Report of the NII IAB Meeting 2015

27 November 2015

Prof. Wolfgang Wahlster (Chair),

Prof. Michel Cosnard, Prof. Tamer Özsu, Prof. Christine L. Borgman, Prof. Dong Thi Bich Thuy, Prof. Calton Pu, Prof. Hank Levy, Prof. Hugh Durrant-Whyte, Prof. Anthony Finkelstein, Prof. Willem Jonker, Prof. Hong Mei

1. Introduction

This is the report of the 2015 meeting of NII's International Advisory Board (IAB), which took place on October 28 and 29 in Tokyo. The program of the meeting can be found at Appendix 1 and 2. Three of the participants in the last IAB meeting in 2013 also attended this meeting (M. Cosnard, T. Özsu and W. Wahlster). All other members of the IAB were newly recruited experts providing a very broad topical coverage and wide geographical distribution.

This report contains general observations and specific comments as well as recommendations on the positioning and strategy of NII, the research program, management and organization, industry engagement and the organization of the IAB. The report summarizes the consensus opinion of the entire IAB.

2. General Observations

First of all, the IAB would like to commend Prof. Kitsuregawa on his first term as Director General of NII. He and the entire staff of NII are to be congratulated on the significant scientific progress that has been made since the last IAB review in 2013. Although NII had to cope with a decrease in the overall budget in 2013 and 2014, Prof. Kitsuregawa and his team were able to increase the overall budget to an all-time record for 2015 by a very successful external project acquisition strategy.

NII, with its tripartite mission, is a unique institute and gradually the potential benefits of synergy between the three pillars of the mission are being realized. NII is pushing the envelope in some key areas and has leading researchers with boldness and clear vision. The international focus is particularly impressive and should be commended, as well as the engagement with society.

NII continues to be globally competitive in basic and applied research in the broader field of informatics. More than 80% of all innovations in mobility, manufacturing, retail,

logistics, health and farming are enabled by IT. This means that NII is a key enabler not only for scientific progress but also for the Japanese economy. We expect more demand for IT from industry and society in the years to come.

It is nearly impossible to carry out any scientific research without the involvement of informatics. After the mathematization of the sciences, the informatization of all contemporary sciences is now in full swing!

To take full advantage of this potential, it is essential to take a broad perspective and to embrace new fields, or to combine core IT with other disciplines in an interdisciplinary fashion. We are happy to see that current research at NII covers a wide range of relevant topics of modern informatics.

The excellent network of international academic relationships in combination with the team's strong relationship with leading Japanese companies and important government agencies allows NII to strike the fine balance between scientific impact and practical relevance.

The IAB is pleased to observe that many of the recommendations and advice given after its last meeting have been followed.

General Recommendations:

Information technology is the key enabler for all areas of science and technology in the 21st Century. Information technology is disrupting all areas of business while simultaneously building new industries and new capabilities. For the benefit of Japan, NII must be in the vanguard of this revolution. NII must be in a position to develop and build Japan's capacity in information technology, and be the conduit through which universities apply this technology to both existing industry and new businesses. To achieve this, NII is encouraged to develop a strategic plan which provides a vision and a way of executing this vision over the next five years - in research, and in engagement with new and existing industries.

We believe that NII is in a position to increase further its impact both in research and in broader society. We recommend that NII develops a strategy and vision document laying out a plan for maximizing its impact, especially where it comes to addressing the key societal challenges Japan is facing. The IAB suggests that such a document should include a driving strategic narrative, the competitive landscape, the NII differentiating factors and the key impact evaluation metrics.

The IAB believes that it is of critical importance that NII makes sure that the role of IT research is central for the 5th Science and Technology Period (2016-2020) that is now being specified, since IT is the key enabler for innovation. Further, we believe that NII has a broad mission and informatics is a key enabling technology. As a result, it is not adequate to compare a National Institute of Informatics with, for example, a National Institute of Polar Research, Statistical Mathematics or Genetics, which have more focused missions.

3. Positioning and Strategy

NII has a unique position in the Japanese informatics ecosystem with its tandem organization serving world-class research and education whilst at the same time building and operating Japan's academic IT infrastructure. The operations role is a unique aspect of NII. This organization is being tasked with building challenging, large-scale artifacts that will be operated for many years in support of the educational and research missions of Japan's universities and research centers.

The opportunity for the two roles to influence each other is large, especially when focusing on really disruptive technologies. To take advantage of this opportunity requires significant advanced thought and planning, e.g., conceiving of the important research questions that might impact an operations project from the initiation of its design, as well as what would be needed to evaluate those research questions once the system is operational.

Under the leadership of Prof. Kitsuregawa, NII continues to work at the forefront of technological innovation in fields that help the Japanese society and industry to face the disruptions of the digital world and marketplace. NII's technology can help tackle some of the most urgent societal problems in Japan like the demographic challenge of an aging society, more effective disaster management and a sustainable energy system. Such problems require multi-disciplinary approaches that involve domain specialists, socio-technical experts, and technological systems. Only collaboratively can these areas be addressed effectively.

Regarding the outline of the strategy presented, NII might consider sharpening the focus on specific societal challenges. The combination of a stronger ecosystem embedding and sharp societal focus will provide a firm basis for concrete and tangible impact creating new companies and innovating industry sectors.

By addressing problems of industrial and societal interest, NII also gets a continuous supply of new research challenges to solve. All projects pursued within the basic funding allocations act as a multiplier since they form the intellectual basis for a large number of more applied projects with industry and other national and international sponsors. We are pleased to see the impressive increase (more than 500% since 2011) of industrial contracts from major companies like NTT, NEC, and HITACHI, resulting in more than 900 K USD in 2014 from industry. We commend the endowed industrial chairs program that will commence shortly.

SINET operated by NII is a critical infrastructure for research and education in Japan with 3 million users in more than 800 universities and research institutions across the country. SINET5 starting in April 2016 is a very important next step to upgrade this infrastructure with a 100 Gbps backbone network and high-speed lines to the rest of Asia, Europe, and the US. NII's plan to serve as a Cybersecurity center for its academic partners with a direct link to law enforcement agencies and NISC is very important to secure SINET5 professional operation in all its nodes avoiding excessive costs. Collaboration with NICT on this topic is taking place and definitely encouraged.

With regard to infrastructure activities, NII would benefit from developing a strategy that allows the limited resources to be focused on provisioning of connectivity to the academic community while leaving the added-value services such as basic cloud,

authentication, security services and the like to other providers. It will, we judge, be hard to create a unique position in these services that are becoming a commodity. NII can serve as a broker to procure cloud resources. The design and implementation of an open science platform including a domain-independent open data platform is a very important goal of NII.

One example where NII could have immediate impact, nationally and internationally, is to invest in the infrastructure for open access to Japanese publications and data. These are national and international scientific priorities, and NII has the systems and expertise to address them. We were surprised to learn that NII is operating institutional repository services for other academic institutions, without having one for its own researchers.

NII serves as a hub for collaborative research with an impressive worldwide network of 95 universities and institutions that have signed MoUs with NII. The IAB thinks however, that it may be timely to develop some guidelines and strategic prioritization based upon an evaluation of these international relations.

Recommendations on Strategy:

In addition to the positive trend towards more external funding, particularly from large corporations, the IAB encourages increased cooperation with small and medium sized companies, which are often innovation leaders in their markets. The new digital revolution is being driven by small and agile companies that can rapidly take an idea and create a new business. For this reason, NII needs to think carefully about how it can build engagement with smaller companies and assist these companies in innovating through the use of information technology. It is through this process that new ideas and the latest research can become a new economic driver for Japan.

This could achieve excellent leverage of NII's core funding through increased impact as an innovation engine in various economic sectors.

In order to fulfill its broader educational mission**,** NII might wish to consider playing a more prominent role in stimulating IT teaching at primary and secondary schools, for example through initiatives similar to the "Code Week" program in Europe (http://codeweek.eu/), promoting coding skills for children and through the provision of educational resources.

4. Research Program

Within the last two years, the advisory board has witnessed a continuing increase in the influence, output and scientific impact of NII, and we are very pleased with the number and quality of publications at top international conferences and journals. In addition, newly created research groups have positioned themselves very well within the ecosystem of NII.

The increased number of best paper awards at selective conferences and first places in international academic competitions and benchmarks is particularly notable. The IAB is pleased to see the dramatically increased visibility (almost 200%) of NII's research results in Japan's public media and even in the international press, TV/radio, and online media.

The scientific success, quality, and international standing of NII is further evidenced by numerous examples of talent developed at NII transitioning into industry, academia, or more recently to spinoffs.

The IAB is pleased to see that the feedback loop between NII's research division and its service division has been strengthened by the newly established "Center for Cloud Research and Development" and the "Center for Dataset Sharing and Collaborative Research" in the service division.

NII has become one of Japan's key players in the important field of Big Data, mainly focusing on new algorithms and innovative methods for data analysis and data mining. But it is also important to do research on the infrastructure necessary for Big Data, especially the software-defined platforms for big data management and processing. This could increase the synergies between the research and service division of NII.

Although the overall research quality is very good, the IAB found that a few of the smaller projects have something of a "me-too" flavor, instead of establishing new research fields and tackling original research goals. By contrast, the IAB was impressed by some of the disruptive projects like "Voice cloning", the "PrivacyVisor" and "Fast Hyperspectral Fluorescent Imaging", presented by early-career professors.

NII's large-scale flagship projects addressing grand challenges are impressive. Challenge-led research projects like the Large Graph Project, the Cyber-Physical Systems IT Platform Project, and the Todai Robot Project are yielding interesting, high quality results.

New high-impact projects could be in cyber-physical production systems for smart manufacturing, collaborative and cognitive robotics, usable IT security and privacy, smart service and smart data platforms, and autonomous systems (self-steering cars, trains, ships, or aircrafts).

The newly established collaboration with the Japan Agency for Medical Research and Development (AMED) to advance IT-based gerontology and with the National Research Institute for Earth Science and Disaster Prevention (NIED) for disaster mitigation are excellent steps to increase the societal impact of NII's research.

NII should consider to renew its investment in traditional areas of strength such as knowledge management, information retrieval, linguistics, and scholarly communication, since these topics are again in their ascendancy in an era of big data, multilingual societies and global trade, open science, and open access.

In conclusion, NII is on the right track since the key areas of the vibrant fields of modern informatics are well covered, and the positioning of the research agenda is focused onto timely and visionary topics.

Recommendations on Research Program:

The IAB recommends organizing NII principally around large-scale research projects on grand challenges and to increase the collaboration with Japanese and international research institutions within these high-impact initiatives.

The impact of a project should not only be measured by publications with high citation rates, but also by the number of downloads and the usage of open-source software tools and annotated data sets and benchmark suites.

NII should consider sharpening the focus on specific societal challenges, while at the same time keeping the academic freedom and creativity. The combination of ecosystem embedding and strong societal focus provides a firm basis for concrete and tangible impact creating new companies and innovating in industry sectors.

Information technology is critical in addressing many societal problems in Japan, from traffic management, through disaster response to aged care. These types of societal problems, which are becoming so important to Japan, would make a good focus for new research challenges for NII.

5. Human Resource Development and Entrepreneurship

There is excellent research at NII with a cadre of talented professors, in particular early-career professors. This trend towards early-career professors, started under Sakauchi-san as a Director General, is transforming NII and should be continued. Through its human resource development strategy, NII retains its agility to react to new upcoming research challenges and has succeeded in hiring top talent leveraging its rich network of university connections and international collaborations.

In addition, the number of international researchers and female researchers has been increased every year, so that the level of diversity is now higher. This positive trend should be continued to match the level of diversity of similar organizations like ICSI in the US or DFKI in Germany. A strategy to increase participation is to invest in socio-technical areas, where international and female researchers are available in greater proportions than in areas such as software engineering. Such recruiting must be done carefully to avoid concentrating or isolating women and international scholars in certain areas.

Another challenge is apparently recruiting and retaining the high-quality staff required for operations roles in the service division. NII might need to create more job titles and career development pathways to allow it to recruit these high-quality staff - particularly people who have both (1) skill in the design and implementation of large-scale systems and also (2) an understanding of research and its processes and methodologies.

NII may provide more opportunities to NII staff and students to create their own startup companies by developing a process for supporting startup creation and development (seed capital money), business angels, incubation and acceleration programs. Links to EIT Digital and the Software Cluster in Europe, or institutions like the RocketSpace

campus in Silicon Valley could be used to boost such an ecosystem to help NII's startups to thrive.

Recommendations on Human Resource Development and Entrepreneurship:

In order to be able to recruit and retain top performers for the service division, a parallel career development pathway for experts engaged improving and operating the cyber-infrastructure should be established. Recognizing high performance, e.g. in cyber security, is vital. Such experts need to be treated differently than the scientists in the research division.

We recommend that NII should create an environment that stimulates and facilitates entrepreneurship especially of young researchers and students, amongst others leading to startup creation.

In our last report we had noted the success NII had in attracting foreign researchers, but we felt that reciprocity is not evident. Thus, we recommend that NII should create opportunities for younger researchers to spend some time with research groups outside Japan, and encourage them to do so.

With respect to economic and career development impact, we recommend that NII seeks to establish itself as a leader in setting up an ecosystem that connects academic research with startups, small and medium enterprises as well as large corporations. Such an ecosystem would clearly go beyond the current industry relationships. The legal framework for easy startup creation should be improved in cooperation with government.

6. Organization of the IAB Meeting

The IAB thanks the staff of NII for the excellent preparation and organization of the meeting as well as the great hospitality. It was very good to have the opportunity to interact with researchers during the poster session and the reception, in addition to the plenary and workshop presentations.

We appreciate that the IAB was expanded with two female members, following our recommendations in 2013.

IAB felt however, that the summary of the workshop results in the morning of the second day are less relevant than more time for interactive discussions with researchers and time for closed-door IAB committee meetings.

Recommendations on the Organization of the IAB Meeting:

It is recommended to have the next IAB start with a presentation and discussion around the strategy and vision document that the IAB recommends. At the next IAB meeting there should be no plenary session for the reports about the workshop results on the

second day. Instead, this time should be reserved for further discussions with the staff and management as well as closed-door meetings of the IAB. The IAB could have made greater contributions, had material been sent in advance, formal presentations reduced to less than half the meeting time, and the focus placed on asking challenging questions of the assembled experts.

The meeting should be extended to two full days, so that visits of individual labs with discussions and demos become possible. In general, more time for candid discussion between the IAB and NII leadership would be appreciated. The material presented at the plenary sessions should be distributed in digital form at least 7 days before the next meeting so that the IAB can prepare precise questions in advance.

Appendix 1: Schedule of the International Advisory Board Meeting

October 27-29, 2015

Tuesday October 27

19h00 dinner at Niwa Hotel hosted by Director General Prof. Masaru Kitsuregawa: participants IAB members and some NII representatives: prof Jun Adachi, Shinichi Honiden , Prof Henri Angelino, Prof Shigeki Yamada, Prof Zhenjiang Hu, Prof Ichiro Satoh.

Wednesday October 28

9h30 coffee (rooms 1901-1903)

10h00-12h00 IAB meeting Master of ceremony: Prof Jun Adachi

-10h00-10h40 Prof. Masaru Kitsuregawa Director General: NII policy present and future/discussion with IAB members

- 10h40-11h00 Prof Ken Kawarabayashi: Introduction to JST ERATO Large Graph Project (15+5 Discuss)

- 11h00-11h20 Prof Imari Sato: Spectral Modeling of Reflective-Fluorescent scenes
- 11h20-11h40 Asso.Prof Junichi Yamagishi: Voice cloning and its applications

- 11h40- 12h00 Prof Noriko Arai "Can an A.I. pass the entrance exam of the Univ. of Tokyo? - Todai Robot Project".

12h00-13h00 O bento lunch

13h00-16h15 (including a coffee break)
IAB members will divided into 3 parallel sessions/workshops
- **workshop 1 Cyber infrastructure: chair session Prof Shigeki Yamada**

- workshop 2 Fundamentals of Algorithm and Software : chair session Prof Zhenjiang HU

- **workshop 3 Digital content and Media: Chair session Prof Ichiro Satoh**

16h15- 18h00 Posters sessions rooms (1208-1210)

18h15- buffet Get Together: IAB members and NII researchers.

Thursday October 29
9h15-10h45 Master of ceremony: Prof Jun Adachi
Presentation of reports by Chair session and IAB members of the 3 sessions/workshops : discussion (rooms 1901-1903) 30 min per report including discussion

10h45-12h30 coffee break/IAB members close session

12h30 presentation of comments /suggestions of IAB members

13h00 O bento lunch

14h00 end of IAB meeting

Appendix 2: IAB meeting Wednesday October 28: Posters Sessions

16h15 – 18h00

List of additional posters

1. Assoc. Prof. Ikki Fujiwara Assoc. Prof. Michihiro Koibuchi: In-water Datacenter Computing (the industry-collaborative projects-2 posters)
2. Assoc. Prof. Nobukazu Yoshioka: Top SE : Education Program for Top Software Engineers
3. Assoc. Prof. Kenji Tei: ClouT: Cloud of Things for Empowering the Citizen Clout in Smart Cities
4. Assist. Prof. Soichiro Hidaka: Robust and Efficient Infrastructure Software with Crystal-Clear Behaviors
5. Prof Zhenjiang Hu: Bidirectional Programming: Principle and Practice
6. Prof Ichiro Sato: Adaptive Distributed Systems
7. Assoc. Prof Fuyuki Ishikawa: Adaptive service composition under diversity
8. Assoc. Prof Kazunori Sakanoto: WillingRing: A Motivation System based on Analysis of Users' Behaviors
9. Assist. Prof Kana Tsushima: Type error debugging systems with an existing type checker
10. Assoc. Prof Gene Cheung, graph signal processing for image representation and restoration
11. Zhen Wang and Assoc. Prof. Kazuya Kodama, Dense Light Field Synthesis and Rendering from Multi-focus Images
12. Assist. Prof Kenshi Takayama, Generation and editing of meshes for surfaces and volumes
13. Prof. Helmut Prendinger, Unmanned Aerial Systems: The Next Frontier in IT-based Services
14. Assoc. Prof. Asanobu Kitamoto, Solving the problems of information overload and information scarcity for disaster response using big data