Report of the External Peer Review Panel to the OIST Graduate University Board Of Governors following the Review held at the OIST Campus on July 27-29, 2015

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Executive Summary

OIST Graduate University is a bold vision by the Japanese government to create in Okinawa a truly international, world-leading, science and technology university, where research and education are conducted in English and where at least half of the faculty, students and researchers come from abroad. The success of such a venture will bring sustainable technology-based economic development to Okinawa. It will also serve to influence Japanese universities to adopt more global academic and educational structures.

The Panel recognizes that the rapid achievement of the initial phase of the University results from the Japanese government's steadfast commitment to the bold vision and to the generous financial support that has been provided. As detailed in the agenda, and based on the comprehensive documentation provided by OIST, the Panel (Karl DEISSEROTH, Haim HARARI, Mitiko GO, Maki KAWAI, Olaf KÜBLER (chair), Erwin NEHER) has assessed the primary goal of OIST to establish a leading international graduate university in Okinawa.

The Panel is happy to state that progress across all key measures of excellence has been outstanding. In these measures, OIST is on a par with the 25 universities ranked highest by Times Higher Education, QS or Jiaotong World University Rankings 2014/2015.

The key measures of excellence were:

- Physical campus infrastructure
- Management structure and management processes
- Academic Program and Recruitment of Faculty
- Graduate Program
- Instrumentation
- Course to research outcome

- Technology transfer
- Welfare, social, and cultural support programs

The Panel would like to highlight some especially meritorious achievements in the form of explicit commendations.

We commend OIST:

- for the design, construction, implementation, and use of a harmonious, uplifting, sustainable, efficient, and frankly inspirational physical campus infrastructure
- for the major effort made in installing highly effective management structure and management processes, which we regard essential for the transition from a research institute to an international top-level graduate university
- for considering the management process outlines as living documents, for gathering evidence, for listening to the faculty, and for expressing the will to add amendments when necessary
- for the welfare, social, and cultural support programs.

Building on this solid foundation, the Panel endorses the plans for the future evolution of OIST as detailed in Framework Document II (July, 2014). We put forward one encompassing central recommendation and six subordinate recommendations regarding the future of OIST and two minor recommendations towards optimizing current operations.

The encompassing central recommendation is:

- **The Panel endorses the general plan of growth suggested by the management of OIST, aiming at a goal of approximately 100 outstanding research groups, with a proper balance among different fields of research, and a graduate school of a few hundred students, one decade from now, by the mid 2020's. Towards the end of this decade of development, further evolution of OIST must be deliberated and planned.**

To assure well-structured and well-ordered growth, the Panel includes the following subordinate recommendations:

- the construction budget for new buildings should always precede the recruitment steps
- the budget needed for building the complete space for 100 groups by 2025, should be fully allocated by 2020, and fully spent by 2023
- some arrangement of a multi-year budget indication should be offered to OIST
- the management of OIST should have an official rolling estimate for the operating and construction budget for several years
- certain unspent funds should be carried from one budget year to the next
- the sources of income of OIST should be diversified.

The minor recommendations towards optimizing current operations suggest:

- OIST continue to look for and increase opportunities to provide academic teaching experiences for graduate students and postdocs
- OIST sustain constant effort towards establishing uniformly high levels of support and access across all shared facilities.

The Panel expresses its appreciation to the Board of Governors as well as the Senior Management of OIST and their staff for the excellent preparation and organization of this evaluation, for candid and truthful discussions, for the opportunity to interact with faculty, postdocs, graduate students, staff scientists and technical support, for the wonderfully attentive human assistance and for their generous hospitality.

Conducting this evaluation was for the Panel members a rewarding exertion, and indeed inspirational as well

Chapter 1. Has the University Established All The Facets Required of its Primary Goals?

For OIST Graduate University to establish itself as a world-leading institution, it must develop high-quality programs in: education, research and technology transfer. With these three programmatic themes always in mind, the Panel considered the following questions.

1.1 Has OIST designed, built and implemented modern, state-of-the-art, world-leading physical infrastructure?

We commend OIST for the design, construction, implementation, and use of a harmonious, uplifting, sustainable, efficient, and frankly inspirational physical infrastructure. The committee felt that the buildings and grounds were integrated well with (and met the challenges of) the natural environment. We were particularly impressed with the energy-efficient air conditioning, with the highest power consumption restricted to night when electricity is cheapest, and its use least disruptive to the local community.

The animal facilities including the fish and rodent vivaria were also felt to be impressive, well-managed, humane, clean, and modern. We noted that with the zebrafish viviarium nearly full (and zebrafish a rapidly growing experimental system likely to be of special value to OIST), and the rodent facility 70% full, that the expansion trajectory of OIST will likely require new vivarium space in the new buildings.

Finally we noted with approval the arrangement of the buildings with respect to the accessibility of the child care facility, only a few minutes' walk from the research

laboratories, and the presence of nursing and lactation rooms. As with the other aspects noted above, these will likely have to be expanded with the campus expansion as well.

These aspects, among many others, demonstrate the unequivocal achievement of modern, state-of-the-art, top-level physical infrastructures. We note that item 1.5 below addresses the infrastructure aspects beyond the physical plant, including instrumentation.

1.2 Has OIST established a management structure capable of supporting a world-leading university? Have high-quality senior managers and administrative staff been recruited?

OIST has been led, from its very beginning, by an outstanding group of Japanese and international trustees and scientific leaders, and it has made impressively successful strides towards becoming a graduate university at top international level. In line with principles of international best practice, OIST has established a system of Governance, headed by the Board of Governors (BOG), its subsidiary Board of Councilors (BOC) and the corporate auditors as elaborated in the years 2005 in Act No 26 and 2009 in Act No 76. These bodies operate under a set of bylaws and rules approved by the Minister of Education, Culture, Sports, Science and Technology on September 10, 2013, and put into force on October 2, 2013.

The BOG, as the strategic supervisory organ, entrusts the operational management to the President (CEO) and Executive Vice President. Three Deans - of Research, of Faculty Affairs, and of the Graduate School - take responsibility for the edcucational and academic functions of OIST. Six Vice Presidents - for Financial Management, for Human Resources, for Buildings and Facilities Management, for Gender Equality, for Communication and Public Relations, and for Adminstrative Compliance share

responsibility for the adminstrative functions of OIST. These senior managers and adminstrative staff have impressive (and partly international) professional, track records.

The Deans and VPs report directly to the President with whom they have regular weekly meetings to ensure smooth operation of OIST. OIST has established a Faculty Affairs Office under a Dean to address faculty matters which can become intricate and require dedicated attention. These involve appointment, tenure, promotion, review, leaves and sabbaticals, appeals, and visiting faculty.

The Faculty Affairs Office has created

- a Faculty Handbook which sets out the policies and principles that govern the operation of the Faculty
- a series of Handbooks which cover the main processes that are needed to develop the Faculty (recruitment, tenure, promotion and review).

In addition, rules and regulations have been reappraised and reformulated where necessary.

We commend OIST for this major effort in installing a highly effective management structure and management processes, which we regard essential for the transition from a research institute to an international, top-level graduate university. We equally commend OIST for considering the Handbooks as living documents, for gathering evidence, for listening to the faculty, and for expressing the will to add amendments when necessary.

1.3 Has OIST established an academic program capable of achieving world-leading status? Have high-quality faculty been recruited? Has OIST set a course

to achieving world-competitive research outcomes? Are Faculty Units that have had sufficient time to establish their programs producing high-quality science?

The Panel has examined the procedures for recruiting and evaluating research faculty. These were found to agree with the highest international standards. We realize that the evaluation of individual research units is the charge of special 'External Review Committees'. Nevertheless, we would like to state that we have visited laboratories and witnessed presentations by outstanding researchers, who are leaders in their respective fields. The academic program reflects the breadth of research topics and the quality of the faculty which is well on the way to reaching parity with internationally leading institutions.

1.4 Has OIST established a graduate program capable of training world-competitive researchers? Have high-quality students been recruited?

At the time of this evaluation, as a private graduate university OIST had recruited 79 students from 24 nations/regions during 2012-2013, and 24 students in the 2015 class, with over 100 students in total during the past three years. The students were recruited through much higher levels of competition than that of the entrance examination for graduate schools of top national universities in Japan. Many of the students were attracted by the inter-disciplinary teaching program and outstanding laboratory facilities and campus of OIST, as well as the internationally competitive support package. They are trained in a core discipline with multi-disciplinary enrichment, rotating with three professors/disciplines in the first 3 terms, one of which must be out of the student's core discipline.

OIST has recruited high-quality students and established a graduate program capable of training world-competitive researchers. The peer review committee met eleven students and found that all of them are ambitious and outstanding. They have diverse

and solid ideas on the interdisciplinary research direction and what they require in addition at OIST. The students want courses in mathematics and computer science, including training in programming. The students also want to have academic teaching experiences in high-school and college settings, as well as in open-campus and community outreach events. Their experience in academic teaching will be valuable for the students in obtaining academic positions at universities in the future.

The Panel recommends that OIST continue to look for and increase opportunities to provide academic teaching experiences for graduate students and postdocs.

1.5 Has OIST established modern, state-of-the art infrastructure and instrumentation capable of supporting a world-leading research program?

One of the most outstanding strategies taken by OIST is the development of major infrastructure to support the research, implemented with high-level equipment and staff. The management of these resources as common and shared facilities has been utilized in a highly successful manner in order to facilitate interdisciplinary research.

One outstanding example, that the Panel was introduced to, is the clean room for micro-device fabrication. This facility has been successfully utilized in extending microfluidics studies to microfluidic devices, with considerable potential for application in bio-devices and in turning the knowledge of surface science to promising new applications.

The high performance "SANGO" HPC computing cluster of OIST is another outstanding example of a shared facility. Despite minimal staff which needs expansion, this shared-use facility is widely embraced across a range of applications in OIST, from fundamental research to management and administrative tools. Their success is based in no small part on careful attention to the needs of the users, which

are identified through frequent discussion with user groups. This kind of approach is well-suited to adapt and respond to shifting demands of users, that will change as the fields of science and technology progress over time.

Key instruments such as mass spectrometers, electron microscopes and diffractometers are always ready for use. Likewise the DNA sequencing facility is heavily used and carefully maintained. These common facilities are of great help for research unit heads, not only during the crucial start-up period but also when entering a new field, and provide very important infrastructure for maintaining the top-level OIST environment for research. As in most top-level research institutions, constant effort is required to sustain high levels of support and access with such shared facilities.

1.6 Has OIST established the core requirements to achieve technology transfer, in particular as might benefit sustainable development for Okinawa?

The Panel endorses the OIST plan for technology transfer, which is clearly of the kind that might be sustainable and benefit economic development in Okinawa. Specific policies are in place that encourage enterprise among the faculty, and that will (and indeed already have) led to technology transfer and direct development in Okinawa.

We note that OIST established a dedicated Office for Sustainable Development of Okinawa in July 2014, which encompasses efforts devoted to Technology Licensing and Business Development, under supervision of the Office of the Executive Vice President that oversees the activities of the Office and tracks the impact of its activities on innovation at OIST and economic growth in Okinawa.

OIST has assembled guidance to faculty, students, and staff regarding the recording, disclosure, and patenting of intellectual property. Invention disclosure forms, MTA

Forms, and forms for industry-sponsored research agreements and collaborative agreements are readily available. And despite the short time windows involved, tangible outcomes have resulted. More than 50 patent applications have been filed and a startup company (Okinawa Protein Tomography) has been launched, which is local and represents a clear example of benefiting sustained development in Okinawa.

1.7 Has OIST established adequate welfare, social and cultural support programs capable of recruiting and retaining an multi-national research community and their families?

OIST has put great effort into creating a support structure for new employees. Good housing, health support, counseling, a pre-school, and a resource center have been deemed essential for helping staff adapt to a new life in Okinawa, and have been put in place.

The Graduate University has established a counseling service, named Ganjuu, to ensure that the students and staff have guidance and help. OIST also has established a Child Development Center that provides care for children from 2 months to six years old. There is also an after-school program and a Holiday Program.

OIST also has established a clinic with a doctor and 3 nurses. Minor and emergency concerns can be dealt with on campus and the staff can refer patients to the most suitable specialists on the island. In addition, OIST has created a Resource Center to provide help and advice on every aspect of life in Okinawa to facilitate integration.

The Panel met with the responsible staff and was very favorably impressed by their high spirits and evident competence. The Panel heard unanimous praise for the

support structure and its operation by faculty, staff scientists, postdocs, and graduate students.

We are amazed, and we commend OIST for these resources that have been constructed and staffed.

Chapter 2. Does the University Have a Credible Future Plan?

The Panel endorses the broad lines of the OIST general plan, continuing the pursuit of its original goals:

- Performing outstanding research at the best international level;
- Combining basic research with applied topics;
- Covering a very wide range of disciplines in all the natural sciences, including life sciences, chemistry, physics, mathematics, computer science and excursions into medical, agricultural, environmental, and engineering topics;
- Performing all research and graduate education in a truly international environment, with an international faculty, staff and student body;
- Emphasizing interactions among different scientific disciplines;
- Contributing to the economic, industrial and cultural development of Okinawa;
- Serving as a role model for research organizations in Japan and elsewhere;
- Enhancing the general interaction of academic research and the high-tech and biotech industry in Japan.

OIST has made extraordinary successful strides towards achieving all of the above goals. However, it must be clearly stated that no scientific organization anywhere can reach a true world leading status in less than a few decades. This calls for controlled growth, and step by step development, based on a periodically updated evolving plan of action. It also requires a consistent pursuit of excellence and a delicate balance between a long term vision and the attention to day-to-day details.

In order to achieve the above goals, outstanding research at OIST must cover a sufficient number of topics with a minimal critical mass in each one of them. It is not necessary or possible for OIST to contribute to every niche in science, and, since it does not have an undergraduate program, it is even legitimate to leave out some

larger areas of research. However, enough subfields must be covered with a sufficient quality and intensity, in order to have a significant impact on the world of science. A rough estimate of the absolute minimal size of an Institute which aims at these goals calls for several subfields of each of the broad areas of the Life Sciences, Chemistry, Physics, Mathematics and Computer Science as well as some topics dealing with environmental, medical, agricultural and engineering research.

If we consider the above as 4-8 broad major disciplines, with several main subfields in each one, and an average of half a dozen principal investigators, leading their own research groups, in each subfield, we arrive at a bare minimum of approximately 100 units. At the same time, the growth rate of OIST cannot be too rapid, in order to ensure quality control and to be consistent with a realistic construction plan for laboratories and infrastructure. Experience derived from other developing young research organizations shows that an annual growth by approximately five new units is optimal, allowing for a successful recruitment program, a reasonable construction plan and a realistic annual increase of operating budget. Based on this "rule of thumb", the current 50 or so units at OIST can grow to the minimal 100 units, described above, in no less than a decade. An average experimental research group should include approximately 10 scientists, including postdoctoral fellows and graduate students, with typical theoretical research groups being somewhat smaller. The 100 or so professors should then be associated with a few hundred postdoctoral fellows and several hundred graduate students, studying towards advanced degrees. Adding administration, infrastructure and scientific services, one then reaches an estimate of about 1000 people around the year 2025.

In order to reach the target of 100 principal investigators, of the highest international standard, ten years from now, OIST must pursue a careful and balanced elitist recruitment policy and procedure. On one hand, the building up of an outstanding faculty is the most important task of the President and his top senior academic officers. On the other hand, the existing permanent faculty members must contribute

towards the selection of the recruited new professors. Finally, as long as the desired balance among the different broad fields of science has not yet been achieved, reaching such a balance is an important priority, to be considered within the framework of the recruitment process. It is also necessary to guarantee a fair and equal level of assessment and quality assurance for different fields of science. A recruitment autonomy or even semi-autonomy of a given field of science may lead to some loss of quality in the recruitment efforts in such a field.

The Panel therefore suggests that some process, initiated by the President and considered by a well-balanced body of faculty and possibly outside scientists, should give the final imprimatur for all new tenure appointments. Models for such multi-discipline committees or boards exist in a few similar institutions and the trustees and management of OIST may benefit by studying their procedures and borrowing those ingredients which suits the structure and conditions of OIST Graduate University.

Today OIST takes pride in having all presently installed research groups interacting with each other and not being divided into disciplinary departments. Extensive discussions were conducted this past year within OIST regarding the expansion of the University. While recognizing that growth will necessitate change in the organizational structure governing the faculty, the obvious dilemma is how to maintain the all-important inter-and multi-disciplinary interactions, while creating an extended organization. No administration can function when 100 professors all "report" directly to one person, be it the president or a provost or a dean. Even the need for all principal investigators to approach directly a single head of finance department, or of human resources, becomes challenging. This is particularly so, when almost all funding comes from one main government source, channeled through the management of OIST, as opposed to a typical American funding pattern, where most financial support comes from diverse outside grants, directly aimed at a given research group, which then operates largely like an independent economic entity.

The experience of most leading successful international universities and research institutes points at establishing several large organizational entities, with rotating chairs, and a very small skeleton administration. Each such entity would have several dozen research groups, with financial and administrative mechanisms that encourage and induce inter-entity scientific interactions. Intramural competitive funds, allocated to specific purposes by the OIST management, and emphasizing multi-disciplinary work, may contribute to the flourishing of outstanding research groups, while enhancing collaboration between the entities. However, the careful creation of scientific entities within OIST must wait until a good balance has been achieved among the different main scientific disciplines, or else the larger disciplinary groups would dominate all expansion plans, leading to further imbalances. The issue of extending the current scientific organization to accomodate 100 faculty units should be tackled by the Board of Governors and by the management of OIST, only after such a balance would have been achieved.

The Panel endorses the general plan of growth suggested by the management of OIST, aiming at a goal of approximately 100 outstanding research groups, with a proper balance among different fields of research, and a graduate school of a few hundred students, one decade from now, by the mid 2020's. Towards the end of this decade of development, further evolution of OIST must be deliberated and planned.

The Panel notes that the planning and review of a young growing institution differ from a similar exercise in a stable well-established university or institute. A young organization cannot be in a steady state of age groups, while an established older organization often has similar numbers of retiring professors and new professors.

The Panel believes that the above plan of growth, and the special circumstances of a fast growing young organization, must dictate the following five financial measures:

The operating budget of OIST must grow approximately linearly, for the next ten years, until it is doubled in 2025, relative to 2015. This means an increase of about 10% of the 2015 operating budget, per annum, in real terms, allowing for new recruitments and promotions, and subject to a detailed analysis of needs and plans. The Panel realizes that such an annual increase would be very significant, but it is necessary in order to achieve the ambitious goals and to preserve and retain what has been achieved so far. Given the budgetary constraints of other Japanese universities and academic organizations, there may be a hesitation to favor OIST in such a way, but it must be stated very clearly that, in such circumstances, the choice is really between a considerable growth on one hand, and a move to mediocrity with a loss of what have already been invested, on the other.

The construction budget for new buildings should always precede the recruitment steps, rather than be coincidental with them. Every new laboratory building must be planned, funded and built with a lead time of approximately three years relative to the recruitment time of its future tenant groups. This means that, not only the total laboratory space of OIST should be doubled over the next decade, but the doubling of space must precede the recruitment. One can recruit, when space is available, but not create new space around a new existing recruited professor. The budget needed for building the complete space for 100 groups by 2025, should be fully allocated by 2020, and fully spent by 2023, so that its last resulting construction is ready for the recruits of 2023, 2024 and 2025. Likewise, immediate funding should be allocated now for the next new lab building, needed for the first recruitment steps of the planned coming decade of doubling the size of OIST. In 2023, funding should already be allocated for the first construction of a possible additional expansion plan for 2025-2035, always a few years ahead of the corresponding recruitment.

It is absolutely essential that some arrangement of a multi-year budget indication be offered to OIST. Nothing in science happens in one year. Every new recruit takes a few years to establish his or her lab; every building and every major piece of

equipment requires a couple of years to plan, and acquire; every student and postdoc makes and receives commitments for several years; every research project and every external grant lasts several years. The best brains worldwide cannot be recruited without a perspective for stable funding of at least 5 years. It is therefore crucial that the management of OIST will have an official rolling estimate for the operating and construction budget for several years, even if normal government funding is not operating in such a manner. The government of Japan should be applauded for taking the bold initiative of building OIST as an extraordinarily ambitious project. But this cannot be achieved without a mandatory decade-long planning, accompanied by a moving multi-year budget estimate.

It is also crucial to allow OIST to carry certain unspent funds from one budget year to the next, based on its own multi-year commitments to its leading researchers. The Panel suggests that OIST be allowed to create separate closed dedicated internal funds for those internal commitments which span several years (commitment for major equipment purchasing, commitments for research allocations to new research groups, and similar allocations). Such internal funds should be treated as liabilities in the financial statements of the University and not as unspent funds leading to a surplus.

The Panel endorses the aim of OIST to diversify its sources of income by approaching philanthropic foundations, international competitive grants, industrial sponsors, and other sources, including, eventually, income from intellectual property. However, it must be realized that both private fundraising and financial income from the exploitation of intellectual property, require lead times which are even longer than those needed for establishing a new outstanding research University. Efforts should be made continuously, and the foundations for these avenues of funding must be installed at a very early stage, but it would be a miracle, if such sources of funds would become very significant before 2020 or 2025. On the other hand, individual competitive external research grants can be pursued immediately by the principal

investigators, with possible administrative, moral and financial inducement by the OIST leadership.

Appendices

1 Reference Data

1.1 Unit Overview and Unit Publication List

1.2 Statistical Information

2 Biographies of the Panel Members

3 Specifics for the 2015 Peer Review: Charge

4 External Peer Review of OIST Agenda and Group Activity Participants