

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

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

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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

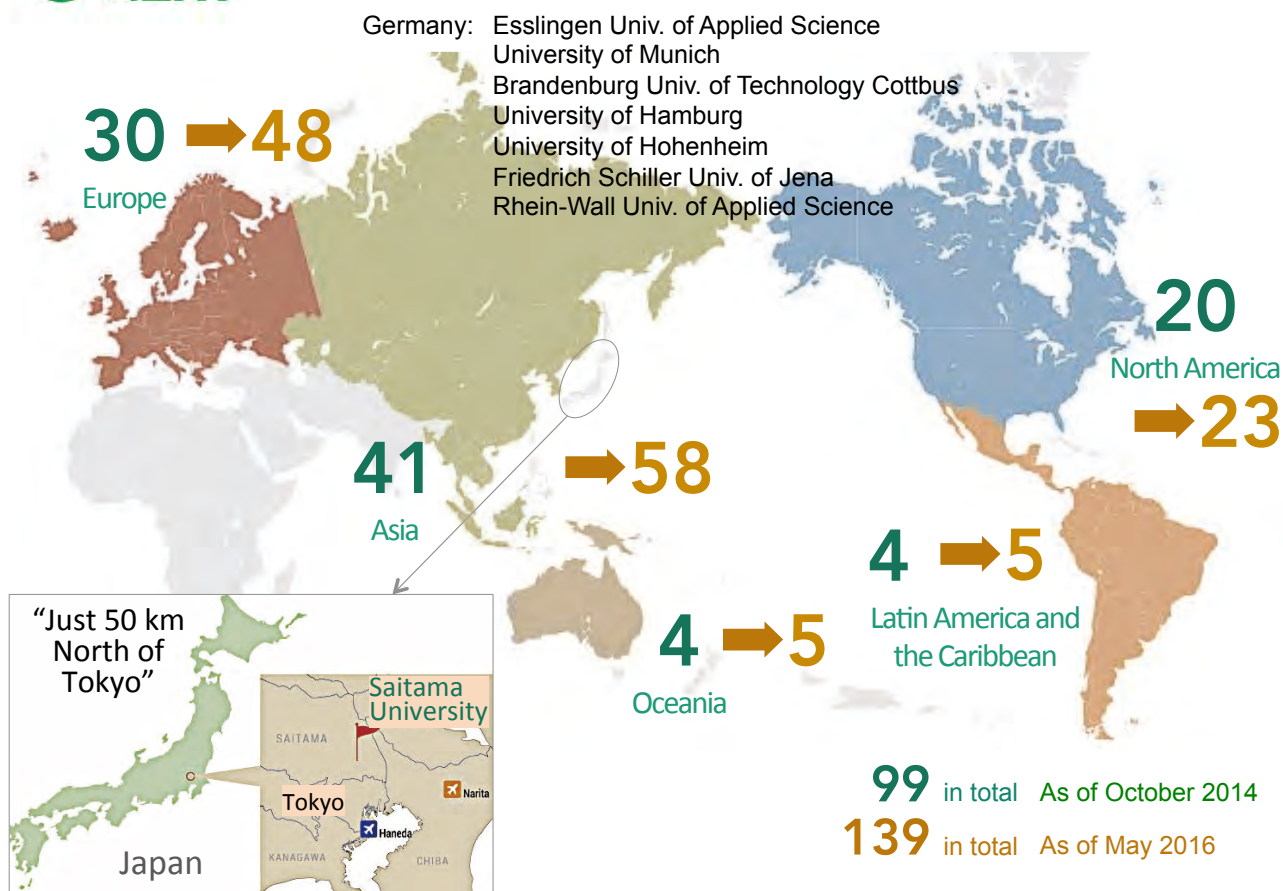


As of May 2016

Undergraduate	Student	Graduate School	Student		Exchange Student Etc.	Total No. Student	Faculty	Staff
			Master	Doctor				
Liberal Arts	847 23	Humanities & Social Science	179	73		2,572 161	102 17	
Economics	1,473 42		87	9				
Education	1,974 7	Education	144 9	-		2,118 16	108 0	
Science	902 19	Science & Engineering	843	174		3,894 271	227 14	
Engineering	1,975 56		98	98				
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

International Partnerships with SU



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

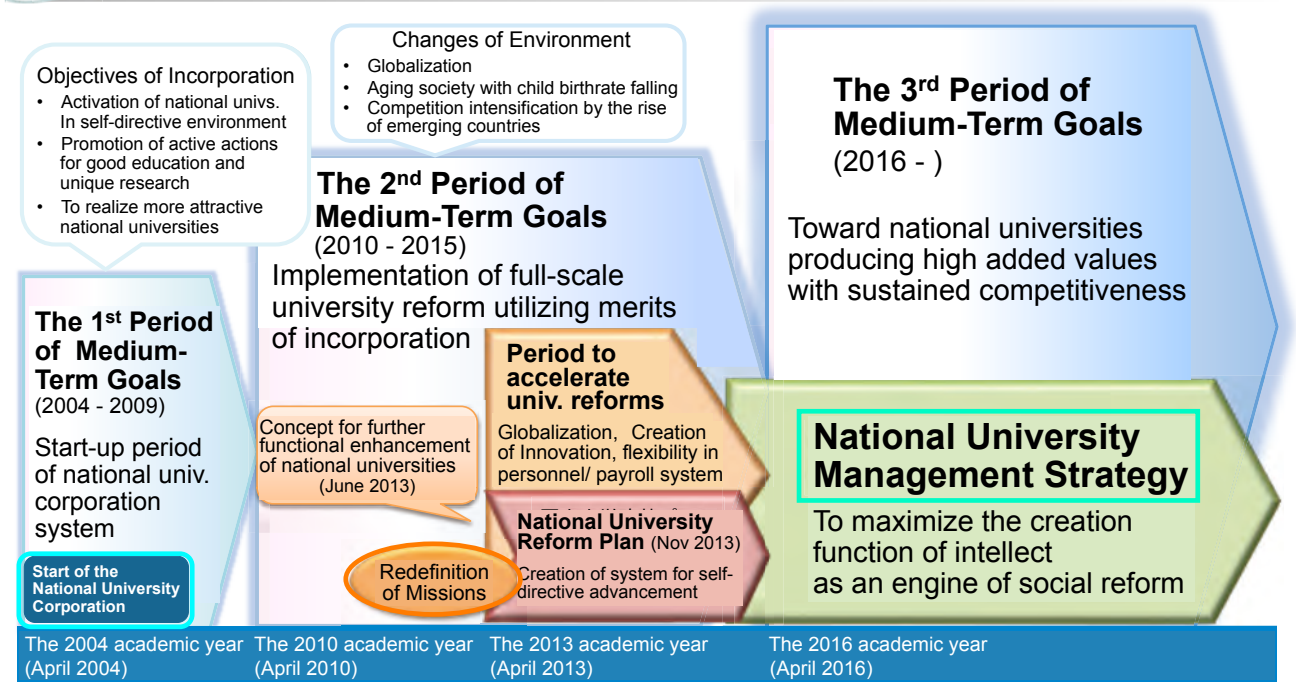
- 86 National Universities in Japan since 2004 Incorporation
Globalization, Innovation
University reform, Functional enhancement
- National University Management Strategy (2016~)
To maximize the creation function of intellect
as an engine of social reform
International (Global), National, Regional, Specific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



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

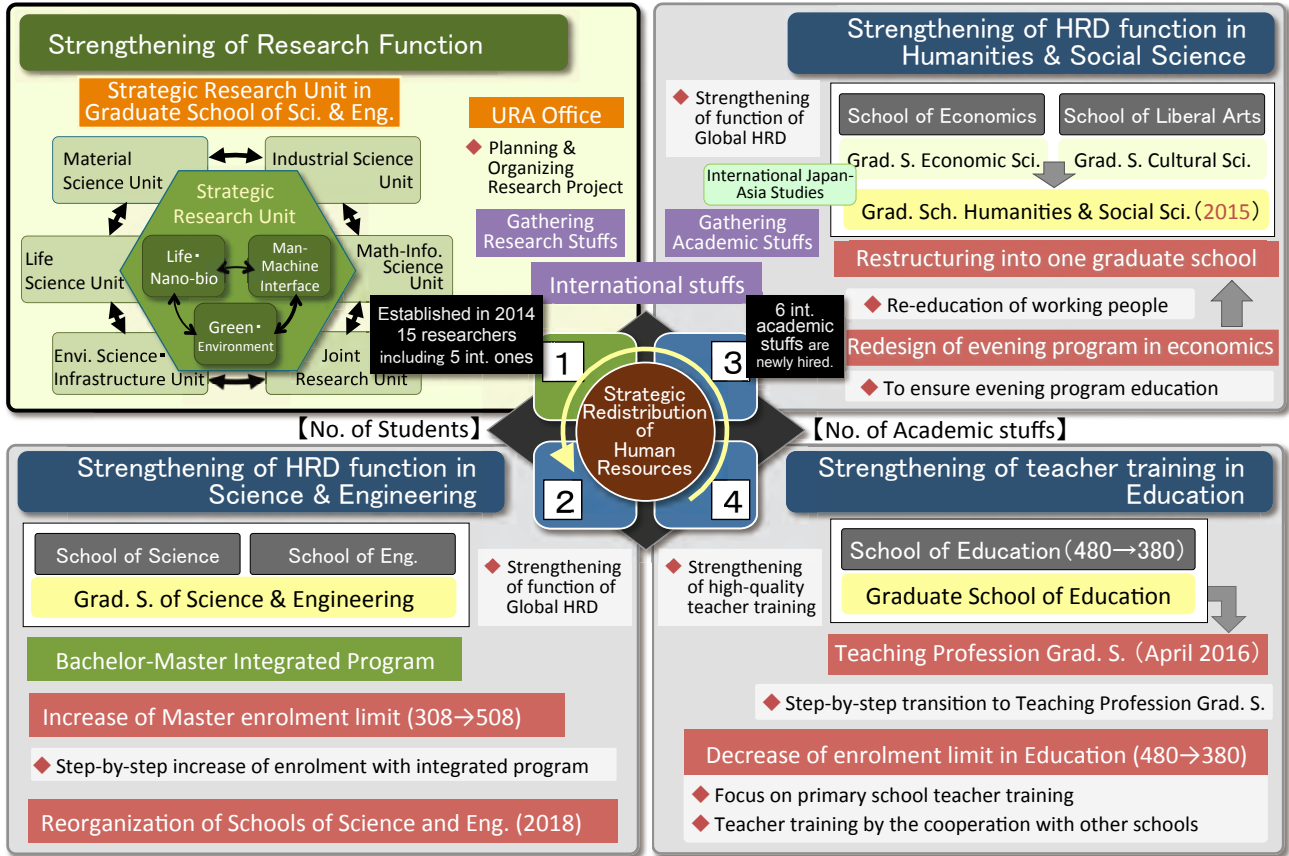
Priority Support 3

Establishment of COE in competition with **the world's top** universities

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

Strengthening of SU's Research & Education Functions



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					

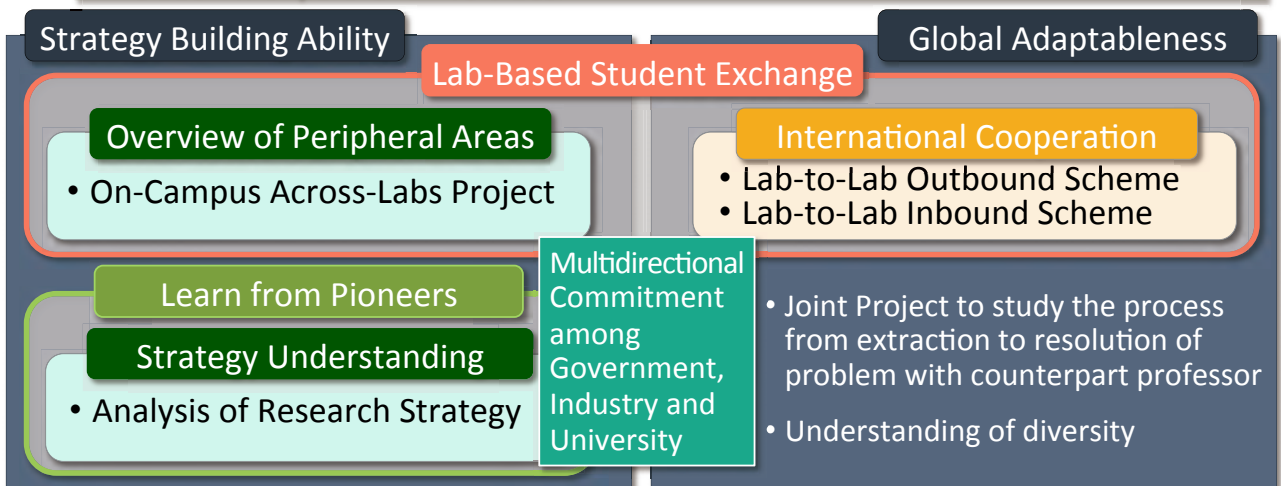


- Academic staff in Science and Engineering is about 50%.
- + Quality of research paper is relatively high.

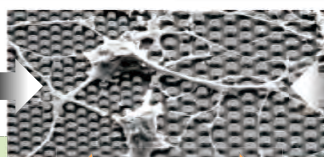
Area	Performance indicator	Weight (%)	
Teaching	Reputation survey	15	30
	Staff-to-student ratio	4.5	
	Doctorate-to-bachelor's ratio	2.25	
	Doctorates awarded-to-academic staff ratio	6.0	
	Institutional income	2.25	
International Outlook	International-to-domestic-student ratio	2.5	7.5
	International-to-domestic-staff 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

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.



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

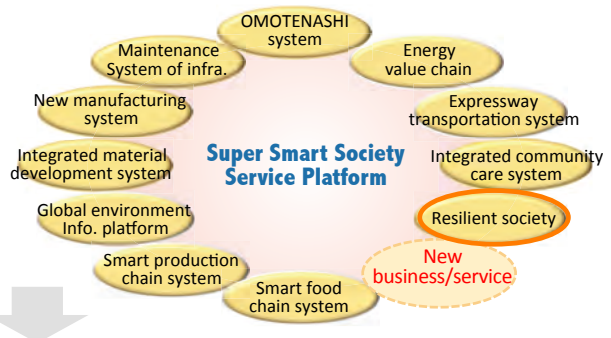


Science and Technology Policies in Japan

● 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.



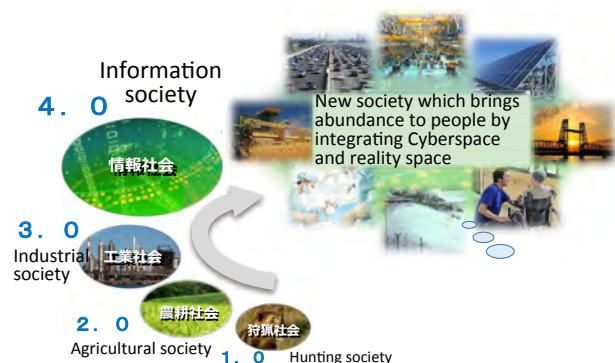
● Japan Revitalization Strategy 2016 - for the 4th Industrial Revolution – (June 2016)

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



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

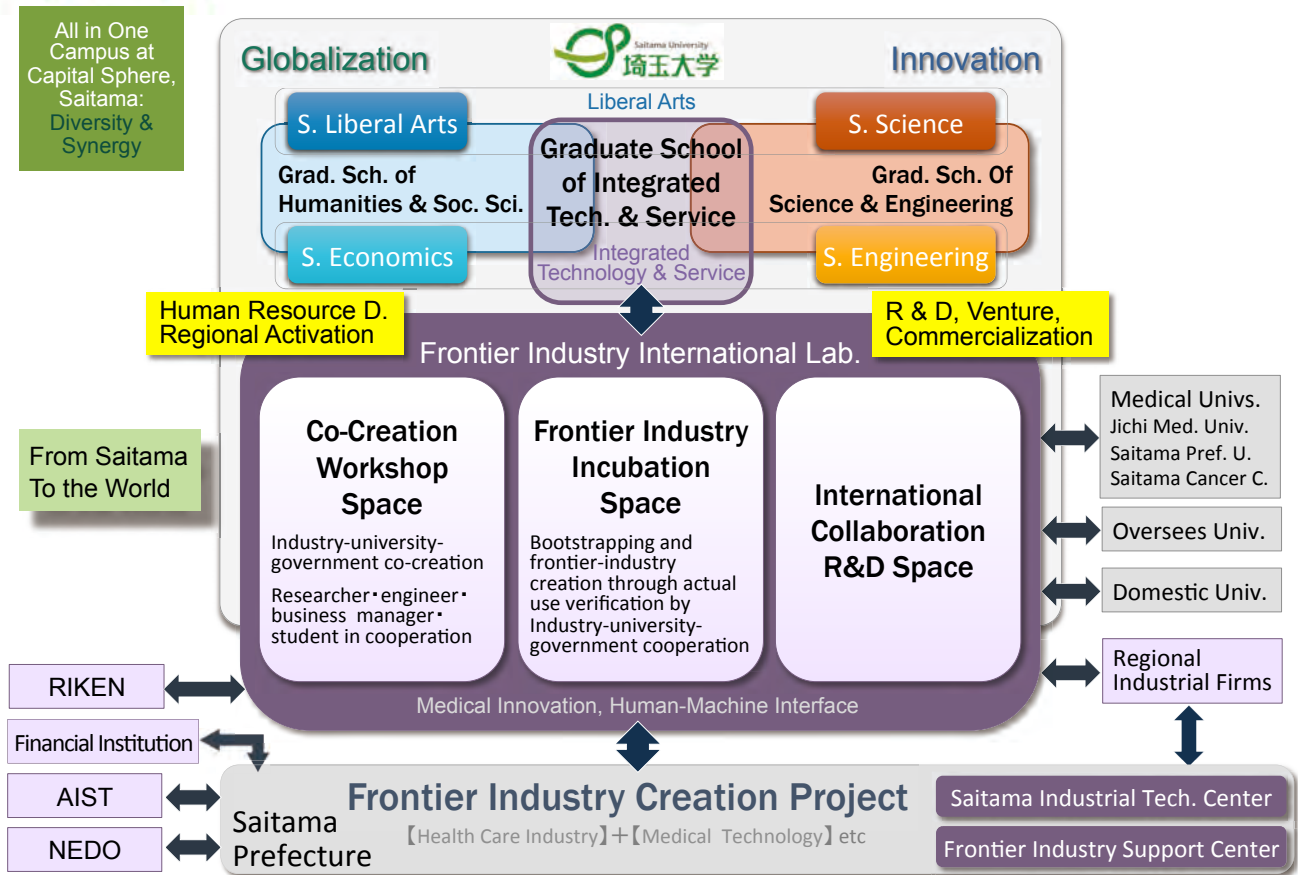
Issue No.3

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?

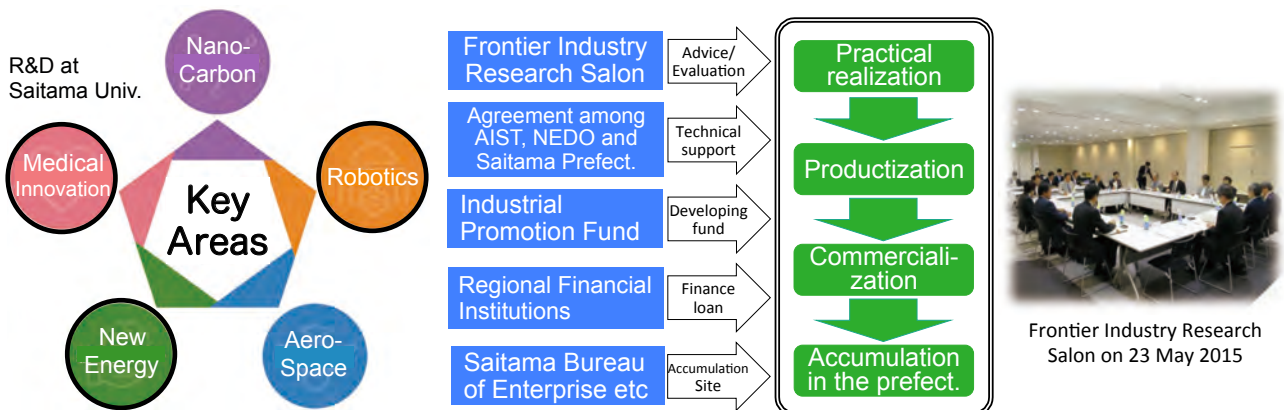
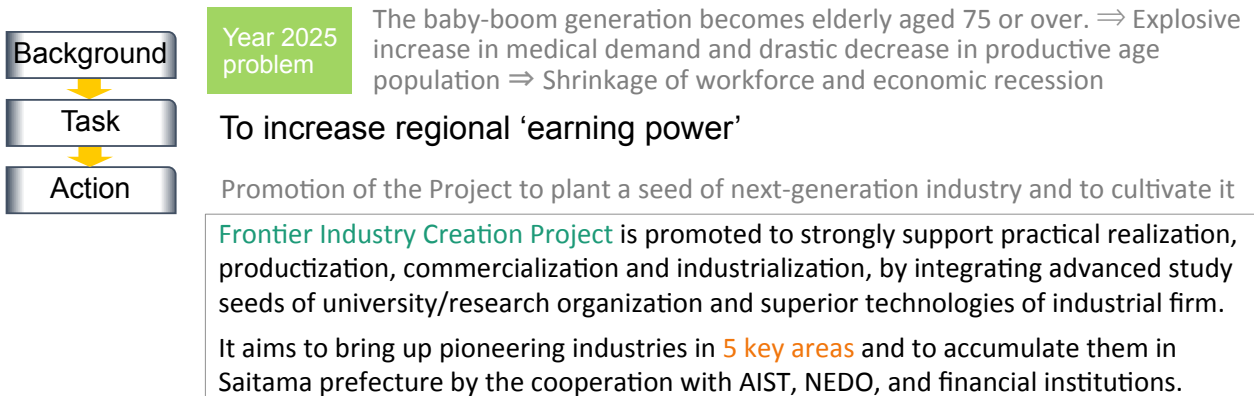
Innovation is not a spark of genius. An ability to take the initiative in solving problems with a diversity of people is a key factor for innovation.

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



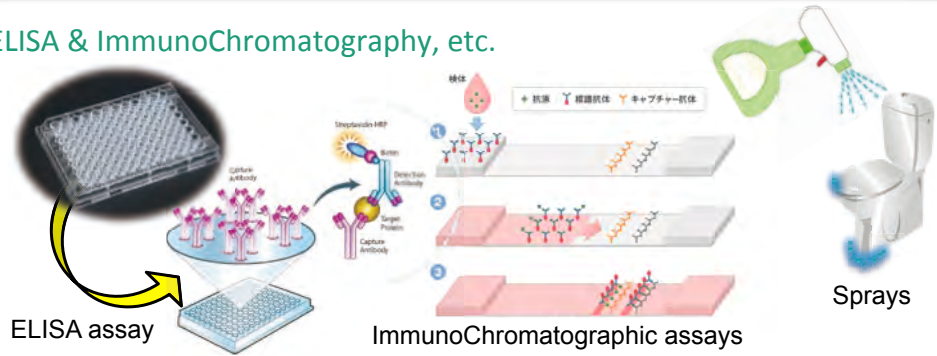
Frontier Industry Creation Project by Saitama Prefecture (2014~)



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

ELISA & ImmunoChromatography, etc.

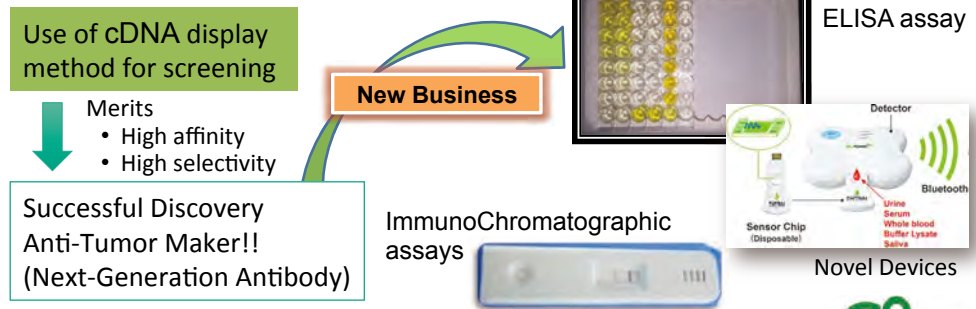
Vero toxin,
Influenza viruses,
Noro Viruses,
Dengue Viruses,
etc.



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

Survivin,
Other known
tumor makers,
etc.

ELISA & ImmunoChromatography, etc.

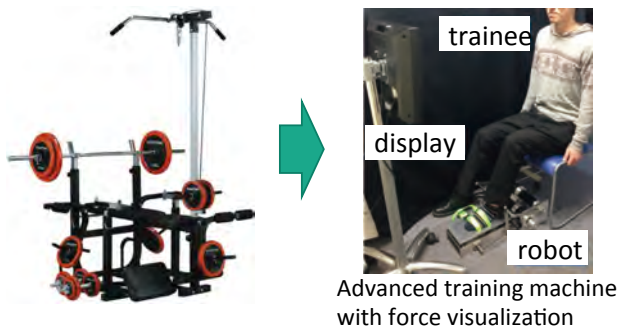


What is the merit of introducing robot to rehabilitation when robots are **bulky**, **expensive**? Additionally, it is **less-skilled than therapists**.

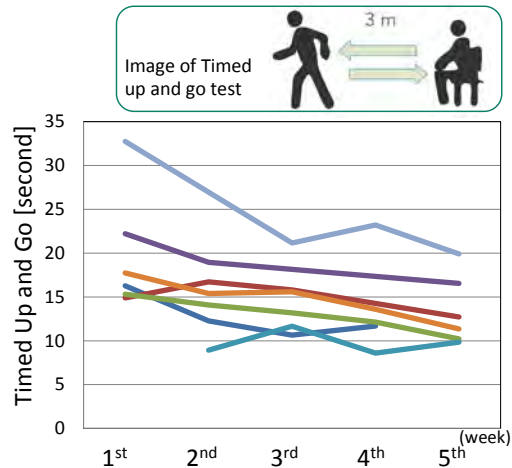
- Robot can measure **accurately** and **automatically** with the equipped sensors.
- **Augmented reality** is also good solution for enhancing rehabilitation.

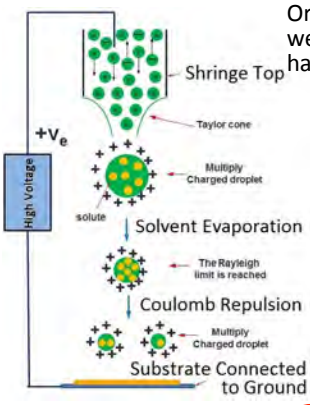
Proposal in this project

Effective training based on **visualization** of force information

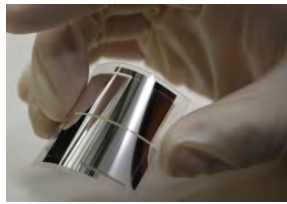


6 out of 7 participants had much **shorter time** after 1 month training. This is a possible beneficial effect of **improvement in ambulatory function**

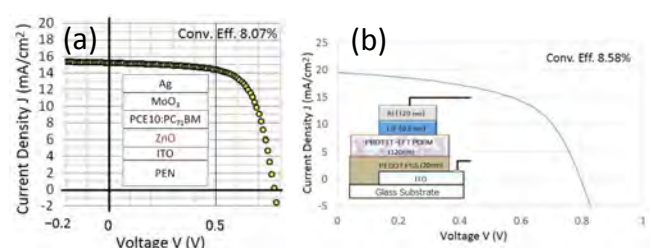




Organic Thin Film Solar Cells by Electro Spray Deposition (ESD) method provide light weight, flexible / 3D curved surface and versatile applicability for mobile and energy-harvesting fields.

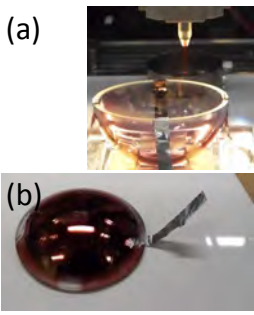


An example of flexible organic solar cell fabricated on a PEN substrate.



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!**



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.

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!
THANK YOU!

