Social and Technical Innovation and Societal Impact in the Context of the Engineering Sciences

- In the case of Saitama Univ., a mid-sized national university -

Hiroki YAMAGUCHI
President, Saitama University

Congratulations!
Nobel Physics Prize 2015
Prof. Takaaki Kajita
(graduated from SU in 1981)

Fast Facts of Saitama University (SU)

Founded in 1949 → 2016: 67 years old

Ceremony for Foundation (Nov. 1949)

Faculty of Literature & Science

Faculty of Education

As of May 2016

Undergraduate	Student	Graduate School	Student		Exchange Student Etc.	Total No. Student	Faculty	Staff
			Master	Doctor				
Liberal Arts	847 23	Humanities & Social Science	179 87	73 9		2,572 161	102 17	
Economics	1,473 42							
Education	1,974 7	Education	144 9	–		2,118 16	108 0	
Science	902 19	Science & Engineering	843 98	174 98		3,894 271	227 14	
Engineering	1,975 56							
Others (Education Bureau, Research & Development Bureau)					126 104	126 104	34 8	
Total	7,171 147		1,166 194	247 107	126 104	8,710 552	471 39	224 0

Number (included in Number): International Student, Faculty and Staff

Saitama University 埼玉大学

International Partnerships with SU

Germany: Esslingen Univ. of Applied Science
University of Munich
Brandenburg Univ. of Technology Cottbus
University of Hamburg
University of Hohenheim
Friedrich Schiller Univ. of Jena
Rhein-Wall Univ. of Applied Science

30 ➡48
Europe

20
North America
➡23

41 ➡58
Asia

4 ➡5
Latin America and the Caribbean

4 ➡5
Oceania

99 in total As of October 2014
139 in total As of May 2016

Issue No.1

How can universities in Germany and Japan react to current societal demands while at the same time safeguarding the true mission of universities?

Missions of and Societal Demands to National Universities in Japan

- 86 National Universities in Japan since 2004 Incorporation
  - Globalization, Innovation
  - University reform, Functional enhancement
- National University Management Strategy (2016～)
  - To maximize the creation function of intellect as an engine of social reform
  - International (Global), National, Regional, Specific field

Way of Achieving True Mission and Reacting Societal Demand

- In the Case of Saitama University
  - COE in Specific Fields of Studies: Strengthening of Research & Education Functions
  - Regional R/D & Education Center　　Importance of Int. Cooperation

National Universities in Japan since 2004 Incorporation

Objectives of Incorporation
- Activation of national univs. In self-directive environment
- Promotion of active actions for good education and unique research
- To realize more attractive national universities

Changes of Environment
- Globalization
- Aging society with child birthrate falling
- Competition intensification by the rise of emerging countries

The 1st Period of Medium-Term Goals
(2004 - 2009)

Start-up period of national univ. corporation system

Start of the National University Corporation

The 2nd Period of Medium-Term Goals
(2010 - 2015)

Implementation of full-scale university reform utilizing merits of incorporation

Concept for further functional enhancement of national universities (June 2013)

Redefinition of Missions

Period to accelerate univ. reforms

Globalization, Creation of Innovation, flexibility in personnel/ payroll system

National University Reform Plan (Nov 2013)

Creation of system for self-directive advancement

The 3rd Period of Medium-Term Goals
(2016 -)

Toward national universities producing high added values with sustained competitiveness

National University Management Strategy

To maximize the creation function of intellect as an engine of social reform

The 2004 academic year (April 2004) | The 2010 academic year (April 2010) | The 2013 academic year (April 2013) | The 2016 academic year (April 2016)

埼玉大学

Actions of SU

- Base reinforcement as an intellectual institution
- Self-branding as Saitama University

2013 National University Reform Project

Reform of Saitama Univ. by reorganization/corporation of schools - Extensive enhancement of research and education functions (2013-2018)

Saitama University, All in One Campus at Capital Sphere, Saitama - Embodiment of Diversity, Synergy and Integration (2016-2022)

2016 Budgetary request for functional enhancement

National University Management Strategy

1. Promotion of functional enhancement based on future vision of university

A framework of 3 Priority Supports is introduced in the national budget allocation to carefully support a functional enhancement action of each national university. In this way, national universities are converted into the organizations performing the development of frontier research areas and the human resource cultivation depending on regional needs.

Priority Support 1 Promotion of HRD and research depending on regional needs

55 national universities

THE World University Ranking 601–800: Saitama U, Yokohama National U, Niigata U, Shinshu U, Gifu U, Toyohashi U of Tech, Tottori U, Tokushima U, Ehime U, Nagasaki U, Kumamoto U

Priority Support 2 Promotion of establishment of COE and network in specific field covered by univ.

15 national universities

THE World University Ranking 401–500: Tokyo Medical and Dental U, 601–800: Kyushu Institute of Tech

Priority Support 3 Establishment of COE in competition with the world's top university

16 national universities

THE World University Ranking 43: U of Tokyo, 88: Kyoto U, 201–250: Tohoku U, Tokyo Institute of Tech
251–300: Osaka U, 300–350: Nagoya U, 401–500: Hokkaido U, Tsukuba U, Kyushu U,
501–600: Tokyo U of Agri and Tech, Kanazawa U, Hiroshima U, 601–800: Chiba U, Kobe U, Okayama U

Saitama University 埼玉大学

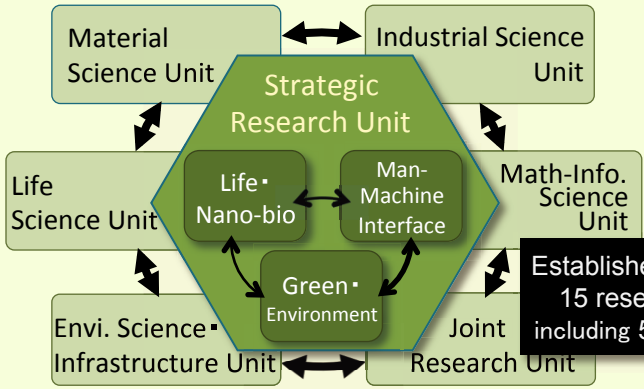
Direction of Functional Enhancement: COE in Specific Fields of Studies

Intellectual Institution

Strengthening of SU's Research & Education Functions

Strengthening of Research Function

Strategic Research Unit in Graduate School of Sci. & Eng.



URA Office

- Planning & Organizing Research Project

Gathering Research Stuffs

International stuffs

Established in 2014
15 researchers including 5 int. ones

6 int. academic stuffs are newly hired.

Strengthening of HRD function in Humanities & Social Science

- Strengthening of function of Global HRD

International Japan-Asia Studies

Gathering Academic Stuffs

School of Economics | School of Liberal Arts

Grad. S. Economic Sci. | Grad. S. Cultural Sci.

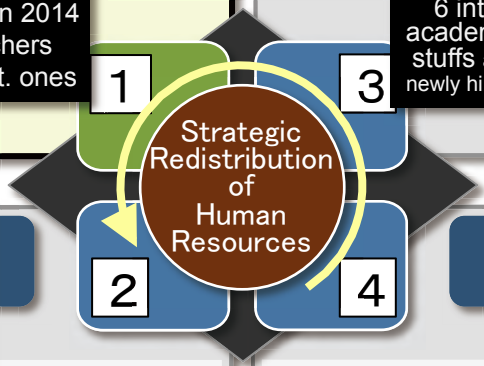
Grad. Sch. Humanities & Social Sci.(2015)

Restructuring into one graduate school

- Re-education of working people

Redesign of evening program in economics

- To ensure evening program education



【No. of Students】

【No. of Academic stuffs】

Strengthening of HRD function in Science & Engineering

School of Science | School of Eng.

Grad. S. of Science & Engineering

- Strengthening of function of Global HRD

Bachelor-Master Integrated Program

Increase of Master enrolment limit (308→508)

- Step-by-step increase of enrolment with integrated program

Reorganization of Schools of Science and Eng. (2018)

Strengthening of teacher training in Education

- Strengthening of high-quality teacher training

School of Education(480→380)

Graduate School of Education

Teaching Profession Grad. S.(April 2016)

- Step-by-step transition to Teaching Profession Grad. S.

Decrease of enrolment limit in Education (480→380)

- Focus on primary school teacher training
- Teacher training by the cooperation with other schools

Saitama University 埼玉大学

Direction of Functional Enhancement: Regional R/D & Education Center

Self-Branding

Saitama University, All in One Campus at Capital Sphere, Saitama

- Embodiment of Diversity, Synergy and Integration -

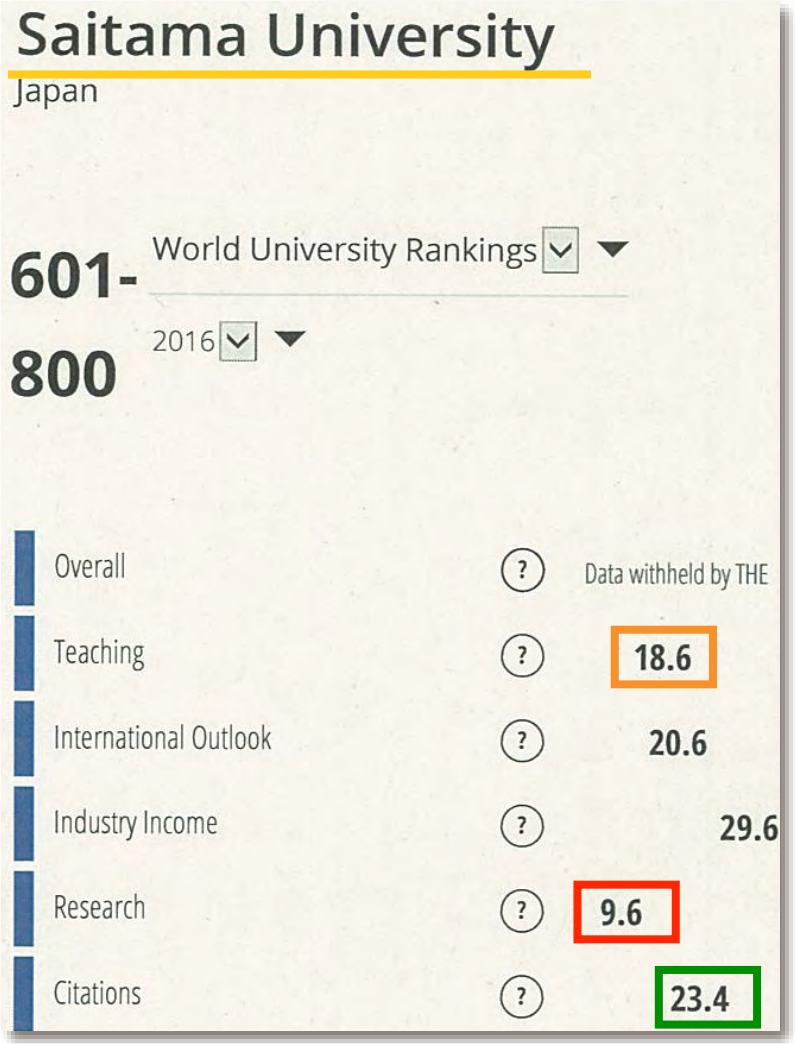
- Liberal arts, economics, education, science and engineering in one campus
- Japanese students, overseas students and adult students in one campus

- Various regions and regional problems because of Saitama
- Many overseas and adult students gathered in SU because of the capital sphere, Saitama
- From Saitama to the world ! (Local ⇄ Global)

SU aggressively takes a role of regional R/D & Education center to activate the capital sphere around Saitama by the industry-university-government collaboration and by the regional communication.

	2016	2017	2018	2019	2020	2021
Strategy 1: RD and education in integrated sciences for innovation and regional activation		**Action 1:** Establishment of Graduate School of Integrated Technology & Service				
	Action 2: Doctoral expert in tech.					
	Action 3: Establishment of Frontier Industry International Laboratory					
Strategy 2: HRD and teacher training based on regional needs	**Action 4:** Establishment of Career Center SU					
	Action 5: Establishment of Teaching Profession Graduate School and its enhancement					
	Action 6: Advancement of teacher training					
Strategy 3: Establishment of COE in specific fields of studies	**Action 7:** Promotion of international joint researches in Strategic Research Units, Grad. S. of Sci. & Eng.					
	Action 8: Enhancement of Graduate School of Science & Engineering					
	Action 9: Lab-to-Lab Program in Sci. & Eng.					
		Action 10: Enhancement of global human resource development at SU				

THE World University Rankings among 18,000 Univs.



Area	Performance indicator	Weight (%)	
Teaching	Reputation survey	15	30
	Staff-to-student ratio	4.5	
	Doctorate-to-bachelor's ratio	2.25	
	Doctorates awarded-to-academic staff ratio	6.0	
	Institutional income	2.25	
International Outlook	International-to-domestic-student ratio	2.5	7.5
	International-to-domestic-staff ratio	2.5	
	International collaboration	2.5	
Industry Income	Knowledge transfer	2.5	2.5
Research	Reputation survey	18	30
	Research income	6.0	
	Research productivity	6.0	
Citations	Research influence	30	30

− Academic staff in Science and Engineering is about 50%.

＋ Quality of research paper is relatively high.

Saitama University 埼玉大学

New Scheme of Cooperation in HE at Saitama Univ.

2014- : Lab-to-Lab Program for Graduate Students in Science & Engineering

- A research-oriented student exchange program based on Lab-to-Lab or Prof-to-Prof relation with partner universities.

Strategy Building Ability

Overview of Peripheral Areas

- On-Campus Across-Labs Project

Learn from Pioneers

Strategy Understanding

- Analysis of Research Strategy

Lab-Based Student Exchange

Multidirectional Commitment among Government, Industry and University

Global Adaptableness

International Cooperation

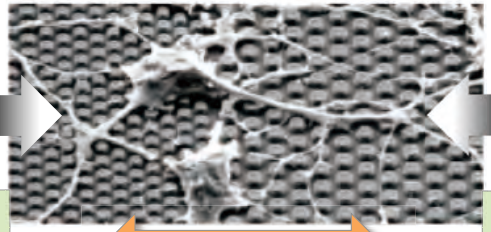
- Lab-to-Lab Outbound Scheme
- Lab-to-Lab Inbound Scheme

- Joint Project to study the process from extraction to resolution of problem with counterpart professor
- Understanding of diversity

Physical Chemistry

Prof. S. Nakabayashi and his **Lab** students

Saitama University, Japan



Lab-to-Lab

Biophysics

Prof. I. Ortega-Blake and his **Lab** students

National Autonomous Univ. of Mexico

Issue No.2

How do we define “innovation” and “societal impact” in the context of engineering science?

Science and Technology Policies in Japan

- The 5th Science and Technology Basic Plan

  Realizing a world-leading “super smart society” (Society 5.0)

- Japan Revitalization Strategy 2016

  For the 4th Industrial Revolution

  ➡ The most important key is innovation.

What is innovation?

Innovation is not mere technology renovation nor a spark of genius, but overall new concept to spread in human society. Paradigm Shift

- Innovation in Earthquake Engineering

  New Technology of Seismic Isolation and Control

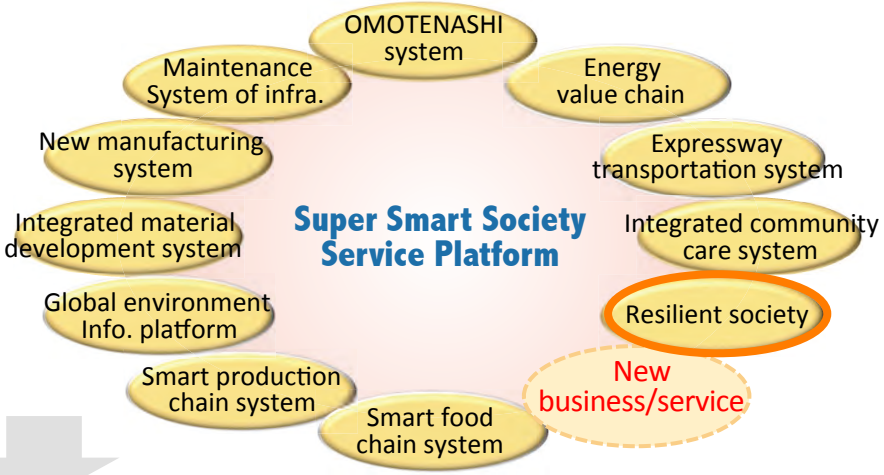
  New Concept of Resilient Society

Science and Technology Policies in Japan

- The 5th Science and Technology Basic Plan (Jan. 2016, CITI, Japan)

Realizing a world-leading "super smart society" (Society 5.0)

where the various needs of society are finely differentiated and met by providing the necessary products and services in the required amounts to the people who need them when they need them, and in which all the people can receive high-quality services and live a comfortable, vigorous life.



- Japan Revitalization Strategy 2016 - for the 4th Industrial Revolution – (June 2016)

The 4th industrial revolution

which creates new businesses that resolve social issues and arouse consumers' potential needs by using the technological breakthrough of IoT (Internet of Things), Big Data, Artificial Intelligence and robot sensor.

In promoting the 4th industrial revolution, we will coordinate with the consideration of the basic policy of the Society 5.0 strategy.

The most important key is innovation.

Innovation in Earthquake Engineering

The Great Hanshin/Awaji Earthquake (**Kobe Quake** M7.3) Jan. 17, **1995**

- World's pre-eminent antiseismic techniques → Disillusionment with Japanese seismic engineering
- The honest explanation of bridge engineers: "The earthquake far exceeded what was assumed in the design."

➡ Improvement of design standard and introduction of seismic isolation & control

Science & Technology Innovation

The Great East Japan Earthquake (**Tohoku Quake** M9.0) Mar. 11, **2011**

- No severe damage of bridges by direct quake action ← Experience and lesson of Kobe Quake
- The disaster and accident due to the **tsunami** were far beyond imagination !

➡ Introduction of new concept of Resilient Society

Creation of resilient society is to create a disaster-resistant and flexible community.

The hardware measures for disaster prevention which only prepare for a disaster as "pre-risk" based on the past way of thinking for natural disaster, are powerless when the "outside assumption" happens.

A new way of thinking is to create the society, which is resilient to natural disaster, by adding "on-risk" at the time of disaster and " post-risk " after disaster to "pre-risk" before disaster.

Innovation by integration of Science & Technology and Humanities & Social Science

Looking back on the history, human beings have always learned from tragic disasters and moved forward.

The 2016 **Kumamoto Earthquake** ➡ ?

All in One Campus at Capital Sphere, Saitama: Diversity & Synergy

Saitama University 埼玉大学 **International Institute for Resilient Society**

which aims at research, education, and international contributions in the areas of disaster prevention, environment, and infrastructures for constructing truly resilient society.

Issue No.3

What kind of training and education do today's graduates in the engineering sciences require to act successfully as technically expert and interculturally sensitive citizens of the world?

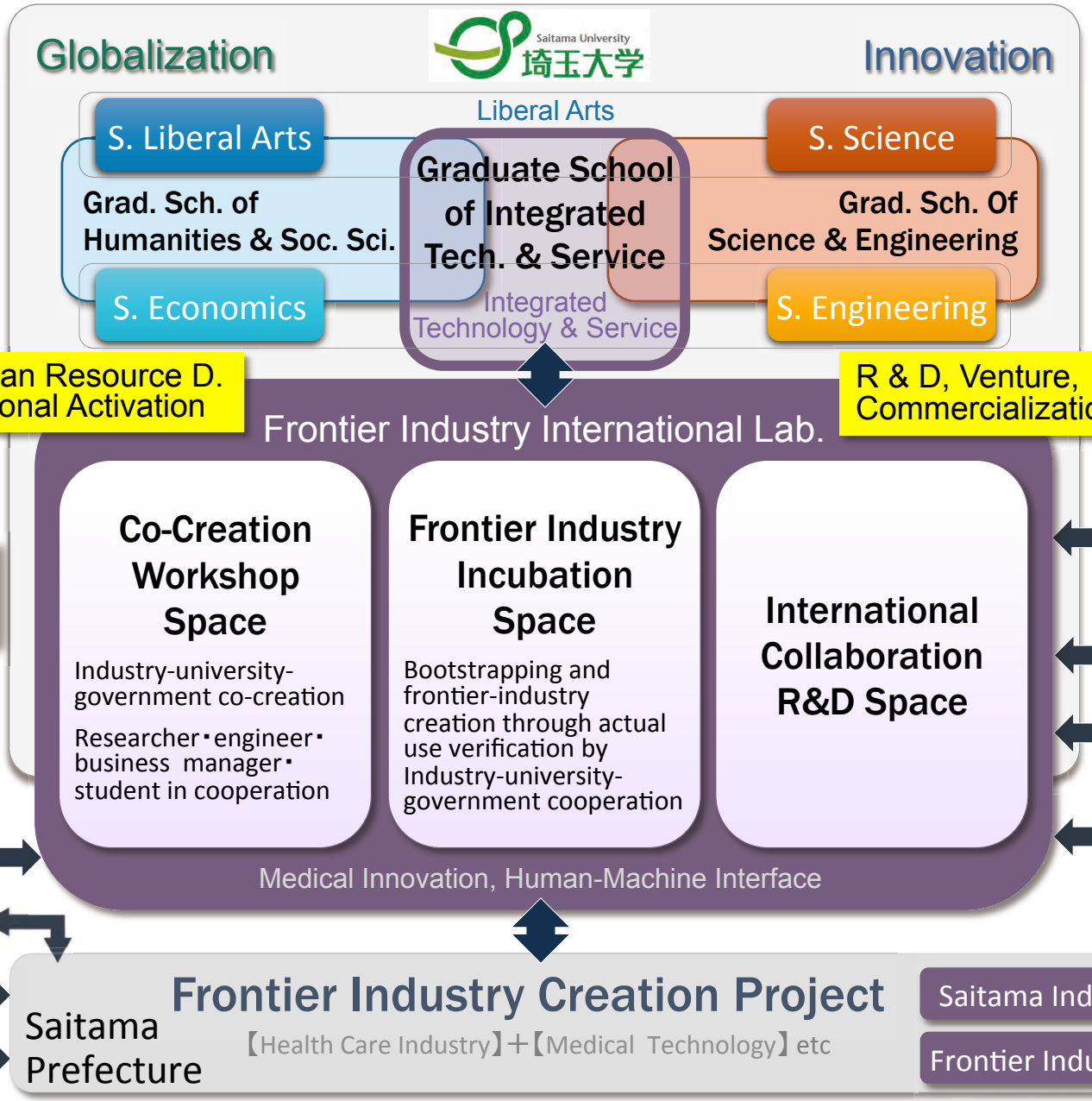
Innovation is not a spark of genius. An ability to take the initiative in solving problems with a diversity of people is a key factor for innovation.

In the Case of Saitama University

- Frontier Industry International Lab. & New Graduate School
  - Globalization, Innovation
  - Liberal Arts, Technology and Service
  - Integration of Arts and Sciences
- Frontier Industry Creation Project by Saitama Prefecture
  - Project Based Learning
  - Industry-University-Government Collaboration

Frontier Industry Int. Lab. (2016) & New Graduate School (2018)

All in One Campus at Capital Sphere, Saitama: Diversity & Synergy



Frontier Industry Creation Project by Saitama Prefecture (2014～)

Background → **Task** → **Action**

Year 2025 problem

The baby-boom generation becomes elderly aged 75 or over. ⇒ Explosive increase in medical demand and drastic decrease in productive age population ⇒ Shrinkage of workforce and economic recession

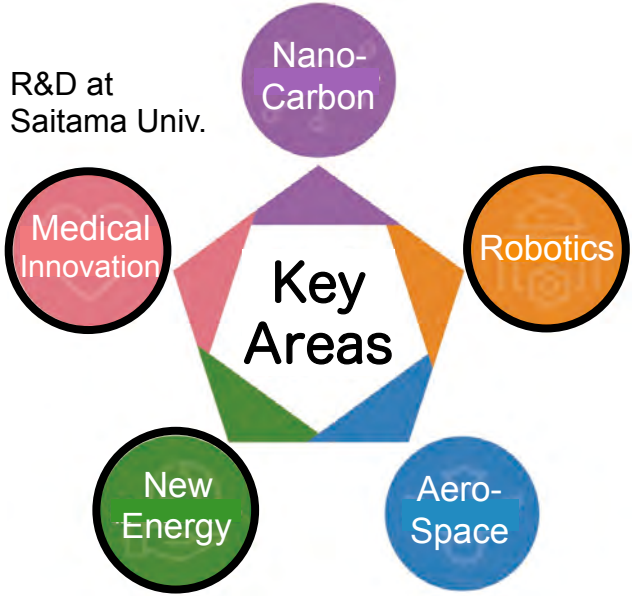
To increase regional 'earning power'

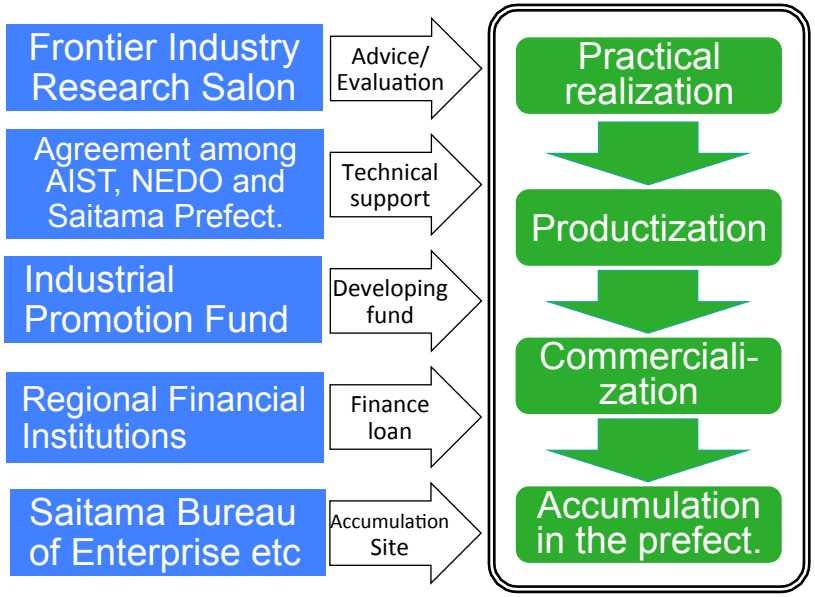
Promotion of the Project to plant a seed of next-generation industry and to cultivate it

Frontier Industry Creation Project is promoted to strongly support practical realization, productization, commercialization and industrialization, by integrating advanced study seeds of university/research organization and superior technologies of industrial firm.

It aims to bring up pioneering industries in 5 key areas and to accumulate them in Saitama prefecture by the cooperation with AIST, NEDO, and financial institutions.

R&D at Saitama Univ.





Frontier Industry Research Salon on 23 May 2015

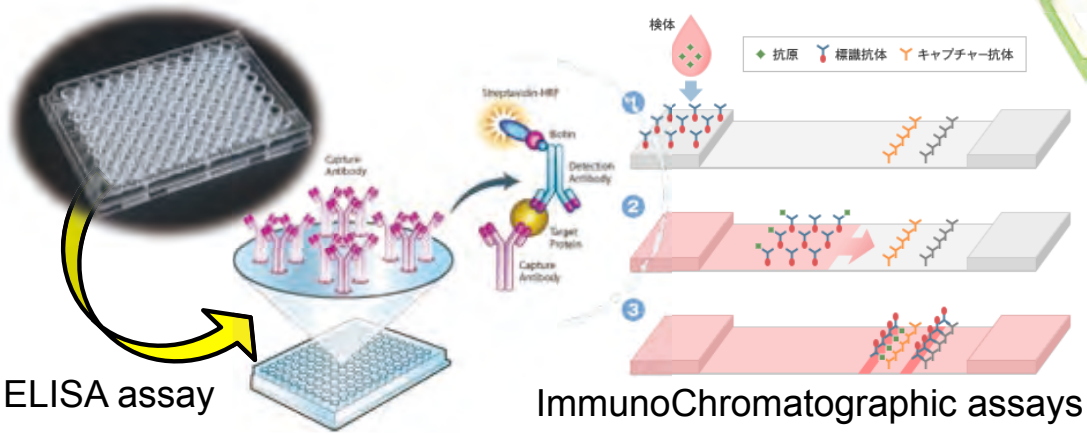
Development of Detectable Drugs and Diagnostics Drugs

Medical Innovation

Project 1: Quick detection for Toxins and Infectious Viruses on the basis of Next Generation Antibodies

Vero toxin,
Influenza viruses,
Noro Viruses,
Dengue Viruses,
etc.

ELISA & ImmunoChromatography, etc.



ELISA assay

ImmunoChromatographic assays

Sprays

Project 2: Quick diagnostics for Cancer (Tumor) Makerson the basis of Next Generation Antibodies

Survivin,
Other known
tumor makers,
etc.

ELISA & ImmunoChromatography, etc.

Use of cDNA display method for screening

Merits
- High affinity
- High selectivity

Successful Discovery
Anti-Tumor Maker!!
(Next-Generation Antibody)

New Business

ELISA assay

ImmunoChromatographic assays

Novel Devices

Development of Rehabilitation Robots with Visualization Techniques

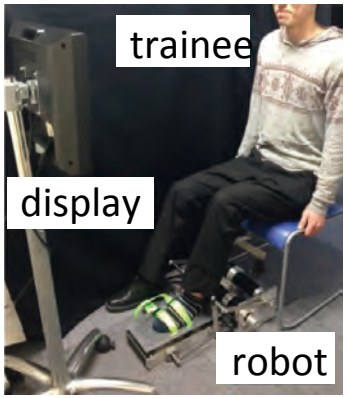
Robotics

What is the merit of introducing robot to rehabilitation when robots are bulky, expensive? Additionally, it is less-skilled than therapists.

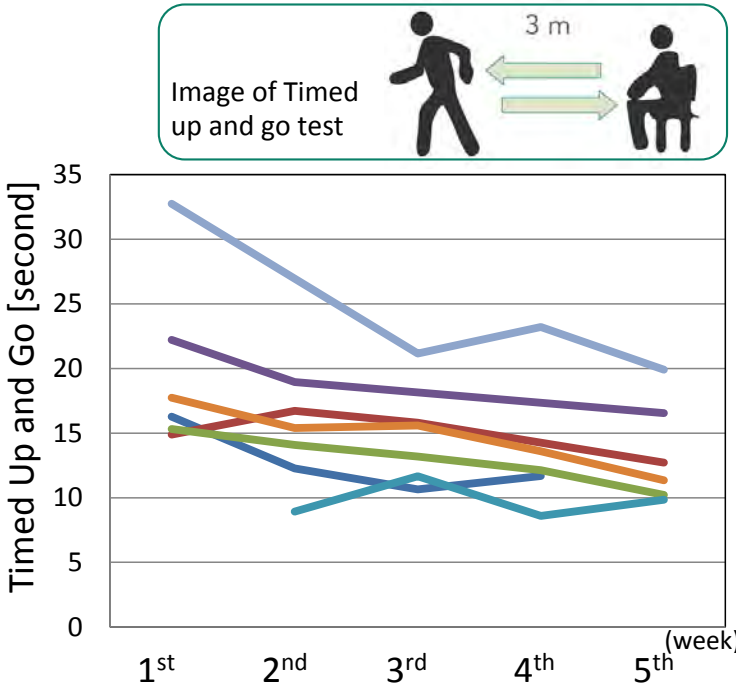
- Robot can measure accurately and automatically with the equipped sensors.
- Augmented reality is also good solution for enhancing rehabilitation.

Proposal in this project

Effective training based on visualization of force information



Advanced training machine with force visualization

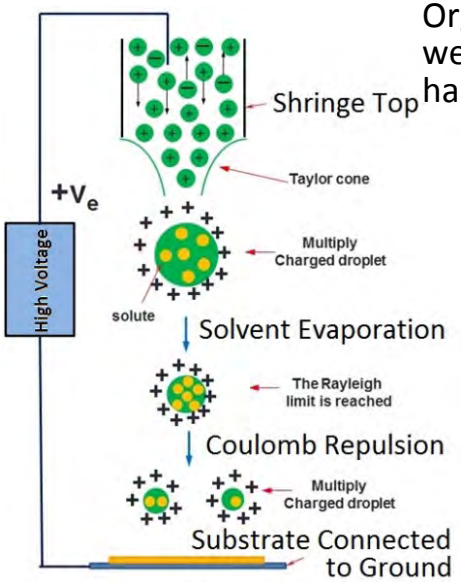


6 out of 7 participants had much shorter time after 1 month training. This is a possible beneficial effect of improvement in ambulatory function

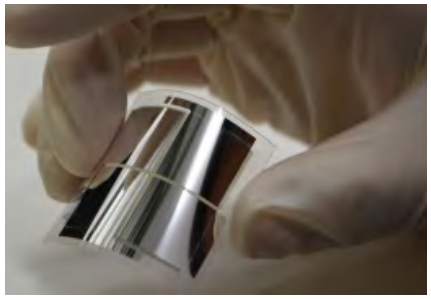
Solution-Processed Flexible/3D Curved Surface Organic Thin Film Solar Cells

New Energy

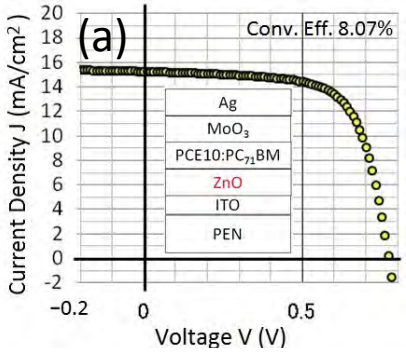
Organic Thin Film Solar Cells by Electro Spray Deposition (ESD) method provide light weight, flexible / 3D curved surface and versatile applicability for mobile and energy-harvesting fields.

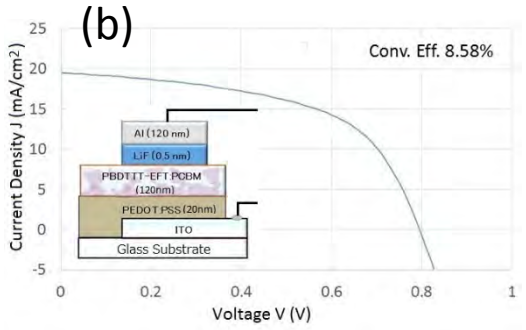


Principle of ESD method.



An example of flexible organic solar cell fabricated on a PEN substrate.

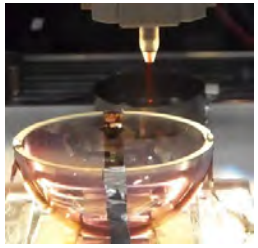




Typical C-V curves and conversion efficiencies of fabricated organic solar cells: (a) An inverse-type cell on a flexible PEN by spin-coating, 8.1%, and (b) A conventional-type cell on a glass by the ESD, 8.6%.

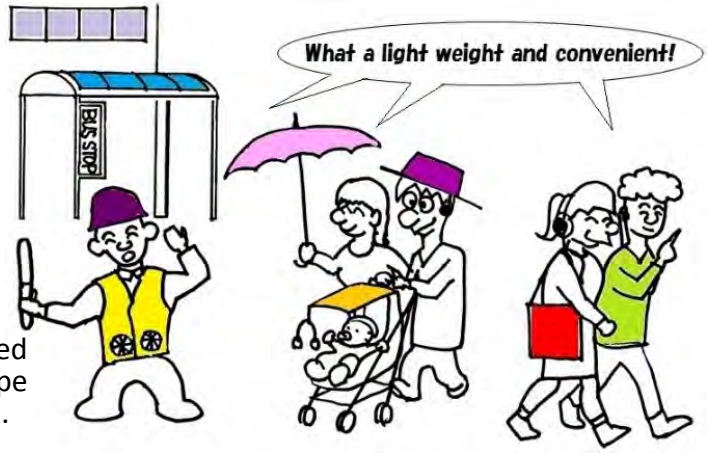
Light Weight, Thin and Flexible!
Combination to Energy-Harvesting Applications!
Diverse Design Capability!

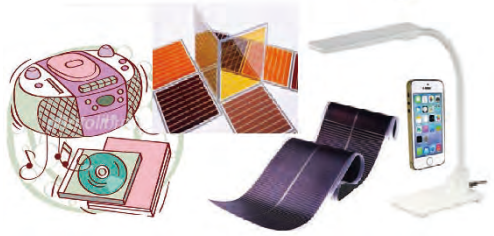
(a)



(b)

First successful Electro-Spray to 3D curved surface (a) and fabrication of Dome-Shape Solar Cells (b) in cooperation with RIKEN.





We aim at cost-effective organic solar cell technology based on solution-processed approach in cooperation among industry, prefectural government and academia.

Saitama University 埼玉大学

Concluding Remarks

In the case of Saitama University,

For true mission as an intellectual institution

➡ Global Center of Research & Education

↕ Co-existence

For innovation and societal impact

➡ Regional Center for Frontier Industry Creation & Human Resource Development

Important keywords:

- International Cooperation
- Industry-University-Government Collaboration
- Technology and Service
- Integration of Arts and Sciences

➡ Diversity, Synergy and Integration

THANK YOU!