JICA's support to engineering higher education through various approaches

JICA's support to engineering higher education is classified into three approaches: 1. development of leading universities of each country (Hub type); 2. formation of an international network of universities including Japanese ones (Network type); and 3. support for building institutions (Institution-building type). In order to strengthen "education", "research", "university-industry collaboration" and "university management", JICA has various menus besides LBE, such as curriculum revision, facilities and equipment development, and university-industry joint research, and carries out its support in a way that responds to the current situation and needs of developing countries, while working closely with Japanese universities to take advantage of Japan's experience. Because of the strong economic and academic tie with Japan, JICA's support has been mainly targeted to Southeast Asian countries, however it is also spreading to East Asia, South Asia, Middle East and Africa in responding to growing needs of those regions and internationalization of Japanese universities.

	Hub Type	Network Type	Institution-Building Type
Education	Degree Obtention		Establishment of accreditation organization for engineering education program
	Curriculum/Syllabus Revision, Training on Teaching Methods, and Experimental and Practical works, Facilities and Equipment Development, LBE Introduction		
Research	Research Guidance, Joint Research, Scholarship for Degrees		
	Facilities and Equipment Development, Patent Acquisition, LBE Introduction	Establishment and management of academic societies, Journal publication	
University-Industry Collaboration	University-industry joint research, endowed chair/invited lecturers from industry, Internship at industry, Establishment and Strengthening of University-Industry collaboration center	University-industry joint research	
University Management	Development of University Strategy, Strengthening of University Administration		

Main cooperations of JICA in engineering higher education

Egypt

Egypt-Japan University of Science and Technology (E-JUST) [Hub Type]

This University was established with the cooperation of both Japan and Egypt with the aim of developing advanced industrial human resources in the field of science and technology, in the Middle Eastern/African region. Japanese side has established a mechanism to support E-JUST with close collaboration among industry, academia and government. Amongst all, the top 12 universities in Japan formed a consortium and has been supporting E-JUST by making the best use of Japan's experience in engineering education centered on the introduction of LBE.

Malaysia

Malaysia-Japan International Institute of Technology (MJIIT) [Hub Type]

MJIIT has been providing education for developing advanced human resources with applied skills and research development capacity, though the introduction of "i-kohza" which utilizes the characteristics of Japanese style engineering education, especially LBE. Furthermore, in order to carry out human resource development that meets the needs of Japanese and Malaysian Industry, MJIIT has strong collaboration with Japanese universities and local Japanese companies. Also MJIIT has received students from ASEAN and Middle-East countries with the objective of becoming an international hub of Japanese style engineering education in the future.

Kenya

Pan African University (PAU)/Jomo Kenyatta University of Agriculture and Technology (JKUAT) [Hub Type]

Under the leadership of the African Union Commission (AUC), PAU was established targeting the whole African countries. JKUAT became a host university of PAU in the field of Basic Sciences, Technology and Innovation (PAUSTI) in 2012. The Government of Japan agreed with AUC and Kenya to support PAUSTI as the Key Thematic Partner. Japan is providing technical support to PAUSTI through promoting Science, Technology and Innovation activities at JKUAT, especially practice-oriented education and research toward African innovation. Japan supports human resources development and encourages innovation vitality in collaboration with industry and community across Africa.

India

Indian Institute of Technology Hyderabad (IIT-H) [Hub Type]

IIT-H is one of the leading universities in science and engineering field in India. JICA is providing multi-level support to IIT-H such as campus facility development, joint research promotion with the aim of creating a research network with Japanese universities and industry, as well as developing advanced industrial human resources.

Indonesia

Establishment of Indonesian Accreditation Board for Engineering Education (IABEE) [Institution-Building Type]

With the objective of improving the quality of engineering education in Indonesia JICA has been supporting establishment of Indonesia Accreditation Board for Engineering Education (IABEE) and development of accreditation mechanism.

ASEAN Countries

ASEAN University Network/ Southeast Asia Engineering Education Development Network (AUN/SEED-Net) [Network Type]

With the objective of developing advanced human resources in engineering field in ASEAN, JICA has created a network among the top engineering universities of ASEAN and Japan. JICA is also supporting improvement of education and research capacity of ASEAN universities through overseas study program of academic staff and promotion of joint research. JICA is aiming to develop it into a self-supporting network in the future.

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Photos: JICA

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Japan Brand ODA

Development of Human Resources in Engineering Field with Practical Skills through Research Activities in a Team

LBE (Laboratory-Based Education)

Development of quality human resources in engineering field has become a major need in developing countries, and JICA has been responding to it by introducing Laboratory Based Education (LBE) to engineering education in universities. Whereas, in general, course work and individual guidance are the cornerstones of engineering education in Europe and the United States, engineering education in Japanese universities emphasizes research activities implemented on a laboratory-by-laboratory. At a laboratory, which is headed by faculty members and composed of post-doctoral students, graduate students, and 4th-year undergraduate students, students can obtain not only expertise and problem-solving ability but also soft skills such as management and communication skills by practical education through research.

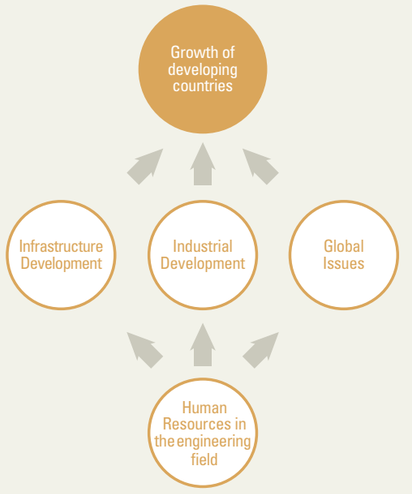
Unique know-how, experience and technologies originating in Japan and cultivated at international cooperation sites around the world are proving useful in the field in many developing countries. JICA is disseminating these methods and program models that are effective for solving problems to the rest of the world as the Japan Brand of international cooperation and promoting its use.

Growth of developing countries and development of human resources in engineering field

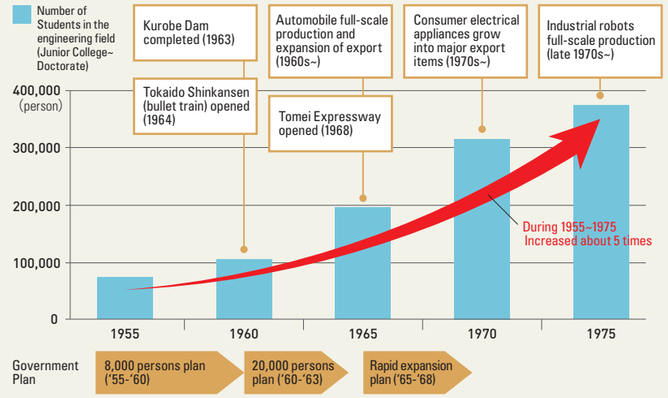
The growth of developing countries requires efforts in many ways, but human resource development is one of the essential elements. In particular, quality human resources in engineering field are required to respond to growing needs of infrastructure and industrial development, and to global issues such as natural disaster, climate change, energy issues, and others.

One of the factors explaining the rapid economic development of Japan after the World War II was developing a large number of advanced human resources in engineering field. In Japan, from the late 1950s to the late 1960s, higher education in science and technology field expanded rapidly and developed human resources in engineering, who supported high economic growth.

In developing countries, development of human resources in engineering field is still to be achieved. It is indicated bythe small number of researchers per one million person (i.e. 0.1 to 1 researcher) in developing countries while the one in developed countries is more than 10 researchers. A shortage in human resources in engineering field results in lack of industrial infrastructure, low productivity, and vulnerability of economic development as it was pointed out at the time of the Asian currency crisis in the end of the 1990s.Therefore, the expansion of higher education to develop human resources in engineering field is necessary.



Rapid economic growth of Japan and development of human resources in engineering field



Source : Created by JICA based on the "School Basic Survey" (Ministry of Education, Culture, Sports, Science and Technology) and "Japan's Period of High Economic Growth and Science and Technology Education" (Akihiro Itoh, 2013)

Expansion of higher education in developing countries and challenges of engineering education

Higher education in developing countries has largely expanded quantitatively in the past 10 years – in terms of both the number of enrolled students and the enrollment rate. The causes of the expansion are growing demand for advanced human resources corresponding to the advancement of industrialization and the knowledge-based society; and growing number of applicants to higher education due to the expansion of primary and secondary education.

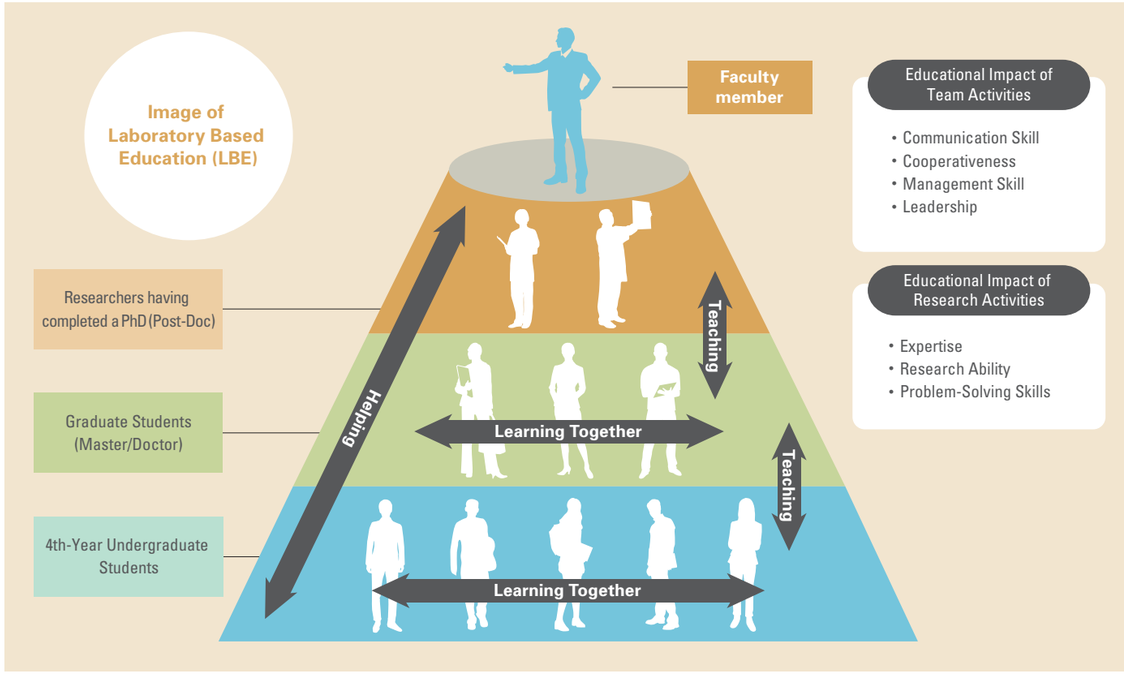
On the other hand, the quantitative expansion of higher education is not necessarily leading to the quantitative and qualitative expansion of engineering education. In many developing countries, the development of human resources in engineering field is prioritized as a means to leading economic growth, however, quantitative expansion has been carried out mainly in humanities and social sciences because of severe financial conditions. In addition, the deterioration of education and research quality has become a challenge since faculty staff, facilities and equipment, and research funding, which are indispensable to secure/improve the quality of engineering education, are insufficient.

In developing countries, due to the lack of experiments, training equipment, and research funds, education centered on classroom lecture and memorization is often carried out, and makes it difficult to develop human resources with practical skills and application ability required by industry.

The characteristic of Engineering Education in Japan: LBE (Laboratory-Based Education)

Development of quality engineers has become a major need in developing countries, and JICA has been responding to it by introducing Laboratory Based Education (LBE) to engineering education in universities. Whereas, in general, course work and individual guidance are the cornerstones of engineering education in the United States, and many of European countries, engineering education in Japanese universities emphasizes research activities implemented on a laboratory-by-laboratory. At a laboratory, which is headed by faculty members and composed of post-doctoral students, graduate students, and 4th-year undergraduate students, students can obtain not only expertise and problem-solving ability but also soft skills such as management and communication skills by practical education through research. Also, in a laboratory, besides teaching by a faculty staff to the students, there are various interactions such as assistance to academic staff's research by students, teaching to younger students by senior students, and mutual learning among students. These interactions will contribute to improving students' communication skills, cooperativeness, management skills, and leadership. Human resources equipped with such skills are very highly valued by companies after their graduation.

Therefore, JICA is actively promoting LBE in its assistance programs such as receiving international students to Japan, and establishing /strengthening engineering education in universities in developing countries. In doing so, JICA supports other related activities together such as improvement of course work, capacity development of faculty members and development and maintenance of research equipment as prerequisite to introduce LBE.



Examples of LBE Introduction

JICA Project with Surabaya Institut Teknologi Sepuluh Nopember, (ITS),Indonesia(2012-2014)

Major Initiatives

- Development of LBE guidelines (clarification of LBE definition and authorization criteria)
- Authorization of LBE laboratories which meet LBE definition
- Seminar to share LBE experience
- Monitoring and evaluation of LBE (development and utilization of guidelines)
- Commendation for distinguished LBE laboratories
- Support to research activities of authorized LBE laboratories (Patent application, paper submission to international journals, application to external funds and others)

Major Results

- Activation of research activities of authorized LBE laboratories: Out of 50 authorized LBE laboratories, 90% succeeded in obtaining external funding and 80% posted paper in international journals
- Improvement of education capacity of authorized LBE laboratories: 60% of the students were satisfied with LBE, and the average period to complete the Master's program was shortened (LBE student: 4.03 semesters ↔ General student: 4.4 semesters)

Reputation of LBE in Developing countries and Japan

[Developing countries]

- "We want to grow practical human resources through LBE where senior and junior students are helping each other to resolve problems under the supervision by a faculty member. I expect graduates to fully use their thinking and discipline, developed through Japanese-style engineering education, at their jobs."
  (Prof. Dr. Rubiyah Yusof, Dean of Malaysia-Japan International Institute of Technology)
- "In this university, we provide practical education based on the experience of engineering education in Japan. Industry has high expectation on our graduates as industry-ready engineer and values their potential for growth, since graduates show their strength in practical technology, and diligence based on excellent ethics learned from the Japanese."
  (Prof. Dr. Mabel Imbuga, Vice Chancellor of Jomo Kenyatta University of Agriculture and Technology, Kenya)
- "In Japanese laboratories during my studies abroad, I learned the importance of the development of the next generation."
  (Assistant Professor Lucas Donny Setijadji of Gadjah Mada University, Indonesia)

[Japan]

- Benefits of Japanese-style research-based education (Results of a survey conducted by JICA to Japanese professors in engineering field)
  - ▶Effective as a method to cultivate high level of expertise.....81.5%
  - ▶Effective as a method to cultivate high research capacity and agenda setting/analytical skills.....more than 90%
  - ▶Effective to introduce Japanese-style LBE in developing countries.....75%