50 professors, their research units, and research equipment, as well as the Graduate School, the University's administrative functions and its central plant.

These buildings were designed to fit onto level platforms prepared by slicing off the tops of two adjacent ridges. When Lab 3 is completed, these buildings will be linked by three skywalks that span the ravine between them (Figure 2.2.2.2).

The Center Building has a grassed center court on its uppermost level, which serves as the hub of the campus as a whole. This is surrounded by a covered passageway, the cafeteria, and seminar rooms, and provides access to the laboratory buildings and the main elevators that connect this upper campus area with the main entrance and support facilities below (Figure 2.2.2.2).

Figure 2.2.2.2. The Center Building and adjacent Lab 1. The inset illustrates the bridges that connect the Center Building to Lab 2 and will soon connect Lab 3 (under construction) to the other three buildings.

The laboratory buildings all have the same basic floor plan providing maximum flexibility to accommodate changes in research requirements over time. Any lab area can be used as wet or dry lab space with minimal modification (Figure 2.2.2.3). This flexibility is enhanced by the provision of interstitial spaces between each lab floor. These expanded voids above the ceilings have catwalks that enable service personnel to easily access any area and to install additional utilities, etc. into a lab from above, without disturbing surrounding areas.

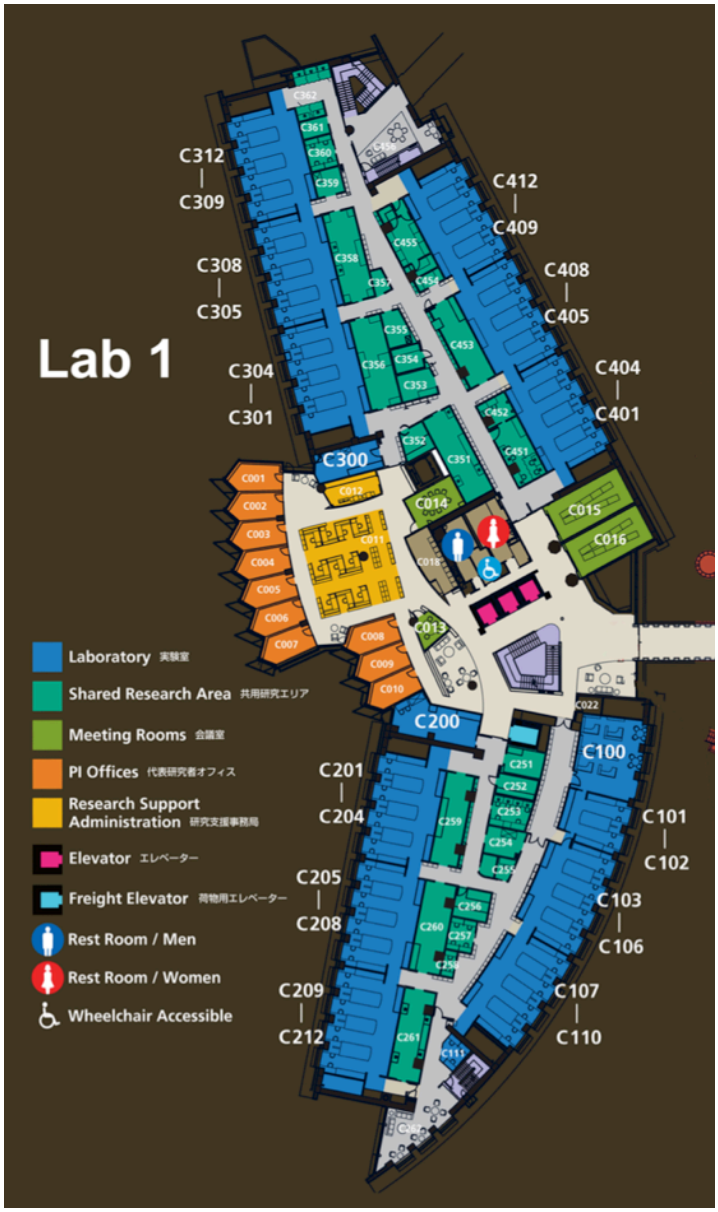


Figure 2.2.2.3. Lab building typical floor plan, illustrating the locations of laboratories, shared resources, meeting rooms, and faculty member offices.

The floor plan arranges research units around the perimeter, while service rooms for common equipment such as freezers, centrifuges, and incubators are placed along the central spine. This arrangement encourages shared use of such equipment by multiple research units, increasing efficiency and avoiding duplication of resources (Figure 2.2.2.3).

The Phase 1 facilities in the upper campus include one large, stepped-floor seminar room for 150 people and five seminar rooms of varying layouts, each accommodating up to 60 people. Two of these rooms are equipped for simultaneous interpretation.

Other key support facilities include a two-floor cafeteria with a kitchen, a library, a server room for the high-performance computing system, an animal facility with space for 5,000 mouse cages, an aquarium for research using zebrafish, a radioisotope facility, a clean room with Class 100 and 1,000 areas, and mechanical and electrical machine shops.

2.2.3 Lower Campus and Village Zone

This part of the site contains the residential Campus Village, as well as a 500-seat auditorium, a multi-story car parking building for 320 vehicles, and the Child Development Center, able to accommodate up to 100 children of OIST personnel (Figure 2.2.3.1).

Figure 2.2.3.1. Lower Campus Buildings.

The Campus Village, comprising housing of several types, from 1-bedroom apartments to 3-bedroom faculty houses, has been developed under a public-private partnership, with the first 100 units completed in 2012, prior to admission of the first class of graduate students that September (Figure 2.2.3.2). Construction is continuing in stages, with full completion scheduled for 2015, by which time there will be just over 200 units of housing, sufficient to accommodate approximately half of the University's Phase 1 academic population.

Figure 2.2.3.2. Campus Village.

There is also open space remaining at the front of the lower campus, which has been tentatively zoned for future construction of commercial facilities, such as cafes and specialty shops. The OIST campus already hosts over 40,000 public visitors annually, including Okinawa residents, high-school students, and tourists. This number is expected to grow further as the university expands. Retail facilities operated by local businesses will not only serve this visitor market, but will provide improved retail services to the growing university community.

2.2.4 Seaside House and Faculty Houses

As noted above, the university owns an 8 ha tract of land approximately 2 km away from the main campus, located on the coast of Onna Village by the East China Sea (Figure 2.2.4.1). A defunct Ministry of Social Welfare recreation facility on this site, originally known as Haku-unso, was renamed Seaside House, and refurbished to serve as the temporary headquarters for the University until the new campus could be constructed. This facility is now used as a venue for international research workshops, with seminar facilities, a dining hall, and 22 twin-bed guest rooms (Figure 2.2.4.1). Adjacent to Seaside House are a tennis court and a wooden deck by the beach, which is used for outdoor events.

Figure 2.2.4.1. Seaside House, along Route 58 in Onna Village.

On a headland further northeast along this site stands a compound of eight single-family houses. These were constructed to provide accommodations for faculty members and executive staff who joined OIST early in its development.

2.3 Financial/Business Status

2.3.1 Budget: Subsidy Funding

The Okinawa Institute of Science and Technology School Corporation (OIST) operates according to the provisions of the Okinawa Institute of Science and Technology School Corporation Act, effective as of November 1, 2011. On that date, the OIST Promotion Corporation, an interim entity created in FY2005 to prepare for establishment of the University, was transformed into the OIST School Corporation, with the legal status of a private university: OIST Graduate University. The OIST fiscal year commences April 1 and ends on the following March 31.

The University has three main sources of funding: subsidies for operating expenses (hojokin) and subsidies for construction expenses (shisetsuseibi hojokin) from the Japanese Government, and other sources of funding such as competitive grants, donations, contract research, etc.

Annual budget planning and budget requests

The University plans its budget and monitors the execution thereof on an annual basis (Table 1.3.4.1). In principle, accounting rules applying to the main source of University funding, i.e. subsidies from the Japanese Government for operating expenses (hojokin), do not allow for multi-annual budgeting. Rare exceptions to this rule include large equipment with long delivery lead time, or for which costs cannot be absorbed in one year. In such cases, lease agreements may be employed. This annual budgeting frame does not apply to large construction projects, for which specific subsidies may be used over two fiscal years.

The history of Japanese governmental subsidies received by OIST (operation and construction) reflects major milestones in OIST's development (Figure 2.3.1.1).

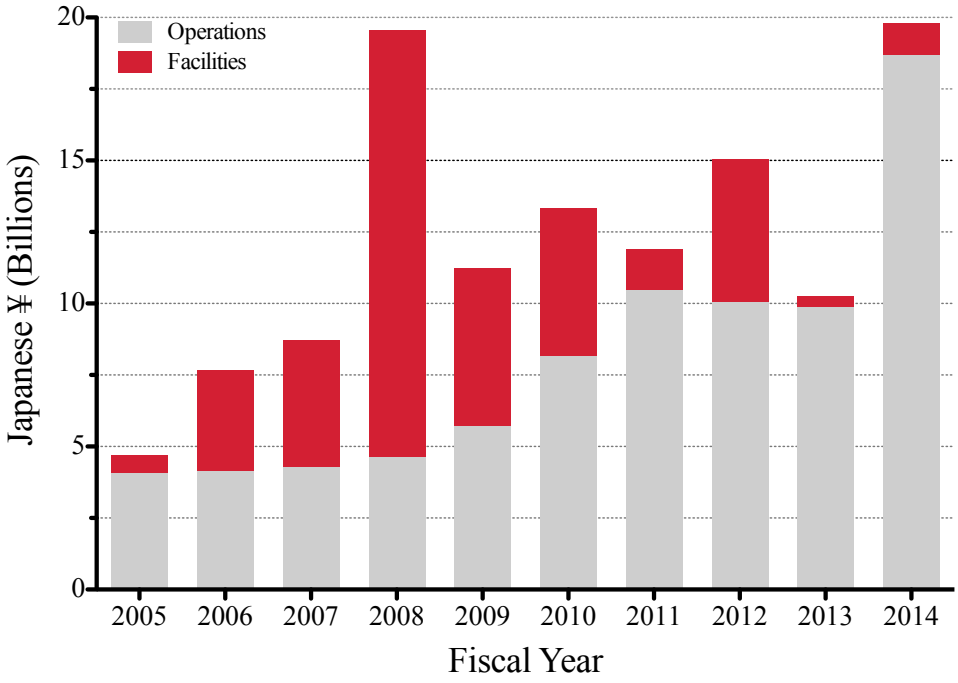


Figure 2.3.1.1. History of subsidies for operations and facilities.

From FY2005 to FY2009, OIST administrative and research functions were housed in temporary facilities while Onna Campus landscaping was underway. In FY2008, the budget for construction of Laboratory 1 and the Central Building was released and the new campus opened in FY2010, with additional space allowing for a significant increase of number of research units. In FY2010, the budget for construction of Laboratory 2 was allocated and this facility opened in FY2012, at which time the budget for Laboratory 3, scheduled to open in FY2015, was released.

A significant increase in subsidies for FY2014 operations, reflects the active development of facilities in support of R&D Centers of Excellence, such as the new Marine Science Center, which will have international stature.

Budget allocation and execution monitoring

The President of the University, acting under the direction of the Board of Governors, is responsible for the University budget, from planning to execution and reporting. The President, in turn, delegates this responsibility to the Vice-Presidents and other officers, who are accountable to the President.

The University budget is allocated, executed, and monitored following a hierarchical structure mapped on the University Organizational structure (corporation, divisions, sections, etc.) (Figure 2.3.1.2) Doing this clarifies accountability and "ownership" of budget responsibility at different levels.

For proper management of its resources and in support of multidisciplinary research, the University expects researchers to share facilities, services, and major equipment, as they do their scientific ideas. Common resources are the responsibility of specific sections for all phases of their life cycles, from initial specifications (developed with future users), to acquisition, maintenance, and operation. With few exceptions (e.g., reagents for DNA sequencers), the section managing a common resource does not charge internal users for the cost of using these resources (but will charge external users).

The University constantly monitors budget execution, and optionally reviews and adjusts its allocation, usually at a mid-term review in September and in January, to estimate the necessary carry-forward to the next fiscal year for research activities.

To assist in keeping a general overview of budget allocation and future commitments, the Budget for Operations is aggregated into three main categories: Personnel Expenses (PEREX), Capital Expenses, such as equipment (CAPEX) (excluding construction expenses) and Operational Expenses (OPEX) (excluding personnel expenses).

Budget Breakdown structure

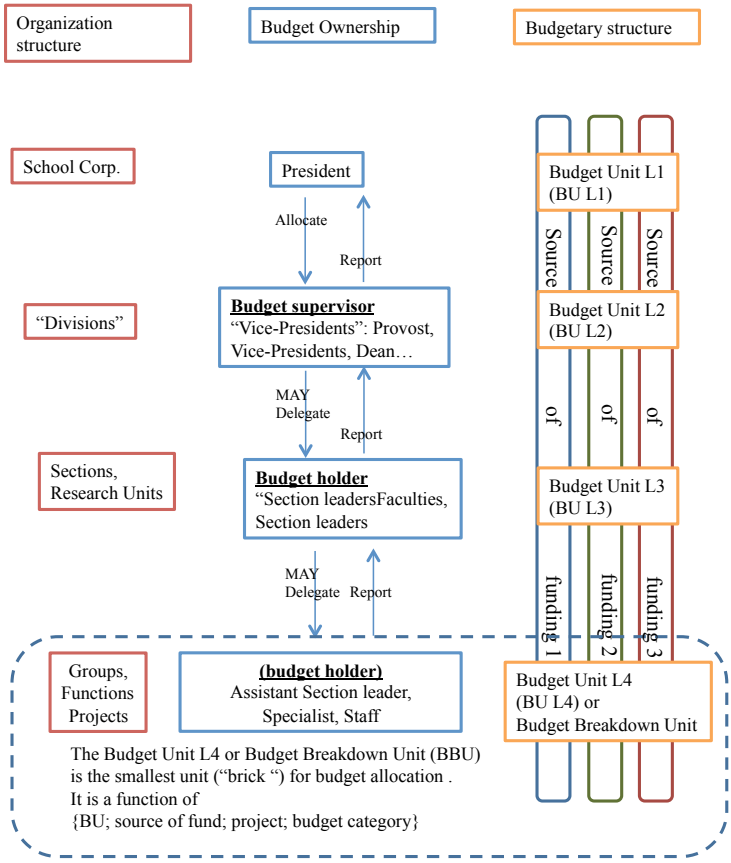


Figure 2.3.1.2. OIST Budgetary structure matches OIST organization structure.

2.3.2 Budget: Procurement and supplies

At present, OIST's primary funding consists of subsidies from the Japanese Government. It is therefore of critical importance that procurement of equipment, goods, and services be executed in compliance with rules and regulations attached to this funding.

Researchers need equipment and services with highly complex technical specifications in diverse research areas. This often requires the procurement section of OIST to engage in complex public procurement and tendering operations, sometime taking several months to conclude, while ensuring compliance with OIST procurement rules (Table 2.3.2.1). Leasing contracts require particular attention, being tripartite agreements between OIST, the manufacturer or its representative in Japan, and the leasing company.

Contracts of the University are based on principles of transparency and competitiveness, with the obligation of information disclosure, while evaluating rules and procedures regularly from the perspectives of efficiency and simplicity. The volume and amount of procurement activity is steadily increasing (Table 2.3.2.1).

Since April 2014, OIST has outsourced its supply chain and inventory management of research consumables and administrative stationery. Initial results and feedback from users are very positive.

A. Competitive Bidding (Numbers)	FY2010	FY2011	FY2012	FY2013
Competitive bidding	167	131	152	113
Qualified bidder identification (Proposal)	6	4	3	10
Unsuccessful bidding (no proposal)	0	1	2	4
Negotiated contract (direct negotiation)	21	15	291	283
Sum	**194**	**151**	**448**	**410**

B. Competitive Bidding by Contract Type (Amounts in JPY Million)	FY2010	FY2011	FY2012	FY2013
Competitive bidding	8,923	3,300	5,727	6,117
Qualified bidder identification (Proposal)	435	76	240	231
Unsuccessful bidding (no proposal)	0	4	54	39
Negotiated contract (direct negotiation)	470	317	982	982
Sum	**9,828**	**3,697**	**7,003**	**7,369**

C. Procurement activity		FY2010	FY2011	FY2012	FY2013
Public construction	Number	20	15	41	54
	Amount	7,159	1,585	1,672	4,221
Goods and services	Number	174	136	407	356
	Amount	2,668	2,115	5,331	3,148

Table 2.3.2.1. Competitive bidding and procurement activity. All amounts are in millions of Japanese yen.

2.3.3 Budget: PPP Funding

Since its conception, the University campus has included a residential area for its students, and about half of its researchers and faculty members. The "OIST Village Zone" has been financed using a Public-Private-Partnership (PPP) scheme (Figure 2.3.3.1).

This PPP approach had two main advantages for OIST and the Japanese Government. First, it enabled the University to transfer the responsibility to build and operate a residential facility to the private sector, and second, the capital investment necessary to build the facilities was borrowed by the private partners (such as banks).

The "Build-Transfer-Operate" (BTO) model has three major phases. The private partner (Special Purpose Company or SPC) borrows the capital from banks and other financial institutions with a 37-year loan and is responsible to build the facilities. The SPC then sells

these facilities to OIST (Transfers the ownership of the project) and reciprocally OIST leases the facilities back to the SPC for a period identical to the duration of the loan, with the agreement that the SPC will manage (Operate) the housing management. Finally, OIST staff and students rent the apartments and housing, which repays its loan from the rental fees received.

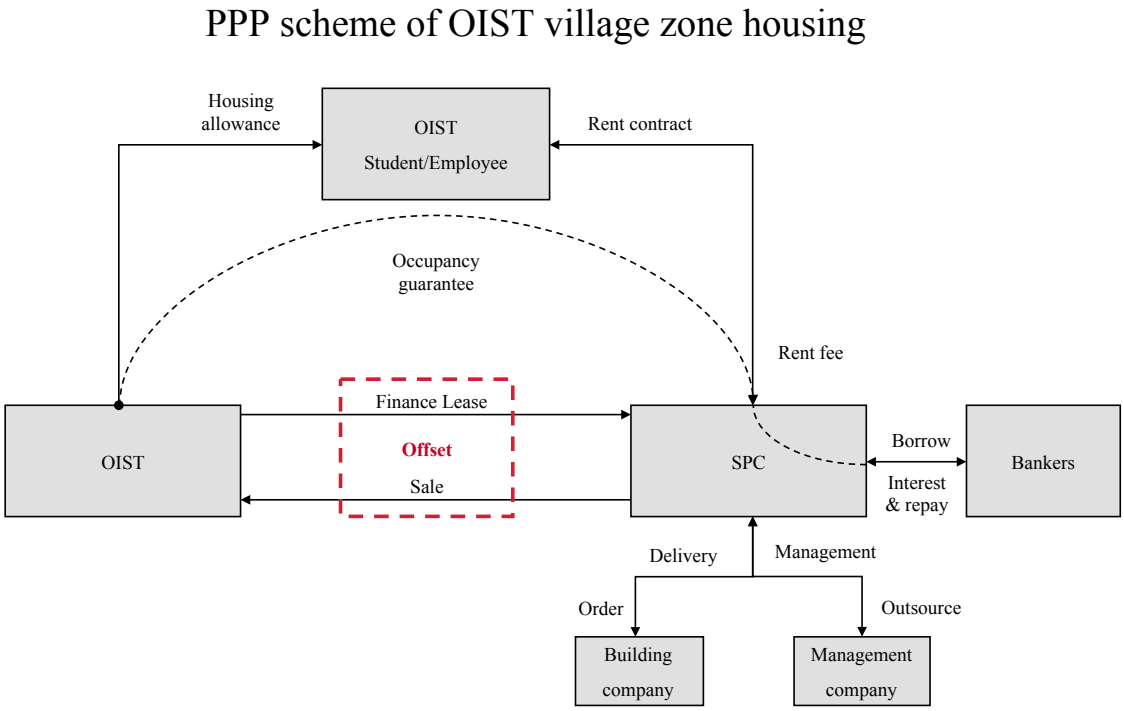


Figure 2.3.3.1. General principle of Public Private Partnership scheme for OIST Village zone housing. A different system was effected in FY2014.

2.3.4 Budget: External Funding

The University is gradually developing sources of funding other than Government subsidies, such as competitive research grants, sponsored research funds, donations, technology licensing, etc (Figure 2.3.4.1).

The main sources of research grants are Japanese since there are very few international funding programs, such as the Human Frontier Science Program Organization (HFSPO), which support basic research. Three sections of OIST are actively involved in supporting OIST researchers in their efforts to apply for external funding: the Sponsored Research Section focuses on research grants, and the Business Development Section (BDS) and the Technology Licensing Section (TLS) support OIST researchers in patenting their inventions, to develop sources of future royalty income, and also developing collaborations with industry for joint research or contract research projects.

Activities of Sponsored Research Section

The Sponsored Research Section provides both pre- and post-award support for researchers. Pre-award support for research includes distributing information on funding opportunities, usually upon translation into English, as well as consultation on research plan documentation and budgeting. Post-award support includes financial management of the

project and report documentation. Administrative support of joint research activities with academic partners is also provided for Joint Research Agreements, Material Transfer Contracts, Visiting Researcher Agreements, and fellowships for individual researchers. Major sources of research grants for are KAKENHI (grants in aid), MEXT, JST, JSPS fellowship, NIH of USA, and HFSPO. It is also noteworthy that OIST is a full member of Human Brain Project of the European Union FP7/Horizon2020 program, although no funding is allocated to non-EU institutes. As a part of pre-award support, the section has been engaged in grouping researchers for team-oriented research grants and center grants. Similarly, coordinating collaboration and cooperation with academic partners is one of the Section's support activities.

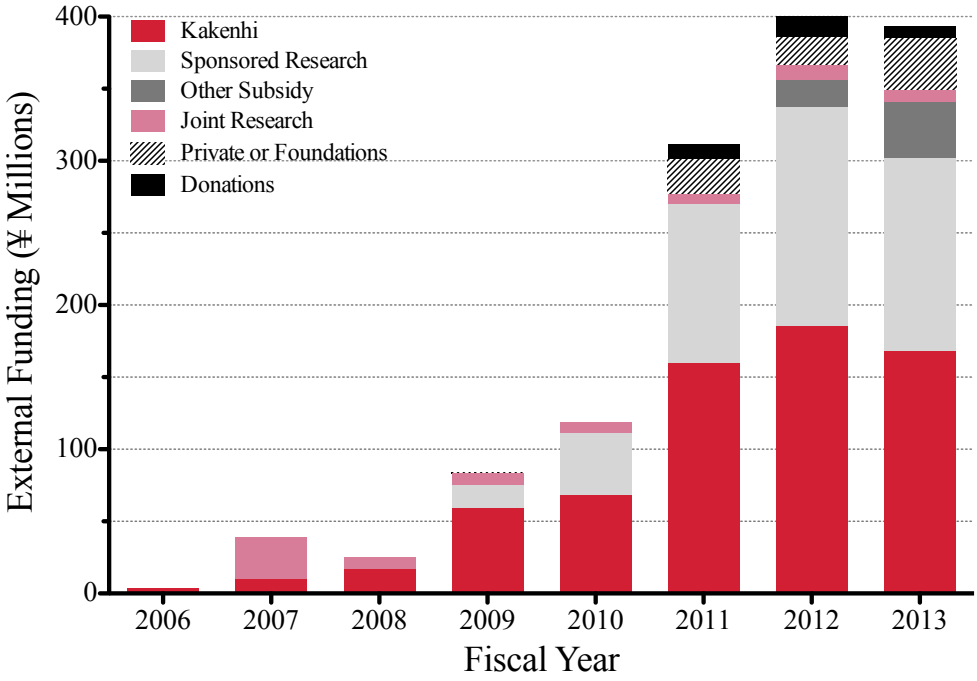


Figure 2.3.4.1. External funding from various sources.

Activity of the Business Development and Technology Licensing Sections

The BDS coordinates collaborative research with industry through joint research or contract research projects. For government-related funding, services are provided to faculty and researchers from the initial stage of information gathering and to the final phase of reporting. Major grant sources include the Okinawa Prefectural Government, MEXT and METI. Financial execution is carefully monitored according to each grant's rules, and BDS reports to each funding agency.

Matching events such as BioJapan and Nanotech Japan provide opportunities to actively seek potential industrial partners. The BDS provides continuous support throughout the negotiation of collaboration conditions and during the contracted projects.

The TLS supports OIST researchers, and OIST employees in general, by protecting the intellectual property generated by research activity at OIST, and by managing the invention

disclosure and evaluation processes (Section 2.3.7). The TLS also conducts market intelligence in order to identify potential licensees for OIST patents and will negotiate collaboration and licensing contracts with industrial partners, to put knowledge to practice and also to create income through sponsored research and royalties.

Donations

The Friends of OIST Foundation is a U.S. non-profit founded in 2011 to support the mission and programs of OIST and to expand its global presence. The primary activity of the Friends of OIST Foundation is to raise and distribute funds to support education, research, and development programs conducted by OIST in Okinawa. The Foundation may distribute funds by issuing grants to individuals or organizations, by awarding fellowships to individuals, or by sponsoring events and meetings. The Foundation was registered with the State of California Office of the Attorney General on September 26, 2011, under the name "Friends of OIST Inc." The Friends of OIST Foundation is in the process of applying for tax-exempt status as a public charity under U.S. Internal Revenue Service Tax Code Section 501(c)(3).

OIST recognized as "Special Public-Interest" institution in Japan

In 2011, OIST School Corporation applied for and was granted the status of a "Special Public-Interest Promotion Corporation." With this status, donors resident in Japan are eligible for preferential tax treatments equivalent to those for donations to national universities. This applies to donations made by individuals residing in Japan or by Japanese Corporations.

2.3.5 Budget: FY2013 Spending by Division

The total FY2013 OIST budget (Figure 2.3.5.1) amounted to JPY 14.3 Billion (B), including JPY 4.731 B in subsidies for construction of Lab 3 (JPY 4.3 B) and the Child Development Center (0.4 B) and JPY 9.9 B in subsidies for operational costs. The latter comprised personnel expenses (4.232 B), capital investment (1.077 B), mostly for research equipment and building fit-out and operating expenses (4.570 B).

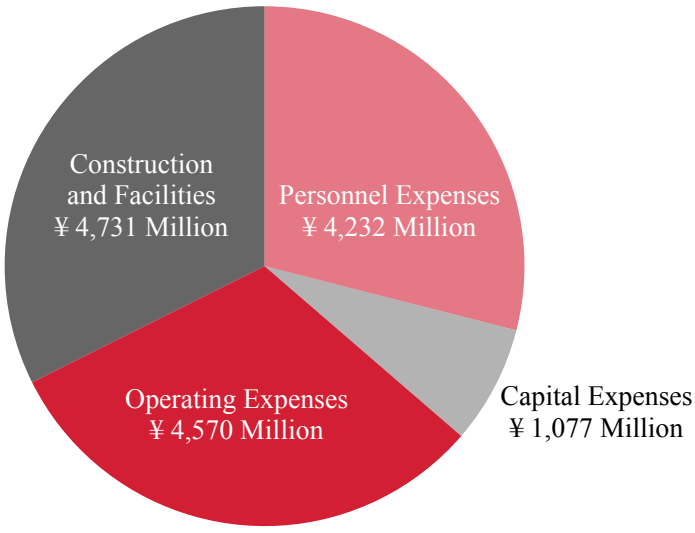


Figure 2.3.5.1. Allocation of OIST FY2013 budget by type of expenditure.

Personnel expenses are split between research units (43%) and administration (57%). The latter is broadly defined to include research support and research services. Capital and operating expenses are allocated by division as indicated for FY 2013 (Figure 2.3.5.2).

Research-related activities were allocated to the Office of the Provost, the Office of the Vice-Provost for Research, and to all of the research units. In total, these accounted for 70% of capital investment and more than 50% of operating expenses (non-salary).

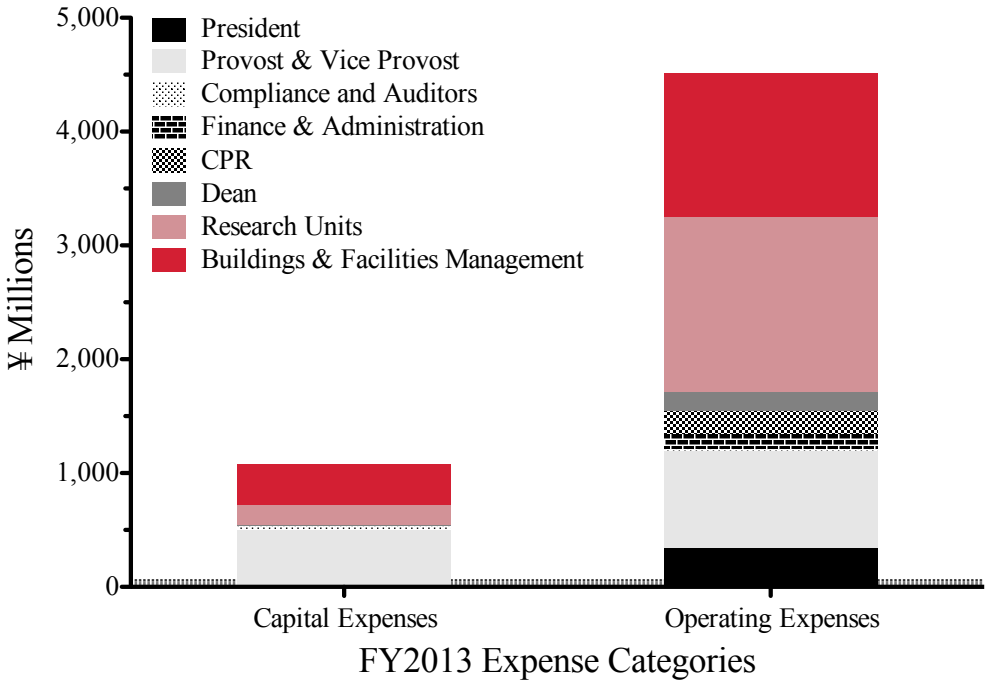


Figure 2.3.5.2. Allocation of capital and operating expenses by division.

2.3.6 Business Development

Business development and collaboration with industry

OIST's founders envisioned a school built upon three principles: excellent research, innovative education, and outstanding contributions to society.

Contributions to society, locally and globally may take different forms. Innovation, technology transfer, and entrepreneurship are key strengths for societies that aim to be globally competitive. As foreseen in the OIST School Corporation Act itself, OIST has a role to play in the economic development of Okinawa and Japan. OIST firmly believes that excellent fundamental research sparks technologies and products with the highest potential impact.

"… research outcomes generated by the University's research in science and technology may be developed and applied by industry for the benefit of society in general as well as to facilitate sustainable development of Okinawa and the competitiveness of Japan." (OIST Policies, Rules and Procedures, Chapter 1.1.1)

OIST expects to contribute significantly to enhancing the R&D competitiveness of Okinawa and Japan by creating intellectual capital, through technology development and patents, bringing this intellectual capital to market by collaborating with, and transferring technology to industrial partners, both locally and throughout Japan. By transferring technologies to entrepreneurs and businesses, OIST anticipates helping to create new materials, IT, medical therapies, and devices, and to improve other technologies, creating a range of jobs, reducing waste, creating affordable clean energy options, and more. With its international and bilingual environment, interdisciplinary research, and strong commitment from scientists and management, OIST is poised to establish a new model of partnerships between research and industry in Japan.

Dedicated resources

The OIST mission to contribute to the economic foundation of Okinawa is centered in the Office for Sustainable Development of Okinawa. This Office has a broad range of responsibilities to enable transfer of research discoveries at OIST into innovation in the marketplace. The Office presently consists of two sections, the Business Development Section (BDS) and the Technology Licensing Section (TLS). These sections are dedicated to implementing OIST's mission to contribute to sustainable development in Okinawa through collaborations with industry that also benefit the research and educational activities of OIST. The BDS seeks to foster an institutional network between the University and industrial partners in Okinawa, Japan, and abroad. The collaborative environment of this network encourages contact among researchers, facilitates negotiations for technology transfer, and generates opportunities for industry-sponsored joint research projects. This section also organizes workshops and seminars for the OIST community of researchers, students, and staff members to raise awareness of the challenges and excitement of entrepreneurial development.

The TLS is dedicated to building a strong IP portfolio and to managing contractual aspects of technology transfer to industry (see Section 2.3.7). These two sections work closely. Importantly, the activities to encourage entrepreneurial and industrial collaboration at the University are carried out so as not to compromise the focus on basic research.

Outreach activities for business development

The BDS organizes many outreach activities. A key example is participation in industrial fairs and exhibitions, which has the goal of building a network of industrial partners to facilitate collaborations and future technology transfers. For the last three years, in October, OIST has sponsored a booth at BioJapan, which is considered to be the premier event in Asia for the global biotechnology industry. OIST coordinated its attendance with other Okinawan participants to enhance the visibility of opportunities for innovation in Okinawa. Regular participation by OIST and the resulting increased recognition have led to many contacts with private companies from Japan and abroad (Table 2.3.6.1). In addition, OIST attended

Innovation Japan for the first time in August 2013, and Nanotech Japan in January 2014, to promote its research activities in materials science, imaging, etc.

Field	Number
Agriculture	3
Bio	8
Business Association	2
Chemical	2
Construction	1
Drug	41
Energy	6
Environment	15
Finance	11
Information Technology	5
Manufacturing	16
Research Institution	9
Service	1
Transportation	1
Companies	**121**

HQ Location	Number
Okinawa	43
Japan	76
Overseas	2
Total	121

Table 2.3.6.1. Summary of fields of activities and locations of companies with which OIST has official contacts, in view of active collaborations.

Another focus for the BDS is the development of relationships with corporate partners and sponsors. For example, OIST and one of the largest Japanese pharmaceutical companies, Shionogi Inc., of Osaka, signed a Memorandum of Understanding (MoU) in 2010, defining their mutual desire to collaborate in specific areas of OIST research. This MoU was followed by Non-Disclosure Agreements (NDAs) to allow an exchange of confidential information among researchers at meetings held both at OIST and at Shionogi.

OIST has signed NDAs with five private companies. The most recent was concluded in 2014 with the largest Japanese developer and manufacturer of automotive parts and systems. Information exchanges are now being held to identify collaboration opportunities between OIST and various R&D groups within this large and diversified company. One area of research has already been identified will be formalized in a Joint Research Agreement.

OIST is already involved in twelve joint research projects with six Okinawan companies, and one private industrial foundation located in mainland Japan. Collaborations between OIST and Okinawan companies are actively promoted and supported financially by the Okinawa Prefectural Government (OPG) via competitive grants specifically aimed at such academic-industrial R&D collaborations. These grants also encourage multilateral partnering between local industries and higher education institutions (e.g., OIST, University of the Ryukyus, Kosen, etc.).

In 2014, the BDS experimented with a new approach to stimulating collaborative research opportunities, which consists of selecting areas with strong economic potential that have many technical uncertainties or challenges where the research strength of OIST may contribute greatly. OIST organizes an international symposium on campus, inviting representatives of academic institutions, industry, and government to share expertise and to develop collaborations. Such areas for technology development are selected after careful consideration of their relevance to Okinawan needs, OIST research strengths, and the interest of OIST researchers to participate.

In the first such event, OIST and Sony Computer Science Laboratory co-organized the "International Open Energy Systems Symposium" in the field of renewable energy management for regions not connected to the main energy grid. One hundred and forty external participants (5 from international companies, 135 from Japanese companies, local government, and universities) gathered at OIST to discuss challenges, opportunities, and future collaboration in the field. A second, expanded symposium in this area is planned, and others are under consideration.

Entrepreneurship

It is also natural for OIST to participate, as a key regional scientific innovator, in the collective effort to develop entrepreneurship in Okinawa. Over the last two years, the BDS has organized or hosted several events aimed at promoting entrepreneurship in an informal setting (Startup-weekend OKINAWA, SCORE competitions, SAMURAI Venture Summit, Kyued-up workshop (based on the "design thinking" method from Stanford University), Asian Start-ups for Healthcare (ASH) workshop etc.) OIST is also one of two Japanese institutions selected by the Kauffman Foundation to join its Entrepreneurship International Global Network.

Beyond these promotional activities, the BDS also directly supports promising projects stemming from OIST research. Although in many cases technology transfer will be to existing companies, there are situations where it is more appropriate to commercialize an OIST innovation via a newly created company. OIST does not play an active role in the decision to create such a company, but may facilitate the steps toward creating a new venture.

One important example of such support is the establishment of a framework of rules, regulations, and best practices, to help prospective investors in new ventures understand the terms of their interaction with the University. This will enable them to plan and operate under predictable and stable assumptions regarding contractual access to OIST equipment, facilities, IP, etc. Particular attention is also given to avoiding conflicts of interest in research activity or use of University resources, which also helps to prevent encroachment of private interests on OIST's research.

The first start-up company from OIST fostered by the BDS will be established in 2014. This project, in the field of molecular imaging, was among the 27 projects selected from 168 applications in a new program launched in FY2013 by MEXT, the "Start-ups from Advanced Research and Technology "START" Program that funds the pre-inception phase of new start-ups based on Japanese university research. The most direct contribution by OIST to Okinawa

economic development (See Section 3.4) will be its encouragement of spin-off and start-up companies based on OIST research and facilitation of corporate support by the BDS.

2.3.7 Development of an Intellectual Property Portfolio

Building a portfolio of intellectual property to share with commercial partners.

OIST is among the few research institutes established without borders between scientific fields, a philosophy that extends throughout its graduate program, carrying with it the goal of fostering interdisciplinary discovery. To put research discoveries into practice, OIST protects the resulting intellectual property, which then can be licensed to companies that will use this technology to develop and commercialize new products and services. This task is the responsibility of the Technology Licensing Section (TLS) (Figure 2.3.7.1).

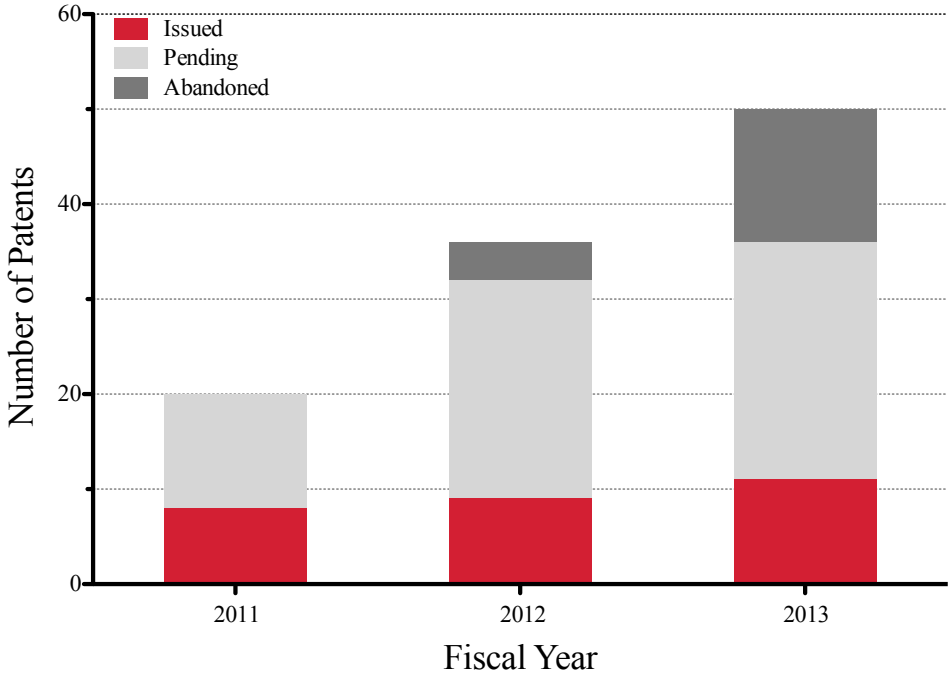


Figure 2.3.7.1. Evolution of the OIST patent portfolio.

Inventions made by OIST employees and students during the course of their research activity belong contractually to OIST, with a royalty distribution scheme if there is income from licensing. The accumulation of OIST IP starts with confidential disclosure of information by researchers to the TLS. TLS is by design, careful to accommodate various constraints affecting researchers. In particular the TLS protects the focus on basic research and on the publication of research results as early as possible.

The TLS encourages inventors to protect their findings before public disclosure, but researchers retain the freedom to publish without patenting, as stipulated in OIST policy. The TLS provides bilingual support to researchers, organizes IP training seminars, and has established an efficient invention examination procedure involving an international network of patent experts, covering the major fields of research (life science, materials science, physics, informatics etc.).

Each invention considered follows a rigorous procedure for evaluation and decision whether to patent. It is first scrutinized by external patent experts for possible prior art, inventiveness, and non-obviousness. The OIST "Invention Evaluation Committee" then reviews the invention with the researchers, considers opinions of the patent experts, and after a preliminary appraisal of commercial potential, decides whether to proceed further and file a U.S. provisional patent application. This establishes a priority date, while allowing one year to add supplementary information to strengthen the claims (Figure 2.3.7.2).

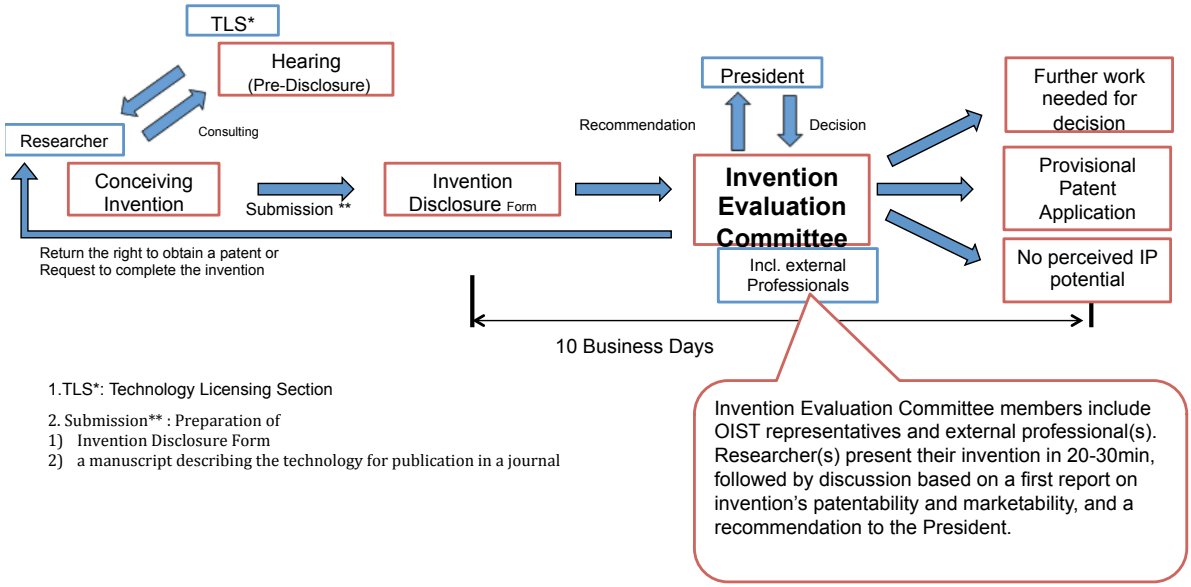


Figure 2.3.7.2. Process for filing a U.S. provisional patent application.

Tracking and managing multiple deadlines is among the biggest challenges in administrative management of an IP portfolio. A missed deadline may have dramatic consequences, such as loss of IP ownership. A professional patent-data-management system was introduced in 2014 to cope efficiently with the increased number of OIST invention disclosures and patent-related actions. In order to cover the entire process, from technology scouting to licensing, this software is modular. This is the first implementation of such a system in a Japanese university.

Maximizing licensing opportunities and return on an IP portfolio: market intelligence, applied R&D research and proof of concept.

Dedication to basic research means that in general, inventions and discoveries are far "upstream" in the long process to product commercialization. The potential commercial value of an invention is not always obvious or easy to demonstrate. Often this requires additional applied research to provide a "proof of concept" or a prototype that will interest the R&D managers of companies, who often do not have the necessary resources or expertise to do the required applied R&D research themselves. Researchers need not necessarily be responsible for this applied research activity (although they may choose to), especially if they would prefer to devote their time preferentially to discovery-oriented research. In 2013,

OIST started outsourcing such applied research to reinforce patent claims and to demonstrate their commercial potential (Figure 2.3.7.3).

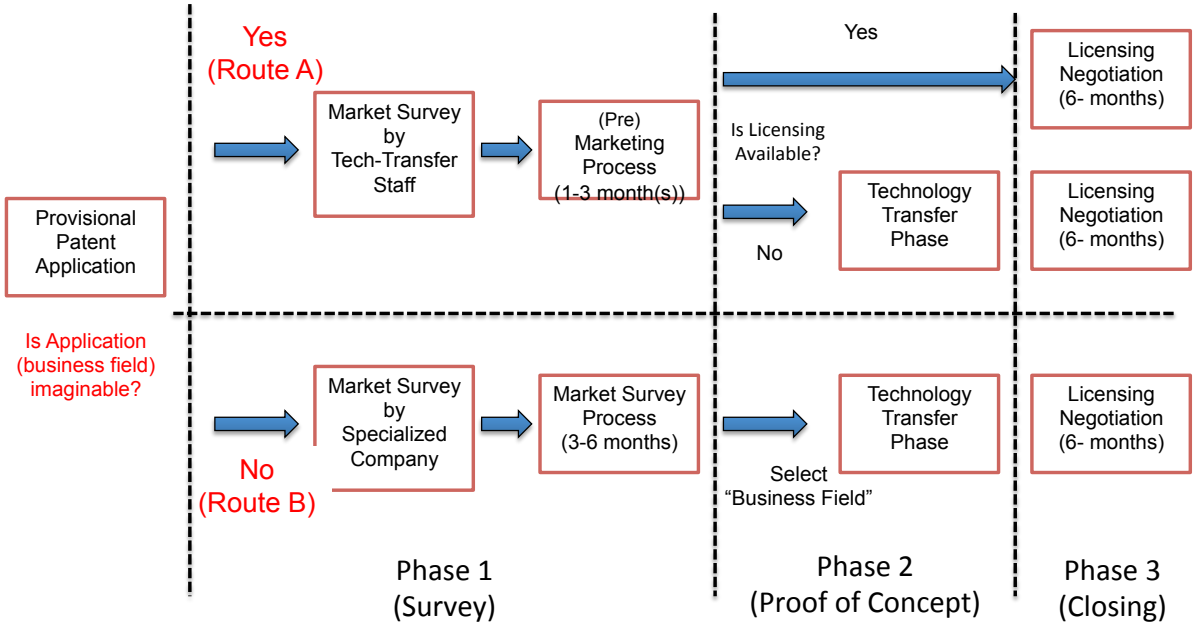


Figure 2.3.7.3. The technology transfer process including proof of concept.

In many cases, applied research for proof of concept or prototyping could be readily carried out on campus, and space has been earmarked in Laboratory 3 for this. This laboratory-based applied research is complemented by commercial R&D market research, which is outsourced to specialized companies. Market research consultants for large corporate R&D activities help to identify potential commercial partners at very early stages in the R&D pipeline. This approach was first implemented at OIST for a patent in the field of material science, and the results are promising.

Contractual and legal support

The TLS is responsible for providing legal support for sponsored research contracts between OIST researchers and industry partners with regard to IP management. No technologies have been licensed yet, but when that occurs, the TLS will provide the necessary support.

The traditional model of industry-sponsored research in Japan is based upon the joint ownership of IP derived from the research. This is not the prevailing model in many parts of the world, where the university owns the IP, although the university may give priority of licensing to the sponsor, under negotiated conditions. Japanese patent law obliges each co-owner to give formal approval in order to license the co-owned patent. This deprives the university of its freedom to operate, particularly in cases where the industrial co-owner decides to not exploit the patent. As a result, university inventions and patents may be blocked from development, and revenues that could potentially be derived are lost for the university. This generates a circular problem in that few universities in Japan have had

enough resources to build and maintain a proprietary IP portfolio, and they rely upon external support from the industry sponsor. OIST is implementing an alternative model of IP management that safeguards both the University's and industry sponsor's interests, while allowing the university to benefit maximally from the IP generated by its researchers.

2.3.8 Sponsored Research

The University is developing sources of funding other than government subsidies, such as sponsored research funds, donations, technology licensing, etc. Sponsored research funds available to the University can be separated into two types, depending on whether the project and the partners involved are industrial or academic (Table 2.3.8.1). In the Research Support Division, the Sponsored Research Section (SRS) deals with funding opportunities for academic research projects, while in the Office for Sustainable Development, the Business Development Section (BDS) supports industrial funding opportunities for R&D projects, as well as basic research projects sponsored by industrial partners.

The main sources of academic research funding opportunities are Japanese since there are relatively few international funding programs. SRS actively supports OIST researchers in their efforts to apply for external funding, such as competitive research grants provided by the Japanese Government or other public funding agencies. SRS also assists researchers with management of the awarded grants.

Responsibilities of the Sponsored Research Section

SRS provides both pre- and post-award support for researchers, which can be summarized into following four components.

1. Pre-award support of grant applications
2. Post-award support of grant management and reporting
3. Assistance to faculty members and researchers in submitting competitive research and development applications
4. Administration of agreements on joint research, material transfer, and visiting researchers, etc.

Pre-award support for individual research includes distributing information on funding opportunities, including translation into English, as well as consultation on research proposal documentation and budgeting.

Post-Award support includes financial management of the ongoing project and close-out report documentation. Administrative support is also provided for joint research agreements with academic partners, material transfer agreements, visiting researcher agreements, and fellowships for individual researchers. Fellowships for post-doctoral researchers are considered a type of competitive sponsored research grant, and both pre- and post-award support for fellowships are also important responsibilities of SRS.

Funding Institution	Nature of Institution	Amount (kJP¥)	Academic-oriented (SRS)	Industry-oriented (BD)
MEXT	Japanese Govt.	17,100	17,100	
MEXT	Japanese Govt.	26,696	26,696	
MEXT	Japanese Govt.	32,140		32,140
Ministry of Internal Affairs and Commun.	Japanese Govt.	1,222	1,222	
NIH, HFSP	Overseas Grants	24,826	24,826	
Nansei Shoto Industrial Advancement	Okinawa Pref. Govt.	8,782		8,782
Okinawa S&T Promotion Center	Okinawa Pref. Govt.	13,020		13,020
Okinawa S&T Promotion Center	Okinawa Pref. Govt.	4,200		4,200
Okinawa Environmental Research	Okinawa Pref. Govt.	9,450		9,450
Okinawa S&T Promotion Center	Okinawa Pref. Govt.	4,200		4,200
Okinawa Prefectural Government	Okinawa Pref. Govt.	2,561		2,561
Okinawa TLO & Tropical Tech. Center	Okinawa Pref. Govt.	3,501		3,501
Japan Science and Technology Agency	Public Organization	1,860		1,860
RIKEN	Public Organization	18,000	18,000	
Technology Res. Assoc. for Next Generation Naural Products Chemistry	Public Organization	12,072		12,072
Canon Foundation	Private Foundation	7,500	7,500	
Japanese Industrial Corp. (confidential)	Private Foundation	6,240		6,240
Sony CLS	Private Foundation	8,206		8,206
Miscellaneous	Miscellaneous	15,153	8,206	6,947
Total		**216,729**	**103,550**	**113,179**

Table 2.3.8.1. Sponsored research in FY2013 by funding source (grants-in-aid not included). MEXT denotes the Ministry of Education, Culture, Sports, Science, and Technology.

The management of academic joint research agreements is an important activity of SRS, which extends beyond responsibilities related to external grants and encompasses comprehensive management responsibilities with external academic partners.

Major sources of research grants for academic research include Kakenhi (grants-in-aid from JSPS), MEXT, JST, JSPS fellowship, the National Institutes of Health (USA), and the Human Frontier Science Program. While OIST is a full member of the Human Brain Project of the European Union FP7/Horizon2020 program, no funding is allocated to non-EU institutes.

As a part of pre-award support, SRS assists groups of researchers in applying for team-oriented research grants and center grants. Similarly, coordinating collaboration and cooperation with academic partners is part of section's support activities.

Providing access to a wide variety of funding opportunities for post-doctoral scholars and faculty members, is fundamental to assisting them in exploring new research directions and developing their careers. Extra effort is required to help non-Japanese researchers, because

for linguistic and administrative reasons, it is more difficult for them to access research funding from Japanese agencies is than for Japanese researchers. Often crucial information for applications only becomes available in English well after it is made public in Japanese. This time delay means less time for conceptualization and writing of grant applications. There are also concerns about the impartiality of the reviewing of applications written in English. Although significant progress has been realized, clear disadvantages remain for non-Japanese researchers. This issue needs to be raised repeatedly with Japanese funding agencies to equalize the opportunities. As a part of the networking effort of SRS, over 20 organizations from Japanese research universities and academic research institutes are starting to share and exchange information translated into English.

Activity of the Business Development Section in sponsored research

The Business Development Section coordinates business-related collaborative and sponsored research through joint research agreements or contract research agreements. For both corporate- and government-sponsored funding, continuous support is provided throughout negotiation process, during the execution of the project, and at the close-out of the agreement. The major government grant sources for OIST are the Okinawa Prefectural Government, MEXT, and METI. Corporate sponsors include both large and small companies. Financial execution is monitored according to regulations for each type of grant and reported to the funding agencies.

2.4 Administration and other Support Functions

Executive Leadership and Administration

The University leadership consists of the President and a team of ten councilors: the Provost, the Vice-Provost for Research, the Special Advisor to the President, the Executive Vice President, the Dean of the Graduate School and the Dean of Faculty Affairs, and Vice Presidents of Administrative Compliance, Buildings and Facilities Management, Finance and Administration, and Communications and Public Relations. Close liaisons with the Cabinet Office and the Ministry of Finance are highly beneficial to the senior leadership at OIST, as are strong ties with the Okinawa Prefectural Government. Staff sizes of administrative sections are shown in Table 2.4.1.1.

Unit	# of Staff	Comment
Office of the President	43	Human Resources, Child Development Center
Office of the Provost	19	Research Support Division, Library, and Information Services
Office for Sustainable Development of Okinawa	18	Business Development and Technology Licensing
Faculty Affairs	4	Hiring and review of faculty members
Graduate School	16	Academic Services and Student Support
Administrative Compliance	9	Government Relations, Rules and Procedures, and Diversity
Finance and Administration	40	Budget, Accounting, Procurement
Buildings and Facilities Management	20	Campus Building, Facilities Management
Communication and Public Relations	19	Conferences and Workshops, Community Relations, Media, and Language Support
Auditor's Office	3	

Table 2.4.1.1. Staff members in administrative units.

Governance

OIST is a private university, constituted as a School Corporation. The Okinawa Institute of Science and Technology Promotion Corporation was established in September 2005 to lay the foundation for a world-class research university. In November 1, 2011, the School Corporation Act effected the conversion of the Promotion Corporation into a School Corporation, with the objective of promoting self-sustaining development of Okinawa, as well as contributing to the advancement of science and technology in Japan and throughout the world. In connection with the passage of this Act, and with prior authorization from the Minister of Education, Culture, Sports, Science and Technology, the Okinawa Institute of Science and Technology School Corporation was established to operate the Okinawa Institute of Science and Technology Graduate University.

The President is appointed by the Board of Governors (BOG). The President and the Provost function as CEO and Vice-CEO, respectively, of the Okinawa Institute of Science and Technology School Corporation. The President is accountable to the BOG.

In fulfillment of responsibilities specified in the OIST SC Act and the OIST Bylaws, the Board of Governors (BOG), which consists mainly of non-executive members, assumes ultimate responsibility for the operation of OIST SC and OIST Graduate University. The Board of Councilors (BOC) reviews corporate operations from the broad perspective of society, including those of the local community. These two Boards will continue to ensure effective and transparent governance of OIST SC in accordance with pertinent Japanese laws and OIST SC Bylaws.The Chairmen of both bodies are selected from their respective memberships.

The CEO/President will continue to execute the business plan. He is accountable to the BOG and the BOC. Auditors of the corporation will conduct rigorous audits to ensure appropriate and efficient operation of the corporation.

2.5 Welfare Functions

OIST will continue to facilitate development of the University community, including not only employees and students, but also their families. Support for families is fundamental to OIST's success. OIST will take necessary measures to control risks, prevent or mitigate disasters, and protect the safety of employees, students, and visitors. OIST will improve the education and childcare environment available to families of OIST employees with enhanced services at the Resource Center and with a new Child Development Center building in the summer.

OIST must support all members of the university community in a comprehensive way. Many universities are experiencing an increase in employee and student visits to campus councilors and clinics. OIST is not immune to employee stress and mental health challenges. For these reasons, OIST is building a Resource Center and a Clinic to proactively promote the physical and mental health of its members. The Resource Center is a gateway to a broad suite of support services for members of the OIST community. Information and assistance for settling in a new country, and even guidance for navigating personal crises can be accessed through the Resource Center. In addition to Health Center nurses and staff, OIST is now recruiting a physician and psychologists to augment professional services. A healthier university community is a more productive community.

2.6 Current Achievements as Measured Against the Primary Mission Goals

2.6.1 Leading-edge Science, Technology, and Education

OIST Graduate University is at the forefront of creating change in how scientific research and education are practiced. OIST hires world-leading faculty and gives them substantial support and considerable freedom to pursue basic research. By avoiding traditional administrative and physical boundaries, and by creating easy access for people to each other and to research equipment, OIST has established a very open and intimate environment, which naturally promotes cross-disciplinary education and research. By establishing these principles OIST has demonstrably met several of its primary mission goals.

Leading-edge Science and Technology

The OIST research program is at the leading edge of science and technology, encompassing the life sciences, the physical sciences, the environmental sciences, and mathematics. OIST's mandate of collaborative, boundary-free research is built into every element of the campus design and layout. Flexible workspaces and shared major research instruments keep disciplines from becoming too insular. Detailed information on the current status of research at OIST can be found in Section 2.1.1 of this document.

Recruitment of world-class faculty was a fundamental objective in establishing the university and meeting its primary mission goals. There are currently 48 research units at the university (Table 2.6.1.1).

Faculty Member	Unit Name
Gordon Arbuthnott	Brain Mechanism for Behavior Unit
Mahesh Bandi	Collective Interactions Unit
Sydney Brenner	Molecular Genetics Unit
Thomas Busch	Quantum Systems Unit
Pinaki Chakraborty	Fluid Mechanics Unit
Keshav Dani	Femtosecond Spectroscopy Unit
Erik De Schutter	Computational Neuroscience Unit
Kenji Doya	Neural Computation Unit
Evan P. Economo	Biodiversity and Biocomplexity Unit
Eliot Fried	Mathematical Soft Matter Unit
Gustavo Gioia	Continuum Physics Unit
Igor Goryanin	Biological Systems Unit
Shinobu Hikami	Mathematical and Theoretical Physics Unit
Hiroki Ishikawa	Immune Signal Unit
Holger Jenke-Kodama	Microbiology and Biochemistry of Secondary Metabolites Unit
Hiroaki Kitano	Open Biology Unit
Denis Konstantinov	Quantum Dynamics Unit
Bernd Kuhn	Optical Neuroimaging Unit

Faculty Member	Unit Name
Julia Khusnutdinova	Coordination Chemistry and Catalysis Unit
Nicholas M. Luscombe	Genomics and Regulatory Systems Unit
Tatiana Márquez-Lago	Integrative Systems Biology Unit
Ichiro Maruyama	Information Processing Biology Unit
Ichiro Masai	Developmental Neurobiology Unit
Alexander Mikheyev	Ecology and Evolution Unit
Jonathan Miller	Physics and Biology Unit
Satoshi Mitarai	Marine Biophysics Unit
Síle Nic Chormaic	Light-Matter Interactions Unit
Mary Ann Price	Developmental Signalling Unit
Yabing Qi	Energy Materials and Surface Sciences Unit
Fadel Samatey	Trans-Membrane Trafficking Unit
Noriyuki Satoh	Marine Genomics Unit
Hidetoshi Saze	Plant Epigenetics Unit
Nic Shannon	Theory of Quantum Matter Unit
Amy Shen	Micro/Bio/Nanofluidics Unit
Tsumoru Shintake	Quantum Wave Microscopy Unit
Robert Sinclair	Mathematical Biology Unit
Ulf Skoglund	Structural Cellular Biology Unit
Mukhles Ibrahim Sowwan	Nanoparticles by Design Unit
Greg Stephens	Biological Physics Theory Unit
Tomoyuki Takahashi	Cellular and Molecular Synaptic Function Unit
Fujie Tanaka	Chemistry and Chemical Bioengineering Unit
Gail Tripp	Human Developmental Neurobiology Unit
David Van Vactor	Formation and Regulation of Neuronal Connectivity Unit
Jeff Wickens	Neurobiology Research Unit
Matthias Wolf	Molecular Cryo-Electron Microscopy Unit
Tadashi Yamamoto	Cell Signal Unit
Mitsuhiro Yanagida	G0 Cell Unit
Yoko Yazaki-Sugiyama	Neuronal Mechanism for Critical Period Unit

Table 2.6.1.1. Names of OIST professors and research units.

The number of academic publications and the numbers of presentations made at international scientific conferences has been increasing rapidly (Figure 2.6.1.1).

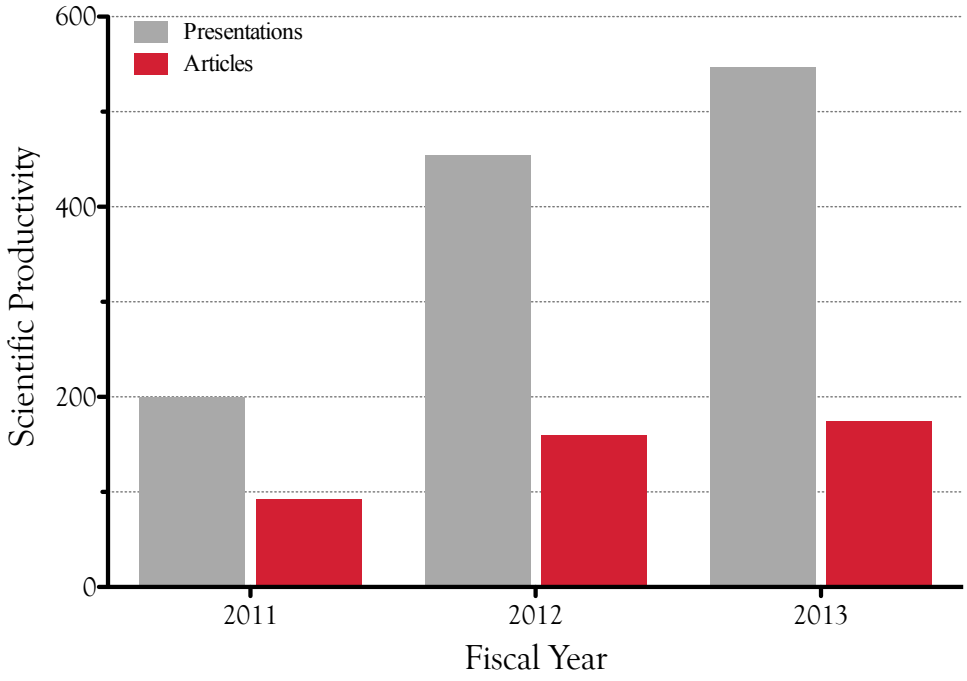


Figure 2.6.1.1. Numbers of academic publications (journal articles and book chapters) and presentations at international scientific conferences (invited lectures and poster and oral presentations) by OIST researchers from FY2011 - FY2013.

In addition to international scientific conferences that OIST researchers attend, OIST Graduate University also hosts international conferences and workshops. The frequency of such events has increased steadily as OIST's faculty has increased in size and as the institution's professional stature has grown (Figure 2.6.1.2).

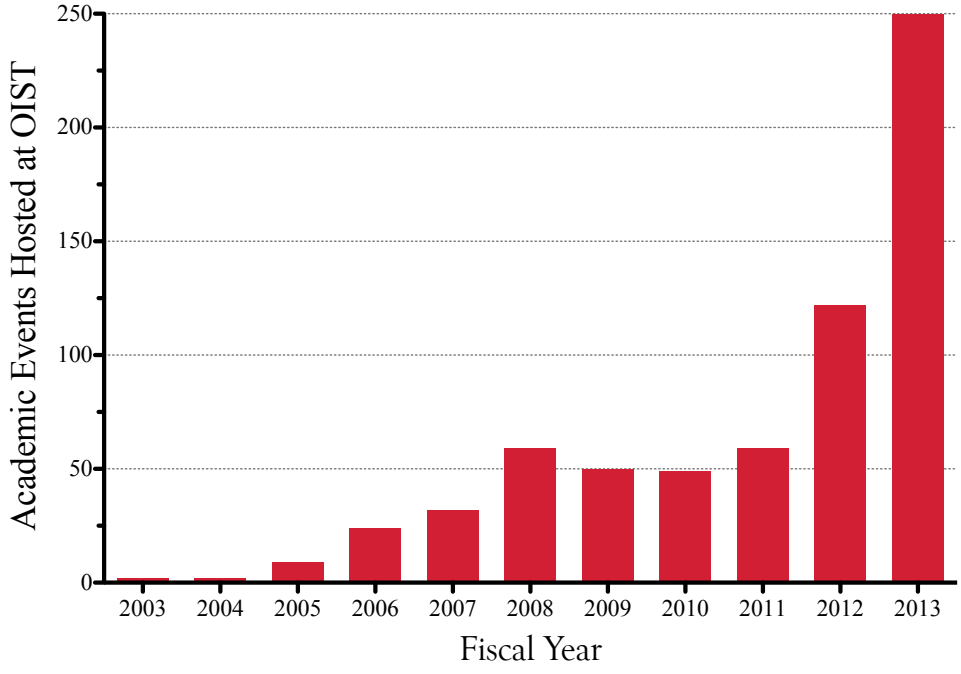


Figure 2.6.1.2. Academic events at OIST from 2003 – 2013. These include workshops, seminars and lectures, training symposia, colloquia, public lectures, joint symposia, academic events sponsored by external institutions or entities, but hosted by OIST, etc.

International Networking

Establishing international research collaborations is one of OIST Graduate University. These efforts are progressing well and OIST's collaborators come from across the globe (Figure 2.6.1.3).

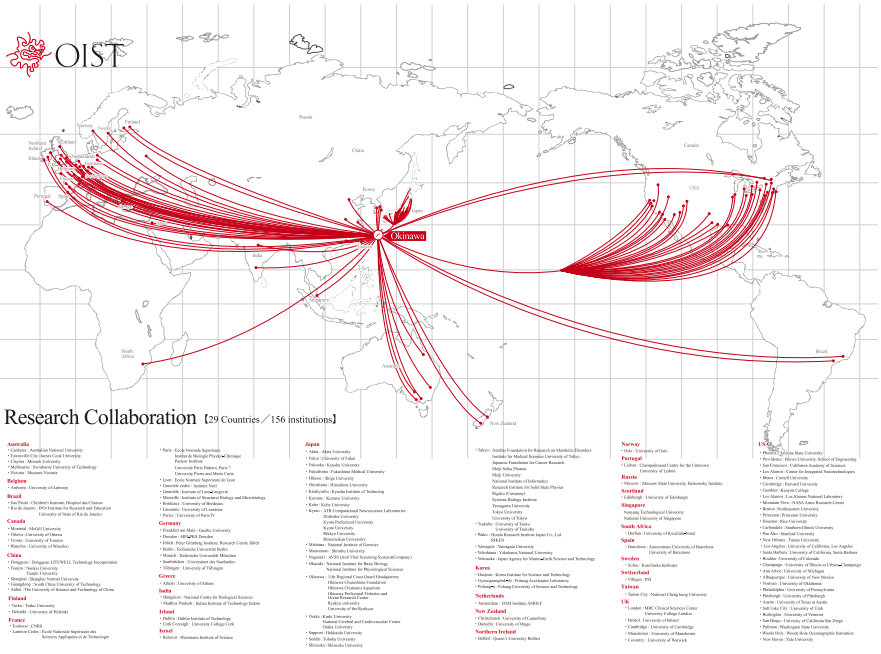


Figure 2.6.1.3. International research collaborations in which OIST is presently involved.

Workshops

An essential part of OIST's research activities is the workshop program. OIST Funded Workshops are used as a vehicle to provide training in advanced scientific techniques and to share new discoveries at the cutting edge of science. One of the main goals is to expose participants to a wide range of scientific approaches and a broad overview of the field of research. By inviting some of the most prominent researchers from around the world, and offering eager workshop participants the opportunity to be exposed to that latest advances in science, OIST Workshops strive to become a hub for scientific exchange between Asia and the rest of the world. Between FY2003 - FY2013 more than 4000 participants and lecturers from more than 50 countries/regions around the world participated at OIST Workshops.

The number of applications for participation in OIST Workshops demonstrates the rising popularity of the workshops and the increasing recognition of OIST as a world-class university (Figure 2.6.1.4). An example is the Okinawa Computational Neuroscience Course, which celebrates its 10th anniversary in 2014. This workshop received 224 applications from around the world for 29 available slots. Furthermore, OIST Workshops have also contributed to the recruitment of researchers. Some lecturers invited to earlier OIST Workshops have become members of the OIST faculty.

Figure 2.6.1.4. Origins of OIST workshop participants.

Innovative Education

OIST has built a graduate program to attract the highest quality students from within Japan and around the world, placing OIST at the forefront of international interdisciplinary science education and research. The 55 graduate students come from 23 different countries on four continents, demonstrating that OIST is already a known presence in the international science education community. OIST is training a new breed of students and young researchers to become future leaders in the global world of academia and/or industry—young talent that is receiving strong disciplinary training while additionally being exposed to a truly multidisciplinary experience that challenges them to bridge the boundaries between the physical and life sciences.

As a university that grants exclusively graduate degrees, students undertake an individualized program leading to a Ph.D. The education is tailor-made for each student based on his or her needs and interests. Students are assigned an experienced faculty member to act as mentor, guiding them until they choose a thesis lab. Students take a customized schedule of classes in the first two years while simultaneously beginning research. Students can also work with an OIST professor in guided independent study if a particular scientific topic is not available as a class. With a faculty to student ratio of 2:1 students benefit from easy access to faculty expertise.

In the first three terms, students conduct a research project in different labs. Typically, two rotations fall within their chosen field, perhaps theoretical and experimental physics, and one far outside of it, such as ecology. This opportunity is facilitated by the lack of traditional departmental boundaries at OIST and the collaborative environment within the university. In the second year, students define their Ph.D. directions and begin work on their dissertation research.

International Program

OIST is redefining what it means to be an international university. With a requirement that at least half the faculty and students come from outside of Japan, OIST is paving the way as a model for tomorrow's global university. With over 45 countries represented, the

university benefits greatly from the diversity built into its foundation (Figure 2.6.1.5). OIST is following in the rich cultural traditions of the Okinawan people, who have a history of international relations stretching back for centuries.

At OIST the language of instruction and research is English and around half of the faculty, researchers, and graduate students come from outside of Japan, providing excellent preparation for a career as a scientist in the international research community. The academic year begins in September, making the school year match international programs. Students are encouraged to develop professional skills, travel internationally to keep abreast of new developments, disseminate their research findings, and tap into the extensive networks of the international OIST faculty members. These qualities will develop future career opportunities in leading research institutes and universities worldwide.

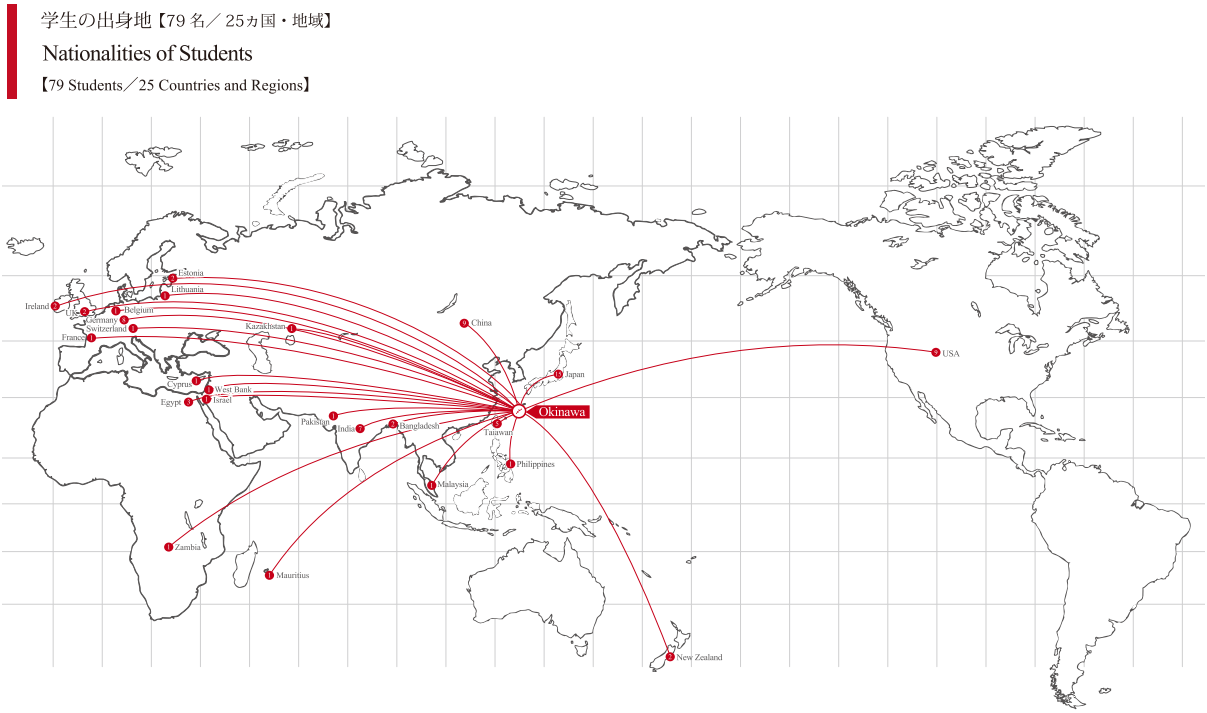


Figure 2.6.1.5. Nationalities of OIST graduate students.

Independent Student Research

Considerable freedom is provided in the choice of thesis topics. Interdisciplinary collaboration, fostered by the emphasis on cooperation and interaction, is built into the architecture of the state-of-the-art laboratory buildings, which provide an outstanding environment for modern-day research and education. Access to this equipment and faculty studying a wide array of topics creates new avenues of unique interdisciplinary research for students.

Seminars and courses bring researchers from around the world to OIST on a regular basis. Students have exciting opportunities to interact with leaders in research from around the world and meet other students and postdocs at the many international workshops and courses held at OIST.

Interdisciplinary

OIST has a single academic graduate program promoting collaboration and interaction across traditional barriers and between disciplines. Students receive a firm foundation in their core discipline, but special emphasis is also given to ensure an education that is interdisciplinary. This is highlighted by the mandatory laboratory rotation that students have in a field that is outside their research subject.

The absence of academic departments, a policy of broad access to all research equipment, and shared common space for faculty-led research units from widely differing disciplines remove traditional barriers to collaboration and promote cross-disciplinary research opportunities.

2.6.2 Sustainable Development of Okinawa

Woven into the fabric of OIST's core mission is the aspiration that it will contribute to the socio-economic prosperity of Okinawa, historically the most economically disadvantaged prefecture in Japan. However this process will take time and will need to be carefully nurtured. OIST has taken several important steps to initiate this development.

Like components of an ecosystem, the success of OIST and Okinawa are interconnected. OIST is committed to enhancing Okinawa's innovation infrastructure by fostering an internationally competitive R&D cluster, a hub of world-class education, research, and industry that is intimately connected to the local and global economies. The downstream benefits of fostering an R&D cluster are new jobs, a continual flow of diverse people and creative ideas, dynamic ventures, and novel products that meet changing global needs.

Since 2010, OIST has been working shoulder-to-shoulder with key stakeholders, leading discussions and strategic planning efforts for transforming Okinawa's socio-economic outlook, and by extension that of Japan and the Asia-Pacific region.

Timeline and Milestones

2010-12 OIST organized 2 workshops in which 81 leading cluster experts from 7 countries generated 83 ideas to foster innovation and to establish an international R&D cluster in Okinawa.

2012 Memoranda of Understanding (MOU)s were formalized for OIST-government and OIST-academia partnerships for R&D cluster development.

The Okinawa Prefectural Government promoted the international R&D cluster concept in the "Okinawa 21st Century Vision Basic Plan," its 10-year policy document.

2013 The Japanese government promoted the international R&D cluster concept for Okinawa in its "Basic Policies for Economic and Fiscal Management and Reform."

OIST assembled a Task Force composed of academic-government-industry stakeholders to establish an autonomous Promotion Organization, responsible for planning, coordinating, and executing the international R&D cluster

vision. The task Force formed 3 working groups and conducted 3 meetings in FY2013.

2014 OIST will organize a symposium with Sony on sustainable energy, an area where Okinawa, its R&D institutions, and Japan's high-tech industry can combine their collective strengths to build global expertise.

Startup

The first startup company originating at OIST will be launched in FY2014. This will be the first step toward achieving OIST's goal of contributing to the self-sustaining development of Okinawa and to the development of science and technology in the world. The venture company will use electron tomography technology invented by Prof. Ulf Skoglund, which integrates cryo-electron microscopy and an original 3-D reconstruction program. It will enable, for the first time, imaging of the structural dynamics of proteins at a molecular level. The venture company will provide novel types of data that can be used for drug development by pharmaceutical companies.

Establishing the patenting procedures

In 2011, the Technology Licensing Section (TLS) was set up to patent inventions and commercialize OIST technologies (Figure 2.6.2.1). To manage the many inventions generated at OIST, TLS has established procedures for effective patenting. The proactive and English-based patenting procedure enables patent protection in major markets all over the world. This procedure uses a U.S. provisional patent application and a subsequent Patent Cooperation Treaty (PCT), which is an international, non-provisional application to secure the filing date, followed by patenting in individual countries including Japan. In addition, the global patenting process is expedited using the Patent Prosecution Highway, a fast track examination of patent applications that was recently introduced by Japan and is now becoming the world standard.

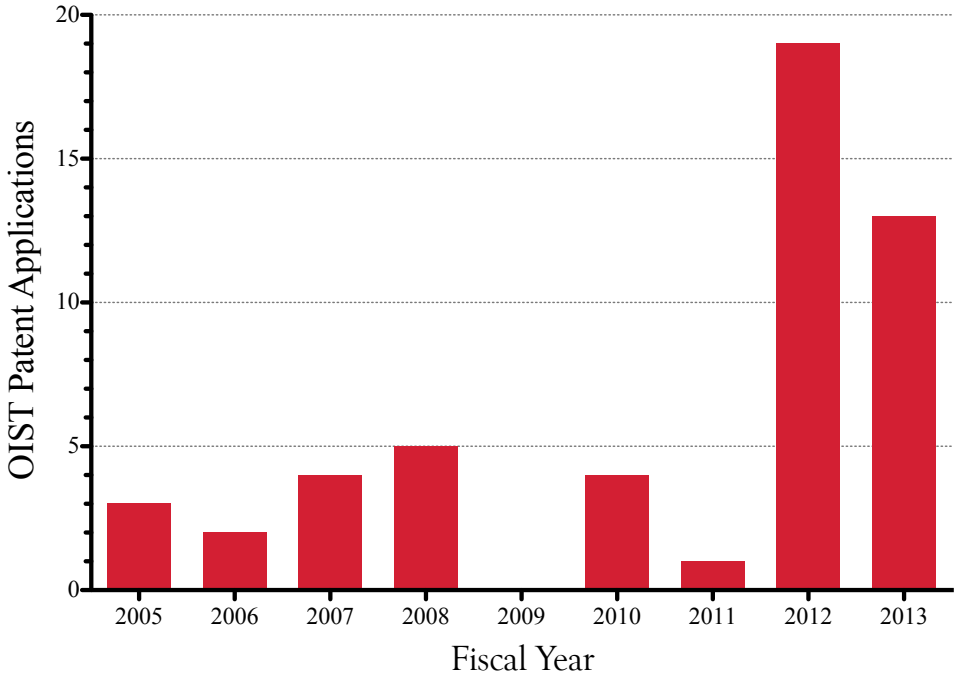


Figure 2.6.2.1. Increasing numbers of OIST patent applications by fiscal year.

Intellectual Property management system

OIST is not interested in owning patents, but rather in using them to commercialize academic achievements as tangible products that contribute to society. This focus is also reflected in the software used to manage intellectual property at OIST. Unlike typical software from Japan, its strength lies in managing licensing. Although OIST is the first user of this software in Japan, it is commonly used in university technology licensing offices abroad.

Maturing Patents

The responsibility of the TLS is to unleash the inherent potential of OIST inventions and ensure that the task is not left to individual researchers. To overcome the gap between academic inventions and technologies that can be commercialized, TLS actively engages in developing early-stage inventions by organizing both domestic and overseas companies to perform necessary assays or simulations. This process has already matured individual inventions into strong patent applications. Lab 3, the third laboratory building now under construction, will offer incubation space for industrial partners and future startups.

Marketing and Networking

In 2011, the Business Development Section (BDS) was established to further promote academia-industry relations. One of its main roles is to strengthen relationships with industry through joint/collaborative research projects. To conclude an agreement with a private partner is a long process, and the first step was to make OIST visible to industry. The BDS routinely goes to exhibitions inside and outside Japan to speak face-to-face with potential licensees, venture capitalists, patent attorneys, and other university licensors. The BDS actively seeks one-on-one partnering using private meetings at major exhibitions including Bio Japan and Nanotech Japan. OIST also welcomes industry associations and individual companies to the campus to see and hear about OIST's research. Several visits have resulted in agreements, demonstrating that this method works well and will be useful in the future as the number of visitors grows. Currently, OIST is in contact with 121 companies in various fields.

Motivating OIST researchers and local talent toward commercialization

In 2012, with support from the Okinawa Prefectural Government and the Okinawa Prefectural Federation of Chamber of Commerce and Industry, OIST was selected as one of the inaugural members of the Kauffman Global Partners Network. The network is supported by the Kauffman Foundation, based in Kansas City, and is one of the largest foundations in the U.S. devoted to entrepreneurship. Since then, OIST has hosted various workshops related to entrepreneurship.

Human capital has an important role to play in the development of a sustainable economy in Okinawa. Young people on the island must have ambition if they are to work in scientific careers. To that end , OIST carries out large numbers of community relations activities.

Campus Visits

OIST is open to the public 365 days a year. Guests can take a guided campus tour, or they can just walk onto the campus. OIST encourages Okinawans to feel that OIST is part of their community. From FY2011 to FY2013, the number of visitors to the OIST campus increased from 10,565 to 39,984 (Figure 2.6.2.2).

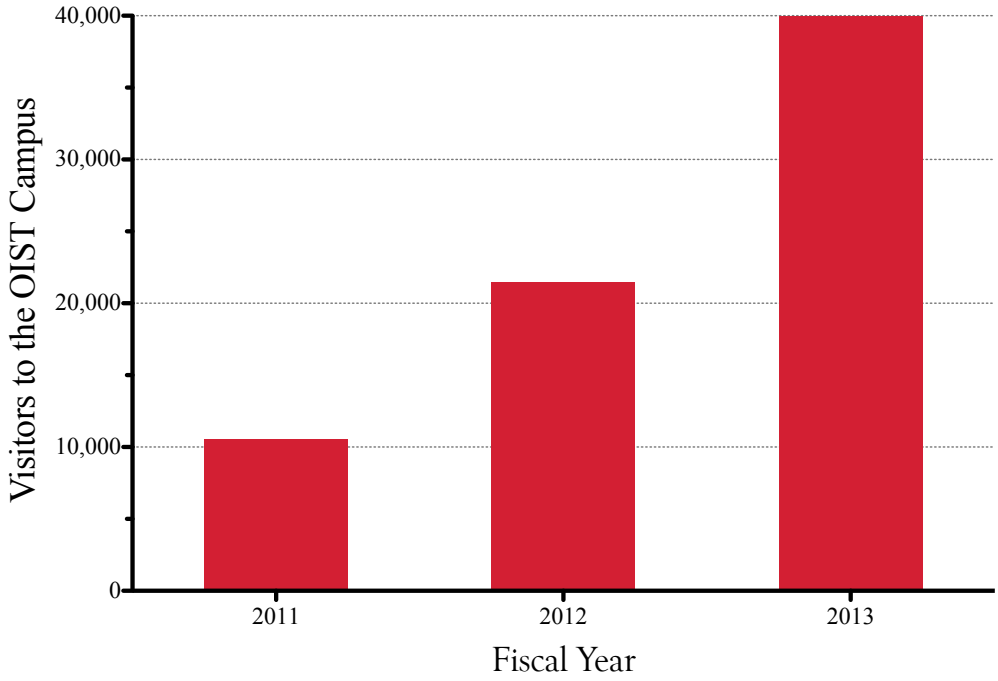


Figure 2.6.2.2. Visitors to the OIST campus during FY2011 - 2013.

Each year OIST sponsors a large community service and public relations event called "Open Campus." The public is invited to this family-oriented function during which OIST professors and researchers give lectures and put on science demonstrations for all age groups. Open Campus has been growing in popularity year-by-year (Figure 2.6.2.3).

Academic Programs

OIST has given many lectures at local schools and public events involving the members of the Board of Governors, OIST faculty members, OIST researchers, as well as prominence lecturers from all over the world. Also, OIST has organized several science programs for young people including; OIST Open Campus, Children's School of Science, SCORE!, and local science events. These activities are part of our effort to raise the interests of youth in science and technology, and to promote the graduate university to local communities. In addition, OIST runs a program to encourage all the local high school students on Okinawa to visit the campus to better understand the graduate university's purpose, goals, and activities in hopes of inspiring more young people on Okinawa to consider careers in science and other international fields.

Cultural Programs

In order to OIST to be a part of local community, the university promotes cultural events involving local artists such as Jazz Concerts, Classical Concerts and Art Exhibitions. These

activities are to establish opportunities to local artists to perform/exhibit their talents, as well as to give opportunities to many local people to come visit to OIST to enjoy art. OIST staff also participate in local events such as, dragon boat races, softball and volleyball games.

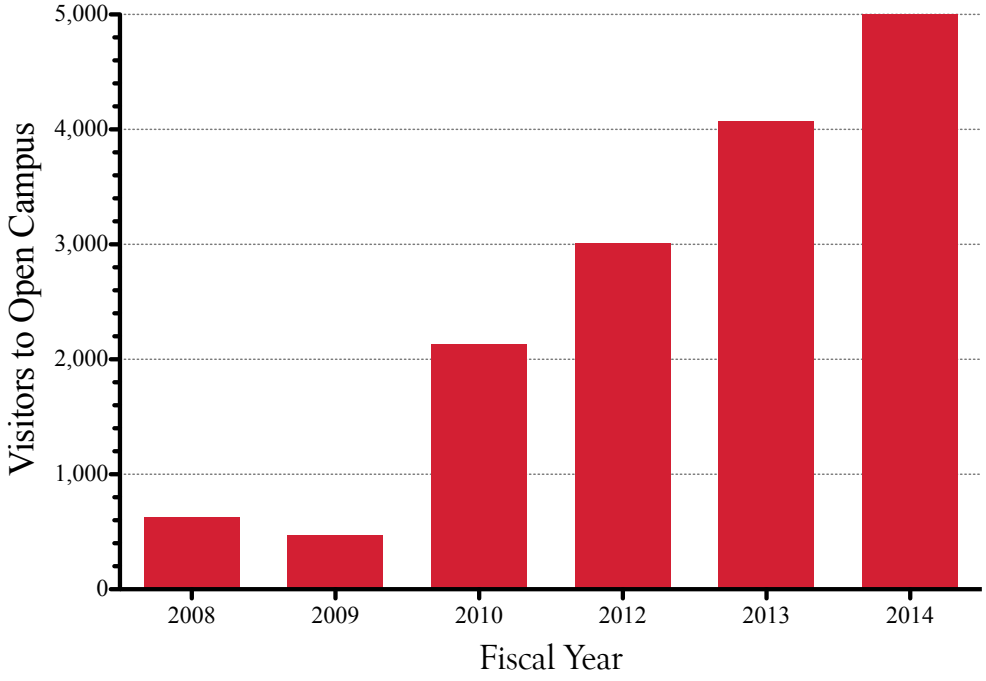


Figure 2.6.2.3. Visitors to the annual OIST Open Campus.

2.6.3 A Great Impact on Japanese Universities

OIST has already achieved internationality and flexibility, two of the central concepts mandated in its founding documents Since the Ministry of Education, Culture, Sports, Science, and Technology (MEXT) is encouraging all Japanese graduate schools to increase internationality and credibility, OIST is a good model for other universities in Japan.

International

The founding documents direct that "more than half of the faculty and students will be non-Japanese, and that English, as the international language of science and technology, will be the University's official language."

As of May 1, 2013, the percentage of foreign faculty members in Japanese universities generally was only 4.0%, while that at OIST was 68.9% (Table 2.6.3.1). In order to facilitate recruitment of foreign faculty members, OIST, unlike other Japanese universities, adopted annual salary and tenure-track systems for young faculty to do research independently, both of which are prevalent in North America.

	National	Public	Private	Total	OIST
Number of Full-time Professors	63,218	12,871	102,580	178,669	45
Number of Foreign Professors	2,147	492	4,436	7,075	31
Percentage	3.4%	3.8%	4.3%	4.0%	68.9%

Table 2.6.3.1. Percentage of non-Japanese professors at OIST and other Japanese universities.

As of May 1, 2013, the percentage of foreign students in Japanese graduate schools collectively was 16.4%, while 84.8% of OIST's graduate students were foreign. The percentages at the University of Tokyo, Kyoto University, and Tokyo Institute of Technology were 18.5%, 13.0%, and 17.8%, respectively (Table 2.6.3.2). In order to facilitate enrollment of foreign students, OIST adopted a school year starting in September, which is the most prevalent schedule worldwide, but different from the Japanese system. OIST's achievements on these counts have already surpassed the original goals, "that more than half of the faculty and students will be non-Japanese," giving OIST a distinctly international character that other Japanese universities do not possess.

	National	Public	Private	Total	OIST	Univ. of Tokyo	Kyoto Univ.	Tokyo Tech
Number of Graduate Students	152,338	16,161	86,887	255,386	33	12,559	9,323	5,101
Number of Foreign Students	25,549	1,842	14,430	41,821	28	2,318	1,212	910
Percentage	16.8%	11.4%	16.6%	16.4%	84.8%	18.5%	13.0%	17.8%

Table 2.6.3.2. Percentage of foreign graduate students at OIST and other Japanese universities.

At OIST, English is the official language not only in education and research, but also in administration. The university website is one of the few entirely bilingual websites in Japan. This truly international environment was created where Japanese and non-Japanese staff and students can interact without barriers.

Also, OIST provides careful support for non-Japanese staff and students regarding their personal lives, including operation of the Child Development Center, which provides a bilingual pre-school, and after-school/holiday programs. Based on these practices, international community was already built in OIST campus.

Interdisciplinary

OIST's founding documents directed it to "establish an interdisciplinary academic structure, and treat every student as a unique individual." OIST has only one graduate school and major in order to develop interdisciplinary program unrestricted by traditional discipline boundaries. Faculty members are interspersed throughout the lab buildings without regard to discipline. There are no precedents for this approach in Japanese graduate universities, where one major covers diverse fields, including Neuroscience, Molecular, Cell, and Developmental Biology, Mathematical and Computational Sciences, Environmental and Ecological Sciences, as well as Physics and Chemistry.

Students prepare individualized course plan optimally combining coursework and laboratory rotations with the support of an Academic Mentor appointed to each student. In the first year, students broaden their horizons by rotating through three different research units, of which one is from outside the applicant's field. These practices parallel MEXT policies to promote substantial improvement of graduate courses including strengthening of course works.

Leading management style

OIST has been managed by strong leadership from the Board of Governors and the President, who enjoy amicable and productive relations with the Faculty Assembly. Some Japanese universities have difficulty starting new institution-wide initiatives because of contentious relationships with their Faculty Assemblies. Therefore, MEXT is now planning to revise the related Act to strengthen the leadership of the President in other institutions. From the side of university management, OIST is also a good model for other Japanese universities.

OIST respects gender equality. The present ratios of female faculty and female students at OIST are a bit higher than those at other science departments in Japan; however, they are still far lower than international standards, OIST is undertaking new initiatives to improve the situation. As in other regards, OIST will soon lead other Japanese universities from the standpoint of gender equality.

Chapter 3. Expansion of the Graduate University

3.1 Expansion of OIST Graduate University: A Compelling Need

OIST is an extraordinarily bold vision by the Japanese Government to establish a world-leading science and technology graduate university in Okinawa. Conceived in the early 2000s and developed through the mid 2000s, the vision became a reality with the passing of the OIST School Act in July 2009. Accreditation by MEXT followed in October 2011, and the University began operation in late November 2011. In September 2012, the first class of 34 graduate students began their Ph.D. studies. By any standard, the realization of the Government's vision has been achieved at blistering speed.

The defining document for the governance and operation of the University has been the Framework Document, which was developed with great care over several years and finalized in 2008. Strongly guided by the example of the highly successful California Institute of Technology (Caltech), the Framework Document foresaw about 300 professors as the goal for the eventual size of OIST. The base of 300 professors at Caltech allows sufficient breadth and depth in key areas of the natural sciences to facilitate effective interdisciplinary education and research, while at the same time being small enough to permit flexible administration, better optimized resource utilization, and the ability to respond quickly to changing scientific imperatives. With 300 faculty units, Caltech has been able to pursue a cutting-edge, discovery-oriented basic science program that nonetheless produces highly innovative technology transfer and economic growth for the benefit of humankind. The Weizmann Institute of Science, a graduate university in Rehovot Israel, has an extremely impressive record of accomplishment in the basic sciences and is one of the world-leading technology transfer "engines." As of 25 years ago, the Weizmann deliberately capped its growth when it reached just under 300 professors. Both of these institutions began by first establishing a high-quality base from which they could successfully grow to their current size. The OIST Framework Document took a very similar approach, focusing on an initial phase comprising 50 faculty units, 300 researchers and 100 graduate students.

OIST Graduate University has made an outstanding start, attracting attention both domestically and internationally. Articles in *The Economist*, *Science,* and *Nature* have described a unique institution dedicated to supporting cutting edge research and high quality graduate education. Knowledgeable academics across the world are pointing to OIST as a leader in creating a novel and exciting approach to graduate education and interdisciplinary research. A scant three years into its initial phase, 48 outstanding faculty from around the world have been hired and are operating successful research units in Okinawa. Very high quality students have been recruited to OIST along with a vibrant group of postdoctoral scholars. More than 40 nations from five continents are represented in what has rapidly become one of the most culturally diverse campuses worldwide. A highly stimulating intellectual and culturally diverse environment has been created and the campus is abuzz with visiting researchers from around the world. OIST is on track to meet its goal to recruit at least 100 graduate students within the first five years.

Completed research has been published in top international journals. Contacts with more than 40 companies have been made, with various levels of engagement. One start-up

company is being formed, based upon exciting results from the research of an OIST professor. Collaborations have been formed with other researchers in Okinawa as well as throughout Japan and the rest of the world. OIST is leading a Research and Development Task Force that involves Okinawan, Japanese, and international leaders to reinforce OIST's efforts to ensure that social and economic benefits accrue from its activities. Substantial intellectual property is being created, as evidenced by the growing number of patent applications. The Minister of State for Okinawa and Northern Territories Affairs, in a letter to the Chair of the OIST BOG on April 8th 2014, said that, as part of future expansion, it "is also important for OIST to become an international base for innovation." The expectation that OIST will play a vital role in moving Okinawa and Japan into a more knowledge-based economy is high.

It has, by all measures, been a very successful beginning. All the critical elements that comprise a mature research and educational institution have been put in place and are operating effectively. The University has successfully been able to achieve its goals while insisting on excellence as the standard for all its endeavors. Yet as successful as OIST Graduate University has been, the limitations of its current size are already apparent and it is time to begin the process of expanding the University. This can be achieved with confidence, knowing that the base from which the University will grow is fully formed.

Why is growth needed now? Why not wait? There are many reasons, all of which compel an immediate start. First, OIST has great momentum and a strong taste of success. This has happened at a time when many of the world's leading academic communities are unable to absorb all of their best talent, which makes this is a very opportune time to capture outstanding researchers for OIST. But this opportunity will not last for many more years.

Second, while there is very exciting inter-disciplinary research emerging at OIST, golden opportunities are missed because OIST does not have enough breadth or depth in the disciplines of its faculty. This is not a surprise, but simply a symptom that OIST is still too small. OIST is under-represented in key sub-disciplines like marine science, structural and molecular biology, neuroscience, microbiology, pure and applied mathematics, statistics, computer science, including artificial intelligence, robotics, data-mining, bioinformatics, atomic physics, condensed matter physics, accelerator physics, radiation physics, oncology, several key areas of chemistry, and clinically-oriented science and technology. There are several areas of applied science where OIST has no strength. OIST is currently under-represented in the area of innovative academic engineers. Some areas of high profile science, like nanoscience and brain science, require developing teams of scientists from many fields working together in order to be successful. In such areas, OIST will have to follow this path if it is to be competitive.

Third, OIST's smallness limits the likelihood of achieving a truly sustainable and world-competitive R&D cluster in Okinawa. At its current size, the amount of intellectual property OIST could realistically produce will be limited, even if it has very high levels of innovation. Nor does OIST have sufficient engineers and technicians to help turn innovative ideas into marketable products.

Fourth, OIST's educational program needs broadening. Excellent student candidates who are very keen to join OIST, are lost because they do not see a professor working in the area(s) that they wish to pursue. The limitation in the OIST faculty's depth and breadth poses challenges in delivering sufficient core courses. Even relatively well-represented areas like neuroscience, molecular and cellular biology, and physics are under-represented in the curriculum in terms of the range of courses that can be offered.

What limits the rate at which OIST could grow? The main growth-limiting factor is the current size of the Faculty. If OIST wishes to maintain its very high standards for the selection of faculty members, while at the same time maintaining a clear academic and educational purpose, then current faculty members must play a central role in recruitment. With only 50 faculty members at present, too aggressive a hiring policy will overload them and retard their scientific productivity. Recruiting 7 faculty per year is the limit that OIST can achieve in the near-term if it wishes to maintain a strong, productive program of excellent quality.

Students are a key ingredient in the success of OIST research. As the Faculty grows, the student population must grow in direct proportion. The target for Phase I has been a student to faculty ratio of 2. It is already apparent that this is too small for an environment that is optimized for individual initiation and interdisciplinary opportunities. The ratio of students to faculty should be no smaller than 3. Table 3.1.1 shows the anticipated growth, by year, of the OIST faculty over the next 10 years. Also shown is the associated growth in the student population and the research staff. The student to faculty ratio will reach 2 as planned in the fifth year of the graduate school. Thereafter, graduate admissions will be accelerated to achieve the desired ratio of 3 by 2020.

Assumptions regarding growth of faculty in Table 3.1.1 are as follows. The hiring process that began in 2013 is expected to yield 6 new faculty members (three are already on board). Thereafter new hires associated with increased research depth and breadth are planned at an average of 7 per year. There will be three kinds of faculty attrition: retirements, failure to receive tenure, and self-initiated departures. These are estimated in the line titled "Departures/Retirees." Some of the departures will be in research areas that the University will want to continue: these replacements are captured in the line entitled "Replace departures." Taking account of these three categories provides the anticipated number of faculty members in each succeeding year, leading to an estimated 97 faculty by year 2023.

Estimation of the student population in any given year takes account of the anticipated number of new recruits, the expected number of students who will not advance to candidacy (estimated as 10% of the class) and students that depart as graduates. One third of the students who advance to candidacy are assumed to graduate in 4 years and the remainder in 5 years. By the year 2023, it is estimated that the student body will reach 300 students.

Regarding the size of research units, current average data are used as a guide. On average, each research unit is assumed to comprise 5 postdoctoral scholars, 2 staff scientists, 1 technician, and 1 research administrator. From 2016 onward, the number of postdocs will be 4 per unit, because the student population will increase.

By 2023, it is estimated that the total of faculty members, students, and research unit staff will be 1,150 full time equivalents (FTEs).

Table 3.1.2 estimates the staff associated with executive, research-support, general administration, graduate school, and other university functions through 2023. Several new functions, such as an on-site baccalaureate K-12 school, offices in Tokyo, the U.S., and Europe, and an on-site Guest House are assumed.

Performing projections beyond the next ten years is challenging and correspondingly have larger uncertainty. Base assumptions are shown by decade in Table 3.1.3. On the basis of these assumptions, the University would reach 300 faculty members by 2043. The student body would be about 900 and the total research population about 3,600.

The same caveats that pertain to estimates of faculty members, students, and research staff, also apply to administrative staff estimates. These are presented in Table 3.1.4 through 2043.

Model for Future Growth		Sept 2012	Sep 2013	Sep 2014	Sep 2015	Sep 2016	Sep 2017	Sep 2018	Sep 2019	Sep 2020	Sep 2021	Sep 2022	Sep 2023
PERSONNEL (PEREX: FTE)													
Faculty:	New Hires			6	7	7	7	7	7	7	7	7	7
	Departures/Retirees				2	2	3	3	3	3	4	4	4
	Replace Departures						1	1	2	2	2	2	2
Faculty:	**Total**	**44**	**44**	**50**	**55**	**60**	**65**	**70**	**76**	**82**	**87**	**92**	**97**
Students	New enrollment	34	21	20	25	35	50	55	60	65	70	70	70
	Drop-outs/Failures			3	2	2	2	3	5	5	6	6	7
	Graduate in 4 years					10	6	6	7	10	15	16	18
	Graduate in 5 years						21	13	12	16	22	30	34
Students	**Total**	**34**	**54**	**71**	**94**	**117**	**138**	**171**	**207**	**241**	**268**	**286**	**297**
Student/Faculty Ratio		**0.8**	**1.2**	**1.4**	**1.7**	**2.0**	**2.1**	**2.4**	**2.7**	**2.9**	**3.1**	**3.1**	**3.1**
Unit Staff													
(Averages)	Postdocs	220	220	250	275	240	260	280	304	328	348	368	388
	Staff Scientists	88	88	100	110	120	130	140	152	164	174	184	194
	Technicians	44	44	50	55	60	65	70	76	82	87	92	97
	Research Admins	35	35	40	44	48	52	56	60	65	69	73	77
Unit Staff	**Total**	**387**	**387**	**440**	**484**	**468**	**507**	**546**	**592**	**639**	**678**	**717**	**756**
Unit Staff/Faculty Ratio		**8.8**	**8.8**	**8.8**	**8.8**	**7.8**	**7.8**	**7.8**	**7.8**	**7.8**	**7.8**	**7.8**	**7.8**
Faculty + Unit Staff		**431**	**431**	**490**	**539**	**528**	**572**	**616**	**668**	**721**	**765**	**809**	**853**
Faculty + Students + Unit Staff		**465**	**485**	**561**	**633**	**645**	**710**	**787**	**875**	**962**	**1,033**	**1,095**	**1,150**

Table 3.1.1. Projected expansion pertaining to academic activities.

Model for Future Growth	Sept 2012	Sep 2013	Sep 2014	Sep 2015	Sep 2016	Sep 2017	Sep 2018	Sep 2019	Sep 2020	Sep 2021	Sep 2022	Sep 2023
PERSONNEL (FTE)												
Faculty:	44	44	50	55	60	65	70	76	82	87	92	97
Students	34	54	71	94	117	138	171	207	241	268	286	297
Unit Staff	387	387	440	484	468	507	546	592	639	678	717	756
Faculty + Unit Staff	431	431	490	539	528	572	616	668	721	765	809	853
Faculty + Students + Unit Staff	465	485	561	633	645	710	787	875	962	1,033	1,095	1,150
Graduate School	11.5	15.5	18.6	24.7	24.8	25.0	25.1	25.1	25.1	25.2	25.2	25.2
Technical Support			74.5	85.0	97.0	111.0	117.0	124.0	132.0	139.0	144.0	154.0
Executives	14.4	14.4	14.4	16.4	16.4	16.4	18.4	18.4	18.4	20.4	20.4	20.4
Administration		72.5	87.5	93.0	103.0	107.0	111.0	113.0	119.0	125.0	129.0	137.0
School (K-12)				0.5	1	1	1	2	6	8	12	18
Buildings, Facilities & Maintenance	11	14	16	17	18	19	20	22	24	26	28	30
Communications & Public Relations	16	21	24	25	30	30	30	31	32	33	33	33
External Offices			1.5	3.0	3.0	3.0	5.0	5.0	5.0	6.0	7.0	7.0

Table 3.1.2. Projected staff estimates through the year 2023.

Model for Future Growth		Sep 2023	Sep 2033	Sep 2043
PERSONNEL (PEREX: FTE)				
Faculty:	New Hires	69	12/year	12/year
	Departures/Retirees	28	6/year	6/year
	Replace Departures	12	3/year	4/year
Faculty:	**Total**	**97**	**187**	**307**
Students	New enrollment	575	~90/year	~140/year
	Drop-outs/Failures	41	~9/year	~14/year
	Graduate in 4 years	88	~20/year	~35/year
	Graduate in 5 years	148	~41/year	~70/year
Students	**Total**	**297**	**547**	**897**
Student/Faculty Ratio		**3.1**	**2.9**	**2.9**
Unit Staff				
(Averages)	Postdocs	388	748	1,228
	Staff Scientists	194	374	614
	Technicians	97	187	307
	Research Administrators	77	149	245
Unit Staff	**Total**	**756**	**1,458**	**2,394**
Unit Staff/Faculty Ratio		**7.8**	**7.8**	**7.8**
Faculty + Unit Staff		**853**	**1,645**	**2,701**
Faculty + Students + Unit Staff		**1,150**	**2,192**	**3,598**

Table 3.1.3. Base assumptions by decade for expansion pertaining to academic activities.

Model for Future Growth	Sep 2023	Sep 2033	Sep 2043
PERSONNEL (FTE)			
Faculty:	97	187.0	307.0
Students	297	547.0	897.0
Unit Staff	756	1,458	2,394
Faculty + Unit Staff	853	1,645	2,701
Faculty + Students + Unit Staff	1,150	2,192	3,598
Graduate School	25.2	40.3	52.0
Technical Support	154.0	215.0	326.0
Executives	20.4	28.4	30.4
Administration	137.0	162.0	171.0
School (K-12)	18	23	23
Buildings, Facilities & Maintenance	30	40	50
Communications & Public Relations	33	35	35
External Offices	7.0	10.0	11.0

Table 3.1.4. Base assumptions by decade for expansion pertaining to academic activities.

3.2 Development of an Intellectual & Industrial Cluster

In keeping with its mandate, OIST is committed to enhancing Okinawa's innovation and entrepreneurial environment. Like the components of any effective R&D ecosystem, the strengths and weaknesses of OIST and Okinawa are interconnected. This chapter describes OIST's anticipated contributions to the socio-economic prosperity of Okinawa, and by extension, to that of Japan, based on the University's strategies and programs.

World-class education, research, and industry are expected to be the foundation of an international R&D cluster in Okinawa, a hub of science and technology that creates new jobs, dynamic ventures, novel products, and a flow of diverse people and creative ideas. OIST will play a leading role in regional planning for this cluster and will continue to develop its structures and programs in ways that can contribute to improving the broader innovation ecosystem in Okinawa. Success requires the effective execution of programs that are linked to long-term strategic planning. These programs are summarized graphically in Table 3.2.1.

Oversight of this effort is provided by the Office for Sustainable Development of Okinawa, which includes the Business Development Section and the Technology Transfer Section.

3.2.1. Technology Transfer and Development: Putting Innovation to Practice

Outcomes of basic research usually require an advanced phase of applied research and development before they are sufficiently mature for commercialization. This phase of advanced R&D transforms and refines ideas generated in the laboratory into practical applications, by pooling specific resources, methods, and expertise to demonstrate functional applications or develop prototypes. The process requires dedicated resources specific to an area of activity (for example genomics, material science, chemistry, etc.). To support this advanced phase of R&D, OIST will develop in-house resources in select areas and build a network of partners in other areas (university partners, contract research organizations, etc.) (Table 3.2.1).

Short-term (FY2014-FY2015) Build R&D infrastructure, services, and networks

As an interdisciplinary university, OIST has the potential and flexibility to focus talents and resources on many intellectually exciting research areas with important potential for the future. These areas derive from sub-fields of the primary disciplines pursued at OIST, namely Biology, Chemistry, Computation, Marine Science, Mathematics, and Physics. The talent, resources, and expertise assembled within these focus areas will lead to discoveries and innovations that may have potential for downstream applications and commercial development. OIST will leverage these discoveries by identifying those that might benefit from applied research and development, thereby maximizing the socio-economic impact of investments made in basic research.

Targeted outreach activities with industry are also used to generate effective technology transfer. OIST hosts high-level international conferences on topics where Okinawa, its R&D institutions and Japanese industry can combine their collective strengths to build global expertise, such as in renewable energy, structural biology, genomics, advanced materials, medical devices, mitigation of environmental damage and others. These international

conferences bring leading academic and industrial participants from around the world to Okinawa and increase opportunities for academic-industry collaboration. OIST is enhancing its infrastructure to accommodate such conferences, including additional meeting space and meeting support services.

OIST will consider implementing an Industry Fellowship Program in which personnel from global industrial partners spend 3 to 12 months working in an OIST research lab on an academic-industry collaborative project. This scheme enhances knowledge transfer and establishes more substantive links between OIST and industry as a foundation for future long-term relationships.

OIST dedicates space on campus to house the OIST Technology Transfer Center. The Center aims to transform technologies developed in focus areas, or in other labs at OIST, into practical applications and then to transfer the know-how for commercialization. The center supports feasibility/proof-of-concept studies on early-stage technologies that hold promise for commercialization. Structured to operate as a "co-laboratory," the center will be made available to OIST researchers and their external collaborators and will offer customizable infrastructure, specialized equipment, turnkey office space, and other support services. Researchers working in the Center will also have access to OIST scientific core facilities and services through the Open Technology Center (see below). Activities not easily supported at OIST will be outsourced to a network of contract research organizations (CROs) and partner institutions.

There are multiple benefits to the Okinawa R&D Cluster community in having a Technology Transfer Center at OIST. The center is a buffer zone on campus where OIST researchers and their external academic/industry collaborators can work together on industry sponsored projects without risk of encroachment of research laboratories by industry. The Center will also help to develop an advanced workforce that will benefit Okinawan universities, colleges, and industry, further promoting the growth of the Okinawa R&D Cluster community.

Through its Open Technology Center (OTC), OIST will establish formal policies and procedures for sharing scientific core facilities and services with the R&D community in Okinawa, mainland Japan, and abroad. Some examples of major equipment and services that can be made available include Next Generation DNA sequencing, microscopy, cell sorting, DNA/RNA arrays, mass spectrometry, bioinformatics, etc. Access will be on a fee-for-service basis in order to offset costs. Sharing OIST's specialized facilities and instrumentation with the external community strengthens academia-academia and academia-industry partnerships, encourages cooperation, meets the technical needs of researchers throughout the prefecture, and produces other mutual benefits.

Medium term (FY2020) Develop OIST incubator and expand applied R&D research capability in Okinawa

As the first phase of the incubator facility is completed, the capabilities and services of the Technology Transfer Center will be expanded to allow more complete testing of proof of concept and development of working models derived from OIST research discoveries. The

incubator staff will include Okinawan, other Japanese, and international members and researchers who will be able to move back and forth within the University and within the growing R&D Cluster community in Okinawa. The OIST Technology Transfer Center will act as a catalyst for R&D training and career development on scale far wider than the University itself.

Long term (FY2025 and beyond) Develop Fully Equipped Technology Transfer Center

OIST's Technology Transfer Center will expand to include advanced technology platforms to tackle major problems and needs of society based on OIST research results. This will necessitate additional space, personnel, and resources planned for the future stages of the incubator facility. Unlike other institutes that focus solely on medical discovery or on materials sciences, the OIST Technology Transfer Center will continue OIST's interdisciplinary traditions by taking broadly integrative approaches to solve global problems in areas where Okinawa can build a competitive advantage, such as health, energy, and the environment. The Technology Transfer Center will be closely linked to basic research conducted within OIST's focus areas, by housing interdisciplinary teams formed around discoveries with potential practical applications. The Technology Transfer Center will continue to host academic and industrial collaborations, enhancing links to the international industrial and R&D cluster community.

3.2.2. Technology Transfer

Universities are an important source of innovative ideas that can be transferred to industry and commercialized, resulting in new products and new jobs. Technology transfer is a key part of achieving OIST's mission to contribute to the sustainable development of Okinawa. OIST will build its internal structures and will allocate resources to enhance the entire technology transfer process, from discovery through to product development and use (Figure 3.2.2.1; Table 3.2.1)

Figure 3.2.2.1 The technology transfer process.

Short term (FY2014-FY2015) Implement policies and procedures covering inventions, patents, copyrights, and other intellectual property (IP)

OIST will develop a full suite of guidelines, policies, and procedures to cover its intellectual assets from discovery through IP protection. These policies will foster a culture at OIST that promotes technology development for the benefit of society and offers

researchers incentive to consider the practical applications of their work. As an international university expected to set a precedent in Japan, OIST has a unique opportunity to create innovative IP policies and procedures, rather than follow established models. This requires setting up robust internal administrative structures to manage the IP process, which include training, setting up review committees, and installing tracking systems for invention/patent status and schedules.

Build a network of external IP experts

OIST faculty, students, and staff conduct research in diverse sub-fields, of the primary disciplines of Biology, Chemistry, Computation, Marine Science, Mathematics, and Physics. It is a challenge for any university to maintain sufficient internal expertise to manage and comprehend inventions derived from such a wide range of disciplines. Therefore, it is critical that OIST supplement its internal capabilities by building a network of external experts with a broader expertise. This external network, made up of technical, legal, and industrial experts from around the world, can be called upon to counsel OIST on the most effective use of its resources for developing and commercializing novel IP. The network will also include patent attorneys in Japan and abroad who prepare and file patent applications on OIST inventions.

Create a visible structure for business development

OIST structures its business development functions around a strategic marketing model, which focuses resources on proactively identifying the best sources of commercialization for IP. By focusing on marketing, and outsourcing legal and other support functions, OIST will be able to build and maintain strong relationships with industry to advance technology transfer and commercial development. Under this model, OIST employs internal experts covering specialties that support marketing functions, such as scientific and technical, market analysis, and product development. Internal guidelines and policies for business development will be implemented, including the participation of OIST employees in industry-sponsored research projects and commercial activities, balancing incentives with considerations of potential conflicts of interest. In some cases OIST inventors may be assisted in setting up their own companies instead of licensing technologies to existing companies. The Business Development Section will provide advice on business strategy and on securing seed financing.

Medium term: (FY2020) Explore feasibility of spinning out technology transfer functions

OIST will conduct feasibility studies on spinning out its technology transfer functions into a separate legal entity, "OIST Technology Transfer," as an independently operated, but wholly owned subsidiary of the OIST School Corporation. The basic concept of "OIST Technology Transfer" is as an autonomous IP management company that would be responsible for the entire technology transfer process of OIST, from patenting to licensing to commercialization. The feasibility study will consider the costs and benefits of a separate legal entity managing OIST technology transfer functions, with particular emphasis on mechanisms that can promote operational and financial self-sustainability. If feasibility is established, OIST will spin out its technology transfer functions by FY2025.

Network with other business development organizations

OIST will establish a robust process for transferring inventions into licensing deals, industry collaborations, and new ventures. OIST will strengthen collaborative networks with external R&D cluster participants to exchange know-how and share business development standard practices, marketing functions, and access to industry networks. This networking will reinforce alliances with related organizations, pool resources for greater efficiency, and promote technology transfer throughout the prefecture. OIST will also exchange standard practices with technology transfer organizations in Japan and abroad.

Long term (FY2025 and beyond) Recruit industry research sponsors

OIST will build networks and relationships with targeted multinational companies to attract significant industry research sponsors in areas where OIST has developed world-class expertise. Focus areas in health, energy, and the environment, can be leveraged to attract such industrial partners. Industry sponsors provide strong technology development know-how, sources of diverse funding for early stage research, and direct routes for technology transfer. The attractiveness of OIST to potential industrial sponsors depends on the successful convergence of parallel activities: advanced research and development, robust business development, and diverse programs such as the Industry Fellowship Program and international conferences.

3.2.3 Regional Strategic Development

No single entity, acting alone or in isolation, can develop an R&D cluster in Okinawa. The goal requires long-term investment, linked to coordinated, collaborative, and sustained efforts by all major stakeholders. OIST will focus on ways in which it and Okinawa can impact each other's success. By playing a leading role in such matters, OIST will create opportunities for direct dialogue with government and industry, and partnerships that increase mutual understanding of the distinct roles academic research, industrial development, and government policy play in spurring innovation and sustainable economic growth (Table 3.2.1).

Short term (FY2014-FY2015) Create an R&D cluster Promotion Organization

OIST has led a cooperative effort with government, academia, and industry in forming a Task Force for the Establishment of an R&D Cluster Promotion Organization for Okinawa. The Task Force has built on the ideas of global experts in two workshops that identified a critical need for a regionally coordinated effort for R&D cluster development. This coordinated effort is to be embodied in a new Promotion Organization, created to plan, implement, monitor, and sustain an international R&D cluster over the long term. Top-level OIST executives, including Dr. Dorfan (Chair), Dr. Baughman and Dr. Sugawara, serve as Task Force Members and OIST hosts the Task Force Secretariat. In this leadership role, OIST facilitates exchanges needed to strengthen partnerships between government, academia, and industry around a shared agenda.

The Task Force has characterized the principles, mission, function, governance, and operational management of the Promotion Organization and will set in place the process and funding to establish the Promotion Organization by the end of FY2014.

Develop tools to measure the socio-economic impact of S&T innovation

Traditional measures such as numbers of research articles or patents or levels of R&D expenditures are no longer sufficient to capture the richness of innovation in today's connected world. The science behind measuring innovation outputs and impact is an evolving area, as governments around the world attempt to assess return on investments in R&D. In an effort to understand and report on its direct and indirect impact on the Okinawa economy and towards development of an R&D cluster, OIST will develop robust tools to measure innovation and its impact. These tools will take into account the type of data to be collected, as well as the process of data collection. It is important to compare data not just over time, but also over space, to provide a window into national and global competition. This requires measurement standards for comparability across sectors, regions, and nations. Data from measurement tools is distilled into metrics and benchmarks in order to understand and track the outcomes of innovation: knowledge, technology, workforce (human capital capacity building), and productivity. Choosing the right metrics, ones that can be measured today, but that impact future outcomes, is an important and complex process. At first, OIST will invite social scientists to explore economic, industrial, and sociological impacts of science and technology and to develop measurement tools. OIST will then build capacity in social science fields such as economics and sociology to deepen expertise in this area in the long term. Metrics can be developed for OIST as a pilot case and broadened to include the R&D cluster, in partnership with the R&D cluster Promotion Organization.

Medium term (FY2020) Assume leading stakeholder role in guiding the efforts of the R&D cluster Promotion Organization

Innovation cannot be scripted, but it can be fostered. To be competitive in today's "flat" world, the Okinawa R&D Cluster must strive to be international in terms of people, markets, culture, and outlook. OIST will play a significant stakeholder role in guiding the R&D cluster Promotion Organization, and will collaborate on joint programs to ensure internationalization of the R&D program. OIST will work closely with the Promotion Organization and local and national governments on strategies to implement innovation policies that allow Okinawa to be competitive in the global economy.

In addition, OIST will partner with the Promotion Organization and other related organizations to develop a detailed R&D cluster roadmap that connects the demand side (local and global market needs), optimally to the supply side (R&D resources in the prefecture). OIST will ensure implementation of the roadmap by collaborating with other stakeholders to organize the resources to support the many diverse development tasks.

Long term (FY2025 and beyond) Network with other emerging centers of innovation in Okinawa

By 2025, several science and technology communities and special zones will emerge in the prefecture in industries such as IT, biotechnology, energy, etc. OIST will partner with the R&D cluster Promotion Organization to build strong communication networks (shuttles, joint workshops, etc.), between these emerging clusters to enhance collaboration and coordination.

Attract large Japanese and multinational corporations to locate R&D in Okinawa

OIST will work with the R&D cluster Promotion Organization, industry promotion organizations, and local government to attract Japanese and multinational corporations to

establish R&D intensive activities in Okinawa, such as R&D labs, pilot facilities, small-scale high-skilled production, etc. This effort will require OIST to dedicate resources to building long-term relationships with potential industrial partners and to coordinate with related R&D cluster organizations such as the Promotion Organization.

3.2.4. Entrepreneurship

Entrepreneurs create a self-perpetuating cycle of entrepreneurship, whereby one successful startup often powers the next wave of startups. Entrepreneurship is not just a matter of starting companies, but is also a style of doing business that includes taking risks to create something new. OIST will promote entrepreneurship, internally and externally, to advance high-growth venture creation in Okinawa (Table 3.2.1).

Short term (FY2014-FY2015) Promote entrepreneurial events, competitions and educational programs

OIST will organize and/or participate in entrepreneurial events and programs, including Startup Weekend Okinawa, TEDxRyukyu, and Kyued Up. By helping gather entrepreneurs to share information and experience, OIST will act as a community-builder, further promoting the local economy.

Formulate guidelines and incentives for staff participation in entrepreneurial activities

OIST will treat entrepreneurship as an important element of the broader educational experience. This will be supported by guidelines and policies on staff participation in entrepreneurial activities such as startups. OIST guidelines will align academic incentives with enterprising activities without compromising the basic science mission.

Accumulate "intraprenurial" support mechanisms

From successes and failures, OIST will develop a basic suite of services to support students with entrepreneurial inclinations. This will include entrepreneurship training and access to a broad network of venture capital and angel investors, business and product development mentors, and bilingual business resource personnel, such as lawyers, bankers, accountants, and translators.

OIST will also develop an "Entrepreneur-In-Residence" program to provide students with one-on-one mentoring and advice on their entrepreneurial career goals and aspirations. Visiting entrepreneurs will come from diverse fields and will be selected on the basis of their success in starting and operating businesses in Japan and abroad.

OIST will open its "intrapreneurial" support services to students from Okinawa universities and community colleges to build networks between entrepreneurially minded individuals and to promote collaboration among them.

Medium term (FY2020) Build an OIST business park and incubator facility on or near campus

In some cases, it is more appropriate for universities to license technologies to new startups than to existing companies. These startups will be independent of the University, but may require access to the University's equipment and facilities under preferential conditions,

in their early developmental stages. For this purpose, OIST will build a business innovation park on or near the campus as a supportive environment to grow new ventures. Eventually, as startups mature, acquire venture financing, and begin to grow, they will move into other Special Zones for R&D in Okinawa. This will allow the OIST business park to act as a feeder and partner to other facilities and services available in the prefecture. The park will support the growth path from lab discovery to sustainability, will connect with other R&D resources in the prefecture, and will be a key component of developing the R&D cluster in Okinawa.

Equally importantly, the business park will work with partners to provide entrepreneurial services, such as legal support, business mentorship, grant writing workshops, and introductions to potential investors. Management of the OIST business incubator facility will be unique for its emphasis on: (1) human capital and technology, rather than on infrastructure, (2) international outlook and market competitiveness, and (3) attracting foreign talent and nurturing local talent.

Partner with the University of Ryukyus to develop a joint entrepreneurship education program

Education in fields such as Finance and Marketing helps entrepreneurs develop a solid foundation from which to grow their businesses. OIST will partner with the University of Ryukyus to develop a strong educational program on science and technology-based, high-growth entrepreneurship. Qualified students from either university will be able to take introductory science and technology coursework at OIST, management and business coursework at the University of Ryukyus, and to deepen specializations at either. The program will leverage the academic resources available in Okinawa to provide entrepreneurially inclined students the basic skills to lead knowledge-intensive ventures as part of their overall education. The program will also partner with an international business school to provide a global track. If successful, the core curriculum could be shared with other universities in Japan.

Pilot test a university-managed venture capital fund

To support high-growth ventures that might seed an R&D cluster, OIST will explore implementation of a pilot of a university-managed venture fund that makes seed-level investments in commercial activities. This fund will be open to projects that are relevant to Okinawa or based on IP developed at OIST, or for which proximity to OIST is a critical success factor. The pilot fund will be capitalized to make 1-2 investments per year for 3-5 years as a test of feasibility. Initial capital to support the pilot will be sought from local or national government sources, but if successful, the fund will generate its own capital in the future. The pilot fund will be managed by an experienced venture capitalist who will apply commercial market analysis to potential investments.

Long term (FY2025 and beyond) Set up an "OIST Innovation Venture Fund"

OIST will consider whether it is feasible to establish an "OIST Innovation Venture Fund" as a legally distinct, but wholly owned subsidiary of the OIST School Corporation, using the experience gained through prior pilot testing. Such independent capital funds have become an important self-supporting resource for IP development at many leading universities. The

venture capital fund will make seed-level investments in commercializing IP developed at OIST. This fund will support creation of new businesses based in Okinawa, with a pragmatic approach. OIST can capitalize the venture fund by proceeds of its licensing deals, from unrestricted donations, and from external capital. The venture fund will be set up to provide investments in return for equity or convertible notes, which, depending on the success of the startups, will have the potential to sustain the venture fund in future years. A key feature of this venture fund is that it will be managed by leading venture capitalists who define clear selection criteria for investments based on objective analyses of market potential and startup team members.

Office for Sustainable Development of Okinawa	Fiscal Years 2014-2015	Fiscal Years 2016-2020	Fiscal Years 2021-2030
1. Technology Transfer			
Implement policies on IP	■		
Identify areas of research focus for technology transfer	■	■	■
Build network of external IP experts	■	■	■
Create structure for business development	■	■	■
Implement technology transfer center and incubator facilities		■	■
Share scientific core facilities and services		■	■
Spin out technology transfer functions		■	■
Network with other business development organizations		■	■
Recruit industrial research sponsors		■	■
Introduce Industry Fellowship program		■	■
2. Regional Strategic Development			
R&D Cluster Promotion Organization			
Create R&D cluster promotion organization	■		
Develop tools to measure economic impact of innovation	■		
Enhance stakeholder role with R&D cluster organizations	■	■	■
Network with other emerging clusters	■	■	■
Attract Japanese and foreign direct investment		■	■
Build OIST business/innovation park			■
3. Entrepreneurship			
Formulate policies and incentives for entrepreneurship	■		
Accumulate "intrapreneurial" support services	■	■	
Develop entrepreneurship educational programs	■	■	
Organize entrepreneurial events and workshops	■	■	■
Pilot test University Venture Fund		■	■
Set up an OIST Innovation Fund			■

Table 3.2.1. Projection of OIST's future technology transfer and entrepreneurship activities.

3.3 Areas of Scientific & Technology Emphasis for OIST Graduate University

3.3.1 In the Next 10 years (~ 100 Faculty)

As detailed in Section 3.1, to achieve world-best status, OIST needs to strengthen and add several disciplines to its faculty. OIST is under-represented in key subdisciplines, such as marine science, structural and molecular biology, evolutionary biology, neuroscience, psychology, pure and applied mathematics, robotics, nanoscience, condensed matter physics, atomic physics, laser-physics, and chemistry. OIST has no faculty in the fields of statistics, computer science, including artificial intelligence, data-mining, and bioinformatics, accelerator physics, device-physics, radiation physics, and radio-biology/oncology, photonics, microbiology, and clinically-oriented science and technology. In addition, OIST needs to add some faculty in fields such as social sciences, philosophy, history of science, science communication, and science policy.

Table 3.1.1 indicates the target number of faculty to be hired in the years 2015-2023. Including normal attrition, on average 7 new faculty and 2 replacements for departures will be hired each year, resulting in an expected population of ~100 professors by the end of 2023. The levels (ranks) of faculty appointment will depend on the discipline. However, OIST Graduate University will continue the current trend of emphasizing the importance of youth: about 35-40% of the faculty should be assistant professors.

The University will continue its rigorous recruiting procedures to ensure that outstanding, world-competitive faculty that meet the highest academic standards are recruited. A range of approaches will be used: a strong emphasis will be placed on attracting female faculty by following the recommendations of the 2014 Task Force on Gender Equality. Traditional searches, which cast a wide net, are best suited to attracting young faculty. A combination of traditional searches and target-of-opportunity searches will be used to recruit mid-career and senior faculty. Target-of-opportunity searches are particularly important for recruiting female faculty.

In considering new appointments, the University will continue its very strong dedication to providing an environment that facilitates and encourages inter-disciplinary research and education. As discussed in Section 2.1.1, the level of interdisciplinary interactions amongst the OIST faculty is very high. Figure 3.3.1.1 further quantifies this reality.

Also discussed in Section 3.1, OIST does not have sufficient engineers and technicians to support scientists with their basic research nor with the development of new technical capabilities. Strong engineering and technical support is also needed to help turn innovative ideas into marketable products. If the University does not quickly develop these capabilities, the R&D Cluster research programs will be severely hampered and the inability to provide engineering support will significantly reduce the attractiveness of OIST to industrial partners.

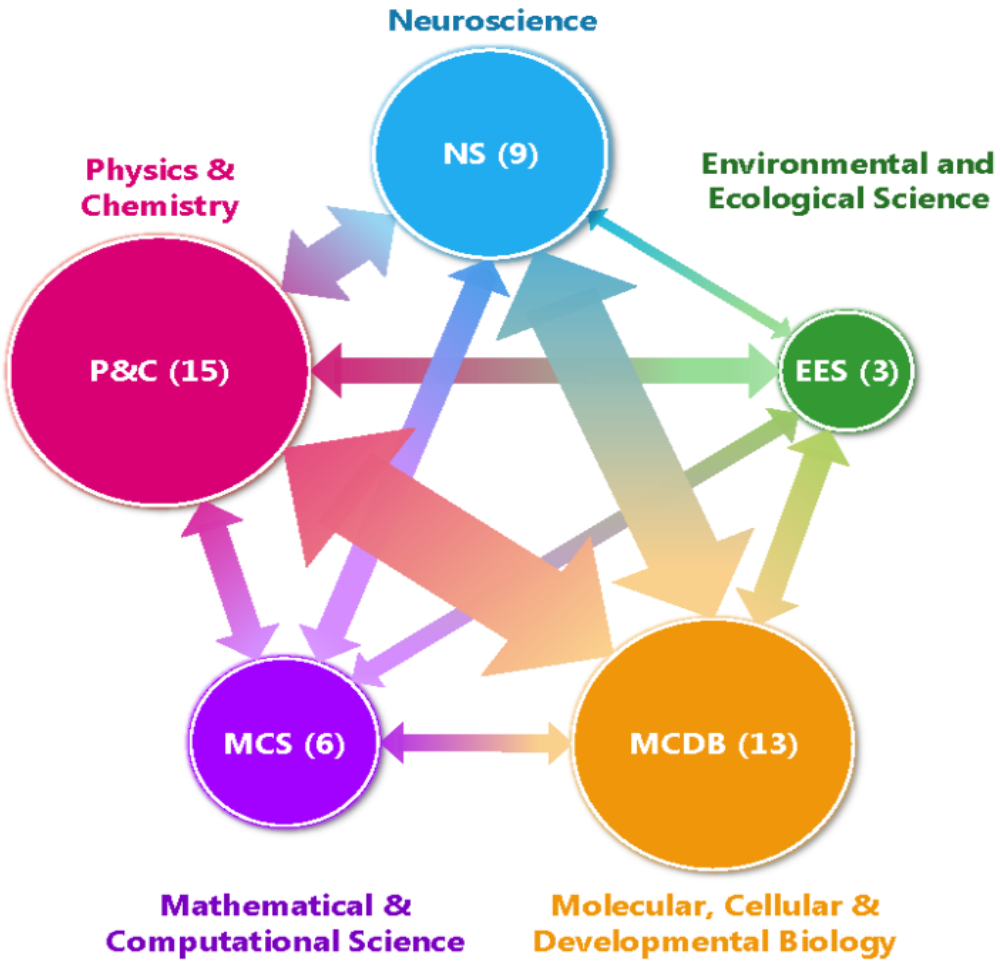


Figure 3.3.1.1. Collaborations among faculty, illustrating the cross-disciplinary nature of research at OIST. The thickness of the lines that connect major areas of discipline represent the amount of interdisciplinary collaboration between the current faculty.

In recognition of this current shortcoming, OIST proposes to construct an Engineering Support Building in FY2015 that will house engineers and technicians, mechanical and electrical machine shops, and other fabrication facilities. Additional engineering and technical manpower is needed to support the complex infrastructure required in the on-shore Marine Facility. The engineering and technical staff must have design, fabrication, and testing expertise that includes mechanical systems, electrical systems, vacuum systems, microwave systems, chemical systems, bio-molecular systems, environmental systems, digital and analog electronics, process engineering, geodetics, and fluids. The FY2015 plan is to hire 4 Engineers and 4 Technicians to staff the Engineering Support Building and 2 Engineers and 2 Technicians to staff the Marine Laboratory.

The exact disciplinary make-up of the future faculty may vary depending on search outcomes; however, trends for hiring have been discussed and can be reasonably well characterized in the near-term. Table 3.3.1.1 summarizes a possible recruitment plan, by discipline, through 2023. Like any faculty recruitment plan, this one will require some flexibility. While the University needs to make its choices with certainty for the next 2-3 years, details of the near-term plan in years 2018-2023 will require adjustment based on the results of recruitment in 2015-2017. Table 3.3.1.2 details the sub-disciplines that are

Fiscal Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Biology	1	2	3	3	2	3	3	3	3
Chemistry			1	1	1	1		2	1
Computer Science	2	1	1		1		1	1	
Marine Science	2	2		1	1				1
Mathematics			1	2	2	1	1		1
Physics	2	3	2	2	2	2	2	2	2
Other Disciplines						2	2	1	1
Total Faculty Members	7	8	8	9	9	9	9	9	9

Table 3.3.1.1. OIST's faculty recruitment plan, by discipline, through FY2023.

expected, over time, to comprise the new hires. The category "Other Disciplines" includes areas such as social sciences, philosophy, history of science, science communication, and science policy. Technology-oriented faculty are assumed to increase with time to comprise at least 15% of the total faculty (currently they are under 10%). The technology-related nature of such appointments is not shown explicitly in Table 3.3.1.2, but is subsumed under the disciplinary categories, such as Physics and Applied Mathematics. The strong intention to build a group of world-class, high-level engineering professionals is not explicitly detailed. While they will not be teaching or research faculty, they are a critical element of the professional staff. As indicated above, OIST anticipates adding 6 such engineers in the upcoming fiscal year.

As discussed throughout the document, and as specifically addressed in Section 3.2, OIST Graduate University will become the central pillar of an R&D cluster. As presently constituted, the University is too small to underpin a major, sustainable R&D cluster. Stronger business and administrative capabilities will be necessary in order to develop a better technology transfer program. Stronger engineering services are also needed, but the heart of an R&D cluster is the new and innovative ideas that create new products and new industries. That innovation can only come from the research program of the University.

Innovation will be led by the faculty. In FY2014, the Government saw the importance of developing the R&D cluster and added funds to the research base of the University. These funds are being used to build programs with near-term relevance to technology transfer. The FY2014 support that OIST received for cluster-related research wisely recognized the importance of leveraging such funds to improve research infrastructure, since such enhancements not only help the existing faculty, but very importantly also attract new faculty members. New professors will come to OIST in areas where it is under-invested, if they see opportunities to do more and better research than they could elsewhere. Research equipment and space are key attractants.

OIST needs to keep building aggressively for a few more years, pursuing the R&D cluster directions established in 2014. At the same time, it needs to enhance some areas that are less directed, that are also very rich in innovation, but where the outcomes are less well defined at this early stage. There will be near-term technology transfer from such research, but such

Biology	Evolutionary
	Molecular
	Micro
	Neuro
	Radio
	Structural
Chemistry	Biological
	Organic
	Physical
Computer Science	Design
	Theory
	Bioinformatics
	Data Mining
	Robotics/AI
Marine Science	Biology
	Biophysics
	Ecology
	Genomics
	Physiology
Mathematics	Pure
	Applied
	Statistics
Physics	Accelerator
	Atomic
	Condensed Matter
	Devices
	Photonics
	Nano
	Radiation
Other Disciplines	

Table 3.3.1.2. Faculty recruitment by disciplines and sub-disciplines. OIST currently has no faculty members in those sub-disciplines highlighted in blue. Other disciplines include social sciences, philosophy, history of science, science communication, and science policy.

areas belong more naturally in the base research program where they can especially benefit from the freedom at OIST. That academic autonomy leads strongly to interdisciplinary surprises, thereby leveraging the investment of integrating new faculty into the base program. Investing wisely now by enhancing OIST's research capacity, will enable the University to recruit new faculty more effectively with substantially lower start-up costs.

Recognizing the need to enhance the near-term research program, the OIST management requested proposals from the faculty. The faculty was specifically asked to consider new

directions that build infrastructure, that attract more external collaborators, and that prepare the way for faculty expansion. The faculty offered 36 new proposals of very high caliber. The BOG and BOC helped to evaluate the proposals. Both Boards put considerable time into the evaluations and delivered blended guidelines for choosing among the proposals. They advised that the selected proposals should:

- significantly enhance research capabilities at OIST.
- make OIST more attractive to new hires.
- generally be supported by and involve several faculty members.

Considering the total funding available, management should focus on proposals that:

- require a substantial funding level.
- might be more difficult to fund later.
- do not commit budgets in excess of 3-4 years.

With these guidelines and knowledge of internal shortfalls and strengths of the research infrastructure, the University management chose 24 proposals for which more detailed information was requested. The University will request support in FY2015 and beyond, based upon this information.

Also as part of the final selection, the University realized that a series of themes were emerging from these new directions. These should NOT be seen by the Government as fund-streams to be controlled by their thematic characteristics, but should rather be seen as semi-independent faculty research programs that nonetheless indicate the eventual emergence of centers of excellence. Those themes include Brain Science, Human Health, Marine/ Terrestrial Science, and Sustainable Living. Three of the kept proposals fell outside these areas.

The Brain Science theme involves many forms of novel imaging, new computational directions, and advanced modeling. The Human Health theme encompasses genomics, cancer and other dread diseases, advanced modeling, novel imaging, and device development. Marine and terrestrial science involves land and sea-based observatories, genomics, and bioinformatics, ocean biophysics, and fluid dynamics. Sustainable Living involves solar energy, hydrogen sequestration, genomics, and epigenetics.

Proposals that have been promoted for funding each support several, if not all of the attributes below. They will

- build core capacity and enhance research infrastructure.
- make OIST attractive to new professors and students.
- create new techniques.
- have substantial benefit for Okinawa.
- make technology transfer opportunities in the near-term possible.
- build local and global networks.

Budgetary information provided by the proposals was used to build a three-year profile (FY2015-17) of OPEX, PEREX, and CAPEX. Total numbers are given in Table 4.2.1 in the row labeled “R&D Cluster/New Initiatives.” Ongoing funding from the R&D Cluster

initiatives funded in FY2014 is included with these monies. This funding is identified in Figure 4.2.1 by the dark green color. The funding tapers off after a few years as it gets incorporated into new faculty support. Most of the new proposals are characterized as "expansion initiatives" and are seen as enhancements of the base research budget, as described above.

3.3.2 Toward the Final Growth Phase (~300 Faculty)

OIST will have about 300 professors when it reaches maturity (Section 3.1). Table 3.1.3 provides an extrapolation using a crude model for the projected growth of the faculty from ~100 to ~300 professors. Figure 3.3.2.1 shows graphically how the various disciplines are anticipated to expand in this crude model. Faculty members in technology-oriented disciplines are expected to comprise about 15% of the total. They are not shown explicitly, but are included within the disciplinary categories.

Significant changes, scientific and social-economic, are expected to occur in the next 5-10 years. Accordingly, around FY2021, the plan for growth beyond ~100 faculty members will be reassessed and adjusted based on relevant considerations at that time.

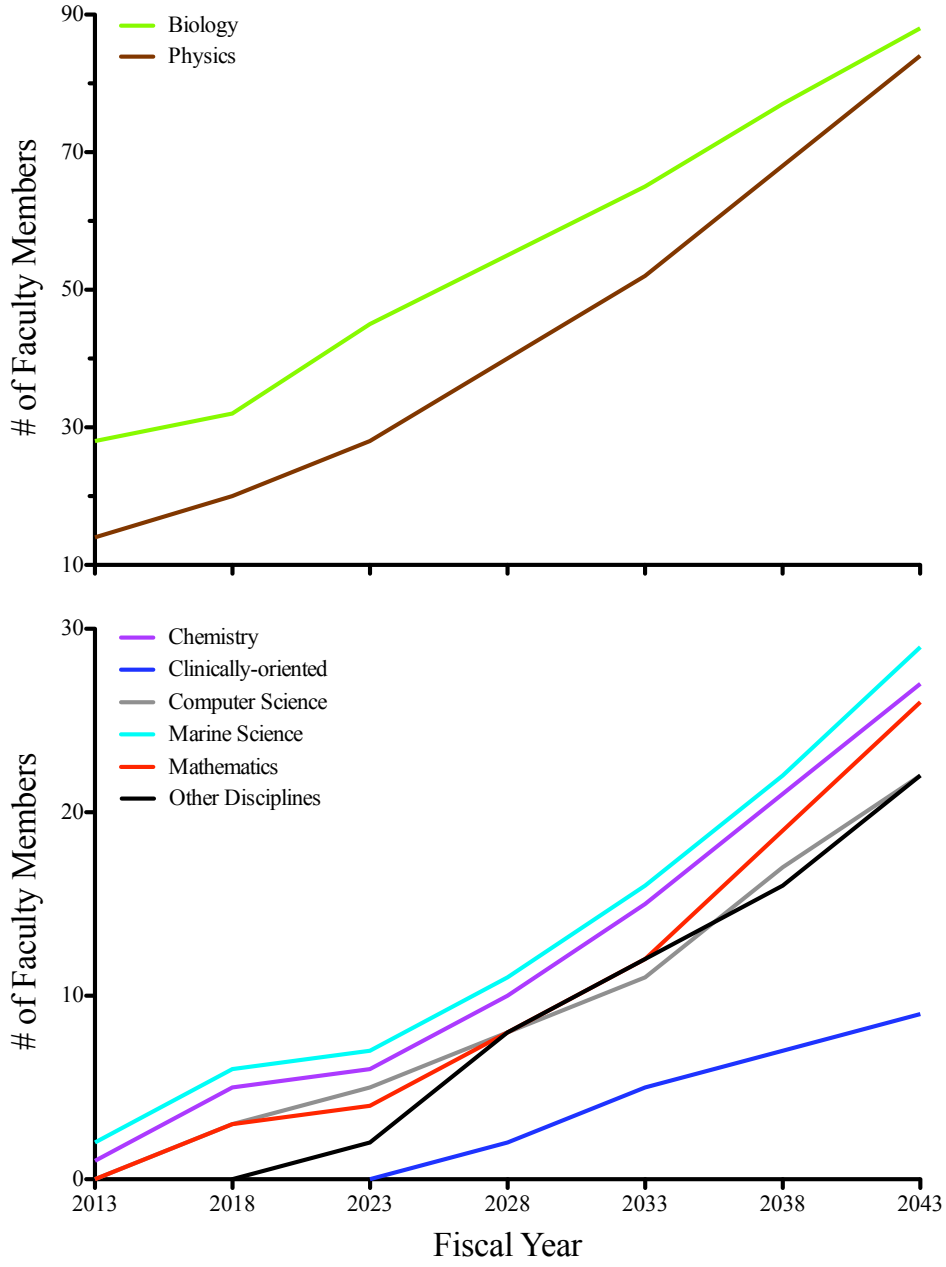


Figure 3.3.2.1. Crude model for the growth by disciplines as OIST expands to 300 faculty members. Other disciplines include social sciences, philosophy, history of science, science communication, and science policy.

3.4 Evolution of the Graduate Education Program

The university will continue to expand the single Ph.D. program in Science and Technology. Stability of the Ph.D. program is vital during this growth. OIST's Ph.D. program is in an early stage, with the first class of students only in its second year. It is therefore important to proceed with care and for the program to evolve in a balanced way.

The distinctive, non-departmental structure of the Ph.D. program is a unique and positive feature that enables a cross-disciplinary curriculum and, where it is appropriate to the question, cross-disciplinary thesis research. At the same time, OIST's students must graduate with a strong foundation in their fields. OIST needs a strong core in each of the major disciplines (biology, physics, chemistry, mathematics) as a basis for cross-disciplinary study. Consolidation of the educational program in the disciplines currently represented is necessary to ensure a strong core.

Prospective employers of OIST's graduates will need to understand its Ph.D. program and to appreciate the quality of its students. It may be advisable to add a specialization to the title of degrees awarded in order to reflect concentration in a field, such as "Ph.D. in Science and Technology (Physics)". Such a step should be taken with care to avoid *de facto* departmentalization, and should wait until there is sufficient depth in a number of disciplines so that there are several choices of parenthetical field.

Growth of the faculty should be directed toward increasing the depth as well as breadth of the Ph.D. program. New opportunities afforded by increased faculty numbers should be balanced against the need to consolidate existing strengths. This is vital for recruitment of excellent students, who seek opportunities to take advanced courses in their fields. OIST will continue to offer flexible one-on-one study opportunities and for this it must increase faculty numbers in key areas that include, but are not limited to, integrative biology (ecology and evolution), chemistry, mathematics, and psychology.

The limited number of faculty members in these areas poses challenges for delivery of core courses in these fields. Even relatively more established areas such as neuroscience, cellular and molecular biology, and physics are under-represented in the curriculum in terms of the range of courses offered

Development of professional skills, ethics, and appreciation of the social responsibilities of leaders in science and technology are important parts of OIST's curriculum that could benefit from expansion beyond the traditional science and technology. A concentration in science communication would be a valuable enhancement to OIST's program. Professorial appointments in this area should be considered.

In the longer term, continued growth of a single program beyond a certain limit may become unworkable. No consideration is being given to developing a new degree in the mid term. However, in the longer term there is the possibility of developing a second or third program. Possibilities include engineering and biomedical sciences, which would complement the strengths in science and technology.

3.4.1 Quantitative aspects

Now in the second year of the Ph.D. program there are approximately 50 OIST Ph.D. students. To achieve the desired ratio of 3 Ph.D. students per professor over the next ten years, OIST must recruit sufficient students to achieve a steady population of about 300 students. Table 4.2.1 shows a projection, based on the assumption that 50% of each class will graduate in four years (M.Sc. admissions) and 50% will graduate in five years (B.Sc. admissions). The model also assumes that 10% of each class will be lost from the program within two years of admission (due to unsatisfactory academic progress, medical, personal, or other reasons). To keep pace with growth in faculty OIST will need to increase the rate of admissions steadily over the next ten years, to about 70 new students per year. This will require an increase in student recruiting activity, admissions workshops, student housing, and facilities.

The number of students in other categories (Special Research Students, Research Interns) can be expected to increase linearly with the number of professors. OIST currently has about 25 Special Research Students (long-term) and 50 Research Interns (short-term), so it is reasonable to project 150 other students in addition to 300 OIST Ph.D. students.

3.5 Physical Infrastructure Needs

3.5.1 Education and Academic

The Graduate School at OIST is a single Ph.D. program in Science and Technology that is not divided into traditional academic departments. This interdisciplinary, non-departmental structure has important implications for physical infrastructure. The facilities and buildings must not only accommodate instructional and student support needs, but must also meet the administrative requirements of a graduate school that performs all of the functions usually distributed among academic departments, as well as normal graduate school administration. Teaching facilities, Graduate School administration, and specialist functions should be located with the teaching spaces in order to provide students with a coherent graduate experience.

The global and local geographic location of OIST creates significant needs for accommodation, recreation, and community facilities for students. There is a need for on-site accommodation for OIST Ph.D. students and visiting students of sufficient scale to support increased student recruiting activities, student exchanges, and admissions interviews. For example, to recruit the best students competitively, it is essential for prospective students to experience first-hand the opportunities here. In order to achieve new enrollments of 75 students per year we will need to hold admissions workshops 10 times per year (based on 30% acceptance of offers to 250 students after interviewing 350, with 35 students per workshop). Accommodation is also needed for short-term students visiting OIST as research interns (on the order of 100 students per year). This is a vital part of our recruiting strategy that must increase for growth in other areas to follow.

The educational program at OIST calls for multiple small-group teaching spaces with AV equipment and distance learning capabilities. In addition there is a need for teaching laboratories for disciplines covered in the program used for Workshops and International Courses, Research Interns, and laboratory skills teaching. These laboratories require suitable infrastructure for a range of disciplines, including fume hoods, biosafety cabinets, lasers, electronics, and the associated preparation areas, as well as space for technicians supporting laboratory teaching.

3.5.2 Research

The rapid development of an outstanding research program at OIST has depended on the simultaneous development of outstanding infrastructure to support the research. Much investment has been made in equipment and staff, but one key to the success of this effort has been the management of these resources as common and shared facilities, to the extent possible. This required an architectural interior design optimized for this function. Large areas of laboratory space were assigned and outfitted from the start as common space, both for major specialized equipment like mass spectrometers, X-ray spectrometers, and electron microscopes, and for routine items like low temperature freezers, centrifuges and incubators. In addition, centralized supplies such as gases, high purity water, and vacuum lines were installed throughout the laboratories. A major challenge for the future is how to maintain such shared facilities as OIST grows to have additional buildings and additional diverse areas of research

As OIST expands and adapts to the continual changes in scientific methods, flexibility will be essential for efficient use of laboratory space. Research groups will start and close, and ever-evolving new methods will necessitate revamping of existing facilities. The research infrastructure will need to be adaptable on short notice as the research demands change. The current laboratories at OIST incorporate the use of interstitial space to provide essentially all facilities in all areas without major building renovations, but more flexibility in the location of benches, desks, hoods, and walls would facilitate the efficient use of space.

The location and distribution of shared resources depend on the type of resource. Some items are only required at one site in the university, and others need to be located in each building, or even on each floor. Major resource areas include imaging, chemical and material analysis, separation and purification, environmental monitoring, computation, engineering, design and development, controlled temperature and vacuum environments, and stable electrical supply. Each of these areas has its own demands for space, time and support.

- Imaging encompasses the full range of microscopy, including conventional light microscopy, confocal and two-photon light microscopy, super resolution light microscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), TEM tomography, magnetic resonance imaging (MRI), X-ray diffraction, X-ray computed tomography (CT), as well as specialized imaging techniques such as atomic force microscopy (AFM), scanning probe microscopy (SPM), and X-ray microscopy (XRM).

- Chemical and material analysis requires a broad range of instruments for characterizing biomolecules, chemicals, and materials, including DNA sequencers, instruments for protein and elemental analysis, mass spectrometers, infrared spectrometers, nuclear magnetic resonance (NMR) analyzers, X-ray spectrometers, X-ray photoelectron spectrometers (XPS), environmental transmission electron microscopes (ETEM), and rheometers, etc.

- Separation and purification of molecules, nanomaterials, cells, organelles, microorganisms, etc. requires gas and liquid chromatography, electrophoresis, centrifugation, and cell and particle sorting.

- The characterization of ecological and environmental relationships requires many types of remote sensors and monitors. OIST has already implemented a multifunctional marine coastal observatory on nearby coral reefs and is establishing terrestrial observation capabilities. In view of the location of OIST in a semitropical environment in the northernmost region of the western Pacific coral triangle, expansion of these resources as OIST grows will be critical in assessing the impact of global warming and climate change.

- OIST has emphasized high performance scientific computing resources (HPC) from the foundation of the university, and must continue to provide outstanding computation in the future. Key elements are centralized HPC server rooms with CPU

architecture that optimizes computation for both Ethernet and InfiniBand. High-speed networking is essential with the extensive use of common equipment. Because OIST is located on an island, the computing facility must communicate with the rest of the world through submarine cables, currently limited to 2.5 GB, and it is important that this be upgraded to 10 GB as soon as possible, and to even 100GB in the future. Data storage and backup, both local and remote is critical.

- Engineering, design and development services are increasingly important as new techniques and technologies are created and employed at OIST. Examples include device fabrication for both mechanical and electronic items, 3-D printing, and micro- and nanodevices. These must be supported by machine shops, electrical shops, and engineering support. Such facilities were built into the current laboratories from the start, but these resources must expand greatly, particularly as OIST begins to develop applications of its scientific discoveries.

- Controlled temperature and vacuum environments are essential for many areas of research. Some experiments require temperatures very close to absolute zero, which involve liquid helium or cryogen-free refrigerators. Others experiments require intermediate temperatures that involve liquid nitrogen or other liquefied gases. In addition to compressor-based systems, new energy-efficient types of refrigeration are being developed as well. High temperatures are also required in some cases, and many types of ovens are needed. Many experiments from the life sciences to physics require high-vacuum (HV) conditions. Sometimes commercial equipment is available, but often it is necessary to design and build controlled temperature and HV systems.

- Even though OIST is very efficient in its use of electricity, the total energy use, particularly for computer servers is great, and access to a stable supply of electricity is crucial for expansion in the future. Adequate external supplies of electricity must be guaranteed, and internal diesel-powered backup generators and UPS's must be planned and incorporated. Supplementary power from local renewable sources such as sun or wind should be explored, particularly with support from programs like the OIST Open Energy System project.

This is just a partial list of the infrastructure for research needs that will be required as OIST expands, but it makes clear that with careful design, construction, and management of the laboratories, great leverage of investment in instruments and staff support can be achieved. In order to succeed at this, close cooperation between the researchers, architects, and buildings and facilities staff is required. This teamwork has been achieved in the first phase of growth at OIST, and it critical that it be maintained as the university expands in the future.

3.5.3 Administration

The OIST Administration presently comprises 168 people, as detailed in Section 2.4. As the OIST campus expands and the research population increases, it will be necessary to support this growth with adequate administration and management. OIST is projected to

reach 100 faculty members by 2022, which will require concomitant increases in administrative personnel, particularly in the following areas:

- Human Resources
- Procurement
- Research Support
- The Graduate School
- Buildings and Facilities Management
- Faculty Affairs
- Technology Transfer

Most administrative sections already fully occupy their space. Office cubicles have been built with temporary walls in what were meant to be hallways and meeting rooms. It will be necessary to relocate some of these sections in such a way that work flow and communications between sections will not be disrupted, while maintaining a healthy work environment and maximum productivity.

The President's Office faces somewhat different constraints. Growth of a university requires new capacities as developmental milestones are reached. At OIST, legal counsel and fundraising are presently becoming increasingly important. The executive offices are currently at capacity. Meeting rooms without windows are being converted into offices, while other rooms are being split to accommodate growth in these areas.

3.5.4 Technology Transfer, Incubation, and Industry Collaboration

Every country is different with regard to the support it provides for technology transfer from academia to industry. In some countries, such as the USA or Israel, there are relatively well-established funding sources dedicated to different stages of the development cycle, from supporting entrepreneurs to bringing new ideas to market. Government and industry play key roles in establishing this environment, but the role of the university research community is to generate innovation and create intellectual property. In Japan, such an environment has not been established, and significant effort will be required to improve intellectual property generation and commercialization.

The Okinawa R&D Cluster project is specifically intended to create such an ecosystem. OIST will be a major stakeholder in the Cluster project and a major source of innovation. As a catalyst for economic development, OIST will actively support technology transfer from its laboratories, but will not duplicate infrastructure implemented by the Okinawa R&D Cluster project. In this context, OIST will contribute to creation of an innovation network in Okinawa by focusing on the very early stages of technology transfer: matching its own technology with market needs, collaborating with industry via joint research programs, establishing small joint ventures using external technology and opportunities in the Open Technology Center, and creating entrepreneurial opportunities by providing dedicated hosting facilities (an incubator) for spin-offs from OIST research. This "OIST Technology Transfer Center" is thus one element of a more comprehensive innovation network at the prefectural level.

OIST's Technology Transfer Center facilities will include an incubator, a multi-tenant, versatile facility with laboratories for hosting young start-up companies, and also an OIST organization dedicated to IP generation, technology transfer, and collaboration with industrial partners for proof-of-concept and prototype design.

The incubator facility will provide an environment for research start-up companies, and their management. It will have basic infrastructure, offices, and support areas, including labs and conferencing facilities, a secretariat, catering, etc. It must be of excellent quality, but simple enough to justify reasonable rental prices. The incubator will offer multiple services that are well identified from experience in other regions of the world. It will be necessary to provide all of these services in both Japanese and English, at the highest professional level.

A detailed plan for the Technology Transfer Center will be developed, but the following facilities and services are considered integral:

Infrastructure
Customized office and lab space
Mentors and coaches
Workshops and business training
Symposiums and lecturers
Support Services
Business development
Business and product planning
Prototype design
Market research
Development of business and marketing plans
Event planning
IT and IP support
Presentation skills development
Travel arrangements
Facilitation with Core Labs
Fund raising
Recruitment of professional employees
Business Intelligence
Customers
Suppliers
Investors

The Technology Transfer Center incubator facility will be designed in a modular way to allow phased development, paralleling the growth of OIST.

Total floor area: 3,000 m^2 in three modules of 1,000 m^2
Construction Fee: ¥ 1 billion in three modules of ¥ 333 million
Design cost: (FY2015)＝ ¥ 50 million

Fit Out Cost (Estimate for first 100 m^2 module)(FY2017): ¥ 550 million

3.5.5 Housing for Short-term Visitors, including a Guest House

Guest House

There is already a growing demand at OIST for short-stay accommodation for university students, researchers and speakers. This demand will increase rapidly as the Graduate University grows both in size and in reputation. There are hotel accommodations available close to the University, but the prices are prohibitive for researchers, especially those at the start of their careers. There are very few low priced alternatives in the area, which is one of the most popular tourist regions in Japan.

OIST will need an on-site guest house to house short-term visitors. Plans should be made for a facility that would offer very simple, single and double rooms. The essentials for such housing are a bed, a shower, a desk, and high speed Internet. Examples of guest houses at other universities and institutions can be found here:

SLAC
http://www.stanford.edu/dept/rde/cgi-bin/drupal/hospitality/guesthouse/index.htm

DESY
http://guest-services.desy.de/hostel_in_hamburg/hostel's_info/index_eng.html

CERN
http://gs-dep.web.cern.ch/en/CERN_Housing

KEK
http://www.kek.jp/en/ForResearcher/KEKMap/Dormitory/
http://uskek.kek.jp/eng/visiting/dormitory.html
http://uskek.kek.jp/eng/visiting/apartment.html

Spring-8
http://www.spring8.or.jp/en/users/services/
http://user.spring8.or.jp/?p=2267&lang=en

University of Tsukuba
http://www.kokuren.tsukuba.ac.jp/researcher/lodgings_e.html

Keio University
http://www.ic.keio.ac.jp/keio_student/short_prog/leadership/kyoseikan.html

University of Tokyo
http://www.u-tokyo.ac.jp/en/administration/housing-office/housing/shukusha/kashiwa.html
Tohoku University

http://www.insc.tohoku.ac.jp/cms/cms/files/UHK_eng.pdf

The administrative and financial model for an OIST guest house will require detailed discussion. At most universities, professional hoteliers administer these facilities.

Users Office

OIST can expect a much higher numbers of visiting, scientists, students, and interns, commonly referred to as Users. These non-staff, short-term employees need special arrangements for visas, installation and office space. Currently various Human Resources and research unit administrators handle the needs of such people. OIST will set up an office, the specific role of which will be to look after the visiting professional population.

3.5.6 Welfare Support, including Recreation

In addition to its focus on research and learning, OIST is dedicated to providing a safe, healthy, and stimulating work environment. Two areas under active development in this regard are Counseling Services and a Medical Clinic. Two counselor candidates are currently considering offers from OIST. A re-purposed apartment has been converted into an interim space to house Counseling Services. OIST is currently recruiting a medical doctor, to complement its health clinic nurses to provide clinical care for the OIST community. The current clinic is already at capacity. Planned growth in the community will result in a larger patient population and will require additional Health Center staff members to serve them. Accordingly, it will be necessary to construct new space for this purpose.

Because physical well-being promotes intellectual health and creativity, sports and intramural athletics must be developed at OIST. The current small program must be augmented to include at least two or three sports. While some preliminary discussions about this have been held, planning for growth at OIST should identify those sports and the facilities needed to host them. Some possibilities include:

- Soccer field
- Tennis courts
- Squash and/or racquetball courts
- Running track with outdoor exercise park
- Softball field

OIST has a Resource Center, that serves as the first point of contact for students, staff and faculty members, especially those who are newly arrived, who need orientation and assistance. This facility is situated in the Village in newly renovated quarters. The Resource Center will continue to be the gateway to a growing range of support functions as described here. It is likely that an Ombudsman will be appointed in the future. Space for these expanded services will be incorporated into plans for larger University infrastructure.

3.5.7 Education of OIST Children

OIST is developing a community. In order to attract individuals, couples, and families who will contribute to make OIST a healthy and vibrant intellectual community, support for families is just as important as support for research-related activities. Children and partners of OIST personnel require physical, social, cultural, intellectual, and emotional support. Children require childcare and schools that provide an international curriculum in English. These schools must be secular and dedicated to the highest international standards so that children of OIST personnel are not hindered in their pursuit of postsecondary education in Japan, or abroad. It is conceivable that students from U.S. military bases and the surrounding countries may also be attracted to OIST's schools.

3.5.8 Housing for University Employees and Students

At the start of the project, the objective was to provide housing on campus for about half the academic population of the University. This ratio was chosen to ensure that there would be a substantial amount of housing available on the campus for those who are new to Okinawa, particularly foreigners, thus alleviating the issues of communication and transportation, which can be quite severe in the northern part of the island. At the same time,

this ratio ensures that good market opportunities are available for the local real estate industry to provide housing off campus for OIST employees who choose to live away from the campus. So far this ratio has worked well. At the time of this writing, the Campus Village of about 130 units is 95% occupied. We therefore propose to maintain a similar ratio as the University expands.

The University needs to provide a range of housing types for the academic population: 1-bedroom apartments for single students and researchers; 2-bedroom apartments for married couples and for students sharing a unit; and 3-bedroom apartments for families. (At present, some of these are occupied by students or interns on a shared basis, but it is anticipated that in the future the number of families with children living on campus will increase as the educational facilities in the area improve.) In addition to apartments, some 2- and 3-bedroom single-family houses are provided for faculty and senior executives. A small number of furnished apartments and houses are held in reserve by the university for use by visiting researchers, faculty visiting OIST on sabbaticals, etc. This minimizes the dependency on hotels, which can be seasonally very expensive and hard to reserve in the Onna area.

Two key issues are involved in expanding the on-campus housing stock: site location and development model. The current Campus Village at the front of the 50-faculty member campus area has little space available for expansion, but there are several options available for future housing development on campus. These include the southern part of the site, both adjacent to the bypass and just below the Self-Defense Force road, the northern area of the site, and the seaside campus area. The pros and cons of each of these will be considered in the course of the expansion master planning work, in conjunction with planning for future academic facilities.

Housing for the Phase 1 campus has been developed under a public-private partnership (PPP) model, since the government was unwilling to provide funding for housing directly. Instead, a consortium of private-sector companies undertook to build and operate the housing on behalf of the university for 30 years. Their income is derived from the rent paid by the tenants, backed by a minimum occupancy guarantee provided by OIST.

It is preferable to construct future housing on the campus directly. While the PPP model has worked quite well so far, is extremely complicated to negotiate and manage, and inevitably housing provided in this way costs more in the long run, as the developer must recover its finance costs, hedge for risks over the 30 years of the contract, and realize a profit. The merits and demerits of various options available to OIST for the construction of future housing need to be carefully studied as campus expansion continues.

The provision of campus housing is not restricted to accommodations alone. Currently the Campus Village has a limited number of support facilities, including a management office, small convenience store, gym, meeting room and community kitchen. As the population living on campus grows, it will become necessary (and feasible) to expand these facilities with more shops, cafes, and other service facilities, as well as health services and sport and recreation facilities.

3.5.9 Site Modifications to Support the Items Above

Clearly, to accommodate all of the anticipated functions on the campus, every part of the site that is usable for construction will have to be utilized. This will include areas further up the hillside behind the existing labs (A, in Figure 3.5.9.1); ridges to the south of the existing buildings (B); areas at the far south end of the site where excavated soil from the construction done to date has been compacted and formed into flat building platforms (C); the northern part of the site which has not so far been utilized in any way, but which has significant areas of buildable land (D); and the seaside campus area (E).

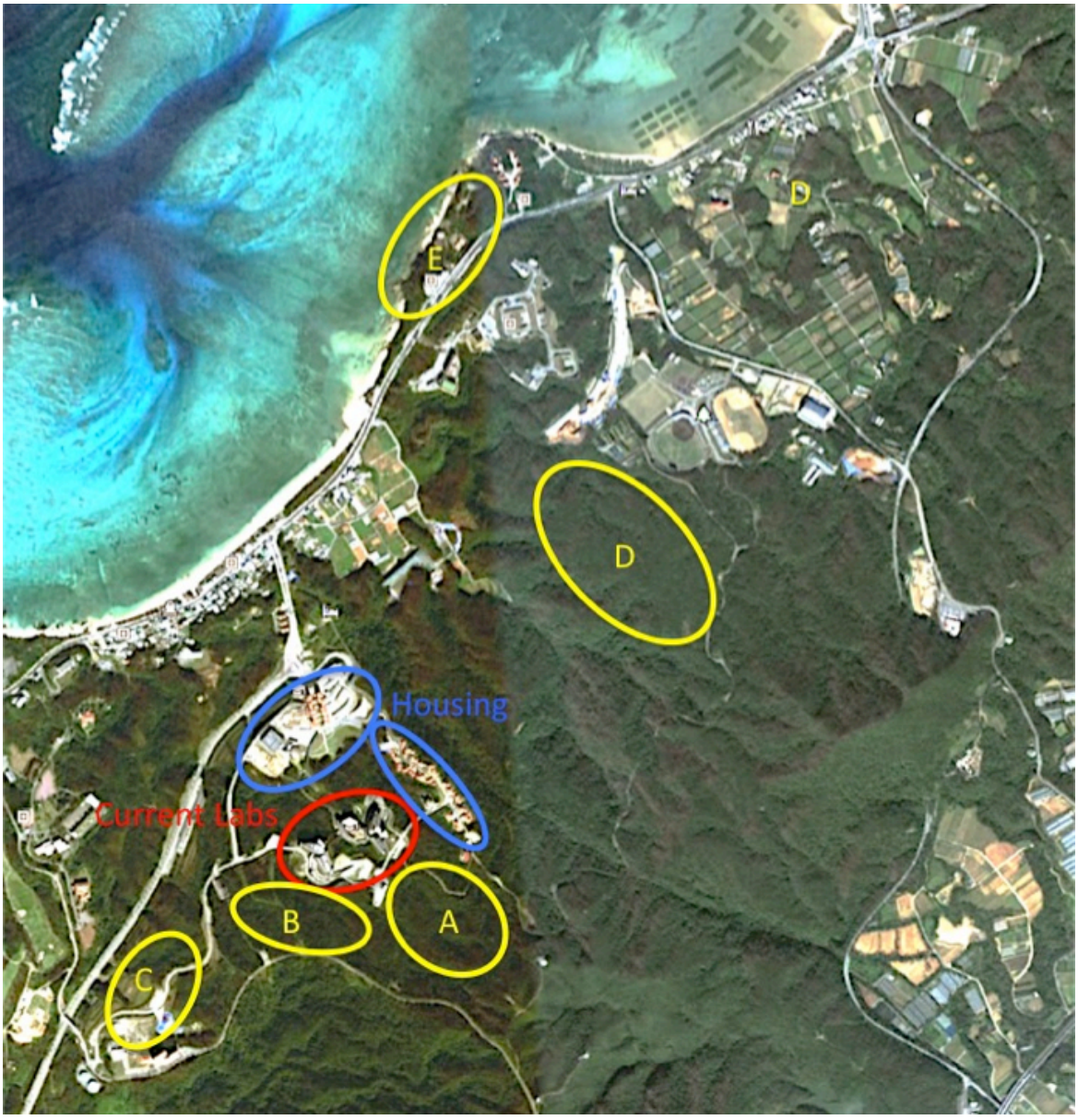


Figure 3.5.9.1. Overall site map with development areas circled.

A consultant is being engaged to prepare a master plan that takes into account the academic requirements and physical constraints for the expansion of the university to a potential ultimate size of 300 faculty members. The results are due to be submitted by the end of 2014. The scope of the consultant's work is summarized as follows:

1. Review the basic concept of the university and the implementation to date.
2. Evaluate the effectiveness of the current campus in enabling and supporting the basic concept.
3. Advise on the appropriate mix and scale of academic, education, and community support functions to support a campus of this character and size.
4. Propose directions for future development that will refine, reinforce, and build on the original concept.
5. Prepare an overall master plan for the Campus Expansion, integrating the completed first phase, able to accommodate development up to a maximum scale of 300 professors.

The consultant has been tasked to develop a master plan for the development of the campus that fulfills the following objectives:

- imparts a unique and attractive character to OIST.
- suits the climatic and geographical conditions of the site.
- provides optimal locations for lab buildings, campus housing, and related village facilities, as well as all support functions. These are expected to eventually include sport, food service, recreation, and social welfare facilities, administrative areas, parking, and a suitable intra-campus transportation system. It will also furnish all utilities and infrastructure lifelines, incubation and 'R&D cluster' facilities, such as private sector labs and offices, a campus school, conference and workshop facilities, and a short-term accommodation facility for visitors.
- facilitates, to the greatest extent possible, the interdisciplinary research carried out at OIST.
- enables maximum interaction among professors, researchers, and students within and between buildings and across the campus as a whole. It is strongly preferred that all lab and educational facilities be located contiguously, or in as close proximity as site conditions will allow.
- provides flexibility necessary for requirements of individual research labs of all kinds, the usage of many of which cannot be known at this time, and for changing lab requirements over time.
- is cost-effective and straightforward to implement.
- minimizes the environmental impact of the campus and its construction.
- enables gradual phased development of the campus over a number of decades with minimum disruption to the activities of its occupants or operation of the facilities.

Separately from the aforementioned study, in 2013, OIST commissioned a study of areas of the campus immediately adjacent to the present buildings suitable for the next expansion of the campus, envisioned as a doubling of the present size to approximately 100 faculty members (Figure 3.5.9.2).

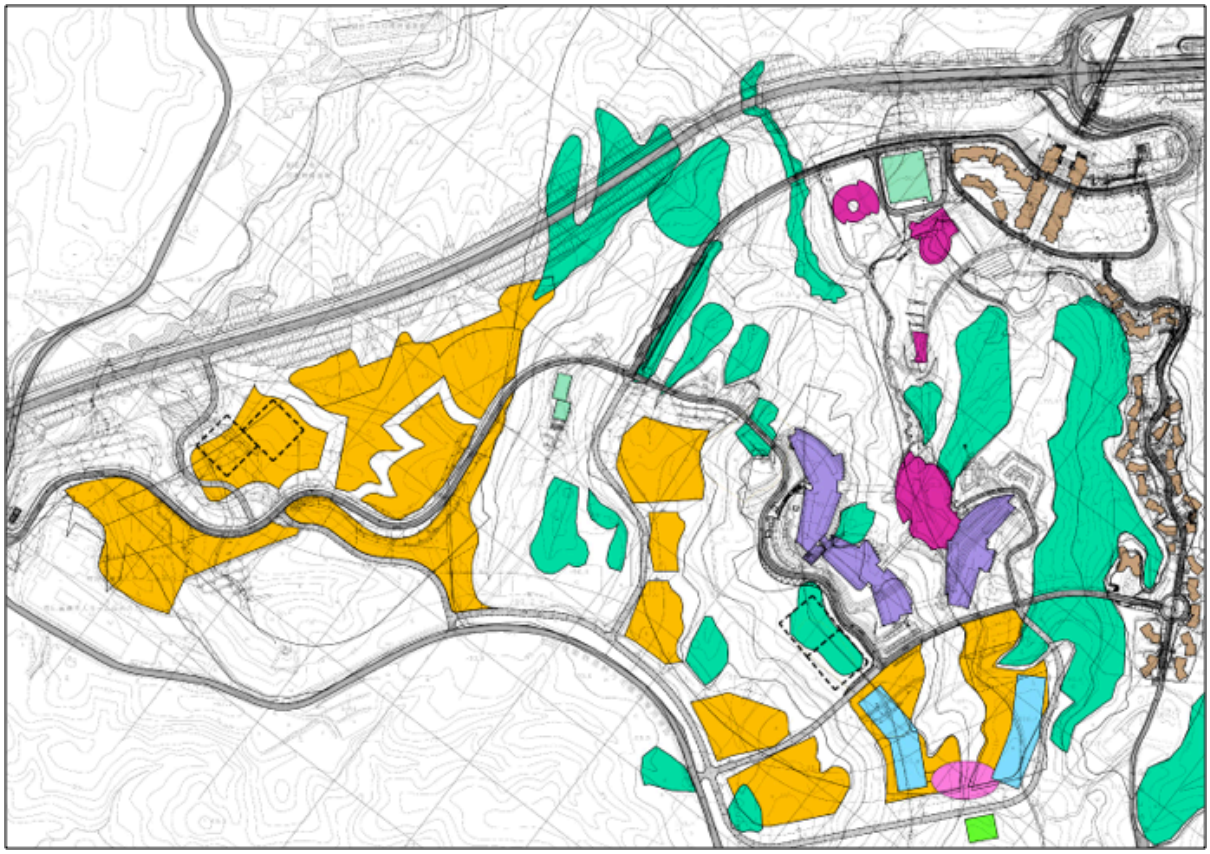


Figure 3.5.9.2. Site use study for the next phase of campus expansion.

The conclusion from this study was that the areas marked in blue (Figure 3.5.9.2) are the most desirable sites for this initial expansion. An early task of the master planner now being engaged will be to review and confirm this conclusion, and to check that such a siting will harmonize with further expansion of the campus in the longer term.

All infrastructure currently in place on the site was designed to support just the 50-professor phase of the university, so expansion of the road network, additional parking building construction, increased capacity of the electrical substation and distribution grid, an additional water treatment plant, and expanded site utility reticulation will be required. This infrastructure expansion must first be designed, and then construction can take place in a series of stages, such that the necessary facilities and capacities are available by the time each set of buildings is completed.

Chapter 4. Construction and Operational Budget Estimates

4.1 Construction Timeline and Associated Budget Estimate

4.1.1 Implementation Timeline for construction (by function)

Figure 4.1.1.1 shows the growth of OIST to date in terms of numbers of faculty members, and the lab space they occupy. For the first few years, until Lab 1 was completed, OIST occupied temporary space in a number of buildings at Uruma, and once it was renovated, in the Seaside House facility close to the main Onna site. Once Lab 2 was completed, this temporary space was vacated and all professors are now accommodated in the main Onna campus buildings.

About 20 new faculty were recruited and came to OIST before Lab 2 was completed (Figure 4.1.1.1, red line). This resulted in a serious shortage of space at the University for a short period. This was managed by temporarily squeezing faculty into every possible space, including Seaside House, meeting rooms in Lab 1 and even the BSL3 facility designed for research using bio-hazardous materials. New faculty members agreed to accept this situation as they could see the new Lab 2 building nearing completion across the valley.

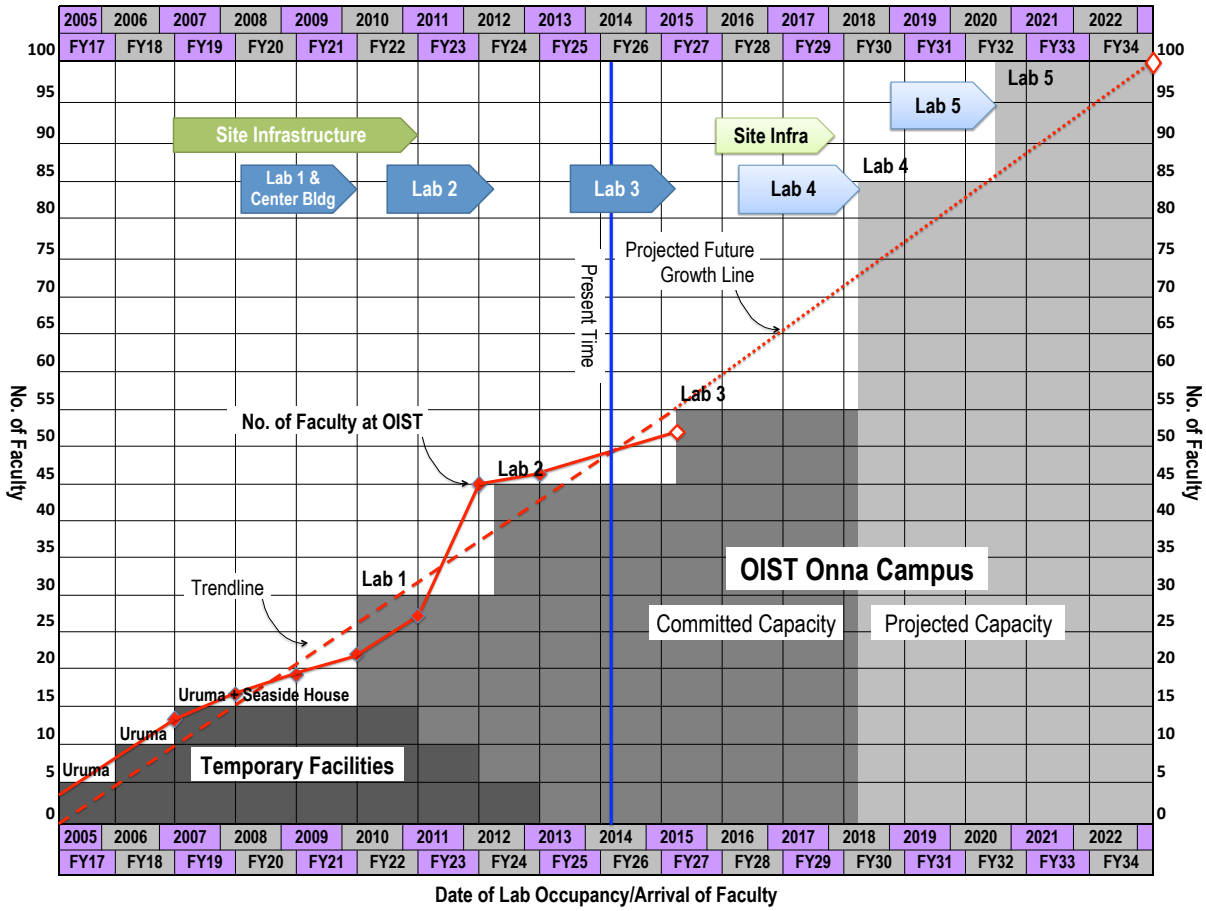


Figure 4.1.1.1. Growth of OIST in relation to faculty size.

Lab 3, now under construction for completion in Spring 2015, has relatively less space available for professors and their research units than Labs 1 and 2. This is partly because the

floor area of the building is smaller, and partly because parts of the building are reserved for use as classrooms for the Graduate School, for a specialized marine science center, and for development labs. As a result, with well over 50 faculty recruited as of mid-2014, the Phase 1 campus will effectively be fully occupied from the day that Lab 3 is completed.

Assuming that OIST faculty numbers will continue to increase at a similar rate to that seen to date (dotted trend line), a lack of space similar to that which occurred in the past is expected to reoccur before Lab 4 can be constructed. The earliest date for the completion of the that building, given the time required for budget approval and design and construction, will be mid-2018. As in the past, this space shortfall can be managed to some extent, but only if prospective incoming faculty can see that construction of their future lab space is underway.

To avoid repeating the same space shortfall in future, we propose that Lab 4 be planned as a larger building than the labs built to date, with a design population of 30 professors and their units. This would probably be a five-story building, with its most likely location higher up the slope of Mt. Ishikawa behind Labs 1 and 3.

As Phase 1 of the OIST campus development comes to completion, we have engaged an international master planning consultant to advise us on the best way to grow the OIST campus and expand the facilities on-site as the university develops toward its anticipated ultimate scale of 300 faculty members during the next several decades. This work will take until the end of calendar 2014 to complete. However, an early task of the master planner will be to confirm that our anticipated site for Lab 4 will not compromise further lab development in the longer term.

Figure 4.1.1.2 shows the anticipated schedule for expansion of the campus to the 100-professor point over the next eight years. Prior to Lab 4 construction, some expansion of the campus infrastructure must be designed and implemented. This will include additional access roads and expansion of the power, water and drainage networks (Table 4.1.1.2).

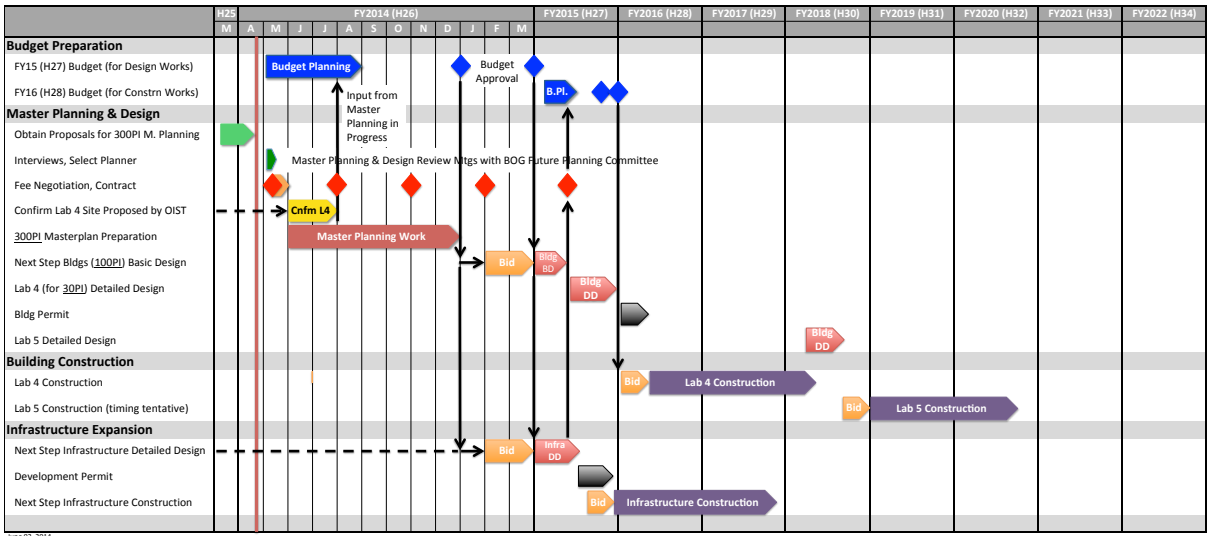


Figure 4.1.1.2. Anticipated schedule for expansion of the OIST campus to accommodate 100 professors.

Figure 4.1.1.3 provides a more detailed schedule for master-planning, design and construction work that needs to take place during the next two years for the overall campus expansion schedule above to be met. In addition to two buildings for which a budget has already been approved, and the construction of which will take place this fiscal year (the R&D Cluster Hall and On-shore Marine Facility), it also shows the development of an Engineering Supply Building and a Technology Transfer Incubator Facility (Table 4.1.1.1). This facility is planned so that additional research space in the existing labs can be made available by moving machine-shops, areas used for research equipment, and furniture storage, and the offices of the Division of Buildings & Facility Management out of Lab 2 into a lower-level specification and less expensive facility nearby.

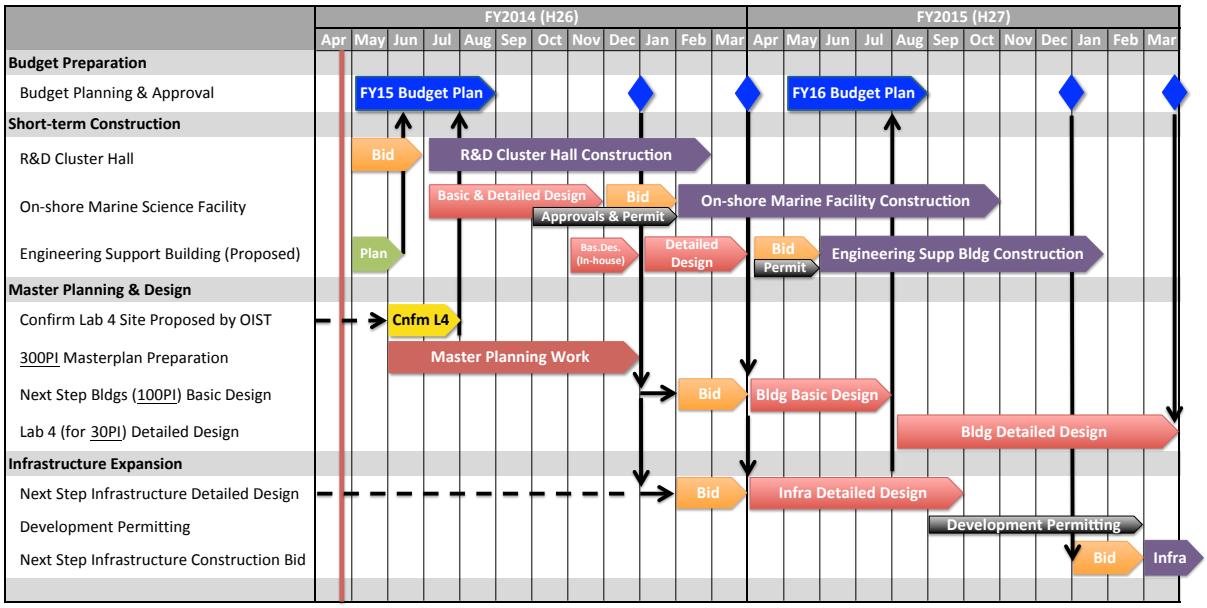


Figure 4.1.1.3. Detailed schedule for master-planning, design, and construction work during the next 2 years.

Fiscal Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	
Japanese Year	平成27	平成28	平成29	平成30	平成31	平成32	平成33	平成34	平成35	
Number of Professors	**55**	**60**	**65**	**70**	**76**	**82**	**87**	**92**	**97**	
Lab Buildings										
Master Planning										**0**
Lab Building Design	300	50	50	200	100	100				**800**
Lab Building Construction		7,000	6,000	1,300	5,000	5,000	300	200	200	**25,000**
Infrastructure Design	100	50	50							**200**
Infrastructure Construction	1,700	300	300	300	300	300	300	300	300	**4,100**
Total	**2,100**	**7,400**	**6,400**	**1,800**	**5,400**	**5,400**	**600**	**500**	**500**	**30,100**
Other Facilities										
Design of Support Facilities	100	200	250	200	200	200	200	200	200	**1,750**
Const. of Engineering Support Building	500									**500**
Construction of Support Facilities	800	1,500	1,500	1,500	1,500	1,750	1,800	1,800	1,800	**13,950**
Total	**1,400**	**1,700**	**1,750**	**1,700**	**1,700**	**1,950**	**2,000**	**2,000**	**2,000**	**16,200**
Total Construction CAPEX										
	3,500	**9,100**	**8,150**	**3,500**	**7,100**	**7,350**	**2,600**	**2,500**	**2,500**	**46,300**

Table 4.1.1.1. Budget estimate for expansion of OIST to 100-professors. Costs are given in millions of Japanese yen (¥). **Above:** Lab buildings. **Below:** Support facilities, including an engineering support building, a technology transfer incubator facility, cafés, housing, sports, guest house, etc.

4.2 Estimation of Near-term Funding Needs, Including Construction Funds

Section 3.1 above provides the rationale for expansion of the University, and argues why it is essential to commence expansion in FY2015. Sections 3.2--3.5 detail the expansion of key University mission elements, namely, sustainable development of Okinawa, and research, education, and infrastructure needed to support its growth. Section 3.3 discusses near-term funding support for research that undergirds the R&D Cluster and that increases infrastructure and scientific breadth to attract new faculty. Section 4.1 provides the construction timeline and associated cost estimates for the near-term growth period. With these sections as background, this section provides a detailed funding plan for the "doubling phase" of University expansion (FY2015-2023), during which it is anticipated that the University will grow from 50 to about 100 faculty members.

In building a funding model for expansion, OIST has used its experience with the existing University budget as a very reliable guide. Having operated a research institution in Okinawa for more than 5 years and a full University for nearly 3 years, OIST well understands the costs of supporting senior management, recruiting and establishing faculty, supporting research units technically and administratively, running the graduate school, and tendering and overseeing major construction.

Most University operating costs grow in proportion to the number of research units. Some, like the cost of the President's and Provost's Offices, are relatively constant. In assembling the budget projection, the most critical elements of the University budget are:

1. Personnel and operating costs for the President's and the Provost's Office, currently about 1.1B yen and assumed to grow at about 3% per year.
2. Cost of operating the Graduate School, reliably estimated at 4M yen/student/year.
3. Cost of all functions (research and administration) for operating a research unit. This amounts to 200M yen/unit/year.
4. Costs associated with equipment and other infrastructure needed to start new research units (new faculty hires).
5. Costs associated with research and infrastructure to support development of the R&D Cluster.
6. Operating costs resulting from completion of new buildings.
7. Cost of functions not currently in operation. The most salient example is personnel and operating costs for the Engineering Support Building, proposed for construction in FY2015.

To remind the reader, the exercise at hand is to estimate the annual budget required to double the size of the University by FY2023. This doubling will involve construction items detailed in Section 4.1. Assuming that the construction investment has been made, the buildings have been built, the infrastructure has been established, and the personnel have been hired, so that 92 units are in full operation in FY2023, what will the operating cost of the University be then? This can be estimated rather simply with reference to the right-hand side of Figure 4.2.1, which shows components of the annual estimated budget from FY2015-2023.

- operating the President's and Provost's Offices at 1.435B yen (royal blue).

Fiscal Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
# Faculty Units	55	60	65	70	76	82	87	92	97
# Students	94	117	138	171	207	241	268	286	297
Assumed Subsidy Funding	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Assumed External Funds	629	874	1,163	1,412	1,553	1,709	1,879	2,067	2,274
Total Income	**20,629**	**20,874**	**21,163**	**21,412**	**21,553**	**21,709**	**21,879**	**22,067**	**22,274**

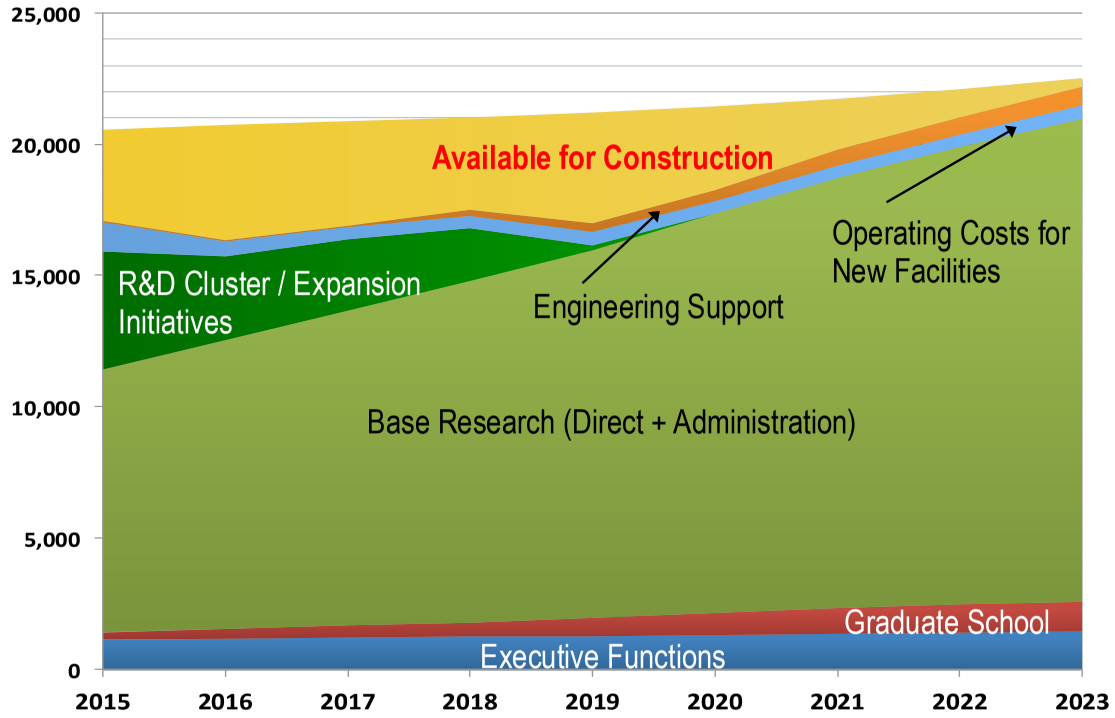


Figure 4.2.1. Estimation of funding needs. Major costs include operating the President's and Provost's Offices at 1.435B yen (royal blue), operating the Graduate School at 1.144B yen (brown), operating 92 research units at 18.4B yen (light green), personnel and operations for the Engineering Support Building (light blue), and operating new buildings completed during FY2016-2023 (orange).

- operating the *Graduate School* at 1.144B yen (brown).
- operating 92 *research units* at 18.4B yen (light green).
- personnel and operations for the *Engineering Support Building* (light blue).
- *operating new buildings* completed during FY2015-2023 (orange).

The total estimated cost of operating the University in FY2023 is 22.259B yen. These costs are summarized in the last column of Table 4.2.1, under the heading "Operating Expenditures." Below a more detailed discussion of costs for FY2015 - FY2023 is presented.

What income sources will offset these expenditures? OIST foresees two sources of income: 1) subsidies, as received currently from the CAO and 2) external funds raised by the University.

Concerning 1): In FY2014, funding for the University is very close to 20B yen. In the funding model being proposed, recognizing that the Ministry of Finance has already achieved this level of funding, OIST encourages the Japanese Government to see the advantages of maintaining the 20B yen level of subsidy funding through 2023. This is assumed in OIST's budget projection.

Concerning 2): As discussed in the *Medium-term Strategy for External Funds document* (submitted to the CAO in September 2013), there are three classes of external funds: a) competitively won research funding, b) funding from business development, and c) private and foundational (donor) funding. OIST has re-estimated anticipated earnings in these areas, given the assumptions of a growing University. The new projection predicts that by FY2023, external income will be about 2.274B yen, or about 11.4% of 20B yen in government subsidies.

With this background, details of the funding model can be found in Table 4.2.1. To clarify, in FY2015 the proposed budget foresees 20.629B yen of income and 17.132B yen of expenditures. This leaves 3.497B yen available for the construction of new buildings/ facilities, etc. The 3.497B yen is very well matched to the construction needs of FY2015 – no additional money is needed to carry out proposed construction that year. The same logic can be applied to each fiscal year. Construction of Lab 4 is projected to start in FY 2016, causing a shortfall (expenditures exceed income) in FY2016/17. However extra money needed for construction is less than half the cost of the building. Another shortfall occurs in FY2019/20 when Lab 5 is built, but in this case the shortfall is only about one-third of the total construction cost of Lab 5. During the 8 fiscal years of growth, of the 46.3B yen for construction to double the size of the University, 26.603B yen can be covered by subsidies and external funding.

This model, in which the Japanese Government maintains its current support envelope of 20B yen through FY2023 and OIST adds external funds, doubles the size of the University by FY2023, for only an additional 19.697B yen – less than a single year of operating funds. OIST feels that this is an excellent economic approach, delivering a world-class university twice its current size, for an additional investment of less than the Government currently provides for a single year of operations.

Fiscal Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	
# Faculty Units	55	60	65	70	76	82	87	92	97	
# Students	94	117	138	171	207	241	268	286	297	
Assumed Subsidy Funding	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	
Assumed External Funds	629	874	1,163	1,412	1,553	1,709	1,879	2,067	2,274	
Total Income	**20,629**	**20,874**	**21,163**	**21,412**	**21,553**	**21,709**	**21,879**	**22,067**	**22,274**	
Operating Expenditures										
Executive Functions	1,133	1,167	1,202	1,238	1,275	1,313	1,353	1,393	1,435	
Graduate School	284	376	468	552	684	828	964	1,072	1,144	
Base Research (Direct + Indirect)	10,000	11,000	12,000	13,000	14,000	15,200	16,400	17,400	18,400	
R&D Cluster/Expansion Initiatives	4,500	3,190	2,700	2,400	200	150	150	100	100	
Engineering Support: Fitout	1,070	200								
PEREX	120	360	480	480	480	480	480	480	480	
Lab 4/5/Engineering Support Bldg. Operating	25	50	50	200	300	350	500	550	600	
Operating costs for sports, guest house, housing				50	50	75	75	100	100	
Total Operating Expenditures	**17,132**	**16,343**	**16,900**	**17,920**	**16,989**	**18,396**	**19,922**	**21,095**	**22,259**	
Available for Construction	**3,497**	**4,531**	**4,263**	**3,492**	**4,564**	**3,312**	**1,957**	**972**	**15**	**26,602**
Construction (CAPEX)										
Infrastructure: Design & Superv.	100	50	50							
Construction	1,700	300	300	300	300	300	300	300	300	
Engineering Support Building Construction	500									
Lab 4 & 5: Design	300	50	50	200	100	100				
Construction		7,000	6,000	1,300	5,000	5,000	300	200	200	
Support Facilities: Design*	100	200	250	200	200	200	200	200	200	
Construction	800	1,500	1,500	1,500	1,500	1,750	1,800	1,800	1,800	
Total Construction	**3,500**	**9,100**	**8,150**	**3,500**	**7,100**	**7,350**	**2,600**	**2,500**	**2,500**	**46,300**
Additional Construction Money		Lab 4			Lab 5					
Beyond 20B yen	**3**	**4,569**	**3,887**	**8**	**2,536**	**4,038**	**643**	**1,528**	**2,485**	**19,698**
* Grand Stair, Housing, Sports, Guest House, …										
1. The number of faculty units as of the end of the fiscal year.										
2. The number of students as of September of the fiscal year.										
3. FY2015-18 taken from the Medium-term Strategy for External Funds, corrected for the increase in faculty. FY2019-23 assumes growth of 10% /yr.										
4. # Faculty units*200,000 yen										

Table 4.2.1. Estimation of future funding needs. The uppermost rows of the Table reiterate expectations from Section 3.1 for numbers of faculty and students per year. Thereafter are two rows projecting income from subsidies and external sources, followed by a row summarizing total estimated income. Immediately below the income summary are seven rows of operating expenditures, followed by a row summarizing these seven operating streams. The row below the expenditures summary provides the expected surplus of income over expenditures, designated as available for construction.

Chapter 5. Anticipated Achievements of the Next Decade

The results of true, basic science defy prediction: creating new knowledge is about just that – the knowledge is formerly not known. Although still young, OIST has already established a record of discovery. With the increasingly strong interdisciplinary nature of the research at OIST, it is anticipated that the pace of new discoveries will greatly increase over the next decade. Many of the discoveries will result in marketable intellectual capital. With the University's strong commitment to increased emphasis on technology transfer, one can expect considerable activity in start-ups, new businesses, and product development. Some of these businesses will likely lead to on-island manufacturing. But such commercial growth cannot occur solely on the basis of intellectual capital – the innovation that results from OIST research must be accompanied by public sector tax breaks and land-use incentives, by private sector investment, by aggressive industrial leadership and by savvy marketing. These public and private partners have yet to emerge.

With OIST in the lead, marine science will receive a very major boost in Okinawa. It is expected that 10 years from now, OIST will host one of the world's leading marine science centers, with hundreds of participants from all over the world, doing break-through science.

As is already the case, research outcomes at OIST over the next decade will be of substantial help in understanding and reversing the damage to the Okinawan marine and terrestrial environment. Genetic-based research will improve food crop yields and produce healthier food products. Genetic trending and the study of blood, representing broadly the Okinawan peoples, will lead to improved health and extended lives.

Other areas of academic concentration where OIST can expect to establish world-leadership are a) sustainable living, including new strategies and technologies for green energy and power distribution, b) brain science based on a high degree of interdisciplinary capability, and c) human health across a very wide range of topics, again derived strongly from the interdisciplinary strengths of OIST.

Networking will grow substantially. Already scientists from around the globe are seeking to establish collaborations with OIST Graduate University. Local scientific collaborations will take strong advantage of the presence of the University of Ryukyus Medical School. Already a coherent program is emerging in the area of cancer biology. This program will receive a large boost with the construction of the Heavy Ion Therapy center in West Futenma.

The next ten years will see the graduation of the first 6 Ph.D. classes from the Graduate School. About 150 students with unique and highly modern skills will have left OIST to pursue careers in science, teaching, industry, and hopefully, government. OIST has very high expectations that these students will emerge as leaders of their generation and will therefore carry their spirit of innovation and social responsibility far and wide.

All of these achievements will occur while the University doubles its size. Just as establishing the current state of the University is a major achievement in itself, so will be the doubling of the University.