Full Research to overcome “Valley of Death” in AIST

Management Policy, Research Strategy and Evaluation for Contribution to a Sustainable Society in AIST

Session: Bridging Gaps between basic and applied Research and Development and the ‘Valley of Death’

Osamu Nakamura, Ph.D.
Deputy Director
Evaluation Department

National Institute of Advanced Industrial Science and Technology (AIST)
AIST’s Role in S&T Administration

**METI (17% of total S&T budget)**
- Creation of technology seeds
- Establishment of new technology for next generation
- Tax Reduction

**MEXT (64%)**
- Grant for operating expense
- Grant to researchers

**AIST**
- Technology Transfer
- Cooperation

**Universities**
- TLO
- Technology Transfer

**NEDO**
- New Energy and Industrial Technology Development Organization
- 22M US$

**Economy**

**Industries**

**Reform of national innovation system**
(industry - university cooperation, national project reform, IPRs, etc.)
Strategy Structure of AIST

Basic principles: Social development through enhancing industrial technologies

Missions:
• Contribution to a sustainable society
• Contribution to industrial competitiveness
• Contribution to local industrial development
• Contribution to Industrial technology policies

Future visions*

* Future visions:
1. High quality life with good health and longevity
2. Intelligent, safe, and secure life supported by advanced information services
3. High industrial competitiveness and reduction of environmental load realized by new materials, parts, and manufacturing technology
4. Wealthy and comfortable life by overcoming environment and energy issues
5. Advanced industrial infrastructure developed by novel measurement technologies and evaluation systems
6. Construction of intellectual infrastructure through understanding of the earth
7. Dissemination of physical and chemical metrological standards
AIST and "Innovation Super Expressway Plan" of METI

Innovation of Japan in the 21st Century

Deceleration of knowledge stream after high economic growth period

Industry

Construction of a new “Expressway” via cooperation among Industry, Academia and Government

Role of Universities, Research Organizations, Industries….

Academia

Basic knowledge of science and technology (has become much more advanced and abundant compared to the 20th century)

Science and Technology Basic Plan (1996～)

1st period (’96 - ’01) ¥ 17 trillion
2nd period (’01 - ’06) ¥ 24 trillion
3rd period (’06 - ’10) ¥ 25 trillion

Universities, Research Organizations, ...

AIST

Full research, Network of Excellence, Innovation Architect, High-Tech Start up, Sustainable industry, ...

Industrial technologies / Marketing products

Intensifying competitive circumstances
Abolishing its own basic research lab.
Changing intellectual property strategy
Concentrating in selected core competence
Cutting down engineers and technicians
“Full Research” at AIST

Carrying on Type-1 and 2 research **concurrently and coherently**

People’s concern and possibility of getting research funds

Public Research Fund

None!

Corporate Research Fund

(J. Hatvany and H. Yoshikawa, 1985)

Research Period

e.g. 15 years

Public research fund needed!

Dream Period

(Type-1 Basic Research)

Discovery & Investigation

Nightmare Period

(Type-2 Basic Research)

Integration & Application

Reality Period

(Product Realization Research)

Product Development and Realization

Academy

Industry

National research institutes (AIST and others)

Full Research
Focused points for innovation promotion

(1) Creation of innovation current in the society towards achieving sustainable society
(2) Integrated publicity of “full research” products
(3) Grasp on the needs of society
(4) Strategic allocation of research resources for practicing “full research"

Innovation promotion is thrust by the leadership of AIST management board.

Strengthening organizational structure

(1) Appointment of three vice-presidents in charge of innovation promotion
   ( "Innovation promotion core" in the AIST management board)
(2) Appointment of "Innovation Architect"
(3) Establishment of "Research and Innovation Promotion Office"
- Providing a new mechanism for collaboration among industry, academia and government
- Sharing a concrete scenario for new industries
- Developing a prototype with an enhanced budget for a limited term (2 or 3 years)
It is necessary to understand the issues and intents of the industry and to reflect them in AIST management.

We agreed to set regular dialogues among the top managements of industry and AIST.

Comments on AIST obtained at preliminary meeting

✓ We have seen great changes after establishment of AIST.

✓ We expect AIST to play a role as a leader of the industrial world.

✓ AIST characters superior to university:
  • Unity of organization
  • Awareness for intellectual property
  • Speed of research and development
  • Awareness for industrial application
  • Efforts for start-ups and their outcomes
  • Training of human resource

20 Companies that Participated in the 1st Session

Life Science and Technology
Astellas Pharma Inc.
Olympus Corporation

Information Technology
Toshiba Corporation
Hitachi, Ltd.
Sharp Corporation
Canon Inc.

Nanotechnology, Materials, and Manufacturing
Toray Industries, Inc.
NGK Insulators, Ltd.
Sumitomo Electric Industries, Ltd.
Nissan Motor Co., Ltd.
FUJIFILM Corporation

Environment and Energy
Nippon Oil Corporation
Mitsubishi Heavy Industries Ltd.
Sumitomo Chemical Co. Ltd.
Mitsubishi Chemical Corporation

Geological survey and Applied Geoscience
Dia Consultants Co., Ltd
Sumitomo Metal Mining Co., Ltd.

Metrology and Measurement Technology
Yokogawa Electric Corporation
Shimadzu Corporation
Horiba, Ltd.

First session was held on December 11, 2006.
Innovation Architect

“Bridging between scientific research and Industry”

3-D Collaboration
(Industry, Academia and Government)

Supplier of Scientific Knowledge
(University, Research Organization)

New Expert
similar concept as an “architect” in architecture

Focused on promising technology fields
(IT, Robotics, Energy, etc.)

User
(Industries)

Innovation Architect:
✓ Sufficient knowledge on both academic research and industrial needs
✓ Promotion of collaboration with Industry (supporting “full research”)
✓ Bring-up of persons talented for working as Innovation Architects
Research and Innovation Promotion Office

President

Innovation Architects
Research Coordinators

Innovation Promotion Core
: 3 Vice-Presidents

Director

Research and Innovation Promotion Office (37 staff)

General Coordination Team

Project promotion Team

Innovation strategy Team

Life Science & Technology Team

Information Technology Team

Environment & Energy Team

Geological Survey and Applied Geosciences Team

Metrology and Measurement Technology Team

Technology Team

Nano-technology, Materials & Manufacturing Team
Strategic funding scheme

to accelerate the stream from basic research to industry/market

AIST research products

“High-Tech Mock-up” making technology seeds visible

“IP Integration” making AIST products more robust and comprehensive by integrating AIST IPs

“Industrial Transformation Initiative” prototyping new industrial technology

”Matching Fund” contract research with industries

“IP Licensing Incentive” joint project with industry targeting IP licensing

“Venture Start-up”

Technology transfer

Industry/Market

Venture business
Capacity-building and turning-out of S&T human resources

It is difficult to employ people who just received doctorate from university as immediate corporate workforce. Therefore, post doctorates are employed by AIST to participate in joint researches. Then, they can be dispatched to companies as immediate workforce capable of fusing fields and creating business.

People who just received doctorate from university

AIST employs them to work on projects

Can't be employed as immediate workforce

University

Joint Research

Company

Employed by company after completion of project

Human resource training by AIST through joint research

Immediate workforce in company engaging in joint research

Major Role of this Activity within Super Highway Initiative

- Generate bi-directional flows for innovation
- Accelerate speed of the flows by smoothing the pathway
- Ensure independence and autonomy of individuals and organizations involved
Collaborative project with shared concept between AIST and industries (1)

Robots that can meet diverse user demands are developed using robot middleware developed as global standard under leadership of AIST. This will be applied to create modules for various demands and to develop standard system. This is geared to transform the robot industry.

- High expectation for robots
- Diverse user demands
- Accumulation of advanced robot technology in Japan, the leader in this field

I want a robot that’ll get things for me!

Can’t develop robots that can meet diverse demands

Join in development

University, company

Modules
Standard System Technology
Middleware

User Centered Robot Open Architecture

Development of standard system technology based on global middleware

Major Role of this Activity within Super Highway Initiative

- Generate bi-directional flows for innovation
- Guide the flows toward goal
- Accelerate speed of the flows by smoothing the pathway

Robots that can meet diverse user demands can be developed
In order for safer and environmentally-conscious cultivation of genetically modified plants, which serve as sources of drugs such as interferon, we have developed the totally-enclosed cultivation system for the genetically modified plants. This “Genome-based Biofactory” will facilitate joint efforts with private companies (Nippon Paper Group, Inc., The Kitasato Institute, Hokkai Sankyo Co., Ltd.) to establish the novel manufacturing industries.
A novel single-crystal tunneling magneto-resistance (TMR) device which shows huge magneto-resistance ratio had been developed for small, high-speed nonvolatile memory (MRAM), but mass production technology was necessary before it could be utilized by device manufacturers. Mass production technology has been developed in short time through technology fusion with manufacturing equipment company.
Performance of AIST

★ Joint Researches

★ Venture Companies

- Both number of joint research and accepted fund increased by ~10 times in 5 years.
- Number of venture company constantly increased.
To bridge the gap, technology integration of scientific findings for utilizing them in society, in addition to analytical research, has been one of the wheels of progress. Traditional journals have been collecting much analytical type knowledge that is factual knowledge and establishing many scientific disciplines. Technology integration research activities, on the other hand, have been kept as personal know-how. They have not been formalized as universal knowledge of what ought to be done.

As there must be common theories, principles in the methodologies of technology integration, We regards it as basic research. This is the reason why we have decided to publish “Synthesiology”, a new academic journal.

- To show an image of AIST performing “Full Research”
- To enhance the motivation of researchers engaged in “Full Research”
Evaluation System in AIST

Evaluation from the perspective of OUTCOME

Subjects of evaluation

1) Evaluation of Roadmaps toward Outcomes
2) Evaluation of Outputs toward Outcomes
3) Evaluation of Management toward Outcomes
Evaluation Indexes

★ Evaluation of Roadmaps
   Outcomes, Milestones, Technical Elements, Benchmarks

★ Evaluation of Outputs
   Papers, Patents, Standards, Academic Activities,
   Press Releases, Prizes, Prototypical Products, etc.

★ Evaluation of Management
   Research Unit Strategy
   1) Full Research, 2) Innovations, 3) Human Resource Development
   Other Management
   1) Overall Management, 2) Budget Management, 3) Risk Management
An Example of Roadmap

Correlated Electron Research Center

- 2002
- 2004
- 2006
- 2008
- 2010
- 2012
- 2020~

1st Mid-Term
2nd Mid-Term
Research Term of CERC

Proposal of the Principles for Correlated Electronics

Verification of the Functions of Correlated Electronics

Application of the Correlated Electronic Devices

Device Prototypes

- MTJ with the Giant Tunneling Magneto-Resistance Effect
- Sensors with the Extra-huge Magnetoresistance Effect
- THz All-Optical Switching Elements
- Joint Research with Private Companies
- Resistance Variable Non-volatile Memories (R-RAM)
- Thermoelectric Heat Exchange Elements
- MOT Transistor
- Correlated Organic Electronic Devices (Optical Switching Elements, Organic EL)

Outcomes

- Construction of the Science and Technology for the Correlated Electron System
- Spread of the Correlated Electronic Devices
- Creation of the Field of Correlated Electronics

Science and Technology for the Correlated Electron System
Strategy Structure of AIST

Basic principles: Social development through enhancing industrial technologies

Missions:
• Contribution to a sustainable society
• Contribution to industrial competitiveness
• Contribution to local industrial development
• Contribution to Industrial technology policies

Future visions*

1. High quality life with good health and longevity
2. Intelligent, safe, and secure life supported by advanced information services
3. High industrial competitiveness and reduction of environmental load realized by new materials, parts, and manufacturing technology
4. Wealthy and comfortable life by overcoming environment and energy issues
5. Advanced industrial infrastructure developed by novel measurement technologies and evaluation systems
6. Construction of intellectual infrastructure through understanding of the earth
7. Dissemination of physical and chemical metrological standards

* Future visions:

Strategy of Research Fields

Strategy of Research Units

Research Subjects

Evaluation of Research Units
Effectiveness of Evaluation from the Perspective of Outcomes on Research Units and Research-supportive and Administrative Departments in AIST

Chair: Osamu Nakamura
Presenters: Osamu Nakamura & Tomoko Mano
Discussant: Katsuhisa Kudo

Please visit tomorrow’s session I’ll chair.
Room: Granite-C
Time: 15:25-16:10

National Institute of Advanced Industrial Science and Technology (AIST)
Appendix
Innovation for industrial transformation
towards ensuring the society sustainable
Unpredictable frontier = Double risk: Qualitative and quantitative

Development in traditional way
Predictable frontier = Moderate risk

Whole group of industries
Concept for sustainable industrial technology

Industrial Transformation based on Minimal Manufacturing Concept

Characteristics of Minimal Process Plant

- **Several processes become compact**
  - Resource and energy conservation; facilitation of evaluation
- **Processes become flexible**
  - Ability to handle various products; increased life span of equipment
  - Simple process optimization
  - Flexibility to shift to better process

Minimum resource
Minimum energy
Minimum waste
Maximum function/product

Increased international competitiveness
Sustainable society

Energy & Resource Conservation

Innovation in Manufacturing Process

Innovation in Material

Performance

Cost

Innovation in System

Demonstrate optimization with indices

- Evaluation using physical quantity (entropy production)
- Universal evaluation