Data Collection and Confirmation Survey regarding Examples of Information Communication Technology utilization that contributes to the Achievement of the Sustainable Development Goals

Final Report

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JAPAN INTERNATINAL COOPERATION AGENCY

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LIST OF ABBREVIATIONS

AAAA	Addis Ababa Action Agenda
AI	Artificial Intelligence
BEL	Bluetooth Low Energy
BOP	Bottom of the Pyramid
C/P	Counter Part
CSR	Corporate Social Responsibility
CSV	Comma-Separated Values
CTA	Technical Centre for Agricultural and Rural Cooperation
CtoC	Consumer to Consumer
DAC	Development Assistance Committee
DFI	Development Finance Institution
FinTech	Financial Technology
FTA	Farming & Technology for Africa
GHG	Greenhouse Gas
GIS	Geographic Information System
GNI	Gross Nation Income
GPS	Global Positioning System
ICT	Information Communication Technology
IDRC	International Development Research Centre
IoE	Internet of Everything
IoT	Internet of Things
ITEE	Information Technology Engineers Examination
ITS	Intelligent Transport Systems
ITU	International Telecommunication Union
JCAP	JICA Country Analysis Paper
JICA	Japan International Corporation Agency
KM(N)	Knowledge Management (Network)
LMS	Learning Management System
LPWA	Low Power Wide Area
MDGs	Millennium Development Goals
MRV	Monitoring, Reporting and Verification
NGO	Non-Governmental Organization
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
O&M	Operation and Maintenance
OTT	Over The Top
OWG	Open working Group
PACS	Picture Archiving and Communication System
PDM	Project Design Matrix
POS	Point of Sales
PSI	Private Sector Instrument

REDD+	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries +
SATREPS	Science and Technology Research Partnership for Sustainable Development
SCADA	Supervisory Control and Data Acquisition
SDGs	Sustainable Development Goals
SDSN	The UN Sustainable Development Solutions Network
SIM	Subscriber Identity Module
SMS	Short Message Service
TOSSD	Total Official Support for Sustainable Development
UAV	Unmanned Aerial Vehicle
UNEP	United Nations Environment Program
USAID	United States Agency for International Development
USDOT	US Department of Transportation
Wi-SUN	Wireless Smart Utility Network

Executive Summary

(1) SDGs and ICT utilization

Currently, we live the era of the greatest information and communications revolution in human history. Over 40% of the world's population has access to Internet, the number of new users is increasing day by day, and people in poverty accounting for 20% of the total population, 7 out of 10 have mobile phones (World Development Report 2016). Through the emergence of Internet and rapid spread of ICT, through the tertiary industrial revolution, everything will be connected to internet, "IoT (Internet of Things) conversion" will make it possible to collect big data at low cost. In addition, analysis by AI (Artificial Intelligence) brings new value creation, and increasing the expectation for the fourth industrial revolution, which is industrial innovation through extreme automation and enhanced connectivity. (Information Communication White Paper, 2017, Ministry of Internal Affairs and Communications,) In developing countries, the rapid spread of mobile phones and Internet is remarkable, regulations are not fully developed then, on the contrary, emerging the cases of ICT utilization by the latest technology based on the unique needs of developing countries.

The current investment amount is about 155 trillion yen / year, compared to about 432 trillion yen / year, which is necessary for achieving SDGs, and an investment gap of about 277 trillion yen / year has occurred. In order to compensate for the gap, private investment is expected first, however the current private investment amount is only about 100 trillion yen / year, even if the investment amount assuming that the private entry rate is the maximum is 200 trillion yen, it is estimated that an investment gap ranging from 100 to 200 trillion yen / year will be generated. In order to solve the gap, innovative approaches that encourage private enterprises to embrace incentives are required, and "ICT innovation" that utilizes private technologies is considered as one of them.

(2) Background and Objectives

On the other hand, “Project Research: Application of Information and Communication Technology in Developing Countries” (October, 2015: JICA), in the scheme based on the request from the recipient country government, such as technical cooperation, grant aid, loan aid etc, the status of ICT utilization is extremely weak compared to international organizations and other bilateral donor agencies (The case utilize ICT is about 10% of all the projects in JICA). However, ICT is widely used in JICA 's proposal-type project (International Scientific and Technical Cooperation (SATREPS) to deal with global issues, support project for overseas deployment of SMEs, etc.). The proposal items in the project research and their correspondence are as shown in the table on the next page.

In this survey, after analyzing examples of advanced ICT utilization in Japanese municipalities and JICA proposal-type projects, even refer to the efforts of insights and other international organizations and other companies obtained as a result, it aims to make concrete proposals to promote the ICT utilization in JICA.

Proposal (To promote ICT utilization by JICA)	Correspondence Situation (from 2016 to December 2017)
(1) Improve recognition and understanding of officers and staff, improve collaboration among departments (internal briefing sessions, organization of knowledge and database, disseminate)	The internal dissemination (YouTube, seminar) was done many times, however it does not exceed the category of the personal contribution. With regard to databases, construction of a mechanism to keep updating "knowledge" in this field where technological obsolescence is fast is an issue.
(2) Direct approach in English to developing country needs to avoid Supply Driven	Delivery some streaming videos (English) of ICT utilization examples, however the number of accesses to the videos is limited.
(3) Proactive example creation to increase concrete examples	A precedent case such as Rwanda "ICT Innovation Ecosystem Enhancement Project" was initiated. Other departments have begun to consider ICT utilization. However, in order to share the cases in a timely and accurate manner, it is imperative to establish a structure to respond to the number of consultations expected to increase rapidly after the full-scale study.

(3) Success factors in Japanese local governments and proposal-type projects (JICA)

Even in developing countries and in Japanese municipalities, since the budget available to the projects is limited, it is observed that the cost for implementation and operation is inexpensive as a success factor. However, there are many cases that there is an issue in the sustainable operation of the project because the subsidy from the central ministries finished, or there is no financial support for maintenance and costs related to renewal of equipment. In the case of business success in developing countries, in particular, localization and customization considering the local behavior as well as compatibility with local languages was confirmed in many cases even in the systems which has the introduction and operation records in Japan. Therefore, when JICA introduces ICT for issues solving, it is important that it is localized, and the lifecycle cost including maintenance and renewal costs is inexpensive (Affordable). In addition, it is indispensable to form consensus with related parties in order to introduce a new approach and to change the operation method while traditional operation is being carried out. Regional leaders who strongly support the implementation of the project with the strong belief that ICT is indispensable for solving this regional problem were observed as success factors.

(4) Ideas for developing and promoting ICT utilization to request-type (sovereign) project

1) Creation of a place for co-creation and innovation for ICT utilization

JICA has the position to directly access the needs of stakeholders in the partner country, and to be able to create a place to develop new applied technology while matching the technology of resource provider to local needs. For example, prior to a request excavation stage and formulation and renewal of the implementation plan, ideathon, brainstorming etc. carried out by the stakeholders such as the partner country government, residents, enterprises (local, Japan, third country), overseas offices of JICA, universities jointly sometimes remotely by using ICT could be one of the approaches. In that case, ingenuity is necessary so as not to damage the community's leadership and ownership.

2) Mechanism to accumulate knowledge on co-creation / innovation

To promote ICT utilization and create a place for that, it is necessary to accumulate, share and disseminate knowledge. Currently, Knowledge Management Network (KMN) and the warning retrieval system have accumulated knowledge, however, accumulation, sharing and dissemination of knowledge is conducted internally (across departments, including overseas offices) and outside (domestic and overseas), in order to proceed more effectively and sustainably, it is necessary to develop awareness that necessity resources are allocated to this area and that all efforts should be maintained by all users.

As a way of regarding to resources, for example, a major management consultant firm in charge of this survey has established a special section called Knowledge Management center (KM center) in the company, collects project results, proposals, deliverables, etc. in a unified manner and creates a database. In accordance with keyword induction and consultation request from consultants, the section extract and present reference cases from the database and introduce relevant experts.

As a way of fostering consciousness, it may be possible to show that each initiative contributes to the overall goal in a visible form such as incentives. For example, the same major management consultant firm has established a system to record employees who provided materials and suggestions, and honor employees who provided a lot of materials and suggestions throughout the year. In other consulting companies as well, they are giving in-department awards to contributions to projects not directly involved, and there are the many cases that the history of such awards is managed in the personnel department and is reflected in the personnel performance evaluation.

3) Human resources to promote ICT utilization and co-creation / innovation

In order to make co-creation and induction of unprecedented impact by utilizing the latest technology, which JICA places as an action for achievement of the vision, even in case of outside organization and human resources are utilized, JICA needs to have the human resource who has basic knowledge on ICT and excellent sense of smell for advanced technology and innovation.

Therefore, in the process of career path of JICA staff, it is able to select ICT professional course from the early stage, but also while taking into account that technological innovation is fast in this field, further active promotion of international human resources on ICT, it is urgent to acquire highly specialized talent in career-changer market.

4) Necessity of continuous consciousness innovation

Continued awareness reform is necessary to execute the above proposal (creation of a place, mechanism to accumulate knowledge, training of human resources). As it is important to show the importance of reform from the top of the organization, as a way to further embody that co-creation and innovation have joined the action to achieve the vision in the new JICA vision, Discussions are needed to be clearly stated in the separate development cooperation policy and JICA Country Analytical Paper (JCAP). In addition, It is important for each and every stakeholder concerned to recognize that carrying out reforms contributes to the achievement of the Goals (SDGs), so it is important that widely shared success stories of projects being implemented in Rwanda etc.

(5) The role of JICA's for complement the effectiveness and sustainability of the proposal-type project

Finally, the role of JICA is considered to complement the effectiveness and sustainability of the proposal-type project by expanding its vision from the promotion of utilization to the request type (sovereign) programs discussed so far. A bird's eye over the trend of the world shows "private enterprises" as stakeholders in the "sustainable development targets (SDGs) implementation policy" decided by the SDGs Promotion Headquarters December 22nd, 2016, As its role, it is decisively important that the private sector contribute to solving public issues, and "funds" and "technology" of private enterprises (including individual businesses) are effective for solving social problems, it is the key to achieving SDGs. On the other hand, regarding the role of public funds, according to "Addis Ababa Action Agenda (AAAA)", "1) Support to promote mobilization of private funds" and "2) Support to the institutional design for minimizing risk when private capital is mobilized to developing countries". Moreover, as a general role, it seems that it will continue to be necessary to respond to "3) Market Failure (Externality, Public Goods, Monopoly and Information asymmetry, etc.)". From this, the expectation that the role of public funds will be the foundation for private funds utilization.

Based on the success factors and issues that organized cases of ICT utilization in domestic municipalities and JICA proposal type projects in this survey, what is considered to be effective in existing efforts is the support for the development of relevant legal systems and guidelines, the support for human resources supply through the combined use of request type projects, the realization of short-term and small-scale loans at preferential interest rates (Two Step Loan, etc.), and the establishment of a local public organization, etc. In addition, there are menus that "basic investigation", "project investigation", "diffusion demonstration project" as JICA private collaboration scheme, however even the schemes to support the subsequent phases (overseas investment and loan etc.) is expected to expand. Also, there is still room for consideration of the development and deployment of innovative investment and financing (eg. a system in which dividends and repayment are reduced based on the degree of contribution to the achievement of SDGs for the target business) along with the recent attention to ESG investment.

1. Background and Objectives

1.1 Background

There has been a remarkable global increase in the dissemination of Information Communications Technology (referred to hereafter as "ICT"), and developing countries have improved infrastructures for ICT, such as optical fiber networks, broadband and mobile phones/communication networks. Also, ICT literacy is rapidly improving. In view of this, ICT is recognized as an effective tool in overcoming challenges in various fields, and contributing to industry development/economic growth and improving both the lifestyles and livelihood of citizens as a shared infrastructure.

At JICA, while requests for cooperation in connection to conventional ICT infrastructure support have been decreasing, the need for cooperation related to the use of ICT is increasing. New types of cooperation are being developed in various development challenges, including ICT business system development in the Project for Development of the National Biodiversity Database System (Technical Cooperation Project; Vietnam) and The Project for E-Customs and National Single Window for Customs Modernization (grant aid cooperation; Vietnam), and the use of UAV/drones as a tool to support special bridge inspections in the Project on Improvement of Quality Management for Highway and Bridge Construction and Maintenance (Technical Cooperation Project; Philippines).

In view of this situation, according to "Project Research: Application of Information and Communication Technology in Developing Countries" (ICT Project Research 2015) conducted by JICA in 2015, the status of ICT utilization in JICA is summarized as follows.

(1) ICT is used at JICA in around 10% of all projects, of which two thirds are not in the "ICT" category on the JICA knowledge site.
(2) The use of ICT in water resources/disaster prevention, resources and energy and urban/regional development is comparatively high.
(3) Conversely, the use of ICT is not progressing in fields such as education, public health care, private sector development, agriculture and fisheries, which are assumed to have a strong affinity with ICT utilization.
(4) Unique examples are emerging that use new ICT in proposal-type Projects (such as Science and Technology Research Partnership for Sustainable Development (SATREPS) and the Project to Support the Overseas Development of Small to Medium Enterprises, etc.).
(5) The ICT used in proposal-type Projects is not being fully utilized in support schemes (referred to hereafter as "request-type projects") implemented following a local request for technical cooperation, grant aids or ODA loans.

In the JICA's Position Paper on SDGs "Toward Achieving Sustainable Development Goals (SDGs)," it states that "JICA will ensure the impact of cooperation on the SDGs by utilizing Japan's own Knowledge, introducing innovations and collaborating with local and international partners in order to accelerate the achievement of the SDGs."

Due to the background detailed above, it is necessary for this survey to clarify the challenges and countermeasures/approaches to develop/promote the kind of leading ICT utilization examples seen in proposal-type Projects for request-type projects in order to further expand ICT utilization for each development challenge to achieving the SDGs.

1.2 Objectives

The objective is to examine the ideal initiatives that will contribute to the achievement of the SDGs through the use of ICT in future request-type projects based on the results obtained from collecting/analyzing leading ICT utilization examples seen in proposal-type Projects, etc.

1.3 Survey approach

Cases of support that use ICT "applicable in developing countries" that are implemented internally and externally of JICA, including JICA proposal-type Projects and Japanese local government, etc., have been collected and analyzed by means of document review and interviews with stakeholders, and, with inspiration from the examples obtained, the challenges and countermeasures for development in request-type projects have been clarified, after which a basic study of the JICA internal knowledge sharing system was conducted.

In addition to the above, with the objective of increasing awareness among JICA staff, staff in the head office and overseas offices were given an introduction to various examples and made recommendations for innovation inside JICA.

Regarding the aforementioned countermeasures, consideration was given so as to demonstrate specific and realistic plans by conducting the examination on the state of progress within JICA over the last two years with regard to the main challenges stated in ICT Project Research 2015.

1.4 Procedures to be followed in this survey

The procedures to be followed in this survey are shown in the following flow chart.

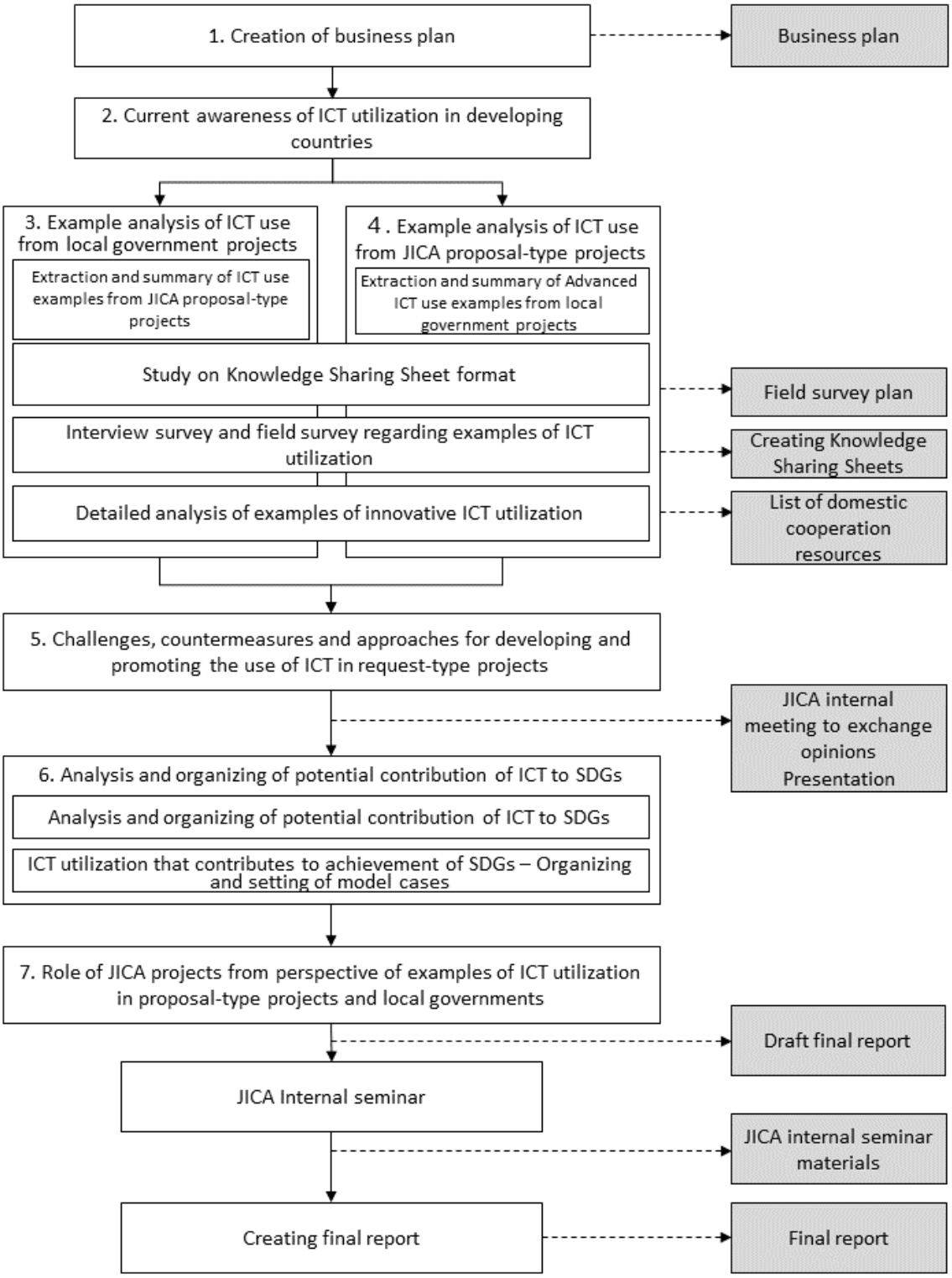

Figure 1 Project implementation flow

2. Current Awareness of ICT Utilization in Developing Countries

Although fixed telephone lines were not widely adopted in developing countries, which require time for installation, the communications infrastructure has spread rapidly with the introduction of mobile phones. According to ITU (International Telecommunication Union) statistics, in a comparison of data charges between developing countries and developed countries, the fees in developing countries were much greater, and, looking at developing countries/least developed countries, the fees for a wireless system are approximately half that of the fee for a wired system in developing countries and a third in the least developed countries, which is one of the main factors leading to the rapid spread of wireless communication system.

In developing countries, there are many users of prepaid SIMs, so telephone numbers often change, but with messaging apps, there is no obstacle to communication by phone or message even if the SIM is changed. With the introduction of a low-cost smartphone market including phones made in China and India, it has become easier to access Internet, and messaging apps such as WhatsApp, LINE and Viber have spread rapidly. Furthermore, OTT (Over The Top) services have appeared that provide access to services such as Google, Facebook and Wikipedia with no data costs. (Google Free Zone and Facebook Zero, etc.)

The price of broadband services against GNI (Gross National Income) is 2% or less in developed countries, whereas it is often between 2% and 5% in developing countries, and the ratio becomes even higher in least developed countries. For that reason, there are many users of WiFi access points, and it is common to have free WiFi at cafes and hotels, while in some developing countries, there are many cases in which WiFi access in buses and taxis is used as a means of acquiring customers.

In this way, even in developing countries, ICT utilization is progressing in various fields due to the spread of broadband services and smartphones, including “mobile payment services” that are increasingly used in developing countries. For example, in Kenya, Africa, M-Pesa, a mobile payment service using mobile phones, began in March 2007, so that remittance, deposits and withdrawals can be made using a mobile phone short message service (SMS) even without a bank account, and financial transactions such as payments can be made, and the same service can be received throughout the country, which is referred to as FinTech due to the use of technology for finance.

Even in animal husbandry, agriculture and fisheries, services are being introduced that have been achieved through the use of ICT, and activities using ICT are being proactively supported by international aid organizations such as the World Bank and USAID.

【Examples from the field of animal husbandry】

・iCow（ http://www.icow.co.ke/ ）:

Developed in Kenya in 2011 with the objective of improving livestock breeding, production and farm productivity. This service provides information (tips) about agriculture and livestock breeding. Information is also provided regarding livestock purchasing and breeding methods. Financial support was provided indirectly by USAID.

【Examples from the field of agriculture】

・Rural eMarket（ http://etsena.net/ ）:

Started by Farming & Technology for Africa (FTA) in 2013 with the objective of exchanging information about crop markets and prices, etc. for suburban regions in Africa. Commodity trade matching is also provided for producers and buyers.

【Examples from the field of fisheries】

・mFisheries（ http://cirp.org.tt/mfisheries/ ）

This service for fishermen is a smartphone application that includes information about market prices, etc., tide patterns, information about the weather at sea, a GPS, a compass and an SOS transmitter. Supported by the International Development Research Center (IDRC) in Canada.

In proposal-type Projects such as JICA's Science and Technology Research Partnership for Sustainable Development (SATREPS) and the Project to Support the Overseas Development of Small to Medium Enterprises, for example, there are unique examples of the use of ICT, including "Development of Rapid Diagnostics and the Establishment of an Alert System for Outbreaks of Yellow Fever and Rift Valley Fever (SATREPS)" and "Verification Survey with the Private Sector for Disseminating Japanese Technologies for Intelligent Transport Solutions (ITS) in major cities in Gujarat Province, India"

The establishment of FabLab, for which Japan overseas cooperation volunteers (JOCV) are working on in the Philippines, is part of the "Maker Movement" that allows anyone to become a product manufacturer due to the introduction of 3D printers, and, due to the increasing diversity of needs and preferences, the feasibility of small-scale multi-item production by individuals using ICT is contributing to BOP (Base of the Economic Pyramid) support.

Global trends such as Cloud computing, IoT/IoE and big data, in conjunction with the use of open source software, enables the development of advanced systems at relatively low cost, which is contributing to the creation of new business industries even in developing countries. Conversely, investment in infrastructure related to cyber security is insufficient, and ensuring security is seen as a major challenge due to the rapid increase in the exchange of all kinds of information on the Internet.

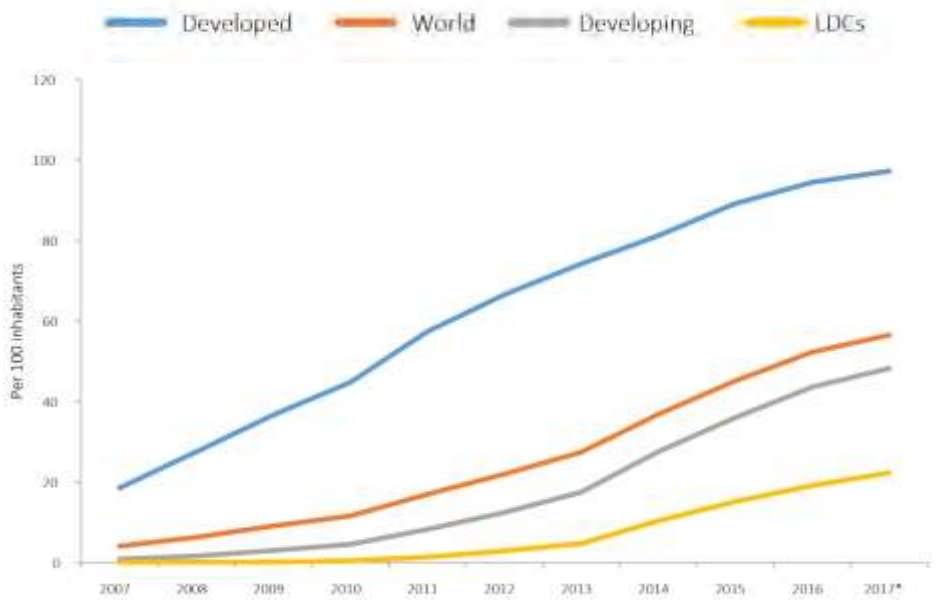

Figure 2 Transition in mobile-broadband subscriptions by region (per 100 inhabitants)

Source :Measuring the Information Society Report 2017, ITU

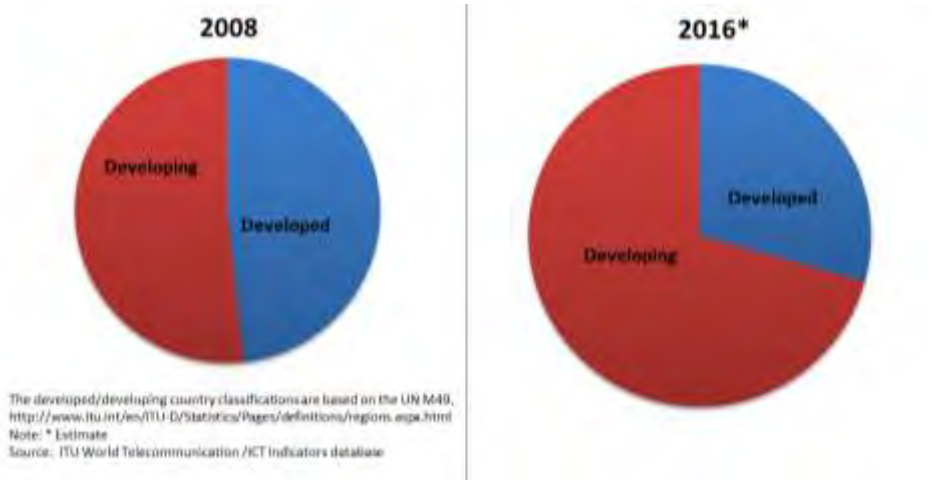

Figure 3 Transition in the ratio of Internet users by region 2008-2016

Source :ICT Indicators database (ITU)

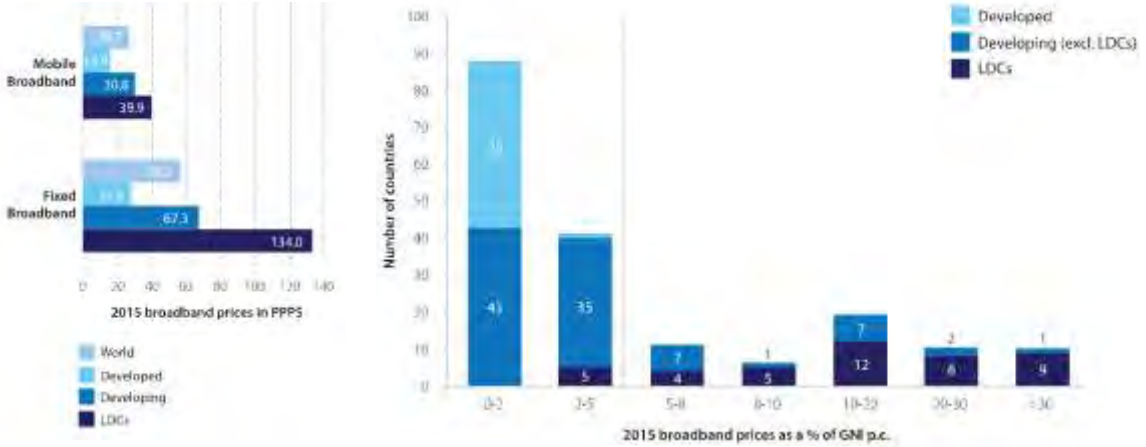

Figure 4 Left: Price comparison between mobile broadband and fixed broadband

(World/Developed countries/Developing countries/LDCs)

Figure 5 Right: Number of countries by broadband price as a percentage of GNI

(Developed countries /Developing countries/LDCs)

Source :ICT Facts and Figures (ITU)

3. Study of Examples of ICT Utilization by Local Governments

3.1 Advanced examples of ICT utilization by local governments

Regarding examples of ICT utilization by local governments in Japan, 10 cases were selected after summarizing the Project details of 37 cases that are (1) “superior cases” with recognized policy effects, etc. from past studies, (2) cases in which the use of technology is positioned as “advanced” (Mobile/Cloud/Big Data/IoT/Drones) within “Application of Information and Communication Technology in Developing Countries” and in this Specification, and (3) those that conform to the SDG goals, and a review of past documents, and interviews with operators etc. were conducted.

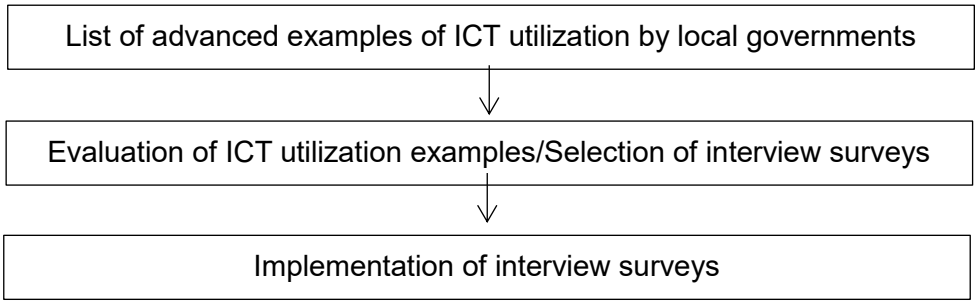

Figure 6 Study implementation flow for examples of advanced ICT utilization by local governments

3.1.1 List of advanced examples of ICT utilization by local governments

In order to list the examples of ICT utilization by local governments in Japan, a complete list was made based on the following perspectives after conducting a study of past documents and stored databases, as well as a study with online searches.

① “Superior cases” with recognized policy effects, etc. from past studies
② Cases in which the use of technology is positioned as “advanced” (Mobile/Cloud/Big Data/IoT/Drones) within “Application of Information and Communication Technology in Developing Countries” and in this Specification
③ Those that conform to the SDG goals

The examples listed from the above are the 37 cases shown in the complete list in Table 1.

Table 1 Complete list and evaluation of advanced examples of ICT utilization

SDGs	Local Government Name	Project Name	Key Technology						
			Mobile	Cloud	IoT	Big Data	3D Printer	Drone	Others
2. Zero Hunger	Nagano Prefecture	"Visualization of Farming," through Analysis of Production Costs and Labor using a Food and Agriculture Cloud	○	○					
	Kitaono Ueda-ku, Shiojiri City, Nagano Prefecture	Cloud System Construction for Remote Monitoring as a Countermeasure for Damage to Agricultural Products caused by Wildlife		○	○				
	Niigata City, Niigata Prefecture, etc.	A System to Monitor the Water Level, Water Temperature, and Humidity in Paddy Fields	○	○					
	Shihoro-cho, Hokkaido	Construction of a System to Support Wheat Harvesting using Satellite-based Remote Sensing							○
3. Good Health and Well-Being for people	Itabashi-ku, Tokyo	Creation of "Human Body Charts" using Wearable Devices	○	○					○
	Kure City, Hiroshima Prefecture	Medical Expense Saving of about 300 Million Yen through Analysis of Big Data concerning Health Insurance Claim Statements	○		○	○			
	Kamakura City, Kanagawa, etc.	Service Allowing Users to Conduct a Medical Checkup by the Combined Use of a Test Kit and an Application, "Smapho-de-Dock"	○						
	Mitsuke City, Niigata Prefecture, etc.	Challenge Project for Charging IoT Health Services with Incentives	○	○					○
4. Quality Education	Akaiwa City, Okayama Prefecture	Introduction and Demonstration of Learning Software for Tablets at Elementary Schools in the City (Cooperation between Okayama University and Benesse)		○		○			
	Tamura City, Fukushima Prefecture	Advancement of "Drone Education" in Collaboration between the Municipality and Keio University						○	
	Yokohama City Special Support School for the Visually Impaired	"Tangible Searching" Project -- Introduction of Next-generation Search Machines that Enable 3D Printing of Voice-activated Search Results					○		
6. Clean Water and Sanitation	Yamanashi Prefecture	Modeling of Dammed Lakes using Drones and 3D Printers					○	○	
	Fuefuki City, Yamanashi Prefecture	Integrated Management of 51 Water Pumping Facilities using a Cloud-based System		○		○			
	Waterworks Bureau, Kawasaki City of Kanagawa Prefecture	Water Meter Reading System Using Smartphone to be Introduced as the First of this kind in Japan	○						
	Nishiawakura-son, Okayama Prefecture	IoT Water Industry Application Software that Enables Management of Water Quality and Purification Level using Sensing Capability	○						○
7. Affordable and Clean Energy	Hirosaki City, Aomori Prefecture	Introduction of a Telematics Service (Remote Communications with Automobiles) Aiming at Fuel Consumption Reduction, etc.		○	○				
	Nanjo City, Okinawa Prefecture	Next-generation Wind Power Generation that Enables Typhoon Wind Power Generation			○	○			
	Nakanojo-machi, Gunma Prefecture	Supply of Recyclable Energy (Solar Power Generation) based on a Demand Response System							○
8. Decent Work and Economic Growth	Kitakyushu City	Improvement of Productivity and Management using Fintech (Financial Information Technology)		○					
	Motobu-cho, Okinawa Prefecture	Realization of Agricultural Product Traceability through Introduction of ICT							○
	Yokosuka City, Kanagawa Prefecture, Tottori Prefecture, Miyagi	Regional Development and Creation of Strolling Behavior among People by Incorporating Gamification -- "Ingress Mission," "Yokosuka GO," etc.	○			○			○
9. Industry, Innovation and Infrastructure	Tokyo	Bridge Monitoring System using Sensor Information			○	○			
	Gifu Prefecture, etc.	Cloud Service to Support Maintenance Works of Road Pavement by Collecting Road Information using Smartphone Acceleration Sensor	○	○					
	Sagamihara City, Kanagawa Prefecture	Smartphone Application for Reporting Road Damage by Email using Smartphone Camera and GPS Functions, "Pa! Torun"	○			○			○
	Chigasaki City, Kanagawa Prefecture, etc.	Inexpensive General Inspection System of Road Undersurface that Enables Understanding of Undersurface Fragility using Microwave Sensor mounted on a Running Vehicle							○
11. Sustainable Cities and Communities	Chiyoda-ku, Chuo-ku, Minato-ku, etc. of Tokyo	Smart Bike Sharing Incorporating Bicycles and Mobile Capabilities	○						
	Entire Japan (RESAS of the Cabinet Office)	Estimation of Floating Population Based on GPS Data Obtained via Smartphone Applications and Development of such Data into Statistical Data				○			
	Niigata City, Niigata Prefecture, etc.	Sensor-integrated Manhole Covers to Prevent Theft and Manage Water Quality, Volume, etc.							○
	Kyoto Prefecture	Prediction-based Crime Prevention System using Statistics, Big Data and AI				○			○
	Tokyo	Remote and Wide-area Monitoring System using Airships							○
13. Climate Change	Tsuwano-cho, Shimane Prefecture	Predictive Information Detection System for Landslide Disasters using Water Volume Sensor		○	○	○			
	Kawasaki City, Kanagawa Prefecture	Resources Recycling System Utilizing IoT at the Kawasaki Eco Town							○
	Ishikawa Prefecture	Flood Damage Prevention using Remote Operation System at 20 Drainage Pumping Stations (Floodgates)		○					
	Tsuwano-cho, Shimane Prefecture, etc.	Predictive Information Detection System for Landslide Disasters utilizing Water Level Sensors							○
	Japan Weather Association	Distribution Project for Energy-saving and Food Waste Reduction by Improving Demand Prediction Accuracy using Weather Prediction				○			
15. Life on Land	Maniwa City, Okayama Prefecture	"Forest and Forestry Cloud" used and managed jointly by City Office and Forest Associations, and Use of Drones to Improve Efficiency in Forest Surveys		○				○	
	Zushi City, Kanagawa Prefecture	Environmental Information System, GAIA, to Support the Creation of Biodiversity Conservation Cities							○

* Cases highlighted in orange are the subject of a detailed study using the evaluation factors in the following section.

3.1.2 Evaluation of ICT utilization examples/Selection of interview surveys

In the complete list formed in the previous section, after the details of each project was figured out and the main technologies were categorized, the projects were evaluated from the following perspectives that should be taken into consideration for application in developing countries.

Affordable: Low cost and ease of introduction
Applicable: Suitability, and conforming to the situation in developing countries
Scalable : Extendable with the view of future popularization and expansion

Based on the above, examples with a relatively high evaluation and examples that are expected to be useful as a reference for future JICA projects were selected in consultation with JICA staff, and literary researches and interview surveys were conducted with the local governments implementing the project or with the operators developing and managing the systems for the 10 cases shown in Table 2.

As for No.3, “Service Allowing Users to Conduct a Medical Checkup by the Combined Use of a Test Kit and an Application, “Smapho-de-Dock”, only a literary research was conducted due to certain reasons of the operator.

Table 2 Surveyed examples of ICT utilization by local governments in Japan

No	SDGs	Project name	Name of local government	Date of interview
1	2. Zero Hunger	Cloud System Construction for Remote Monitoring as a Countermeasure for Damage to Agricultural Products caused by Wildlife	Shiojiri City, Nagano Prefecture, etc.	July 26, 14:00
2		A System to Monitor the Water Level, Water Temperature, and Humidity in Paddy Fields	Niigata City, Niigata Prefecture, etc.	August 1, 13:00
3	3. Good Health and Well-Being for people	Service Allowing Users to Conduct a Medical Checkup by the Combined Use of a Test Kit and an Application, "Smapho-de-Dock"	Kamakura City, Kanagawa Prefecture	—
4		Challenge Project for Charging IoT Health Services with Incentives	Mitsuke City of Niigata Prefecture, etc.	August 2, 10:00
5	6. Clean Water and Sanitation	Water Meter Reading System Using Smartphone to be Introduced as the First in this kind in Japan	Yokosuka City, Kanagawa Prefecture	September 11, 15:00
6	9. Industry, Innovation and Infrastructure	Smartphone Application for Reporting Road Damage by Email using Smartphone Camera and GPS Functions, "Pa! Torun"	Sagamihara City, Kanagawa Prefecture	July 26, 9:00
7	11. Sustainable Cities and Communities	Estimation of Floating Population Based on GPS Data Obtained via Smartphone Applications and Development of such Data into Statistical Data	Entire Japan (RESAS of the Cabinet Office)	July 27, 11:00
8		Creation of IoT and AI-based Real-time Hazard Maps and Provision of Information to Support Action	Hachioji City of Tokyo	August 9, 10:00
9	13. Climate Change	Flood Damage Prevention using Remote Operation System at 20 Drainage Pumping Stations (Floodgates)	Kanazawa City, Ishikawa Prefecture	August 4, 13:00
10	15. Life on Land	“Forest and Forestry Cloud” used and managed jointly by City Office and Forest Associations, and Use of Drones to Improve Efficiency in Forest Surveys	Maniwa City, Okayama Prefecture	August 10, 14:00

3.1.3 Implementation of interview surveys

Contact was made with representatives from local governments and operators implementing the Projects that are the target of the interview surveys, and after confirming that the Projects are still ongoing, the local governments and operators were visited and interview surveys were conducted.

In the interview surveys, in addition to receiving an explanation of the ICT utilization in the Project, they were asked about matters pertaining to Project formation, planning and implementation and management/operations and maintenance. The results were compiled for each Project on a Knowledge Sharing Sheet as shown in Table 3. The Knowledge Sharing Sheets for each Project are shown in the Appendix at the end.

Table 3 Knowledge Sharing Sheet (example)

◆**General Information**

Project Name	"Forest and Forestry Cloud" used and managed jointly by City Office and Forest Associations, and Use of Drones to Improve Efficiency in Forest Surveys (Project to develop an ICT-based community to Make Good Use of Forests of Maniwa)		
Target Country	Japan	Target Area	Maniwa City, Okayama Prefecture
Issue Category of the Project	Agriculture	Start Period	2013
Lifecycle Cost	Initial Cost	Approx. 80 million yen	
	Maintenance Cost	Not published	
Project Operator	Maniwa City (Okayama Prefecture)	Operator's Country	Japan
Key Technology	Cloud, mobile	Technology Category (e.g. Infrastructure, Hardware, Software)	Software, hardware

Current Situation of Key Technology
・Grasping of the on-site situation using drones (robot sensors) ・Digitalization of information on forest resources through construction of a forest and forestry cloud platform

Case Reference			
Project	Country/Area	Reference (report, etc.)	Remarks

Summary
・In the "Project to develop an ICT-based community to make good use of forests of Maniwa," local entities engaged in the forestry industry participated, including the Maniwa City Office (section in charge of forestry) and the Maniwa Forest Associations. ・Through the forest and forestry cloud, it became possible to share not only aerial photos taken with drones, etc. and geographical information such as cadastral maps and forestry plan maps but also information related to various ledgers for forestry roads/forestry work roads, forest reserves, etc. and information on permits and licenses on logging, etc. between the city office and the forest associations. ・In addition, as a means to understand the quality and quantity of forest resources accurately and promptly, robot sensors (radio-controlled drones) were introduced and local and high-frequency photography became possible.

◆**Information on Project Formation**

Prerequisite
· Based on an awareness that for industrial revitalization in local community, collaboration among concerned entities is necessary, in FY2006, the Maniwa System Conference was established to secure and expand the forest production infrastructure. · Utilization of biomass has been promoted mainly focusing on wood resources and a biomass power plant with about 80,000 MW annual power output was constructed (supplying power to 22,000 households).
Content of Preliminary Survey
–
Motive and Introduction Process
· The timber industry has been growing and in FY2015, the wood biomass power plant started operation. Stable supply of forest resources including fuel, etc. became an issue. · In the past, large-scale fallen tree damage occurred when a large-sized typhoon hit the area. It became necessary to take measures from the viewpoint to conserve resources and prevent land-slide disasters.
Purpose of Project
· Sophistication of forest map information by also using aerial photos taken with drones · Increase in efficiency of information sharing based on the forest and forestry cloud · Support for the timber industry such as wood biomass power generation (resource management and stable supply) · Increase of job opportunities and enhancement of public service through revitalization of forestry and other local industries · Creation of "willingness to live a life worth living" through discovery of "satoyama" traditional semi-natural areas
Business Scheme
Development of a system using the Project for Town Development Utilizing ICT of the Ministry of Internal Affairs and Communications

◆**Information on Planning and Implementation**

Total Project Cost
80 million yen

	Implementation System	Initial Cost Burden
Client		—
Central Government (subsidy etc.)	Project for Town Development Utilizing ICT	80 million yen
Project Operator		—

Specific Contents of ICT utilization

・It was realized to identify the forest stock easily in almost real-time, by introducing robot sensors (drones) equipped with a digital camera. The robot sensors (drones) can be mounted on the vehicle and they can be flown over any arbitrary location in the mountains. Thus, estimation of tree locations, tree species, tree heights, etc. is being conducted based on sensing data obtained from above using the sensor and other equipment.

・A system (forest and forestry cloud platform) is being developed to digitalize information on the forest stock that have conventionally been managed on paper media (information on forest locations and owners, tree species and ages, etc.) and to display such information by overlaying it on digital maps.

Implementation Schedule
FY2013 (single-year project)

Introduction Process
①Development of a forest and forestry cloud platform
②Development of a forest information database
③Monitoring of forest resources utilizing robot sensors (drones), etc.
④Creation of basic data for understanding the present forest conditions

Effect After Introduction
・Large improvement in clerical works related to conservation and utilization of forests ・Works to extract and calculate areas benefitting from forestry roads ・Works to extract forest reserve areas ・Grasping of information on forest owners ・Understanding of the present forest situation (land area by tree species) ・Contribution to forest resources utilization made through stable fuel supply to the wood biomass power plant, etc.
Support System on local side (Funds, HR, Relaxation of Regulations, etc.)
・Establishment of a biomass industry mainly composed of local businesses (younger-generation business owners)

Gained Know-how
Knowledge Through Implementation
Efforts made by local people are important and it is desirable to introduce the system in the form of support to those people.
Points to Consider (Remaining Issues, etc.)
Strengthening of functionalities to encourage the system utilization and collection and understanding of information: Grasping of highly accurate topographical and forest resources information and surveying of actual conditions of forests and surrounding areas, by taking Mikamo District (approx. 5,700 ha) as a model district: Project cost of approx. 30 million yen (a preceding project for comprehensive strategy to create towns, people and job opportunities of the Ministry of Internal Affairs and Communications)

◆Information on Operation and Maintenance

Maintenance Cost
Not published
Handling Cyber Security
・Several networks are used, from which an appropriate one is chosen, in order to secure factors corresponding to private information (residents, land areas and taxation).
Issues after Introduction
・Aging of robot sensors (drones) ・Consensus building among forest owners ・Sharing of data with a forest land ledger system which the prefectural government is developing

◆Relevant SDGs

2 Zero Hunger		9 Industry, Innovation and Infrastructure	○
3 Good Health and Well-Being for people		11 Sustainable Cities and Communities	
4 Quality Education		13 Climate Change	
6 Clean Water and Sanitation		15 Life on Land	○
7 Affordable and Clean Energy		12 Responsible Consumption and Production	
8 Decent Work and Economic Growth	○	14 Life Below Water	

3.2 Knowledge gained from the studies of ICT utilization examples

The success factors and challenges for the 10 cases that were studied are shown in Table 4～エラー! 参照元が見つかりません。. The surveyed 10 cases are currently ongoing, and expected to demonstrate continuing effects. The results from the interviews regarding the success factors and challenges during the initial introduction and in ongoing management are shown below.

3.2.1 Success factors

After compiling the success factors into general categories based on the results from studying the cases introduced by local governments, the following factors were extracted.

① Low cost of introduction, operation, and maintenance

・Since the most projects are targeting local governments, the budget for implementation is limited in comparison to that of national agencies, etc. Therefore, plans are made to reduce the introduction and operation expenses to the extent possible in all projects. The efforts include using existing generic products as hardware rather than developing and manufacturing exclusive equipment from scratch.

② Funding support during project start-up from government agencies

・Despite the low cost of introduction, it is difficult for the operator alone to carry out everything, but the operators seek the funds for the initial introduction jointly with the local government by making an application for subsidies from national agencies such as the Ministry of Internal Affairs and Communications, the Ministry of Economy, Trade and Industry, and the Ministry of Agriculture. It was heard that commencement/introduction was thereby simplified, so funding support may be essential to accelerating new initiatives.

③ Support for PR during the management stage from government agencies

・In some cases, rather than providing funding support, government agencies were responsible for PR by introducing operator names and activity details on the websites or in the various documents produced and published by the local governments. In view of the fact that the implementation of projects with local governments is connected to PR activities for the operators, some of them were solely responsible for implementing the projects, which led to interest from other local governments and to fee payments from multiple sources.

④ Ensuring not only ICT technicians but also the personnel needed for efficient operation and services

・Many projects use tools developed by technical groups with IT/ICT technicians, but even in these cases, ICT is obviously only a tool, whereas personnel with specialist knowledge and experience in the target field are required for the actual measures taken based on the data obtained as well as analyses and decisions based on the data. Often, one of the success factors is that the necessary personnel cooperate for actual operation and service provision by gaining the cooperation of universities and learned people rather than focusing solely on the use of ICT.

⑤ Leadership from regional leaders

・It is essential to have regional leaders that can provide strong support for project implementation including those who strongly believe in using ICT to resolve regional challenges among the members of local communities in target regions and managers in government agencies, etc. It is difficult for project operators alone, in the course of their regular duties, to put in the effort to

create an awareness of regional challenges, to explain that the use of ICT is effective in resolving those challenges and to formulate consenting agreements, so many operators identify one of the success factors as the presence of active leaders with strong conviction in regional and government agencies.

3.2.2 Challenges

As a result of studying project introduction examples in local governments, the following factors were derived by organizing and categorizing the challenges in the introduction process and the future challenges.

① Work is needed because operation and analysis is not automated

・Although a huge amount of data and information can be obtained using ICT, analyzing the data, organizing the information and then taking actual measures based on the results of the analyses and decisions, etc. still needs expertise and automation is difficult, so there are many cases in which more work is needed than expected. Some cases may expect a goal of using machine learning and AI, but these cases are mostly in the stage of learning by acquiring correct data.

② Reduction of funding support from government agencies

・Although government support such as funding was obtained at first, many people told that there are challenges to continuing operation of the project as there are no grant support systems for continuous operation There is no funding support for maintenance costs such as operational expenses and equipment replacement, etc.

③ Training and expanded use among people who do not use ICT terminals

・For the ICT utilization in the field of agriculture, etc., there are cases in which farmers are asked to using ICT terminals to provide data and information, but in addition to providing training for the use of ICT terminals, which they do not use regularly, there are challenges to overcoming hesitation and increasing their use. One countermeasure is to make one of the more active local farmers a leader who can provide training and promote use, and to ask for the assistance of students from agricultural colleges.

④ Lack of guidelines for statistical data and data analysis

・This is also related to ①, but there are no guidelines for the analysis and organization of the vast quantities of data and information obtained from the introduction of ICT, and each operator takes up its own organizing method. Although it is difficult to disclose or publicize all of the details because they are competing companies, the establishment of guidelines for standardized analyses/decisions would lower the barrier to the introduction of ICT and this is necessary in order to promote wider use.

⑤ Regulations in legislation such as the Radio Act

・There are regulations in legislation such as the usage of wavebands in the Radio Act, and even though greater efficiency is possible from a technical perspective, some technologies cannot actually be put to use. The regulations need to be lightened by gaining special recognition for pilot projects. New equipment that is not for the Japanese market must be developed because the machinery used in Japan is often not compatible with legislation in overseas Radio Acts, so the market scale is limited only to the domestic one.

Table 4 Reasons for success and challenges in cases from Japan

Project	Operator	Reasons for success	Challenges
Cloud System Construction for Remote Monitoring as a Countermeasure for Damage to Agricultural Products caused by Wildlife (Shiojiri city and others)	Nihon Software Engineering Co., Ltd.	・Local farmers cannot ascertain the true state of activity of wildlife (background, social request) ・Low cost of construction	・Improvement of machinery battery life ・Improvement of sensor reaction against the objects other than targets ・ Although 3G is used in Japan, overseas communications bases are unknown
A System to Monitor the Water Level, Water Temperature, and Humidity in Paddy Fields (Niigata City in Niigata Prefecture, etc.)	Vegetalia Inc.	・In addition to cooperating and collaborating not only with ICT engineers but also agricultural experts, the Project was implemented alongside companies that own sensor technology ・The challenge was to optimize paddy field patrols due to the aging society (background, social request) ・The efficiency of paddy field management greatly improved, which contributed to the acquisition of Special A-Grade rice	・Telecommunication service contracts needed for each terminal (main line/sub-line structure are being developed by LPWA) ・Analysis and diagnosis of data is still done manually. To be automatized in the future. ・Financial support from the government is decreasing ・Currently only for rice, but expanding it to other items creates a huge burden ・Insufficient human resources to promote management and development
Service allowing Users to Conduct a Medical Checkup by the Combined Use of a Test Kit and an Application, "Smapho-de-Dock" (Kamakura City in Kanagawa Prefecture, etc.)	KDDI Corporation	・By combining a special home testing kit and a web-based service, health checks can be performed at home without the need to go to a hospital. ・ Advice is given via the Internet for improvement actions based on the results.	・People who do not use smartphones or computers cannot access to the service. ・42 local governments have introduced this service, and the challenge is to promote other local governments to take it up as well.
Challenge Project for Charging IoT Health Services with Incentives (Mitsuke City, Niigata Prefecture and five other cities)	Tsukuba Wellness Research Co., Ltd.	・ Support for Project launch from the Government (Smart Wellness City General Area") (Background, Local government project) ・Effective influencer on people indifferent to health promotion by means of points conferral ・Genuine results among participants	・Creation of a structure for information advertising via word-of-mouth ・Establishment of single scale of participation figures and application period (because those who are indifferent participate later on) ・Establishment of an attractive participation fee ・Use of ICT systems for visualization of results (also improves ICT literacy of participants)

Table 5 Reasons for success and challenges in cases from Japan

Project	Operator	Reasons for success	Challenges
System for Water Meter Reading using Smartphone, etc. (Yokosuka City)	Daiichi Kankyo Corp	・Introduction of WISUN technology (low-energy wireless telecommunications standard that can be utilized up to just under 1km) ・Use of U-bus system ・Installation of effective relays (telephone poles, etc.) ・Reduction of burden of meter reading work by means of smart meters (even for manual meter reading) *Almost no problem to system implementation as a result of demonstration experiments	・Generalization of smart meters ・Improved waterproof functionality due to underground installation of smart meters for water services ・Requires customization depending on the water service operator (Too many operators since they exist in each local government) ・Development of a fee notification system in the future ・Barrier of wireless regulations in other countries
Smartphone Application for Reporting Road Damage by Email using Smartphone Camera and GPS Functions, "Pa! Torun" (Sagamihara city)	Urban Graphics, Inc.	・Report system that was introduced on flip phones in 2004 even before the introduction of smartphones (background) ・Information transmission by email (easier to implement in terms of server use and advantageous in terms of operation and maintenance costs) ・Accuracy of information (positional information and photographs) ・Usable on both android and iOS	・Ideals for management organizations (strict view of maintenance status if managed by local government) ・Possibility of over-abundance of information immediately after introduction (increased workload) ・Possibility of fake information depending on the region
Estimation of Floating Population based on GPS Data obtained via Smartphone Applications and Development of Statistical Data (Cabinet Office)	DOCOMO Insight Marketing INC.	・Based on statistical information about populations gained from mobile phone networks, the state of the population in all of Japan can be identified, including where large numbers of people from certain regions are staying according to weekdays/weekends, time periods, gender and age. ・By processing and treating the obtained statistical data, consulting can be performed such as providing output data required by local government and private companies. ・Support for wider use/PR from Cabinet Office RESAS	・As only data from the DOCOMO mobile phone network is turned into statistics, it is not all-encompassing as it has not been applied by other mobile phone services, etc. ・Different industries require different data so it needs to be able to adapt to different needs.

Table 6 Reasons for success and challenges in cases from Japan

Project	Operator	Reasons for success	Challenges
Production of Real-time Hazard Maps using IoT/AI, and Provision of Action Support Information (Hachioji, Tokyo)	ABIT Corporation M2B Communications, Co. Ltd.	・Water level measurement devices in use communicate using LoRa. LoRa uses two-way communication not only to receive data but also to send instructions. ・The network server uses a generic license, so it can be used without acquiring a special license for communication.	・Based on national regulations, communication takes place at a frequency of 920MHz, so the capacity of data that be transmitted is limited. For this reason, a new frequency is required in order to send and receive more information. ・The water level monitoring device requires electricity to work, it is expected that the system can be introduced in overseas countries, if the device is installed near the mobile phone base stations where electricity is available, without the need to plan a new power source.
Flood Damage Prevention using a Remote Operation System at 20 Drainage Pumping Stations (Floodgates) (Ishikawa Prefecture, Kahokugata Coastal Land Improvement District))	Hokuryo Denko Co., Ltd.	・The situation of all drainage pumps can be ascertained during heavy rain, etc., and they can be centrally managed. ・E-mails are only sent when there are abnormalities, so permanent observation is not required. ・Data is transmitted only by CSV files, so long-term use of the server is possible due to the small amount of data.	・Notifications are only sent by e-mail, and there is no compatibility with a smartphone-specific website or app. In view of the rapid widespread use of smartphones, countermeasures with smartphone compatibility are required in the future. ・Cameras must be installed for a more detailed identification of the status. ・The server should be placed on the cloud, but there will be expenses for operation and maintenance during abnormalities, so the server has to be managed by the operator for the time being. ・It is difficult for system maintenance to be carried out alone by Kahokugata coastal land improvement district, so support from the operator is required in the future as well.
“Forest and Forestry Cloud” used and managed jointly by City Office and Forest Associations, and Use of Drones to Improve Efficiency in Forest Surveys (Maniwa City)	Maniwa City	・Establishment of biomass industry primarily by local operator (young managers) (background) ・Existence of GIS core system (background) ・Incredible improvement of efficiency in the clerical work as a result	・Deterioration of robot sensors (drones) ・Formation of agreement with land owners ・Separate use of networks to ensure security of personal information (citizens, acreage, tax) ・Exchanges with forest land registry system under construction by the Prefecture

4. Examples of ICT Utilization in JICA Proposal-type Projects

4.1 Examples of ICT utilization in JICA proposal-type projects

After extracting and organizing projects in which ICT may be used from among JICA proposal-type projects (SATREPS, Private Sector Partnerships, SME support programs (basic study, feasibility study, and demonstration project) and JICA Partnership Programs (local government type and JPP type)) based on a review of existing literature (official documents such as reports), 10 cases of best practice were found based on ① the definition and evaluation of Affordability / Applicability / Scalability, ② the definition and evaluation of Benefit / Effectiveness / Contribution / Innovation, and ③ comments from the departments in JICA responsible for the project. Thereafter, in addition to studying existing literature, etc., interviews were conducted with the companies that look the lead in implementing the projects. Furthermore, visits were made to the sites where three of the projects were introduced/operated in order to conduct interviews with counterparts and local staff and to monitor the current operation status, etc.

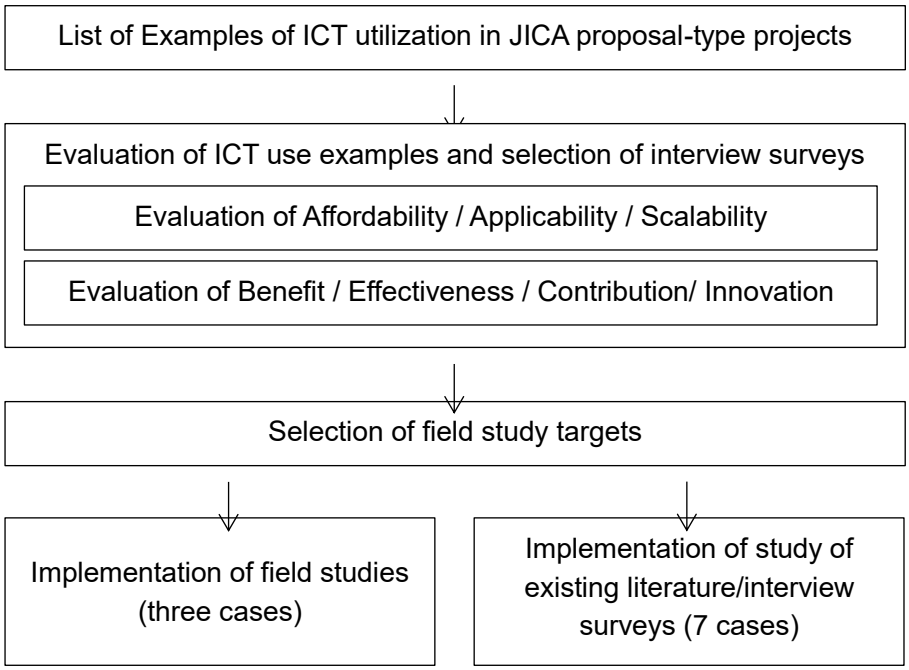

Figure 7 Flow of study implementation for ICT utilization examples in JICA proposal-type project

4.1.1 List of studies of cases of ICT utilization in JICA proposal-type Projects

For the list of cases of ICT utilization in JICA proposal-type projects, the projects which presumably utilize some kind of ICT were extracted and organized among proposal-type projects (SATREPS, Private Sector Partnerships, SME support programs (basic study, feasibility study, and demonstration project) and JICA Partnership Programs (local government type and JPP type)) after arranging project summaries based on documents available in the JICA library, etc.

As a result, 123 Projects were listed. The list of Projects is shown in Table 12 to Table 17.

4.1.2 Evaluation of ICT utilization examples and selection of interview surveys

Of the 123 Projects selected in the preceding section, based on existing documents such as reports available in the JICA library and from information published by the project operators, an evaluation of each project was made of the following points that should be taken into consideration with regard to operation in developing countries.

Affordable: Low cost and ease of introduction
Applicable: Suitability, and conforming to the situation in developing countries
Scalable : Extendable with the view of future popularization and expansion

For the evaluation, the definitions and points of the evaluations shown in Table 7 were established, and each Project was evaluated. The highest scores are given for "Affordable" as shown in the definitions below, since it is important to take the initial step for the introduction of ICT in developing countries.

Table 7 Definition and evaluation of Affordability / Applicability / Scalability

Evaluation item	Definition	Points
Affordable	○Initial introduction cost is relatively low Minimum system configuration can be made at an inexpensive price Not depending on a large-scale infrastructure Existing and widely used equipment and infrastructure can be used ○Procurement can be made locally ○Installation cost is relatively low There will be no construction costs or development can be made easily with locally available technology Existing platforms, etc. can be utilized (including mobile phones and smartphones) ○Operation and maintenance costs are low ○Management has been made on a continuing bases, using profits, etc. ○Operation and maintenance costs will be reduced following the system introduction	□：5 points △：2.5 points
Applicable	○Problems and issues commonly existing in developing countries can be solved ○Development and installation can be made with simple technology Additional facilities (poles for installing equipment, etc.) are not necessary and installation on to existing facilities is possible and easy, etc. ○Cannot easily affected by local natural and social factors (weather conditions and possible theft) ○Applicable to the current level of local infrastructure services (telecommunication capacity, functions of widely used mobile phones and energy supply situation) ○Can be used regardless of skills and experience of personnel in charge (local staff) ○Relations have already been established with the local government and private companies/organizations who are implementing entities ○Reviews have been made on solutions of issues through introduction of advanced technology ○There is not much impact of legal systems (financial laws, telecommunication laws, etc.)	□：3 points △：1.5 points
Scalable	○The scope and size are scalable without the need to conduct significant refurbishment ○Functions can be easily added and they are scalable ○A similar mechanism can be transferred to other regions and developing countries ○Due to the use of ICT, it has influences on and is introduced to a range of related fields using ICT ○Can be expected to apply to other fields	□：2 points △：1 point

As a result of this evaluation process, as shown in Table 8, 29 Projects were selected that had a total score of 7.5 or more and that were seen as being Affordable. Projects undertaken in FY 2016 were not covered in this evaluation as they are still ongoing.

Table 8 Number of projects selected from the evaluation

Definition of Determination Flags (AT column)	No. of Projects
0 ： It is a project approved in FY2016 and survey and the project itself is still in progress.	21
1 ： Detailed information is not available and judgement cannot be made.	25
2 ： Project determined not to be subject to survey (less than 7.5 points).	41
3 ： Although 7.5 points or over are given, it is considered to be not "Affordable."	7
4 ： It is considered to be a candidate project to be subject to survey (7.5 points or over and ○ as "Affordable").	29

Furthermore, the state of progress was confirmed with the JICA departments taking the lead in 27 of these Projects after removing 2 Projects from the 29 Projects that had the same Project operator. For 18 of these Projects that had a relatively high evaluation as proposal-type Projects and that were still ongoing in some way after completion, evaluation of Benefit / Effectiveness / Contribution / Innovative were conducted according to the definitions and evaluations shown in Table 9.

Table 9 Definitions and evaluation of Benefit / Effectiveness / Contribution / Innovation

	Benefit			Effectiveness		Contribution		Innovation	
	Direct	Indirect							
Evaluation Viewpoints	To give quantitative evaluation to direct benefits convertible to monetary value, such as profit increase or sales and cost savings, etc.	To give qualitative evaluation to benefits related to policy issues, etc.	Point a	To give qualitative evaluation to solutions positively affecting other issues than regional issues in the project	Point b	To give qualitative evaluation to how far regional issues in the project have been solved	Point c	To evaluate not only the use of recent advanced ICT but also the development of effective ways or mechanisms to use ICT	Point d
Project having benefits that are larger than project cost	Project having already created qualitative benefits	4.0	Project having a ripple effect on other issues in addition to issues recognized in the project	5.0	Project considered as significantly contributing to solution of issues in the project	3.0	Project in which business model or utilization mechanism can be considered to have applicability to other issues or regions	4.0	
Project having benefits that are smaller than project cost	Project expected to have qualitative benefits but not having created such benefits yet	2.5	Project showing a possibility to have a ripple effect on other issues in addition to issues recognized in the project	2.5	Project having contributed to, in part, solution of issues in the project	1.5	Project in which business model or utilization mechanism can be considered to be, in part, advanced	2.5	
Project having offered no benefit so far	Project not expected to create qualitative benefits	1.0	Project not showing it has a ripple effect on other issues in addition to issues recognized in the project	1.0	Project having not much effect in solving issues in the project	1.0	Project in which business model or utilization mechanism has nothing particularly new	1.0	
Reason for Point Weighting (planned)		To give high evaluation to projects deemed to be creating a positive effect on policy issues, etc.		To give higher evaluation to projects that are creating a ripple effect		To coordinate points given under this evaluation item in comparison with others, because contribution to solution of regional issues is the initial goal of the project		To give higher evaluation to projects considered to be helpful as a business model, in addition to its way to utilize ICT	

Based on the above, projects with a relatively high evaluation and projects that are expected to be useful as a reference for future JICA Projects were selected with cooperation from JICA staff, and interview surveys with operators of each project and existing literature researches were conducted for the 10 items shown in Table 10.

Table 10 ICT usage examples in the target JICA proposal-type projects

No	Field	Project Name	Operator	Target Country	Date of Interview
1	Environment	Project for the Wild Fire and Carbon Management in Peat-Forest in Indonesia	Hokkaido University	Indonesia	August 14, 10:00
2	Education	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Strengthening of Children's Mathematical Ability by e-Learning Through University-Industry Collaboration	SuRaLa Net Co., Ltd.	Indonesia	August 1, 16:00
3	Transport	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Bus Improvement System	Eagle Bus Co., Ltd.	Laos	August 9, 14:00
4	Agriculture	Pilot Survey for Disseminating Japanese SME's Technologies for Introduction of IT for Agricultural Products Distribution	E-supportlink, Ltd.	Philippines	July 31, 16:00
5	Disaster prevention	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Efficient Management of the Multi-purpose Dam and Data Collection for the Climate Change with Real-Time Telemetry System (SESAME system)	Midori Engineering Laboratory Ltd.	Indonesia	August 14, 13:30
6	Education	Preparatory Survey for BOP Business on Improvement of Basic Education utilizing Multimedia Device and Contents	Ricoh Co., Ltd.	India	July 28, 15:30
7	Education	Preparatory Survey on BOP Business to Improve Children's Educational Achievement by e-Learning	SuRaLa Net Co., Ltd.	Sri Lanka	August 1, 16:00
8	Transport	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Intelligent Transport Solutions (ITS) in major cities in Gujarat Province	Zero-Sum Ltd.	India	April 28, 17:00
9	Medical care	The Project for Development of Rapid Diagnostics and the Establishment of an Alert System for Outbreaks of Yellow Fever and Rift Valley Fever in Kenya	Nagasaki University	Kenya	—
10	Education	Feasibility Survey for Utilization of ICT to Improve the Quality of Primary Mathematics Education	Sakura Co., Ltd.	Rwanda	May 17, 13:30

* Cases highlighted in orange are the subject of a field study using the evaluation factors in the following section.

4.1.3 Implementation of interview surveys and selection of projects for local visits

Contact was made with managers in the operators implementing the Projects selected for interview surveys, and each operator was visited to conduct the interviews after confirming that the Project is still ongoing.

In the interview surveys, in addition to receiving an explanation of the state of use of ICT in the Project, questions were asked regarding matters such as project formation, planning and implementation and operations and maintenance. Knowledge Sharing Sheets as shown in Table 11 were produced for the interview results for each project. The Knowledge Sharing Sheets for each project are shown in the Appendix at the end.

Field studies were conducted for three Projects that were still ongoing as of August 2017 and for which cooperation was obtained through these interview surveys.

Table 11 Knowledge Sharing Sheet (example)

◆General Information

Project Name	Project for the Wild Fire and Carbon Management in Peat-Forest in Indonesia		
Target Country	Indonesia	Target Area	Central Kalimantan
Issue Category of the Project	Environment	Start Period	October 1, 2008
Lifecycle Cost (*From the Project Completion Report)	Initial Cost (Yen)		
	Maintenance Cost (yen/year)		
Project Operator	Hokkaido University	Operator's Country	Japan
Key Technology	SESAME system	Technology Category (e.g. Infrastructure, Hardware, Software)	Hardware, Software
Current Situation of Key Technology			
Water level sensors have been installed to collect ground data. Satellite imaging and ground sensor data are used together to develop a more highly precise model.			
Case Reference			
Project	Country/Area	Reference (report, etc.)	Remarks
Project for the Wild Fire and Carbon Management in Peat-Forest in Indonesia	Indonesia, Central Kalimantan State	Final Report on the Project for the Wild Fire and Carbon Management in Peat-Forest in Indonesia	https://www.jst.go.jp/global/kadai/pdf/h2004_final.pdf
Summary			
In order to perform integrated peat land management, 1) a wild fire detection and wild fire prediction model using satellites is developed, 2) carbon stocks in peat land are evaluated using satellite data, 3) efficient river water management is implemented, and 4) ecosystem regeneration is carried out by means of a symbiotic system, and a system for integrated peat land management is constructed based on the results obtained, which will contribute to the realization of REDD+ (reduction of greenhouse gas emissions from forest reduction/deterioration).			

◆Information on Project Formation

Prerequisite
Indonesia comprises half of the tropical peat land area on earth, and has huge stocks of carbon but it is also becoming a huge source of carbon dioxide emissions due to a drop in underground water levels and dehydration caused by rapid development. In comparison to mineral soil tropical forest, it is difficult to regenerate and maintain peat-forest. It is extremely difficult to evaluate carbons stocks and carbon fluxes (balance between emissions and removals) in tropical peat land. It used to be difficult to get a quantitative understanding of carbon dioxide emissions from peat land due to wild fires and microbial decomposition, but the MRV (Monitoring, Reporting and Verification) system proposed in this Project is increasingly seen as the only possible means of accurately understanding carbon dioxide emission volumes.
Content of Preliminary Survey
Tropical peat research began in 1993 (this was the first time that water level meters and loggers were introduced) Research has been implemented continuously over several decades.
Motive and Introduction Process
Hokkaido was originally an area of peat land, so research was being implemented in this field. Later, it was found that the area of peat land in Indonesia is the third largest in the world, and there was an interest in knowing what was happening to its status.
Purpose of Project
To contribute to the prevention of global warming by constructing a system for integrated peat land management in tropical peat land in order to reduce the amount of carbon dioxide emissions from tropical peat.
Business Model
(Further expansion of research, not business) It is necessary to collect long-term data in order to refine the model. Also, training courses will be offered in this field for the capacity building of local researchers. A platform is to be developed in order to analyze various types of data. Commercialization will be required for the purpose of continuation. ・Basically, it is research, so the costs are covered by the budgets of government agencies. ・In the case that private companies become involved, incentives will be required. Example: Carbon evaluation using MRV

◆Information on Planning and Implementation

Total Project Cost (Yen)		
		0
	Implementation System	Initial Cost Burden
Client		–
JICA		0
Project Operator		

Specific Contents of ICT utilization
Peat land carbon balance will be evaluated by constructing a study/analysis and prediction model for CO2 balance using the MRV system by integrating the data studied and analyzed by each research group. In addition to sharing information on Web-GIS and evaluating carbon balance using the MRV system, support will be provided for the formulation of national and state programs for GHG reduction.
Implementation Schedule
(Research development schedule) Continuous use of MRV by means of IJREDD + outsourced project. Set up an international committee and standardize MRV regarding tropical peat.
Introduction Process
Integration with the old system is impossible, so a new system is to be opened in further developments. The system can be entirely completed in Indonesia, but it should be possible to perform data sharing.
Effect After Introduction
By designing and constructing an integrated peat land management system, the integrated MRV system is being considered as a system for carbon management by the Indonesian government, and it is receiving much attention internationally. The Central Kalimantan State was designated by the Indonesia government as the pilot region for REDD+, and the state government is cooperating with national universities in Kalimantan to conduct activities toward system implementation and application with continuous cooperation so that it becomes a model case of REDD+ for Southeast Asia. Also, it has been handed over to the Indonesian BPPT(Agency for the Assessment and Application of Technology)'s Climate Change Center for participation in the international Climate Change Center and Network organized by the United Nations Environment Program (UNEP), which has reached a level at which it has been proposed as an international operational model for integrated MRV systems. The model was established using such research, which was right on the mark for the 2015 Super El Nino.
Support System on local side (Funds, HR, Relaxation of Regulations, etc.)
Kalimantan State Government, Indonesian BPPT(Agency for the Assessment and Application of Technology), and 5 universities including Palangka Raya University

Gained Know-how
Knowledge Through Implementation
The main ministries and agencies in Indonesia have a vertical hierarchy, and it is both extremely important and difficult to have coordination between agencies. However, this project was very advantageous by offering a key concept and technology based on an integrated MRV system, and it was possible to show a clear direction by making several efforts including coordination between other ministries and agencies. By compiling each group's activities onto the integrated MRV system for REDD+, a new program has been demonstrated that has never before been recognized even in other countries.
Points to Consider (Remaining Issues, etc.)
Although management is provided by the Climate Change Center, it is necessary to work together on program reforms, for example. Continuous initiatives are required, such as program reinforcement (practice programs for expansion to other regions) to train staff in REDD+ management. Data not received for one week due to a power outage (it is important to the research that as much data as possible is compiled) It is necessary to increase the satellite sensing capacity even though the precision and volume of ground data collected has increased.

◆**Information on Operation and Maintenance**

Maintenance Cost (yen/year)
0
Handling Cyber Security
Implemented on the local server.
Issues after Introduction
Machinery theft prevention countermeasures are a serious issue.

◆**Relevant SDGs**

1 No Poverty		*10 Reduced Inequalities*	
2 Zero Hunger		11 Sustainable Cities and Communities	
3 Good Health and Well-Being for people		12 Responsible Consumption and Production	
4 Quality Education		13 Climate Change	○
5 Gender Equality		14 Life Below Water	
6 Clean Water and Sanitation		15 Life on Land	○
7 Affordable and Clean Energy		16 Peace, Justice and Strong Institutions	
8 Decent Work and Economic Growth		17 Partnerships for the Goals	
9 Industry, Innovation and Infrastructure			

Table 12 Cases of ICT utilization in JICA proposal-type projects

#	Project Name	Field	Area								Country	Scheme	Period		Key Technology										Company/Organization	System Summary	Remarks	Report Published Situation
			Southeast Asia	South Asia	East Asia	Central Asia	Africa	Europe	Oceania	Central America	South America			Adopted Year	Status	Mobile	Cloud	IoT	Big Data	UAV	Remote Sensing	Supercomputer	Solar Power	e-learning	Other				
1	Project for Ecological Studies on Flying Foxes and Their Involvement in Rabies-related and Other Viral Infectious Diseases	Health	○								Indonesia	SATREPS	2014	In progress					○						Nagoya University	Ecological Survey using drones (however, it is being conducted only as one method.)	Although there are needs in the healthcare sector, it is necessary to consider how to put this into use because a special device, a sequencer, is used.	Report available
2	Feasibility Study on Improvement of Maternal Health in Rural Areas in Central Myanmar by Using the Remote Medical Care System "eMitr"	Health	○								Myanmar	Feasibility Survey	2016	In progress											TRIART Co., Ltd.	Telemedicine system		Summary only
3	Feasibility Survey for "the Elderly Care System" Utilizing ICT towards the Improvement of Welfare, Healthcare in Thailand	Health	○								Thailand	Feasibility Survey	2016	In progress		○									Abis Co., Ltd.	Watching system (sensor, data analysis and reporting, for understanding and predicting care-receiver's movements)	Can lead to a solution of a regional issue, aging of the local society. https://www.aiys.co.jp/mimamori/jicatalstart/ It is a system successfully combining sensors and a cloud platform. It can be considered "Affordable" as a system that includes device, while it is necessary to consider whether the solution of needs related aging society and care-taking of elder people can be applied to other regions and countries or not. Additionally, an M2M IoT device has to be installed for each user.	Summary only
4	Pilot Survey for Disseminating SME's Technologies on Electrifying non-electrified rural villages by micro hydropower	Health	○								Vietnam	Pilot Survey	2012	Completed		○									Viswaemi ICT Co., Ltd.	Telemedical diagnosis system	Although it is a remote system, it has established on-premises servers and a data center and hence it is not "Affordable."	Report available
5	VERIFICATION SURVEY WITH THE PRIVATE SECTOR FOR DISSEMINATING JAPANESE TECHNOLOGIES FOR "REALIZING MEDICAL INFORMATION SYSTEM FOR QUALITY MEDICAL SERVICES IN VIET NAM"	Health	○								Vietnam	Pilot Survey	2016	Completed		○									Techno Project Japan Co.	Network system for regional medical information (collaboration for electronic patient case records, etc.)	It is an effort made by the largest software development company in Shimane Prefecture which has a record in supplying a system for electronic patient case recording to a number of clients in Japan. Although there was an impact of changes in the local legal system, the system has contributed to a reduction of operational burden of local health centers. In Vietnam, it seems that there is an issue about dissemination of the system due to local IT companies' participation in the market with dumping.	Report available
6	Verification Survey with the Private Sector for Disseminating Japanese Technologies for ICT Education Center to Improve Empowerment of Persons with Disabilities	Health	○								Vietnam	Pilot Survey	2016	Agreement not yet concluded											Nippon Telesoft Co., Ltd.	(Unknown)	The entry of the contract period is not made on the JICA website.	Unavailable
7	A Collaboration Project for the Development of ICT Telemedicine for Perinatal Care and Diabetes in Thailand	Health	○								Thailand	Community Revitalization	2013	Completed		○	○								Executive Committee for Telemedicine Support Project	Telemedicine system	Based on the positive record of lower perinatal mortality rates in Kagawa Prefecture, starting 2012, demonstration experiments had been in progress, by obtaining support from APT and the Ministry of Internal Affairs and Communications. The server was installed locally at the Chiang Mai University Hospital and a significant saving in operational expenses was achieved. It is used by healthcare personnel at regional hospitals. In developing countries, the perinatal mortality rate is remarkably high, which has been a major issue, and therefore, the system can be expected to apply to other regions. Indonesia has already started introducing the system independently.	Summary only
8	An approach to sharing radiological technology within a local south area of Vietnam by constructing a medical support network	Health	○								Vietnam	Partner	2010	In progress											Shiga Association of Radiological Technologists	e-learning system	It seems that a domestic e-learning system is used by mainly focusing on medical education. It is unknown whether an e-learning system was introduced in the target area or not.	Summary only
9	Collaboration Program with the Private Sector for Disseminating Japanese Technology for a System to Support Medication Compliance of Tuberculosis Patients	Health	○								Indonesia	Collaboration Program	2014	Agreement not yet concluded											Otsuka Pharmaceutical Co., Ltd.	Compliance support application (based on smartphones)	It is aiming at disseminating a smartphone application to promote the compliance rate but details are not known. It is considered there will be a certain level of ripple effect as compliance can give a positive influence on effectiveness of new drugs.	Summary only
10	Collaboration Program with the Private Sector for Disseminating Japanese Technology for a Radiation-related Digital System and Safety Management Technology	Health	○								Cambodia	Collaboration Program	2015	Agreement not yet concluded											Konica Minolta, Inc.	Digital image diagnosis	The entry of the contract period is not made on the JICA Website.	Summary only
11	Collaboration program with the private sector for disseminating Japanese technology for biometric individual identification for social security system in Kingdom of Cambodia	Health	○								Cambodia	Collaboration Program	2015	Agreement not yet concluded											Hitachi Ltd.	Identification of insured individuals based on their unique and specific factors using biometric authentication technology (finger vein information)	The entry of the contract period is not made on the JICA Website.	Unavailable
12	Collaboration Program with the Private Sector for Disseminating Japanese Technology for an Electronic Medical Information System	Health	○								Vietnam	Collaboration Program	2015	Agreement not yet concluded											NTT Data Co.	Electronic medical information system to centrally manage information on patients and treatment stored within the hospital	The entry of the contract period is not made on the JICA Website.	Unavailable
13	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Standardization of Information Networks of Medical Facilities	Health	○								Indonesia	Collaboration Program	2014	Agreement not yet concluded											Allied Telesis K.K.	Preparation of standard specifications for insurance information networks	Details are unknown and relevant information and press release cannot be found on the implementing company's website.	Unavailable
14	Collaboration program with the private sector for disseminating Japanese technology for SPD system in Vietnam	Health	○								Vietnam	Collaboration Program	2014	Agreement not yet concluded											Alfresa Medical Service Corporation	Central management of operations related to distribution of medical supplies	Detailed information on this project is not available and information cannot be found on the implementing company's website.	Unavailable

Table 13 Cases of ICT utilization in JICA proposal-type projects

#	Project Name	Field	Area								Country	Scheme	Period		Key Technology										Company/Organization	System Summary	Remarks	Report Published Situation
			Southeast Asia	South Asia	East Asia	Central Asia	Africa	Europe	Oceania	Central America	South America			Adopted Year	Status	Mobile	Cloud	IoT	Big Data	UAV	Remote Sensing	Supercomputer	Solar Power	e-learning	Other				
15	Collaboration Program with the Private Sector for Disseminating Japanese Technology for ISPEED Disaster Medical Mission Operating System in Philippines	Health	○								Philippines	Collaboration Program	2015	Agreement not yet concluded	○	○									TOKYO ELECTRONIC SYSTEMS CORPORATION	Simplified real-time reporting process using the medical relief activities reporting system (SPEED) and smartphones	The entry of the contract period is not made on the JICA Website	Unavailable
16	Development of an Infectious Diseases Early Warning System for Southern Africa incorporating Climate Predictions	Health					○				South Africa	SATREPS	2013	In progress							○				Nagasaki University	Early warning system concerning outbreak of infectious diseases based on climate predictions (provision of prediction information to administrative bodies)	It is an early warning system to effectively implement countermeasures against infectious diseases, for which a model to predict outbreaks of infectious diseases is developed by incorporating impacts of a range of environmental factors into a climate change prediction model	Report available
17	The Project for Development of Rapid Diagnostics and the Establishment of an Alert System for Outbreaks of Yellow Fever and Rift Valley Fever in Kenya	Health					○				Kenya	SATREPS	2011	In progress	○	○									Nagasaki University	Mobile SMS network	This project can be considered to offer practical benefits, when taking into account that not only research has been conducted but also technological transfer has been made. It is expected that a certain level of ripple effect will be made, for example, information on other infectious diseases can be obtained from the research. It has been contributing to solution of regional issues. The mechanism to control the expansion of yellow fever can be applied to other regions and fields.	Report available
18	Feasibility Survey concerning a Telemedical System for Maternal Healthcare	Health					○				South Africa	Feasibility Survey	2014	Completed										○	Mitta Corporation	Telemedical system	No description is made here because the technology is not publicly disclosed.	Report available
19	Feasibility Survey and Pilot Project for Disseminating SME's Technologies to Developing Countries	Health					○				Sudan	Pilot Survey	2012	Completed		○								○	AXIOHELIX Co. Ltd.	Telemedical system (DB server, ms identification and video conference system)	Although it is a good approach to have one vehicle that works as a clinic, it is extremely expensive as it requires a set of vehicle and medical equipment.	Report available
20	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Smartphone Application-based Anti-obesity Program	Health								○	Mexico	Collaboration Program	2015	Agreement not yet concluded	○										OMRON HEALTHCARE Co., Ltd.	Japanese-style anti-obesity program based on a combination of digital weight scale, pedometer and smartphone application	There is no detailed information on this project as well as relevant information cannot be found on the website of the company implementing the project.	Unavailable
21	Collaboration program with the private sector for disseminating Japanese technology for smart healthcare for preventing lifestyle diseases in Curitiba	Health								○	Brazil	Collaboration Program	2013	Completed		○	○								TANITA corporation	Chronological management of blood pressure and weight data	It is a health management system that uses a cloud platform to store data obtained with blood pressure gage and activity meter. R/W other than measurement devices is required. N/A	Report available
22	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Medical Collaboration using PACS-based Remote Image Diagnosis Technology	Health								○	Brazil	Collaboration Program	2014	Agreement not yet concluded										○	Fujifilm Corporation	Picture Achieving and Communication System (PACS) for medical use (digitalization and sharing of medical image data)	The entry of the contract period is not made on the JICA website.	Unavailable
23	Preparatory survey on BOP business for solar storage unit and solar lantern	Environment	○								Myanmar	BOP	2015	Agreement not yet concluded								○			Panasonic Corporation	Solar storage (mid price)/solar lantern (low price)	It is mainly concerning the verification of sales methods of commercial products for BOP business.	Summary only
24	Integrated study on Hydro-Meteorological Prediction and Adaptation to Climate Change in Thailand	Environment	○								Thailand	SATREPS	2008	Completed		○	○								Tokyo University	River basin data integration system (from collection of data to sharing of data on the server) and an early warning system	It is a dedicated system (for research and analysis) using a large-scale server. Observation sensors have also been developed independently.	Report available
25	Wild Fire and Carbon Management in Peat-forest in Indonesia	Environment	○								Indonesia	SATREPS	2008	Completed		○	○	○	○	○	○	○			Hokkaido University	Integrated system covering up from data collection/analysis to provision of warnings (including the development and prototyping of a UAV for data verification)	Knowledge obtained through this project has been not only used in JICA projects but also contributing to the development of new technologies for observation and data collection. It is expected that technologies and methods of SESAME system of Midori Engineering Laboratory Co., Ltd. can be introduced to other sectors. Currently, derived projects (#30 and #95) are in progress.	Report available
26	Project for Technology Development of Steam-spot Detection and Sustainable Resource Use for Large Enhancement of Geothermal Power Generation in Indonesia	Environment	○								Indonesia	SATREPS	2014	In progress			○				○				Kyoto University	Remote sensing-based detection of particular spots	It is mainly concerning research-based technological development and it has not been commercialized.	Report available
27	The Project for Development and implementation of New Damage Assessment Process in Agricultural Insurance as Adaptation to Climate Change for Food Security	Environment	○								Indonesia	SATREPS	2016	In progress						○	○				Chiba University	Monitoring system using remote sensing, etc.	-	Summary only
28	Research and Development for water reuse technology in tropical regions	Environment	○								Thailand	SATREPS	2008	Completed							○				Tokyo University	Simulation of sludge flow	It is a large-scale double-step anaerobic digestion system. Being research based, it has not been commercialized.	Report available
29	Climate Variability Study and Societal Application through Indonesia-Japan "Maritime Continent COE"- Radar-Buoy Network Optimization for Rainfall Prediction	Environment	○								Indonesia	SATREPS	2009	Completed							○				Japan Agency for Marine-Earth Science and Technology	Early prediction system and super computer	This project focuses mainly on analysis using the super computer and weather radars and it is research based.	
30	the Project on the Establishment of Real-time Telemetry System for Field Data related to Climate Change with the SESAME System	Environment	○								Indonesia	Feasibility Survey	2013	Completed		○	○								Midori Engineering Laboratory Co. Ltd.	Telemetry system to transmit measurement data to the center on a real-time basis	A verification survey for disseminating Japanese technologies (#95) is underway as a subsequent project.	Report available
31	Feasibility Survey for Introducing Simple Monitoring Kits and Data Management Service to Strengthen Capacity of Water Environmental Management	Environment	○								Vietnam	Feasibility Survey	2016	In progress		○	○								OPTEX Company, Limited	System for collecting water quality data (automatic aggregation of data which have been tested manually).		Summary only
32	Feasibility Survey for Water Supply Management Improvement through the introduction of Water Infrastructure Management System	Environment	○								Indonesia	Feasibility Survey	2015	Completed		○								○	Pipe Design, Inc.	Facilities ledger system	It is highly easy to introduce as a water facilities management system. However, cost and easiness of maintenance of water leak detecting device is unknown.	Report available
33	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Electricity Distribution Planning System	Environment	○								Vietnam	Collaboration Program	2015	Agreement not yet concluded		○									Tokyo Electric Power Company	System to support planning of electricity distribution system	For implementation of this project, the electricity distribution system has to be a Japanese-style system.	Summary only

Table 14 Cases of ICT utilization in JICA proposal-type projects

#	Project Name	Field	Area								Country	Scheme	Period		Key Technology										Company/Organization	System Summary	Remarks	Report Published Situation
			Southeast Asia	South Asia	East Asia	Central Asia	Africa	Oceania	Central America	South America			Adopted Year	Status	Mobile	Cloud	IoT	Big Data	UAV	Remote Sensing	Supercomputer	Solar Power	e-learning	Other				
34	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Training Program on Japanese Standard-based Electricity Distribution Technology	Environment	○								Myanmar	Collaboration Program	2014	Agreement not yet concluded											KINDEN CORPORATION	Technology and skill training system for electricity distribution engineering works	Detailed information on this project is not available and information cannot be found on the implementing company's website, too.	Unavailable
35	Smart Cities development for Emerging Countries by Multimodal Transport System based on Sensing, Network and Big Data Analysis of Regional transportation	Environment									Hanoi	SATREPS	2016	In progress											NAGOYA ELECTRIC WORKS CO.,LTD.	System to collect and analyze traffic volume big data using ICT and to provide optimum transportation means	-	Summary only
36	Preparatory survey on BOP business on rural electrification project using digital grid in Republic of Kenya	Environment					○				Kenya	BOP	2013	Completed	○							○		○	Digital Grid Solutions Inc.	Electricity control and monitoring system using web technology and being linked to existing mobile money system	LED lanterns, radios, and tablets, etc. are rented targeting at non-electrified areas using KIOSKs as the center and on a charged basis and renewable energy (solar energy) is used. Charge collection is made using existing mobile money. N/A	Report available
37	Visualization of Impact of Chronic/Latent Chemical Hazard and Geo-Ecological Remediation	Environment					○				Zambia	SATREPS	2015	In progress						○					Hokkaido University	Monitoring system using remote sensing, etc.	As the project is currently in progress, details of the system are not known during the ongoing research and analysis phase.	Report available
38	Prediction of Climate Variations and its Application in the Southern African Region	Environment					○				South Africa	SATREPS	2009	Completed							○				Japan Agency for Marine-Earth Science and Technology	Earth simulator	It is essential to make simulation using large-scale computer.	Report available
39	Research on the Integration System of Spatial Environment Analyses and Advanced Metal Recovery to Ensure Sustainable Resource Development	Environment						○			Serbia	SATREPS	2014	In progress											Akita University	Remote sensing	Although it is planned to introduce a special sensor, etc. for survey, the project is currently in progress and details are unknown.	Report available
40	Sustainable Management of Coral Reef and Island Ecosystems: Responding to the Threat of Climate Change	Environment							○		Palau	SATREPS	2012	In progress		○									Tsukuba University	Basic biology DB and gene DB	The project is currently in progress and it is in the phase of survey and data collection for developing DB.	Report available
41	Development of the Atmospheric Environmental Risk Management System in South America	Environment								○	Argentina	SATREPS	2012	In progress			○				○				Nagoya University	Real-time information management system that can quickly transmit information on atmospheric environment risk	It is a research program for installing special equipment such as aerosol LIDAR, etc.	Report available
42	Study on the Impact of Glacier Retreat on Water Resource Availability for the Cities of La Paz and El Alto	Environment								○	Bolivia	SATREPS	2009	Completed							○				Tohoku University	System to support water resources policy formulation (simulation)	Simulation is made to construct an evaluation model in research field and it is not a commercialized system.	Report available
43	Carbon Dynamics of Amazonian Forests	Environment								○	Brazil	SATREPS	2009	Completed						○					Forest and Forest Products Research Institute	Remote sensing technology and forest inventory system	It is a system in which a software independently developed by the research group and a GIS software are linked and it has not been commercialized.	Report available
44	The Support Project on the Model for the improvement of Water Quality at the local area in Londrina Parana, Brazil	Environment								○	Brazil	JPP (local government type)	2009	Completed						○					Hyogo Environmental Advancement Association	Although it is named as water quality monitoring system, the details are unknown.	Judged based on web-based information, etc.	Summary only
45	Preparatory Survey on BOP-Business for Audio-Visual Educational Materials, BOP-PS	Education	○								Indonesia	BOP	2016	Agreement not yet concluded								○			NHK educational corp.	Audio-visual educational materials for PS (highly probable that it is not based on e-learning)	The entry of the contract period has not been made on the JICA website.	Summary only
46	Feasibility Survey with the Private Sector for Utilizing Japanese Technologies in ODA Projects Vietnam, Active Learning System for Establishing of Practical "5S/KAIZEN" Skills	Education	○								Vietnam	Feasibility Survey	2015	Completed								○			Zefit Lins Inc.	e-learning system	Only summary is available and detailed situation is unknown.	Report available
47	Feasibility Survey for the improvements of students' Math performance using the hybrid learning material(Smart Lecture)	Education	○								Philippines	Feasibility Survey	2016	In progress								○			Shimashoppansha Kenkyusho Co. Ltd.	e-learning system (video classic explanation via smartphone is provided through reading of barcodes printed on the paper materials)	-	Summary only
48	Feasibility Study for VAT collection and management system	Education	○								Myanmar	Feasibility Survey	2012	Completed											BMC International Corporation	VAT collection management system	Although the field of VAT is considered as "Applicable," it does not mean "Affordable" due to construction on-premises data server.	Report available
49	Saitama Active Learning Promotion Project	Education	○								Philippines	Community Revitalization	2016	In progress								○			Saitama Prefectural Board of Education	learning by utilizing ICT		Summary only
50	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Strengthening of Children's Mathematical Ability by e-Learning Through University-Industry Collaboration	Education	○								Indonesia	Collaboration Program	2014	In progress	○							○			SuRaLa Net Co., Ltd.	e-learning (interactive animation device)	Education system using gamification. Since February 2018, it has been used at class of the Indonesia Education University Elementary School. It is expected that school children's future possibility can be expanded thanks to such improvement in academic achievement. It can be effective in other areas than this, for example, it can solve issues related to active employment of women.	Summary only
51	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Education Programs in Academic-Industrial Collaboration mainly centering on an e-learning System for the Development of Design Engineers	Education	○								Thailand	Pilot Survey	2014	Agreement not yet concluded								○			LeFox	(Unknown)	The entry of the contract period is not made on the JICA website.	Unavailable
52	Verification Survey with the Private Sector for Disseminating Japanese Technologies for a Robot Manufacturing System based on Saigon Hi-tech Park Training Center	Education	○								Vietnam	Pilot Survey	2015	In progress								○	○		Toyooka Co., Ltd.	Automation practice system	In February 2017, training facilities for factory automation were established within the Saigon Hi-Tech Park (SHTP). Utilization of ICT in education is limited.	Summary only
53	Preparatory survey for BOP business on improvement of basic education utilizing multimedia device and contents in India	Education		○							India	BOP	2012	Completed								○			Ricoh Co., Ltd.	e-learning system	Contributed to the solution of an issue related to improvement in the quality of education. It can be used for potential demands (responding to disasters and other emergencies) using recyclable batteries. Contributed to a promotion of autonomous learning and sustainable education in the recipient country. It is a system not on a cloud platform but using direct display by using a projector and a USB flash memory.	Report available
54	Preparatory survey on BOP business to improve children's educational achievement by e-learning in Sri Lanka	Education		○							Sri Lanka	BOP	2013	Completed								○			SuRaLa Net Co., Ltd.,	e-learning system	Students and parents highly evaluate the system as it helps students to master mathematical skills and use of computer as well as to learn Japanese-style "discipline." It is also expected to be applied to other countries and improve teachers' abilities. In addition, it can be a good business model to draw upon as it has already been commercially used in other countries. The same system has been introduced also in Indonesia (#50).	Report available

Table 15 Cases of ICT utilization in JICA proposal-type projects

#	Project Name	Field	Area								Country	Scheme	Period		Key Technology										Company/Organization	System Summary	Remarks	Report Published Situation
			Southeast Asia	South Asia	West Asia	Central Asia	Africa	Europe	Central America	South America			Adopted Year	Status	Mobile	Cloud	IoT	Big Data	UAV	Remote Sensing	Supercomputer	Solar Power	e-learning	Other				
55	Preparatory survey on BOP business on e-learning business for secondary education and vocational education in Bangladesh	Education		○							Bangladesh	BOP	2014	Agreement not yet concluded									○		NetLearning, Inc.	e-learning system	Detailed information on this project is not available nor information on the implementing company's website, too.	Summary only
58	Feasibility Survey for the use of e-learning system, compatible with poor communication environment, for the courses of the Information Technology Engineer Examination (ITEE)	Education		○							Bangladesh	Pilot Survey	2015	In progress									○		KJS Company LTD.	Video content production software	It is an education system for information processing engineer examination in the recipient country, while the fundamental part of this project is continuing in the form of a feasibility survey in Kenya (#61).	Summary only
57	Sustainable use of ICT for improving the quality of primary education in rural Mongolia	Education			○						Mongolia	Partner	2011	In progress									○		Tokyo Institute of Technology	Digital training material for teachers	Project was carried out from March 9 of FY2012 to March 8 of FY2017. Details are unknown.	Summary only
58	Feasibility Survey for Introduction of Learning Management System (LMS) to Improve Implementation Abilities of Government Officers	Education				○					Kyrgyz	Feasibility Survey	2015	Completed		○							○		Digital Knowledge Co., Ltd.	e-learning system (cloud-based)	It is expected to have practical benefit in improving tax collection rate and tax-office clerks' capability.	Summary only
59	Survey for Possible Application of Japanese Industrial Automation Technology	Education				○					Kazakhstan	Feasibility Survey	2012	Completed									○		SHINKO ENGINEERING RESEARCH CORP.	Equipment for mechatronics technology training	A verification survey for disseminating Japanese technologies (#60) is underway as a subsequent project.	Report available
60	Pilot Survey for Disseminating SME's Technologies for Technical Education System for Industrial Automation Technology	Education				○					Kazakhstan	Pilot Survey	2012	Completed									○		SHINKO ENGINEERING RESEARCH CORP.	Equipment for mechatronics technology training	It is training on machine manufacturing and use of ICT is limited.	Report available
61	Project Formulation Survey for Introduction of an e-learning System for Improvement of Quality of Education	Education					○				Kenya	Feasibility Survey	2016	Agreement not yet concluded									○		KJS Company LTD.	e-learning system	The entry of the contract period is not made on the JICA website.	Press Release only
62	Feasibility Survey for Utilization of ICT to Improve the Quality of Primary Mathematics Education in Rwanda	Education					○				Rwanda	Feasibility Survey	2015	In progress		○							○		SAKURA-SHA K.K.	Education software	E-learning contents developed based on excellent instruction methods of Japan are introduced at schools in Rwanda using 100-dollar personal computers that are widely used and it has shown a strong positive effect on improvement of education. It is decided that full support can be obtained from the Ministry of Education and dissemination and verification of this technology can be expected. In addition, considering that Rwanda makes efforts for IT-based national development, the company puts establishment of local agents and sales to neighboring countries in perspective and plans to develop business under a concept, "Made in Rwanda with Japan."	Summary only
63	Feasibility Survey for the Improvement of Vientiane Capital State Bus Enterprise Infrastructure in Lao PDR	Transportation	○								Lao	Feasibility Survey	2014	Completed		○	○	○							EAGLE BUS CO.,LTD.	GPS system (bus location) + infrared ray-based rise and drop counter (the number of users)	To be continued in the verification survey for disseminating Japanese technologies (#66). Evaluation will be made in the SRE survey.	Report available
64	Verification Survey with the Private Sector for Disseminating Japanese Technologies for New Location Information System and Traffic Observation System for Urban Transport Improvement in Vientiane City	Transportation	○								Lao	Pilot Survey	2014	Completed	○	○	○	○							Japan Research Institute for Social Systems	Smartphone GPS bus location system and Wi-Fi packet traffic observation system	Link with the verification survey for disseminating Japanese technologies (#66). N/A	Report available
65	Pilot Survey for Disseminating Small and Medium Enterprises Technologies for Improvement of Traffic Environment in Yangon City by Implementing Traffic Signals	Transportation	○								Myanmar	Pilot Survey	2013	Completed		○	○	○							Wako Industries Co., Ltd.	Traffic monitoring system (central facilities, traffic lights, traffic volume counters, etc.)	Installation of traffic lights. Further development is being conducted with local fund (the Japanese company was forced to give up due to cost mismatch).	Report available
66	Verification Survey with the Private Sector for Disseminating Japanese Technologies for bus improvement system	Transportation	○								Lao	Pilot Survey	2015	In progress		○	○	○							EAGLE BUS CO.,LTD.	GPS system (bus location) + infrared ray-based rise and drop counter (the number of users)	It is a project continuing from a feasibility survey (#63). By utilizing ICT, it successfully visualizes ongoing bus operation and promotes understanding of needs to improve bus business. Collaboration is also made with a request-based technical cooperation project, and it is expected to be a good example of collaboration between a proposal-type project and a request-type projects for other regions to draw on.	summary only
67	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Vehicle Detecting by Weigh in Motion System	Transportation	○								Vietnam	Pilot Survey	2013	In progress											Tanaka Scale Works Co., Ltd.	System linking a weight sensor and camera recognition	Overloading vehicles are an issue common in countries around the world and although WIM systems are sold by many companies, most of those systems are expensive. For Vietnam, the issue is compliance with national technical standards called QCVN.	Summary only
68	Collaboration Program with the Private Sector for Disseminating Japanese Maintenance/Management Technology for a Traffic Control System to Mitigate Traffic Congestion in Bangkok	Transportation	○								Thailand	Collaboration Program	2013	Agreement not yet concluded		○	○	○						○	Sumitomo Electric Industries, Ltd.	Traffic control system (sensor, controlling, traffic lights, etc.)	Judged based on web-based information, etc.	Unavailable
69	Program for Ho Chi Minh City Public Transport Bus ICT System in Vietnam	Transportation	○								Vietnam	Collaboration Program	2014	Completed		○	○	○						○	NEC Corporation	Bus IT (GPS, IC cards and development of operation plans)	The entry of the contract period is not made on the JICA website.	Report available
70	collaboration program with the private sector for disseminating Japanese technology for traffic flow simulation technology and other ITS technologies for road planning in Yangon	Transportation	○								Myanmar	Collaboration Program	2013	Completed		○	○	○							Hitachi Ltd.	Probe information processing system and video traffic counter and simulation	Although it is an analytical system using probe data, it contains expensive systems such as a probe information processing system and a traffic flow simulator.	Report available
71	Feasibility Survey for The Article Tracking System utilizing the information of mobile phone base stations	Transportation		○							India	Feasibility Survey	2014	Completed										○	Genesis Inc.	Freight tracking system (based on mobile phone SMS)	It is expected to have a certain level of effect on freight tracking-based solution of issues of delayed deliveries and on identification of delays in train operation, road congestion, etc. Although efforts for commercialization were made and local needs were identified, there are a number of technology-related issues which make it difficult to commercialize.	Report available
72	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Intelligent Transport Solutions (ITS) in major cities in Gujarat Province	Transportation		○							India	Pilot Survey	2013	Completed	○	○	○								ZERO-SUM, LTD.	System for information on traffic congestion using mobile communications tools and cloud platform	Although it is necessary to identify a long-term effect in terms of response to traffic-related issues, it can be highly evaluated as it constructed a business model having a mechanism to raise money for maintenance by combining publicity with marketing, an important issue in developing countries. In addition, it has a number of factors for other cases to refer, as the business was successful based on deep understanding of the local legal system and commercial practices.	Report available

Table 16 Cases of ICT utilization in JICA proposal-type projects

#	Project Name	Field	Area								Country	Scheme	Period		Key Technology										Company/Organization	System Summary	Remarks	Report Published Situation
			Southeast Asia	South Asia	East Asia	Central Asia	Africa	Europe	Oceania	Central America	South America			Adopted Year	Status	Mobile	Cloud	IoT	Big Data	UAV	Remote Sensing	Supercomputer	Solar Power	e-learning	Other				
73	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Transportation Information System and Public Transport Planning	Transportation		○								India	Collaboration Program	2016	Agreement not yet concluded				○							Hitachi Ltd.	Probe processing technology	The entry of the contract period is not made on the JICA website.	Unavailable
74	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Use of Drones in the Logistics Industry	Transportation					○					Zambia	Collaboration Program	2015	Agreement not yet concluded					○						Aerosense Inc.	Supply of goods using drones	As the business started only very recently, detailed information is not available.	Summary only
75	Feasibility Survey for Next-Generation Drip Fertigation System with ICT Technology in the Da Lat Plateau	Agriculture	○									Vietnam	Feasibility Survey	2015	Agreement not yet concluded		○	○								Rucknik Networks Inc.	Optimum culture fluid will be automatically supplied by analyzing sensor-measured data on the cloud-based server.	By visualizing soil conditions using ICT and being based on experiences, guesswork and past records and by automating the most effective supply of culture fluid, crops' quality and yields are improved. Needs for Japan's high quality vegetables are increasing as Japanese retail stores are increasingly opening in the country. Although the combined use of ICT and agriculture has just started also in Japan, this business model based on Japan's excellent farming technology is expected to be introduced in a range of countries.	Press Release only
76	The Study for Introduction of IT for Agricultural Product Distribution	Agriculture	○									Philippines	Feasibility Survey	2012	Completed		○									E-supportlink, Ltd	IT-based distribution system for agricultural products	A verification survey for disseminating Japanese technologies (#78) is underway as a subsequent project. To be evaluated in #78	Report available
77	Feasibility Survey for Increasing Smallholder Farmers' Income through Improving Agricultural Supply Chain System of Valued Added Products toward Consumers in Jakarta Areas	Agriculture	○									Indonesia	Feasibility Survey	2016	Agreement not yet concluded		○									E-supportlink, Ltd	IT-based agricultural products distribution system	The entry of the contract period is not made on the JICA website.	Press Release only
78	Pilot Survey for Disseminating Japanese SME s Technologies for Introduction of IT for Agricultural Products Distribution	Agriculture	○									Philippines	Pilot Survey	2013	Completed		○		○							E-supportlink, Ltd	IT-based agricultural products distribution system	It has been confirmed that farming has been improving through introduction of cultivation record management and a distribution management system. In addition, it seems possible that obtained predictions on planting and harvesting can be utilized in microfinancing (mortgage) or in collaboration, etc. with fertilizer manufacturers. Although there is an operational issue (proper entry of information, etc.), it is found that data obtained through a mechanism that can practically support farming and distribution are valuable not only to farmers but also to other stakeholders and a business model is proposed. A project has been implemented in Indonesia (feasibility survey of #76) as a subsequent project of this project.	Report available
79	Verification Survey with the Private Sector for Disseminating Japanese Technologies for a Human Resources Development Model for Advanced Greenhouse Horticulture and Agriculture	Agriculture	○									Vietnam	Pilot Survey	2015	In progress		○	○								Saitec Bow Katsuhiki Kaisha	Integrated environment controlling-type greenhouse cultivation system	It not only supports agriculture using ICT such as BLE beacons and Wi-Fi but also supports human resources development. N/A	Summary only
80	collaboration program with the private sector for disseminating Japanese technology for synthesized sensing technologies for enhancing the agricultural productivity	Agriculture	○									Indonesia	Collaboration Program	2013	Completed		○	○			○					NEC Corporation	Remote sensing (confirmation of meteorological environment, cultivation methods and correlation of growth)	Large-scale installation work for meteorological observation devices	Report available
81	Feasibility Survey on Establishment of Paddy Field Information Management System for Improving Agriculture Productivity and Enhancing Food Safety	Agriculture		○								Sri Lanka	Feasibility Survey	2016	In progress						○					VistaTerra Inc.	(Details are unknown) ICT-based wet rice-farming support system (monitoring, analysis and support)		Press Release only
82	Creation of the new industry by IT agricultural innovation	Agriculture		○								Maldives	Community Revitalization	2015	Completed			○								UENO ENGEI Inc.	Remote guidance by utilizing IT	Sharing of cultivation information and offering of guidance using website. Although it is an easy process in terms of ICT, how the operation is being made is not known. N/A	Summary only
83	Income generation project for farmers at the BOP by using ICT	Agriculture		○								Bangladesh	Partner	2009	Completed	○	○									Kyusyu University	Agriculture information system	Making the local telecenter as the operational base, an agriculture support system is constructed using a web system and mobile phones. It has a mechanism to support not only cultivation but also sales. N/A	Report available
84	Support to establish a new society of BOP farmers by using the power of ICT	Agriculture		○								Bangladesh	Partner	2014	In progress	○	○									Kyusyu University	Agricultural production and distribution support platform	Detailed information on this project is not available and information cannot be found on the company's website, too	Summary only
85	Verification Survey of making distribution of agri. Products in W. Bengal in India efficient by utilizing technologies of small solar powered & self charging temperature controlled warehouses	Agriculture		○								India	Pilot Survey	2016	In progress									○		Kawasaki Kisen Transportation Co., Ltd.	(Unknown)	The entry of the contract period is not made on the JICA website.	Unavailable
86	privatized technology promotional business for the social and economic development of developing countries smart agriculture (livestock & greenhouse horticulture) promotional business utilizing ICT	Agriculture						○				Turkey	Collaboration Program	2013	Completed		○	○	○							FUJITSU KYUSHU SYSTEMS LIMITED	Compound environment control system for greenhouse horticulture and plant factory	It is a system to develop production plans by measuring cow gists and transmitting the data to the cloud. Monthly fee is approximately 120 Yen per cow. N/A	Report available
87	Development of Extreme Weather Monitoring and Information Sharing System in the Philippines	Disaster	○									Philippines	SATREPS	2016	In progress		○	○			○					Hokkaido University	Monitoring and warning system		Summary only
88	Research and Development for Reducing Geo-Hazard Damage in Malaysia Caused by Landslide and Flood	Disaster	○									Malaysia	SATREPS	2010	Completed		○				○	○				Tokyo University	Early alert and warning system based on data obtained from satellites, etc. (also including UAV-based data monitoring)	It includes the development of a data center and it is expected to be a large-scale research-based DC.	Report available
89	Integrated Study on Mitigation of Multimodal disasters caused by Ejection of Volcanic Products	Disaster	○									Indonesia	SATREPS	2013	In progress			○			○					Kyoto University	Monitoring, simulator and warning system	It is concerning the installment of a volcano observation station (specialized sensor) and it can only be applied to countries that have volcanoes.	Report available
90	Development of Landslide Risk Assessment Technology along Transport Arteries in Viet Nam	Disaster	○									Vietnam	SATREPS	2011	In progress										○	International Consortium on Landslides	Simulation using measurements of landslides and early warning system.	The content of this project is mainly testing that uses soil quality testers and the project's utilization of ICT is limited.	Report available
91	Feasibility Survey for the Community Disaster Management by Immediate Earthquake Alarm that utilizes Sensor Network	Disaster	○									Indonesia	Feasibility Survey	2015	Completed			○								Challenge Co., Ltd.	Networking of seismometers (early warning system)	It is early-warning device with a built-in seismometer and it can be applied only in countries where earthquake occurs.	Report available

Table 17 Cases of ICT utilization in JICA proposal-type projects

#	Project Name	Field	Area									Country	Scheme	Period		Key Technology										Company/Organization	System Summary	Remarks	Report Published Situation
			Southeast Asia	South Asia	East Asia	Central Asia	Asia	Oceania	Europe	Central America	South America			Adopted Year	Status	Mobile	Cloud	IoT	Big Data	UAV	Remote Sensing	Supercomputer	Solar Power	e-learning	Other				
92	A Simple and Community Friendly Independent Floods Observation System for the Laguna Lake District and National Capital Region in the Republic of Philippines	Disaster	○									Philippines	Community Revitalization	2013	Completed		○	○								ETRUST Corporation	Wireless disaster prevention device with a built-in simplified river-monitoring camera and a website for disaster prevention data	Activities have been undertaken to raise local people's awareness of disaster prevention as well as conducting river monitoring utilizing ICT.	Summary only
93	Enhancing abilities of community-based disaster management of several villages around Merapi Volcano in Central Java	Disaster	○									Indonesia	Partner	2011	Completed		○								○	Community Radio FM YY	ICT workshops, website operation and village information DB	It was implemented with an aim at raising local people's awareness of disaster prevention. Use of ICT is limited.	Summary only
94	Verification survey with the private sector for disseminating Japanese technologies for integrated geographic information system (Integrated GIS) for improvement of regional disaster risk reduction and management	Disaster	○									Philippines	Pilot Survey	2014	In progress		○									Informatix Inc.	Cloud-based, integrated GIS (integrated management of information by sharing the cloud between central and local governments)	The cost of GIS itself is expensive and it is not easy to collect data and implement and operate the system	Summary only
95	Project Formulation Survey for dissemination of the Real-time Monitoring System using a mobile communication network	Disaster	○									Indonesia	Pilot Survey	2014	In progress		○	○	○		○		○			Midori Engineering Laboratory Co., Ltd.	Telemetry system to transmit data to the center on a real-time basis	It is a system developed on the precondition that it will be used in areas where power sources are not available easily, and the system scalability is also high. SESAME system of Midori Engineering Laboratory is the technology and method used in the carbon management system of #25 and it has also been applied in other sectors.	Summary only
96	Collaboration program with the private sector for disseminating Japanese technology for sustainable disaster-prevention with ICT	Disaster	○									Vietnam	Collaboration Program	2013	Completed		○									Hitachi Ltd.	Flood simulation system	It was judged as an expensive flood simulation system based on the descriptions made in the report.	Report available
97	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Forest Fire Monitoring and Instant Response System	Disaster	○									Indonesia	Collaboration Program	2015	Agreement not yet concluded			○			○					NEC Corporation	Forest fire monitoring and immediate support system	The entry of the contract period is not made on the JICA Website.	Unavailable
98	Information Network for Natural Disaster Mitigation and Recovery in India	Disaster		○								India	SATREPS	2009	Completed	○	○									Keio University	Observation data collection, meteorological observation platform and information sharing platform such as survivor information	The concept of the communications system platform has already been commercialized and the Ministry of Internal Affairs and Communications has already made a survey (the project ended as it did not match India's needs). A demonstration experiment is currently in progress using related products from other manufacturers.	Report available
99	Study on GLOFs (Glacial Lake Outburst Floods) in the Bhutan Himalayas	Disaster		○								Bhutan	SATREPS	2008	Completed						○					Nagoya University	Early warning system is developed based on the flow simulation process using satellite data.	It is concerning satellite image analysis using geophysical exploration device and it has not been commercialized because it is developed independently.	Report available
100	Research Project on Disaster Prevention/Mitigation Measures against Floods and Storm Surges in Bangladesh	Disaster		○								Bangladesh	SATREPS	2013	In progress							○				Kyoto University	Simulation	It is planned to make research and development of an evacuation forecast and warning system but details are unknown.	Report available
101	Preparatory Survey on Flood Observation System with Solar Power and Smart Phone Contributing to Improved Water Disaster Management	Disaster		○								Bangladesh	Feasibility Survey	2013	Completed		○						○		○	ETRUST Corporation	River monitoring camera system	It is expected that it will obtain understanding, etc. of local residents as a disaster prevention system and it is expected to have a wide-range ripple effect. A review is also made about the possibility not to sell the system but rent.	Report available
102	Community Initiatives for disaster risk reduction	Disaster		○								Nepal	Partner	2011	Completed										○	Shapla Neer = Citizens' Committee in Japan for Overseas Support	Infrastructure maintenance system	It is a subsequent project of # 118.	Summary only
103	Verification Survey with the Private Sector for Disseminating Japanese Technologies for a Landslide Remote Monitoring System	Disaster		○								Sri Lanka	Pilot Survey	2016	In progress			○								OSASI Technos Inc.	Monitoring system	-	Unavailable
104	Project on Risk Identification and Land-Use Planning for Disaster Mitigation of Landslides and Floods in Croatia	Disaster					○					Croatia	SATREPS	2008	Completed		○	○	○							Niigata University	Movement observation system using ground-level sensors and GPS and meteorological radars (pluviometry)	It is research-based simulation using prototype testing machine and it has not been commercialized.	Report available
105	Project for Enhancement of Earthquake and Tsunami Disaster Mitigation Technology in Peru	Disaster						○				Peru	SATREPS	2009	Completed										○	Chiba University	Tsunami simulation and GIS	It is simulation for research specialized on earthquakes and, therefore, the scope is limited.	Report available
106	Research Project on Enhancement of Technology to Develop Tsunami-resilient Community	Disaster							○			Chile	SATREPS	2011	Completed										○	Port and Airport Research Institute	Damage DB and Tsunami simulation	It is concerning the development of a prototype system and has not been commercialized.	Report available
107	Feasibility survey for disaster recovery supported by the Eye-Dragon, a set-top-box ensuring access to TV broadcasting for persons with auditory and/or visual impairments	Disaster									○	Ecuador	Feasibility Survey	2016	Agreement not yet concluded										○	ASTEM Inc.	Eye-Dragon (a system offering access to general broadcast through subtitles and sign language)	-	Unavailable
108	Project for a sustainable Water Supply Control and Non-Revenue Water (NRW) Management system using SCADA	Infrastructure	○									Malaysia	Community Revitalization	2016	In progress										○	TSS Tokyo Water Co., Ltd.	SCADA	-	Unavailable
109	The Installation of Medical Radio Network for Kandahar Region	Infrastructure		○								Afghanistan	Partner	2003	Completed										○	BHN	Development of medical radio network	Preparation of radio sets and guidance for operation	Report available
110	The Installation of Medical Radio Network for Balkh Province	Infrastructure		○								Afghanistan	Partner	2007	Completed										○	BHN	Development of medical radio network	Preparation of radio sets and guidance for operation	Summary only
111	Integrated Coastal Ecosystem Conservation and Adaptive Management under Local and Global Environmental Impacts	Other	○									Philippines	SATREPS	2009	Completed		○	○								Tokyo Institute of Technology	Data logger sensor (existing product equipped with a recorder) and decision-making support system (network sharing-type DB)	It is an independently developed system and has not been commercialized.	Report available
112	Optimizing Mariculture based on Big Data with Decision Support System	Other	○									Indonesia	SATREPS	2016	In progress				○							Future University Hakodate	Support of mariculture (sea-water aquaculture business) using ICT	-	Summary only
113	Education and training of Myanmar personnel for the realization of phyto-diversity conversation and sustainable use of plant resources	Other	○									Myanmar	Partner	2006	Completed			○								Makino Botanical Garden	Construction of plant resources DB	In terms of use of ICT, GPS is utilized for surveying distribution of useful plants and DBs are developed, while system development has not progressed enough to make the DBs disseminated to other regions and countries.	Report available
114	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Vessel Mounted 24-Hours Operational Camera Surveillance System for Reinforcement of Maritime Security	Other	○									Malaysia	Pilot Survey	2013	Completed										○	KSK Corporation	Surveillance cameras (infrared cameras) to be installed on vessels	Internationally infrared cameras can be under some restrictions and some countries impose a ban on imports of infrared cameras.	Report available
115	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Bridge Maintenance Methods using a Crack Measuring System	Other	○									Thailand	Pilot Survey	2014	In progress										○	KUMONOS Corporation	Light measurement device linked to CAD data	In September 2016, the project was launched and it is planned to be completed in February 2018.	Summary only

Table 18 Cases of ICT utilization in JICA proposal-type projects

#	Project Name	Field	Area								Country	Scheme	Period		Key Technology										Company/Organization	System Summary	Remarks	Report Published Situation
			Southeast Asia	South Asia	East Asia	Central Asia	Africa	Europe	Oceania	Central America	South America			Adopted Year	Status	Mobile	Cloud	IoT	Big Data	UAV	Remote Sensing	Supercomputer	Solar Power	e-learning	Other				
116	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Electronically Recorded Monetary Claim Service	Other	○								Thailand	Collaboration Program	2015	Agreement not yet concluded										○	The Bank of Tokyo-Mitsubishi UFJ, Ltd	Improvement of efficiency in payment transactions (Japanese-type electronically recorded monetary claims)	The entry of the contract period is not made on the JICA Website.	Unavailable
117	Preparatory survey on BOP business on the "smart village" in India	Other		○							India	BOP	2011	Completed										○	NEC Corporation	Remote monitoring system	Greenhouse cultivation system using ICT. The initial investment is 7.7 million INR and operation costs are 2.1 million INR. N/A	Report available
118	Disaster Preparedness and Sustainable Livelihood Development Project	Other		○							Nepal	Partner	2007	Completed										○	Shapla Neer = Citizens' Committee in Japan for Overseas Support	Simplified early disaster warning system	Details of the simplified early disaster warning system are unknown and the project #102 is continuing based on the knowledge obtain in this project.	Summary only
119	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Digital Terrestrial TV Broadcasting System	Other		○							Sri Lanka	Pilot Survey	2016	In progress										○	TOSSLEC Co., Ltd.	Digital terrestrial broadcasting	-	Unavailable
120	Preparatory survey for BOP business on finance and information infrastructure using E-Money technology in Mozambique	Other					○				Mozambique	BOP	2014	Agreement not yet concluded		○								○	NEC Corporation	Electronic money system	Starting from the use and dissemination of biofuel for the local BOP level, an electronic money system was introduced at KIOSKs, which act as the local centers. At present, the project is in progress in collaboration with FOA projects and aiming at obtaining the banking license. KIOSKs are also used as centers for communicating information using ICT. N/A	Summary only
121	Feasibility Survey for Advanced Road Asset Management by Japanese Mobile Mapping System and Technology in Mozambique	Other					○				Mozambique	Feasibility Survey	2016	In progress				○							Iwane laboratories, Ltd.	System that enables measuring and grasping of location information and 3-dimensional space obtained through image processing on the computer	-	Summary only
122	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Resident ID Registration POC in Osun state	Other					○				Nigeria	Collaboration Program	2013	Agreement not yet concluded											NEC Corporation	Issuance of resident ID based on a scheme of "one registration for one resident" by using an automatic fingerprint recognition system	Detailed information on this project is not available and information is not posted on the implementing company's website, too.	Unavailable
123	Collaboration Program with the Private Sector for Disseminating Japanese Technology for Space Development and Utilization Infrastructure	Other								○	Mexico	Collaboration Program	2014	Agreement not yet concluded				○		○					NEC Corporation	Total solution including both satellites and IT	The entry of the contract period is not made on the JICA website.	Summary only

Note

Feasibility surveys in FY2013 and earlier were implemented as projects under supervision of the Ministry of Foreign Affairs (reports, etc. are published on JICA website).

4.2 Field studies for JICA proposal-type projects

As shown in the preceding section, field studies were conducted for three Projects that were still ongoing as of August 2017 and for which cooperation was obtained through these interview surveys.

As for field studies, in order to promote the application of ICT utilization in request-type Projects, field studies were conducted for the three Projects across two countries that will be useful as a reference for model ICT use in developing countries. The team visited the locations where ICT was utilized and monitored the state of use, and they also held interviews with relevant parties in order to clarify the matters stated below.

① Measures to improve the ability to resolve challenges for the use of ICT
② Measures to eliminate bottlenecks to operations and maintenance and management
③ Evaluation of the project locally (among counterparts, etc.)

Table 19 List of visits to the sites

No.	Country	Project name
1	Philippines	Pilot Survey for Disseminating Japanese SME's Technologies for Introduction of IT for Agricultural Products Distribution
2	Indonesia	Verification Survey with the Private Sector for Disseminating Japanese Technologies for Strengthening of Children's Mathematical Ability by e-Learning Through University-Industry Collaboration
3		Verification Survey with the Private Sector for Disseminating Japanese Technologies for Efficient Management of the Multi-purpose Dam and Data Collection for the Climate Change with Real-Time Telemetry System (SESAME system)

4.2.1 Result of field study in the Philippines

In the field study conducted in the Philippines, a visit was made to the target agency, the Sentrong Pamilihan Market (Sariaya, Quezon State), and interviews were held with relevant parties in addition to grasping the state of use. Interviews were also conducted with representatives from the related Ministry of Agriculture.

Table 20 List of visits to the Philippines

Local schedule	Location	Party visited
August 21-25, 2017	Sentrong Pamilihan Market	Mr. Cena
		3 buyers
	Ministry of Agriculture	Mr. Sato, JICA specialist
		Mr. Edmar Fajutagana (Director)

(1) Sentrong Pamilihan Market

This is a market in Sariaya in Quezon State located in the south of Luzon island. There are two types of contract farmers in the market – members (approximately 1,000 registered members who

are small-scale farmers) and non-members (large-scale farmers rent locations in the market). All kinds of vegetables are sold at this market (150 tons/day). This market is characterized by the combined sale of items by the market for small-scale producers for whom sales are difficult, much like a public market. They are striving to make sale prices transparent by uploading market prices to Facebook daily and other procedures.

The buyers that use this market purchase in bulk (500kg to 5t/day), and the items purchased are mostly transported and sold in the Manila metropolitan area. There is a highway (SLEX-STAR) for transport to the Manila metropolitan area that runs to Batangas, and the buyers tend to procure vegetables in this area since there are many farmers and vegetables can be purchased at a lower cost than in the city.

Sentrong Pamilihan Market

Market area for small-scale farmers

Market price list

Interview with market managers and buyers

Figure 8 Survey at the Sentrong Pamilihan Market

Source: Study Team

(2) System introduced to the market and its evaluation

Farmers were not well aware of the market prices and they were unsure about whether the buyers were knocking the prices down to an unfair level. For the wholesale market, there was no awareness of current inventories and many of the needs of buyers could not be met. In the case that the wholesale price changes due to stock and demand, it was difficult to notify the marketers and cashiers in the market, so the introduction of a transaction management system was promoted.

However, for the buyers, it was possible that purchases would be made at higher prices, and at first there were concerns about the introduction of the system. But after introducing the system, the market price became clear, and there was no need to spend time negotiation with farmers. The inventory for each product could be understood in real-time, so there was no longer any need to visit individual farmers to procure items. It also became possible to trace the products to find which farms produce high quality goods, so the system was rated highly by the buyers after its introduction.

Also, for the farmers, while there are many cases in which sales are made collectively in a

wholesale market rather than making direct individual sales, sales can now be made at a suitable price in correlation with the market price. Production capacity can now be visualized based on the records of transactions, which can also be used to consider funding from microfinancing.

The introduced system has also made work time more efficient and reduced mistakes by introducing a management system using handheld terminals and mobile printers for work in the market that was being done manually. Although the systemization costs are a little higher than for manual work, it is highly regarded for being more effective without changing operations and for simplifying and accelerating various procedures.

【Main effects of introduction】

Farmers:	Market pricing information can be checked at any time Sales information is clear and can be obtained immediately
Cashiers:	The sales situation in the market can be understood at any time Transparency of payment management for buyers Real-time confirmation of market prices Clarification of management due to documentation (formerly handwritten notes)
Buyers:	Clarification of purchased volume and price on receipts Tracing of producers of vegetables (farmers)
Marketers:	All sales information can be understood at any time Refinement of produce inventory control in real-time Fast-selling products can be understood

Handheld terminal

System in use

Figure 9 Equipment introduced and the system in use

Source: Study Team

(3) Challenges and requests from the market

In the interviews with market authorities in the field, the following main issues were raised.

- The mobile printers use heat-sensitive paper, so the letters become illegible after a certain amount of use
- Producers' information is provided as data but it is not easy to check when making purchases
- The system is sometimes unusable during power outages (up to 3-4 days)

With the renewal period approaching for the equipment currently in use, requests made by the market authorities include opinions about expected improvements from increased usability by transferring operation of the current system to a smartphone app due to the high cost of making exclusive equipment.

With the renewal period approaching for the equipment currently in use, requests made by the market authorities include opinions about expected improvements from increased usability by transferring operation of the current system to a smartphone app due to the high cost of making exclusive equipment.

According to the interviews with operators that introduced and managed this system, one of the challenges was providing training and explanations of the system usage method (including troubleshooting) at the time of introduction to the wholesale market managers, marketers, buyers and farmers. As there was no thought of permanently stationing Japanese staff locally for continuous operation, superior personnel were found who could learn quickly during the initial introduction, and they were given intensive training on the usage method. They then became leaders that could provide explanations to other markets, buyers and farmers. This was seen as an activity with a high applicability and conformity to Technical Cooperation Projects implemented by JICA.

(4) Planning in the Ministry of Agriculture

In the Philippines Ministry of Agriculture, there is no information for producers and there are challenges to supporting small-scale farmers, so the construction of the Agri-Pinoi Trading Center was examined as means of resolving these issues. With this plan, the construction of public markets through the Philippines has been examined, and the aforementioned Sentrong Pamilihan Market is referred to as a model case for these plans.

The initiatives currently taking place in the Ministry of Agriculture include the publication of market prices on the website (for the suburban Manila area) and the provision of color-coded mapping that clarifies the produce suited to each region and farm.

In the future, with the construction of the Agri-Pinoi Trading Center, a product traceability system will be developed and a request will be made to JICA for a Technical Cooperation Project.

4.2.2 Results of field study in Indonesia

In the field study in Indonesia, visits were made to the elementary schools attached to the Indonesia University of Education (Bandung) where e-learning system was introduced, and interviews were held with relevant parties while also ascertaining the state of use.

Also, monitoring was conducted for the sensor system introduced by Midori Engineering and interviews were held with local managers (National Corporation for Basin Management for Citarum).

Table 21 List of visits to Indonesia

Local schedule	Location	Visited party
September 4-9, 2017	SuRaLa Net Local office	Mr. Furuoka (Coordinator) Mr. Ishibashi (Applied Management)
	Indonesia University of Education	Prof. Dr. H. Tatang Herman (Mathematics Education Department)
	Elementary school attached to Indonesia University of Education	Inspection of actual class (SuRaLa Class)
	JASA TIRTA II	Mr. Mouli De Rizka Dewantoro (Geospatial and Information System Expert)

(1) Using e-learning to enhance academic achievement levels in mathematics

1) Indonesia University of Education

Computers have been used in classes at the Indonesia University of Education, located in Bandung City, Indonesia. The ICT center is independently proceeding with mainly university-oriented open source development. At the annexed elementary school on the campus of Indonesia University of Education, computer classes are a part of the curriculum, and even elementary school students understand basic mouse and keyboard operations, etc.

Also, plans to introduce e-learning are featured in the 5-year plan for the education field, and political measures for the introduction of e-learning have been relatively positive.

2) e-learning system and evaluation thereof

The e-learning system that was introduced aims for qualitative improvement by means of contents that repair mathematical education in elementary schools. The e-learning system introduced at Indonesia University of Education Elementary School also includes game elements, and children do their classwork with a feeling that is close to that of playing games, and motivation towards classwork is improving. At present, continuous monitoring is being carried out, and it has been observed that the grades of the monitored elementary school students (scores in mathematics tests) are improving. Also, through classes based on e-learning, cultivation of Japan's good culture (discipline, etc.) and pupils' independence were highly evaluated.

At first, there was recognition of teachers' hesitation to e-learning, but once introduced, the improvement in academic performance became clear, and while there were some instances of unmotivated pupils walking about in the classroom during classwork, but the contents using animation and gamification attracted their interest and made them concentrate on their work, in turn

reducing the teachers' burden. Since contents relating to manners and discipline are also provided, behavior modification has been seen not only in school but also at home, and together with improved academic performance this factor has also received excellent evaluations from guardians.

Furthermore, as a technique for increasing children's motivation to learn, not only does each child see their own degree of learning progress, but the degree of progress of all children was put on display in classrooms as a "SuRaLa Meter". As a result of this, children became aware of competition between them, and everyone was able to see when their progress became visible, which makes children concentrate more and work harder.

University of Education Elementary School

e-learning class

e-learning class

"SuRaLa Meter"

Figure 10 Survey of Indonesia University of Education Elementary School

Source: Study Team

3) Challenges and requests at education sites

Although motivation toward e-learning is currently increasing, the situation in normal classes is unchanged. This also presents teachers with challenges (unchanged from previous teaching methods), and it takes a great amount of time to improve education itself.

For this reason, e-learning is highly expected, and therefore additional contents (more mathematical education, such as fractions, etc.) and new subjects (English, etc.) have been requested.

(2) Real-time surveillance for data collection optimization in multipurpose dam management, etc.

1) National Corporation for Basin Management for Citarum River (JASA TIRTA II)

Citarum River, which flows through West Java on the island of Java, Indonesia, is the most important river, providing 80% of the capital Jakarta's water supply, and has 3 large dams holding at least 500 million tons of available water. The entire dam-centered basin is managed by JASA TIRTA II, which uses a water volume management system to collect and monitor water level/water quality data.

2) Evaluation of SESAME system

The introduced sensor system was evaluated as being extremely useful. It was recognized that there was a lack of all kinds of sensors for management of the basin as a whole, and that adding a sensor would enable monitoring with greater detail.

3) Challenges and requests for SESAME system

In addition to sensor-based monitoring, there was also a request for an automatic remote gate opening/closing system according to the water level situation. While the functions of the SESAME system itself received excellent evaluation, the system faces the problems of maintenance and management expenses and the cost of application in terms of updating machines, etc., which will be a challenge for further extension and expansion. When the survey was conducted (in September 2017), an interviewee told that local businesses had been promoting sales of almost-identical systems with cheaper introduction and application costs, and if the results are almost the same, then the only choice will be to select the cheaper option.

In interviews with operators, there was also the opinion that recovery of system development expenses and continuous management would inevitably require collection of minimum operating expenses, which would be a challenge going forwards.

Jati Luhur dam

SESAME System

Curug gate

SESAME System

Figure 11 National corporation for basin management for Citarum river survey

Source: Study Team

4.3 Expertise gained from studies of examples of ICT utilization

The success factors and challenges of 10 examples subject to detailed surveys are shown in Table 22～Table 24. The 10 examples are all being implemented as ongoing projects, and are thought to be exhibiting positive results continuously. Under such circumstances, the following items are compiled as results of interviews regarding success factors and challenges.

4.3.1 Success factors

From the results of studying examples of the use of ICT in each project, the following factors were extracted into broad categories after organizing success factors.

① Ensuring affordability when introducing as requisite minimum system

・When introducing the system in developing countries, since it is most important to take an initial step towards introduction within a limited budget, setting a requisite minimum system can ensure affordability. After introducing and actually trying out the system, participators will actively find points for improvement, and strengthen and add hardware/software functions with an awareness of joint growth.

② Cooperation and parallel implementation with Technical Cooperation Projects

・In some examples, there is cooperation/parallel implementation with JICA's technical cooperation projects from the introduction stage. In fact, even in many other examples, the most laborious challenge during introduction is providing instructions of system operating procedures and maintenance/management procedures to local staff. There are thought to be significant effects from cooperation with technical cooperation projects on smooth introduction and continuous application.

③ Localization/customization of contents

・Even with systems that have been introduced and applied within Japan, having such systems accepted by local people requires adaptation to the local language and localization/customization taking into account local customs, etc. Localization/customization was planned for all examples, and in many cases, these are implemented by means of JICA funding support.

④ Use of materials that can be sourced locally

・In addition to reducing cost at the time of local introduction, many examples use generic products that are easy to procure locally in order to deal with machinery failure and updates due to aging, etc. Or, in other cases, supply/sales systems were built to ensure local sourcing of necessary machines together with the system introduction.

4.3.2 Challenges

From the results of studying examples of the use of ICT in each project, the following factors were extracted into broad categories after organizing the results of the challenges in the process of implementation and future challenges.

① Improvement of legal systems and organizations

・Drastic project improvement requires legal system improvement or organizational improvement (production of rules/structures), etc., but many private operators consider that such improvement initiatives are out of scope that the operators can propose or suggest, and it is thought that

cooperation with JICA assistance such as JICA's technical cooperation projects is essential.

② Technology transfer/ability development for local staff/users (including awareness-raising for changes to operational procedure)

・Regarding this item, in some cases, cooperation/parallel implementation with JICA's technical cooperation projects is regarded as a success factor. However, there are many examples in which project operators are responsible for technology transfer and capacity building, requiring significant resources in terms of people, time and funds. Cooperation with technical cooperation projects is important not only with JICA proposal-type projects and but also the projects using private resources.

③ Ensuring price competitiveness and securing budget

・Opinion such as "Japanese products utilize sophisticated technologies, therefore the products can be purchased and used even though these are expensive" is applicable only for handicrafts or a limited number of consumer-oriented products that can be passed through to the selling price, and not applicable to infrastructure technologies/products. The final decision is based on whether the cost is cheap and whether the proposal is beneficial to one's country (in terms of job creation, etc.). In all examples, great efforts are made to minimize the cost of introduction and maintenance/management, but late-starting competing companies sometimes provide items at cheaper prices, and it is common to hear the opinion that support is required not just at the time of introduction but also after starting cooperation in the use of private resources.

④ Undeveloped ICT environments and delayed popularization of smartphones and PCs, etc.

・Looking at the overall situation, there is rapid progress in the spread of cell phones and smartphones and the improvement of ICT environments such as broadband communications, etc. However, in the rural/agricultural areas of developing countries, there are still many areas where broadband communications infrastructure is not facilitated or, even if it is, utilization is difficult in the BOP layer because it is expensive. Assistance will continue to be required for improvement of ICT infrastructure environments in developing countries.

⑤ Complexity of introduction decision process

・As it is related to ①, even if there are Projects that have been started through agreements with local counterparts in advance, actual introduction and operation often need to follow complex processes including agreements or consensus formation with local C/P and leading organizations, which is difficult for private business operators to deal with in many cases.

⑥ Necessity for short-term, small-scale loans

・Unlike large-scale infrastructure projects such as installation of mobile phone facilities and optical fiber networks, projects in which ICT is used to contribute to the achievement of each SDG cannot become large-scale projects that exceed 10 billion yen such as road or bridge construction, even if some proposal-type projects using private resources create opportunities for request-type projects. In addition, the speed of ICT technology development and machine service life generally necessitates updates within 10 years. Since structures in which repayment is completed within a few decades are unsuitable, it will become necessary to review the existing ODA loan structure and produce a new structure that is more short-term and smaller in scale.

Table 22 Reasons for success and challenges in cases from other countries

Project	Operator (Country)	Reasons for success	Challenges
Project for the Wild Fire and Carbon Management in Peat-Forest in Indonesia	University of Hokkaido (Indonesia)	・Cooperation between all related agencies was both extremely important and difficult, but using a concept based on a comprehensive MRV system, and with the benefits of owning this technology, it was possible to promote greater understanding and coordination among various government agencies.	・Project for the Wild Fire and Carbon Management in Peat-Forest in Indonesia
Verification Survey with the Private Sector for Disseminating Japanese Technologies for Strengthening of Children's Mathematical Ability by e-Learning Through University-Industry Collaboration	SuRaLa Net Co., Ltd. (Indonesia)	・Contributes to greater motivation for learning among students by eliminating the need for individual guidance for students with different skill levels, and incorporating a Gamification element ・Efforts are being made to decrease maintenance and operation costs by introducing the system at low cost by localizing the system used in Japan.	・Time and expenses are required for technical transfer in order to improve teachers' understanding and skills to produce content. ・The cooperation of local teachers is essential in order to achieve consistency, including compatibility with the syllabus of the target country. ・The syllabus must be reviewed in some areas.
Verification Survey with the Private Sector for Disseminating Japanese Technologies for Bus Improvement System	Eagle Bus Co., Ltd. (Laos PDR)	・In order to limit management costs, management improvement guidance was provided after introducing the minimum system possible. ・Superior local engineers were discovered, who provided management after being given technical guidance. ・By planning the introduction in conjunction with a JICA technical cooperation project, going beyond the framework of supporting small-to-medium enterprises, guidance was provided in connection to identifying local circumstances and improving management	・Although it is absolutely essential to train engineers who can operate and run the system in order to have continuous management, the issue is time and money ・Reorganization (creating rules and mechanisms) is required for fundamental business improvement, but this exceeds the framework of proposals and guidance that private operators can provide, so cooperation with a JICA technical cooperation project is essential
Pilot Survey for Disseminating Japanese SME's Technologies for Introduction of IT for Agricultural Products Distribution	E-supportlink Ltd. (Philippine)	・System introduction is facilitated and maintenance and management costs are reduced by customizing existing systems in line with local usage methods. ・Guidance is provided for the usage method by actually visiting the area many times ・The effects from development are calculated quantitatively, and a decision was made for continuous use of the system.	・Difficult to introduce the system if there is no organization that enables its integrated installation (as markets are typically based on site loan management, at least, they are not suited to integrated system installation) ・To use it continually, it is necessary to have low cost management, but profit is not being made with the current rate of use, so it is essential to have wider adoption of this system

Table 23 Reasons for success and challenges in cases from other countries

Project	Operator (Country)	Reasons for success	Challenges
Verification Survey with the Private Sector for Disseminating Japanese Technologies for Efficient Management of the Multi-purpose Dam and Data Collection for the Climate Change with Real-Time Telemetry System (SESAME system)	Midori Engineering Laboratory Ltd. (Indonesia)	・Information is acquired from various sensors and transmitted by means of IoT devices on mobile telephone lines, which has not been possible until now. Enables continuous monitoring. ・Support can be provided locally due to the use of generic products.	・Not yet disseminated because the systems and expenses for technical transfer and guidance in connection to support are insufficient and local agencies are still few in number. ・Local business are providing a similar product and service, and there is a great difference in operation cost. Although the superiority of system functionality is evident, continuous use and widespread adoption of this system cannot be expected.
Preparatory Survey for BOP Business on Improvement of Basic Education utilizing Multimedia Device and Contents	Ricoh Co. Ltd. (India)	・Contributes to greater study motivation by providing interactive content ・More cases of use by means of batteries even in areas where there are frequent power outages	・Technical guidance for teachers enabling them to produce their own content is needed and the syllabus must be improved to promote it ・Currently, there is a strong leaning toward CSR, and cooperation with operators who can develop the business side of e-Learning are required
Preparatory Survey on BOP Business to Improve Children's Educational Achievement by e-Learning	SuRaLa Net Co., Ltd. (Sri Lanka)	・Contributes to greater motivation for learning among students by eliminating the need for individual guidance for students with different skill levels, and incorporating a Gamification element ・Efforts are being made to decrease maintenance and operation costs by introducing the system at low cost by localizing the system used in Japan.	・Time and expenses are required for technical transfer in order to improve teachers' understanding and skills to produce content. ・The cooperation of local teachers is essential in order to achieve consistency, including compatibility with the syllabus of the target country. ・The syllabus must be reviewed in some areas.
Verification Survey with the Private Sector for Disseminating Japanese Technologies for Intelligent Transport Solutions (ITS) in major cities in Gujarat Province	Zero-Sum Ltd. (India)	・There are restrictions on placing advertising along roads according to local legislation, but a lighter system has been approved based on the idea of sharing road information. ・A subsidiary in the local mobile phone business is already present, which enables local technical support.	・There is a great demand for expansion from local counterparts and government agencies, and there is a desire for more widespread dissemination, but it is difficult to gain machinery installation costs without the support of public funding. However, the challenge is that the project scale is rather small compared to that of a general ODA loan project (around 10 billion yen) ・In India, it was possible to use local subsidiaries but for expansion to other countries, in order to construct local systems, there was a need for expenses that cannot be covered just by local private companies, such as identifying the local situation and interacting with local agencies, and providing technical guidance.

Table 24 Reasons for success and challenges in cases from other countries

Project	Operator (Country)	Reasons for success	Challenges
Development of Rapid Diagnostics and Establishment of an Alert System for Outbreaks of Yellow Fever and Rift Valley Fever	Nagasaki University (Kenya)	・Using mobile phone SMS that are already widespread in the local area, a low-cost and easy-to-use system has been introduced.	・Requires considerable cost for the use of SMS ・By switching to a smartphone app, positional information can also be obtained, and a structure should be constructed that enables real-time identification on GIS including specific locations
Feasibility Survey for Utilization of ICT to Improve the Quality of Primary Mathematics Education	Sakura-sha K.K. (Rwanda)	・Although a 100 dollar PC has been distributed for every student in every school as part of a national policy, there were no useful contents, and there was no instruction for the usage method for either teachers or students, so it has not been put to use, but benefits have been demonstrated by developing content for this PC that drastically improves the quality of education. ・The use of a cloud server enables changes to the content to be made and useful points identified all together, which is highly rated by the schools.	・In some cases, the teachers do not know how to use the PC itself, so technical guidance is needed including for operation methods ・As a business model, it will be difficult to cover the costs by collecting fees from the pupils (guardians), and a structure must be formulated whereby the costs for use by each school are contributed by local governments. It is also difficult to manage this issue using funding from private companies only as it includes arrangement regarding the local syllabus.

5. Challenges and Countermeasures/Approaches for Developing/Promoting ICT Utilization in Request-Type Projects

5.1 Results of studies conducted in the past years and summary of current status

In order to present specific and realistic countermeasures for the development/promotion of the use of ICT in JICA request-type projects, a proposal shall be made based on a summary of the main challenges stated in ICT Project Research 2015 and how they have been dealt with until now within JICA

5.1.1 Challenges raised in ICT Project Research 2015

In ICT Project Research 2015, various countermeasures were raised one-dimensionally as the main challenges in the promotion of the application of ICT in JICA Projects. In order to summarize how these challenges have been dealt with in the past two years, the challenges are reorganized into different levels in this section, as shown below.

In general, organizational reform is promoted using a flow in which executives clarify a policy for reform, which is implemented based on a system design, but in this case, as information sharing among stakeholders takes on an important weighting, system design is classified generally as knowledge and project implementation processes.

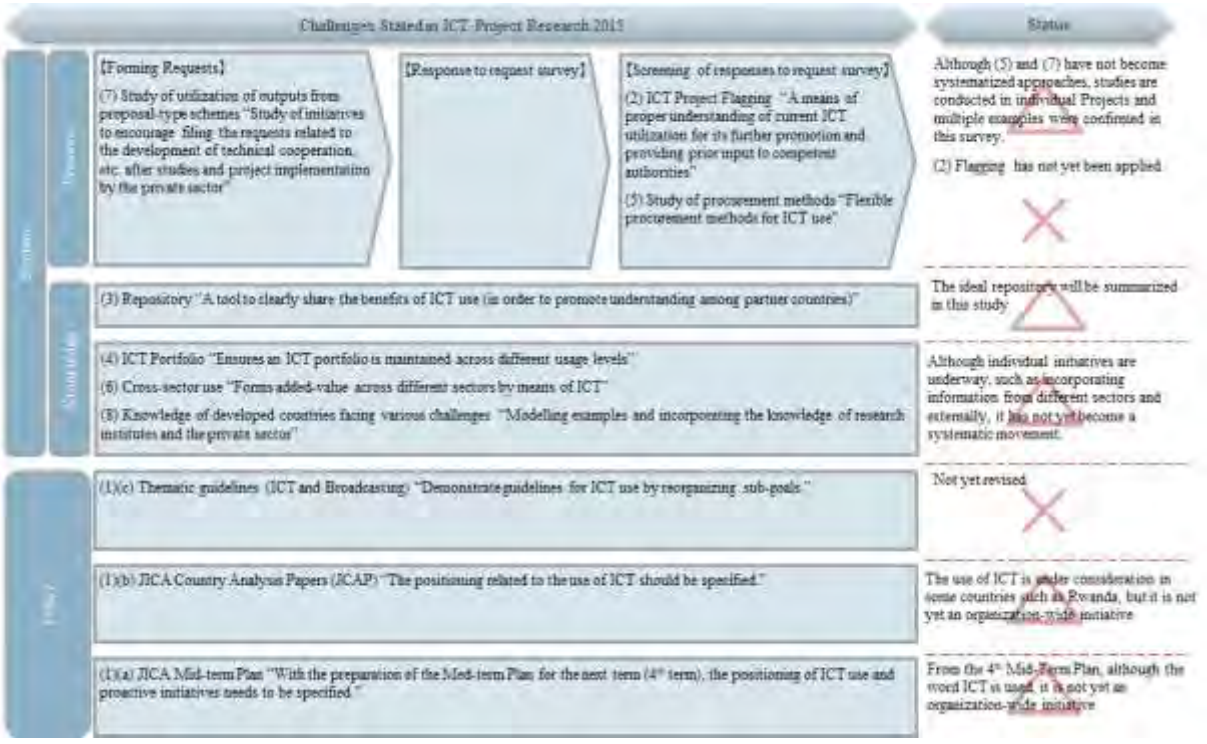

Figure 12 Main challenges shown in ICT Project Research 2015

To realize organizational reforms, in addition to policy presentation/system design, stakeholder must be notified and it is important to also carry out awareness-raising. In ICT Project Research 2015, the challenges related to this step were not specified, but in general, these activities are often given the title "Change Management" (approaches to manage awareness-raising of personnel), and a summary has been made of the initiatives undertaken by JICA from the viewpoint of change management.

5.1.2 Measures taken with regard to the challenges raised in ICT Project Research 2015

The measures taken at present with regard to the proposals in the Project Research compiled in October 2015 are summarized as follows.

① Policy

The proposed approaches in ICT Project Research 2015, were officially announced at the JICA Board of Directors on February 2, 2016, to have a common understanding on further promotion of the use of ICT within JICA. In terms of policy statements to external stakeholders, the expression "JICA will work to develop sustainable and highly convenient and safe transportation and ICT (information and communication technology) infrastructure" was also included in the "Statement on ICT Utilization" presented in the JICA's 4th Mid-Term Plan as one of the main challenges in the said research. On this basis, JICA has shown externally that it is conducting activities with an awareness of ICT, but what this research implies is the "use of ICT in JICA Projects" that is not limited only to developing local ICT environments, which is actually a limited expression.

Also, as indicated in the research as a main challenge, the importance of ICT utilization should have been clarified in the JICA Country Analysis Paper (JCAP), but this has only been reflected in the papers of Rwanda and some other countries, and as for the amendment of thematic guidelines (ICT and Broadcasting) with taking ICT into account that had been raised as one of the main challenges, the amendment itself has not yet been carried out.

Based on the above, from the perspective of promoting reforms for the entire organization, there is still a lack of commitment within JICA, and in view of the fact that JCAP is limited only to Rwanda or some other countries, it has been positioned as "advanced initiatives only in some countries."

② System (knowledge)

One of the main challenges raised in the research is an initiative for information related to ICT utilization to be shared within JICA with the following targets, and the construction of a repository has been proposed as a specific measure in this regard.

- ICT Portfolio "Maintain ICT Portfolios across all levels of use"
- Cross-sectional use "Create added-value through cooperation between different sectors using ICT"
- Knowledge from developed countries (Japan) facing many serious challenges "Modeling examples"

Regarding matters in connection to these targets, the Infrastructure and Peacebuilding Department of JICA is conducting many internal explanatory meetings and study sessions in connection to ICT utilization, which have had some effect on the increasing the awareness and understanding among executives. Also, the acquisition of the knowledge that is needed in order to implement these actions has been summarized in the findings of this survey as a repository (database), and preparations have been made for this over the past two years.

It has been suggested that an approach that involves the knowledge of research institutes and private sectors should be tried as an advanced ICT data collection method, and although external seminars have been attended by JICA staff, there is no formal understanding for JICA in order to actively adopt such process of data collection as an organization.

③ System (process)

The main challenges in terms of processes can be split into three categories. The first is "initiatives related to advancement in the requests made by governments of beneficiary countries," the second is "clear demonstration of ICT projects (flagging)," and the third is "ICT procurement methods."

As for the first point, in some countries such as Rwanda, initiatives are already undertaken, but JICA as a whole is not moving forwards. As for the second point, in order to promote the use of ICT, in addition to accurately sharing and identifying the situation within JICA, a method called "flagging" has been proposed as a means of inputting to the managing department that a requested project is based on the use of ICT. In this regard, there are no clear demonstration as yet. As for the third point, a proposal has been made to take flexible means of procurement by focusing not only on ICT hardware but also on software. Specifically, cooperation between grant aid/ODA loan projects and technical cooperation projects has been cited as an example. These initiatives, which are already undertaken in some projects, can be performed without the need for system reform, so this challenge can be resolved if the points of caution related to ICT procurement methods are shared among the JICA staff.

5.2 Organizational Initiatives that contribute to the achievement of SDGs by other donors

5.2.1 The World Bank

The World Bank understands that information and communication technologies (ICTs) achieve reform in various fields of the world economy, government and society and sees ICT utilization as an opportunity to achieve sustainable development.

In June 2012, the World Bank issued "ICT for Greater Development Impact" as the World Bank Group Strategy for 2012-2015. In addition, it set "Expand digital connectivity with a focus on scaling-up affordable access to broadband for all" and "Develop digital platforms and solutions that can improve public service delivery and make governments more open, effective and accountable" as the goals of the three-year ICT business plan for 2016-2018.

Furthermore, under the World Bank's new Procurement Framework applied from 1 July 2016, in addition to introducing Value for Money to incorporate not just "price factors" but "non-price factors" as needed and to select the "best price bidder" instead of the "lowest price bidder," leased assets and second-hand goods can now be included in the procurement component. As a result, running costs as well as initial costs are included in evaluations and shared infrastructure such as cloud servers are used.

5.2.2 USAID

USAID established the Global Development Lab as a department dedicated to innovation, with the purpose of promoting development in developing countries by innovation creation, including ICT. The Lab promotes new initiatives in partnership with a diversity of private enterprises including venture companies and provides financial aid and matching support between companies to support implementation of new ideas and initiatives. The Global Development Lab tackles development issues by providing funding for collaboration with US and overseas concerned parties, companies and entrepreneurs. It has an annual budget of approximately 1.7 billion yen (2018).

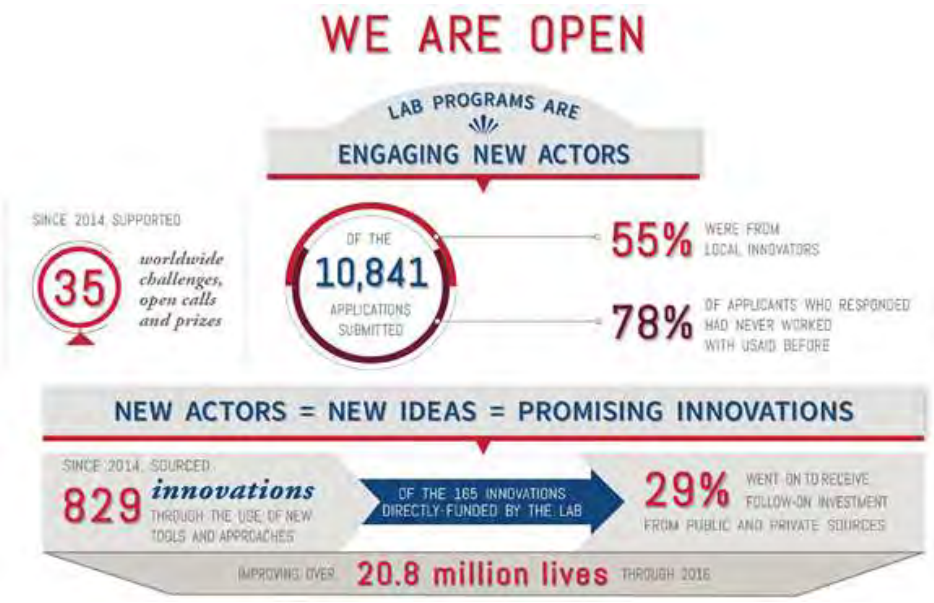

Figure 13 Achievement of the Global Development Lab: 2014

Source: Global Development Lab (USAID)

5.3 ICT Innovation for the achievement of SDGs

As described above, other countries' donors are systematically tackling ICT utilization. Figure 14 shows the estimated annual investment needs required to achieve the SDGs and the predicted private sector investment. In relation to annual investment needs of 3.9 trillion USD, current annual investment stands at 1.4 trillion USD, giving rise to an annual investment gap of 2.5 trillion USD. Private sector investment is expected to bridge this gap, but with current annual private sector investment at 0.9 trillion USD and estimations of up to 1.8 trillion USD, ground-breaking efforts including ICT use, in other words ICT innovations, are seen as vital for resolving the annual investment gap of 0.7-1.6 trillion USD.

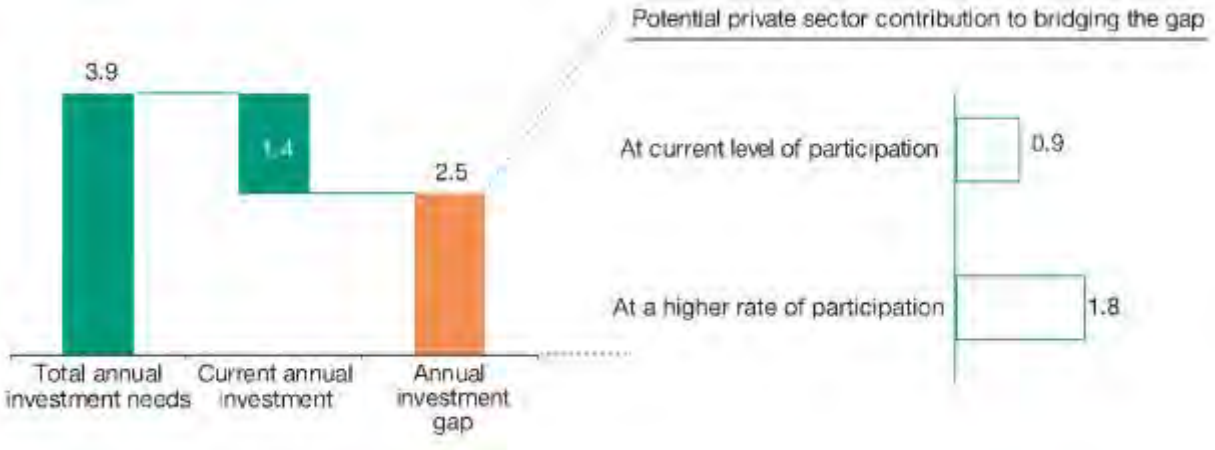

Figure 14 Presumed annual investment needs required for the achievement of SDGs and potential investment prediction of the private sector

Source: World Investment Report 2014 (United Nations Conference on Trade and Development)

Domestic demand in Japan is facing the same decline in investment capability. In this situation, ICT innovation (or digital innovation) in various fields is called for, and the United Nations and ITU are developing ICT utilization strategies to achieve the SDGs.

Figure 15 ICT utilization strategy for the SDGs achievement (Left: Ericsson / UN-SDSN, Right: ITU)

Source: ICT & SDGs (Ericson/UN-SDSN), Fast-forward progress (ITU)

Moreover, JICA has set out a Vision and Mission and five Actions for achieving them in JICA's Vision revised in July 2017. "Innovation: Innovate to bring about unprecedented impacts" is clearly defined as one of the Actions.

Figure 16 JICA's Vision

Source: JICA (https://www.jica.go.jp/about/vision/index.html#vision)

5.4 Direction of measures to be taken from the perspective of the advantages and problems for the organization

In Section 5.3, the current investment amount is significantly short for the investment needs necessary for achieving SDGs, and even if private investment is taken into account, there is an investment gap of 100 to 200 trillion yen / year. In order to solve the gap, innovative efforts that have never been approached are required, and one of them mentioned that "ICT innovation" that utilizes private technology is necessary.

However, as stated in Section 5.1, there are situations in which it is not sufficient to deal with the proposals in the project research compiled in October 2015. In the case of a large public organization like JICA, it seems that there is a situation that it is not easy to proceed quickly and flexibly, as is the case with large private enterprises. Under such circumstances, it is imagined that it is not easy to make efforts to create ICT innovation.

The merits and problems of large organizations and venture companies are listed and compared in Table 25. When the merits and problems are compared, they are found to be mutually complementary in many ways. In other words, in many cases the problems of large organizations are the merits (characteristics) of venture companies and the problems of venture companies are the merits (characteristics) of large organizations. Therefore, there is a good chance of being able to promote innovation including ICT utilization by mutual cooperation.

Table 25 Merits and problems of large organizations and venture companies

	Large organization	Venture company
Merits	・Financial power ・Name value ・Abundant human resources ・Credit worthiness ・Information gathering ability	・Fast-moving ・Group of people who are passionate about ideas ・No fear of failure ・No obsession with precedent ・Strong curiosity ・Flexibility
Problems	・Strict governance ・ Inclination to follow precedent/merit system ・Sectionalism ・ Fear of failure (→once started, cannot stop even if failure) ・Strict risk management	・No financial power ・Name value ・Lack of human resources ・Lack of credibility ・Lack of information gathering ability

Consequently, large organizations involve not only internal human resources and organizations but also external human resources, and efforts directed at innovation creation are undertaken by a variety of companies. However, simply involving external human resources while neglecting the problems of the large organization will not in the end lead to innovation creation. The issues directly facing many large organizations, with reference to past literature, are shown in Figure 17.

The first obstacle is the problem of not being able to involve excellent human resources from outside the company. An awareness of “creating together” is important for involving people with hitherto unheard-of ideas that will generate innovation. For example, when collaborating with someone from outside the company, sometimes the excellent human resources from outside are not involved because the rules of the large organization are imposed on them or there is too much concern

about the information leakage. Or else when there is someone from a direct competitor in the same discussions, it has a mutually restraining effect and visionary ideas and technical information are not brought up for discussion.

The next obstacle is not being able to disclose prototypes/unfinished products. It is especially important for manufacturers to protect their brand, and for this reason every manufacturer has a quality assurance division. Even if a customer says that they are satisfied with lower quality, in most cases the company cannot ship products that do not comply with its own quality standards, because the product will go out into the world bearing the company's name. Furthermore, if the company does not see a prototype just as an unfinished product and has no will to create the product based on mutual feedback, its manufacture will take a long time, resulting in frequent reworking and loss of speed.

Additionally, being unable to accept many terminations is another big obstacle. This is linked to the inclination to follow precedent and the merit system. It is important to adopt the concept of 1) making a prototype of what the creator who came up with the idea believes will be a success, 2) testing it, and 3) if it is no good, "killing" it. In Silicon Valley-type innovation creation, for example, the "3% game" is the basic rule. Out of the products assiduously developed by 100 teams, it is accepted that only about 3 teams will actually be successful, and the majority will fail. Naturally, large organizations are accountable to investors and taxpayers and, while certainly not easy, changing the way of thinking both by individuals and as an organization is a vital element of innovation creation.

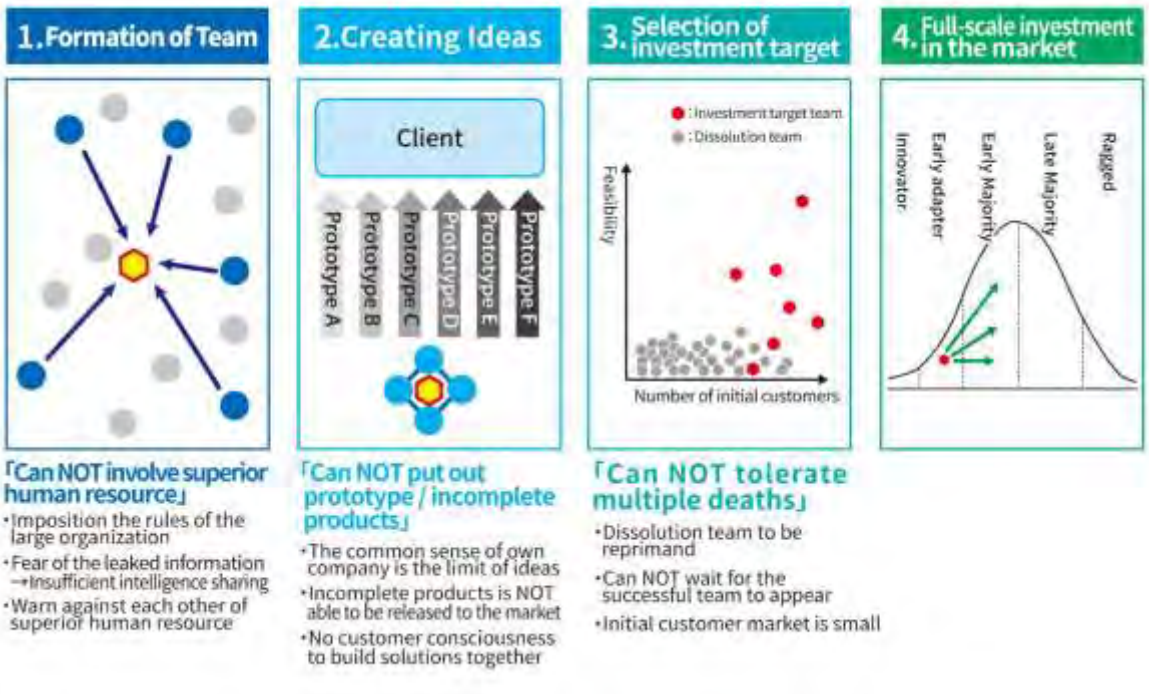

Figure 17 Main issues when a large organization tries to create innovation

Source: Created based on the diagram provided by Inclusion Japan
(http://inclusionjapan.com/article/enterinnovation/)

5.5 Measures/approaches to promote ICT utilization in JICA request-type projects

In Section 5.3, the current investment amount is significantly short for the investment needs necessary for achieving SDGs, and even if private investment is taken into account, there will be an investment gap of 100 to 200 trillion yen / year. In order to solve the gap, innovative efforts that have never been approached are required, and one of them mentioned that "ICT innovation" that utilizes private technology is necessary.

In addition, in Section 5.4, to mentioned the necessity of Organizational Innovation, Consciousness Innovation as a task for innovation creation process and direction for solution in large organization as like JICA.

Based on these, propose the suggestions on measures and methods for promoting ICT utilization in future JICA's request type projects, which will contribute to the creation of ICT innovation.

5.5.1 Measures/approaches for cooperation within JICA

1) Establishment of specialized departments to promote innovation and acquiring personnel by cooperating with external venture organizations

① Background leading to this countermeasure/approach

While certain effects/results have been achieved by means of existing structures for lesson retrieval systems such as the Knowledge Management Network (KMN) and JICA-Net, as summarized in the preceding paragraph, in order for the Team 2, Transportation and ICT Group, Infrastructure and Peacebuilding Department of JICA to promote the accumulation, sharing, maintenance, and transmission of knowledge across all of JICA including overseas offices alongside its normal duties, a huge amount of manpower is needed, which is not realistic.

② Reference examples of this countermeasure/approach

Taking the example of the knowledge management initiatives at ABeam Consulting, which is the team member of this survey, a special post called the "Knowledge Management Center" (KM Center) has been set up in the company where there are employees with consulting experience. The KM Center gathers Project results, proposals and deliverables, etc. on databases, extracts and presents reference examples from the database according to keywords presented by on-site consultants, and introduces relevant specialists/experts. Furthermore, for all employees, queries are made through the Knowledge Management Center where documents/information related to advanced examples can be obtained, and mutual matching with managers takes place.

Most consulting companies also set up specialist positions like knowledge management/quality management departments to centrally manage internal results, proposals and deliverables, but it is recognized from past experience that specialist positions should be set up because, in any consulting company, it is not practical to carry out knowledge management while also taking care of normal on-site duties.

In this case, it is essential that a database is constructed in order to record items in addition to proposals/deliverables, etc., such as the Orderer, project summary, budget, work schedule, success requirements, lessons learned, keywords, managers and contact addresses, for Managers to produce summary documents for each project, and for the management of proposals and deliverables that tie-up with those summary documents.

JICA retains Project information in a great variety of fields in countries and regions around the world, and while the framework of a database is already in place such as the JICA Library, JICA-Net and the lesson retrieval system, this information need to be registered on a database and

advanced examples must be extracted and presented in line with consultations and enquiries from overseas offices and departments facing various challenges based on technical consultations. In upstream stages such as the request stage, Project examination/selection stage and the implementation and planning stage, it is necessary for JICA to confirm request letters and PDM of all the projects and to make comments and recommendations in connection with ICT utilization. As shown in AAAA, the achievement of SDGs requires the mobilization of private resources, and a Global Development Lab was set up in April 2014 in USAID with an annual budget of approximately 1.7 billion yen (2018) for the purpose of carrying out innovation activities inside and outside USAID, and to engage in development issues by securing funding for cooperation with stakeholders, companies and entrepreneurs in the United States of America and other countries.

③ Specific measures and approaches

At JICA, in addition to internal JICA knowledge management, the creation of specialized departments is essential, including personnel with expertise and knowledge related to the creation of innovation by means of ICT utilization and inter-organizational cooperation, such as collaborations with external research institutes, private companies, and universities.

In order to further promote the creation of innovation, there is a considerable need for a review of the existing systems and decision-making processes in JICA.

In this situation, an "Innovation Lab" comprising JICA staff and external personnel (venture companies, manufacturers and consultants, etc.) should be set up as an internal organization in JICA, to take on the following roles.

However, as stated in Section 5.4, if there is a company staffs who is in a direct rivalry relationship among the same discussion, they are checking each other and cases where advanced ideas and technical information do not ride on the round table. In view of the fact that it is assumed, in selecting external personnel, pay attention to extracting from companies that do not have a direct rivalry relationship, and conceivable to involve mainly consultants who do not provide solution development or service by themselves as the business entity.

- **Domestic and overseas ODA project data collection in which ICT is put to proper use**
- **Surveys and collection of innovative technical information related to ICT**
- **Research regarding the local application of innovative technology**
- **Study of application to JICA Projects**
- **Examination of system review to promote the application of innovative technology in JICA Projects**
- **Confirmation of request letters and PDM, provision of comments and recommendations for the use of ICT**
- **Dealing with consultations and enquiries from overseas offices and departments facing various challenges related to ICT utilization**
- **Holding and implementing competitions related to innovative ICT creation**

2) Consciousness innovation among JICA staff

① Background to the need for the measures and approaches

JICA has held several explanatory meetings and internal seminars for JICA staff in connection with ICT utilization and considers that they have had some effect on enhancing the awareness and understanding among executives. The fact that consciousness innovation is required was

mentioned in item 5.4, but change management in the organization is deemed necessary for its promotion, acceleration and successful achievement. Change management can be broadly divided into four steps. Consciousness of change is fostered among the relevant people and the achievement of change from a human perspective is promoted through each step.

The status of the changes that contribute to the promotion of ICT utilization in JICA in the light of the four change management steps is shown in Figure 18.

In the Awareness step, although JICA transmits a certain amount of information such as clearly specifying ICT in the 4th Medium-Term Plan, there is only limited commitment and there is a failure to press ahead with fostering consciousness among the relevant people.

In the Understanding step, ICT projects that will set a precedent in the Infrastructure Department are underway, as showcased in Rwanda and other countries, and it is hoped that the necessity and merits of new initiatives can be shared by sharing the cases concerned.

In the Learning step, however, the system itself has yet to be set up and no concrete explanation of the system has yet been provided. In the Stabilization step too, no mechanism or system for stabilization has been established yet.

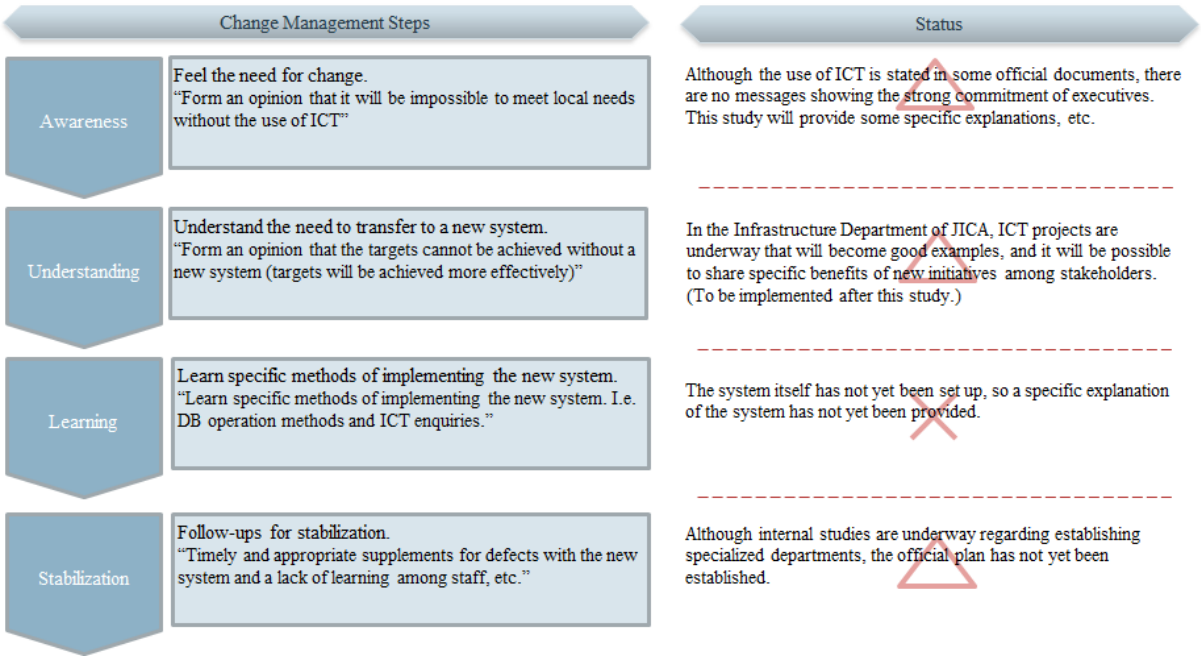

Figure 18 Main challenges shown in ICT Project Research 2015

② Specific measures and approaches

In the Awareness step, due to the importance of showing the significance of change from the executives of the organization, first it is necessary to expand the stipulation of ICT utilization in country-specific development assistance policies. Furthermore, Innovation is already set out as one of the Actions in JICA's Vision and it is vital that the Infrastructure Department aggressively delivers ICT innovations through ICT utilization as a concrete Action measure.

In the Understanding step, the goal is to have each relevant person understand that the targets can be achieved if change is pursued. To this end, sharing of successful examples is the most effective method. In this point, as advanced efforts are currently underway in Rwanda and other countries, it is thought that the targets can be achieved if these examples are appropriately shared in future.

As the Learning step deals with the learning of specific methods of implementing the initiatives and activities, it needs to be implemented at the development and construction stage of the

knowledge repository proposed in this survey.

Stabilization will be promoted mainly by the department with jurisdiction over the role of ICT information sharing proposed in item 1). Collecting of examples of success and failure achieved based on information and knowledge acquired in the Learning step and sharing of the information among the staff will contribute to entrenchment not only among the target staff but among all the staff.

3) Structures to provide incentives for ICT utilization promotion and innovative activities

① Background leading to this measure/approach

In the case that a knowledge sharing system is constructed using JICA-Net and the lesson retrieval system, and appropriate operations and maintenance are performed, there will be cases where a direct exchange of ideas with each responsible officer is required regarding matters such as detailed content, backgrounds and success factors/lessons related to advanced examples.

If a staff member of an organization wishes to reach a specific goal and to accelerate its realization, he or she will have to proactively participate in the activities needed to achieve the goal with "strong motivation". In this regard, the "10% rule" alone is not sufficient in order to encourage all staff to proactively make comments and proposals for the enquiries from the Knowledge Management Center, because activity alone will not add anything extra to the individual. Taking this into account, a structure capable of providing an incentive of something extra is required.

② Reference example of this measure/approach

In the example of ABeam Consulting, which is the team member of this survey, with regard to enquires from the Knowledge Management Center, employees who provided documents and made proposals were listed, and, separately to the results and evaluations, a system was established in which employees are publicly recognized for providing documents and making proposals numerous times throughout the year. In other consultancy companies, there are often structures in place whereby one's history of recognition for activities such as contributing to Projects in which one is not directly involved and optimizing internal business, for example, is managed by the Human Resource Department, which is reflected in employee performance evaluations.

③ Specific measures and approaches

At JICA, for all staff, including those in overseas offices, staff that make proactive proposals/recommendations need to be publicly acknowledged within the office and within the department in order to create a constant awareness of producing innovation, and a structure is needed so that those acknowledgements are reflected in employee performance evaluations in the future.

4) Career path system to secure ICT-specialist personnel

① Background leading to this measure/approach

The Knowledge Management Network (KMN), which is composed of the staff of Transportation and ICT Group, Infrastructure and Peacebuilding Department of JICA and other experienced staff is considered to be an effective structure to support activities on themes that require specialist knowledge and experience, such as ICT utilization. However, in order to use new technology in cooperation with external private companies, as described later, and to use the

latest technology for which there are no JICA precedents or experience, staff are required that engage solely in the ICT utilization. Currently, JICA experts take care of this, but in the future, in the case that ICT is used in all projects undertaken by JICA, there will be an overwhelming lack of human resources.

② Reference examples of this measure/approach

In various companies, there are career path systems to promote the growth of employees, and policies are in place for the company to provide support for the chosen career path and to carry out transfers, for example, after the employee annually selects a career path program for himself/herself and after holding discussions with superiors. Career paths in many companies are split into professional courses and management courses, and there sometimes tends to be more of a push toward management courses. There are also cases in which management courses are viewed as being superior to professional courses or cases in which it is impossible to go back (or difficult to go back) to a management course after a professional course has been chosen.

③ Specific measures and approaches

Also, at JICA, in the same way as a career path system, there is a structure in which a career consultation is conducted with all staff by the HR department (before the third year and between years seven and ten) in order to create a career path according to the motivation and skills of the individual. It is possible to enable the early selection of professional courses including ICT specialist employees within this career path. However, as stated above, even if a professional course is selected as a career path, it is important to have a system design in place so that, rather than branching off, the policy can be changed at any time according to requests made by staff members for professional courses or management courses.

5) Creation of advanced examples through Technical Cooperation Projects

① Background leading to this measure/approach

When deciding what innovative technology and initiatives to implement, including the use of ICT, there are many cases in which the existence of precedents is important to the decision within JICA. Also, it is common for consultants who are the consignees to use highly reliable and proven approaches, and in general in Technical Cooperation Projects based on proposals from consultants, innovative technology and initiatives are rarely used.

② Specific measures/approaches

When producing the PDM in the implementation and planning stage of a Technical Cooperation Project, JICA should take the lead in making proposals for ICT solutions that have no track record and are unproven but contribute to the effective implementation of the Technical Cooperation Project, and a “trial run” should be promoted along with the consultant. The consultant that is the consignee gives priority to avoiding the risk and JICA must take the lead in making proposals and implementation based on the assumption that it may not go well. It is possible to speed up implementation by viewing selected Technical Cooperation Projects as the field.

Whether it is successful or not, the knowledge gained from this trial run can be utilized in the use of ICT, although it is obviously essential that an internal and external appeal will be made if it is successful.

6) Joint Feasibility surveys with JICA staff/experts and counterparts

① Background leading to this countermeasure/approach

Even in the case of generating leapfrogging by making innovative efforts including the use of ICT with regard to the challenges faced by local counterparts, local counterparts alone may not have this awareness. Among counterparts in developing countries, there are employees acting as managers who file requests without knowing the real local conditions, or the needs and challenges faced by their own countries, so the use of ICT as a countermeasure is not properly promoted.

② Specific countermeasures/approaches

In order to clarify such cases and to clarify issues that ICT utilization is supposed to be, it is thought to conduct project discovery and project formation survey in collaboration with JICA overseas office staff, local experts and local C/P.

In that case, in addition to utilizing Webinar as described in paragraph 7) as follows, in order to share the knowledge of related cases of ICT utilization to the local C/P, as necessary, refer to paragraph 1) of Section 5.5.1, “Innovation Lab" to provide case studies and dispatch of staff. In addition, as stated in paragraph 1) of Section 5.5.2 at the project formation survey stage and request research stage, in order to incorporate a wide range of opinions from local IT venture companies, start-up companies, academic fields, ICT utilizing Ideathon may be effective.

7) Improvement of ICT utilization literacy of local C/P by assignment-based lectures and materials

① Background leading to this countermeasure/approach

As in the background in paragraph 6) as above, there are cases where the local C/P alone is not aware of the tasks expected to be taken by innovative efforts, including ICT utilization, and in the first place, in its own business responsibility field, there is only a vague image about the ICT utilization, there are cases where it is impossible to create a request form and a draft TOR.

② Specific countermeasures/approaches

Sharing the success cases and stories are able to be cited as a countermeasure plan. Currently, JICA conducts a wide variety of subject-specific training course for the trainees from all over the world, and lectures and handout materials are also widely disseminated from JICA as a repository using "JICA-NET Library". Therefore, it can be said that the effect of noticing the local C/P can be obtained by sharing case examples using this means. However, due to the reputation of the repository, it is a matter that cannot be ignored concerning that the understanding degree of attendance rate and content is completely depends on the recipient side. Also, there is a possibility that it is not known that the information and materials are publicly disclosed.

In recent years, by incorporating the mechanism of Webinar used by various companies and organizations as Capacity Building, it is considered that such concerns can be resolved to a certain extent. The webinar has two methods, 1) real-time Webinar and 2) always-on Webinar which is the lecture video and text are delivered on the web, students select and take it accordingly.

In the case of USDOT in the United States, there are multiple training courses using Webinar on the Web, and users who have registered in advance take lectures by Webinar and submit the given assignment, as a mechanism to issue Certification.

The biggest feature of 1) real-time Webinar is that it can proceed while interacting bidirectionally between lecturer and participant, there is a merit that content can be communicated while assessing the participants' comprehension degree. In particular, regarding lectures related to ICT utilization, it can be utilized as a means for having local C/P side acquire the necessary

knowledge when forming projects jointly with local C/P and implementing "Ideathon" it is conceivable. In the case of 2) always-on Webinar, there is a merit that users can participate in the gap time of users. Unlike real-time Webinar, there is a disadvantage that interactive distribution is impossible.

In any case, issuing a Certification certifying attendance is considered necessary in order to widely notify the local C/P of the distribution of the content.

In addition to distributing lectures of all existing JICA training as Webinars in addition to copyright problems, etc., it is not a lecture on the premise of delivery as Webinar, so in future training lectures, training, in order to coordinate with consultants and lecturers who support the training course and to agree to distribute on Webinar, it is also necessary to encourage lectures taking place in Wibinar and creating documents.

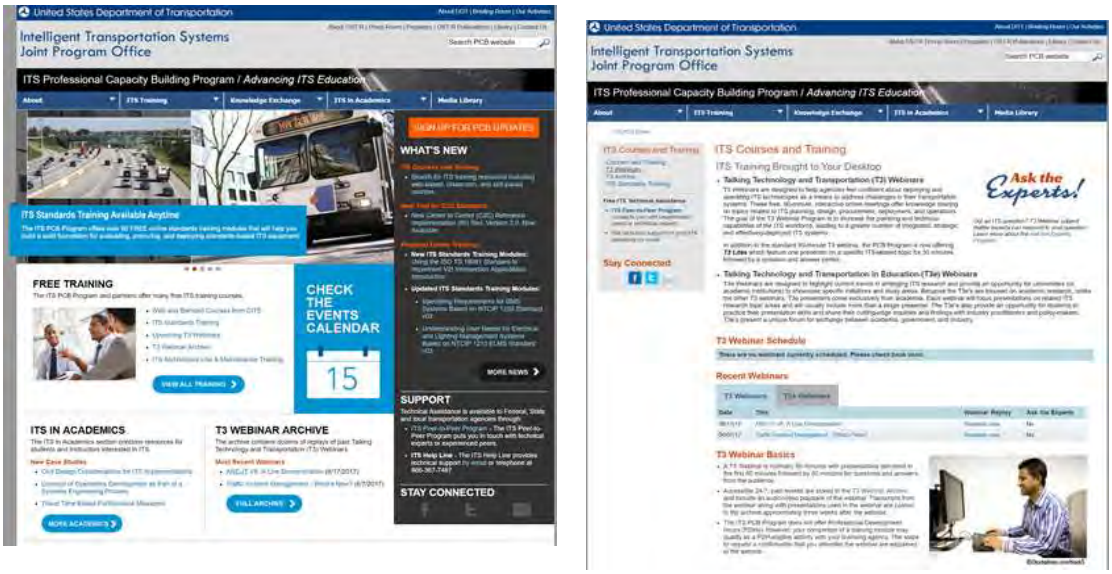

Figure 19 Examples of capacity building by means of webinars (USDOT-ITS)

Source: USDOT ITS website (https://www.its.dot.gov/)

8) Strengthening of knowledge repository for JICA staff

① Background to the need for the measures and approaches

JICA uses a data search/information utilization system as the internal source of information for its staff. It compiles knowledge lesson sheets for each project, individual project lesson sheets, review sheets by project, etc. as a lesson search system and stores and shares the information. However, updating of the sheets is left up to the person in charge of the project and the amount of information and accuracy of the content vary from project to project. Furthermore, the information is not regularly updated nor is any notification that the information has been updated provided, with the result that few staff make use of the system. Therefore, in order to facilitate storage of and referral to information on ICT projects, including Knowledge Sharing Sheets on ICT projects in the current system, it will be necessary to strengthen the repository by making it easier to use and easier to understand from the perspective of both the administrator and the user and ensuring its effective use in work.

② Specific measures and approaches

With the aim of strengthening the repository, from the perspective of the administrator, it is necessary to maintain the volume and freshness of the information by limiting access

authorizations among the staff and regularly organizing and updating the files. In addition, it is necessary to regularly maintain viewing records to grasp what projects are frequently referred to and what information users are looking for. Moreover, from the user's perspective, as well as improving ease of searching in order to acquire the desired information instantly, and if notification is given of each information update, a system will be created that the user both finds easy to use and wants to use. Based on the above, it is deemed necessary to maximize use of the data search/information utilization system and strengthen the repository, which is an important source of information, for future formation and implementation of projects.

Table 26 Current status of data retrieval and information utilization system and functions that are desired to be added

Perspective	Function	Current state	Functions that are desirable to be added to the data retrieval and information utilization system used by JICA
Administrator's perspective	Access authority management	Can be viewed by all staff	For each search target, use a function that enables search using user / group.
	File organizing/ updating	Left to the person who created the file	Use a file server organizing support function that detects documents (dormant files) that have not been accessed for a certain period and notifies the administrator
	Viewing record	No statistics are kept	Since you can grasp the usage status of the search system and have a function to quantitatively calculate the effect of introducing the full-text search engine on the EC site, search within the site, etc., it is possible to visually use the usage situation Using the function to grasp.
User's perspective	Searching	Can only search by file name	We use cross-searchable functions in a centralized manner regardless of file formats such as PDF, database, XML file, etc. regardless of servers and folders, various internal documents distributed on the intranet.
			Even if you do not remember the keyword exactly, display related keywords including that character. When a keyword is input, use the function to display a list of candidate keywords and support the input of search keywords.
	Update notification	None	Use the Smart Link function so that you can reliably notify keywords related to pre-registered keywords.

5.5.2 Countermeasures/approaches related to cooperation with external companies/organizations

1) Implementing ideathons and hackathons in Technical Cooperation Projects and implementing a pilot project

When preparing a PDM in the implementation and planning stage for a Technical Cooperation Project, even in the case that there are no specific ICT solutions that conform to the objectives of the Technical Cooperation Project, an ideathon or hackathon could be implemented under the framework of the Technical Cooperation Project by involving local counterparts, local companies and Japanese companies, and the ideas and prototypes acquired from this could be used to perform a "trial run."

2) Creation of innovation through the technology of Japanese companies and Technical Cooperation Projects

Of the ICT solutions owned by Japanese companies, most of those used in the business field have been developed in order to perform high-level operations required by Japanese companies. In Technical Cooperation Projects aiming at improving various operations by local counterparts, it is important to use ICT in order to make the technical transfer of high-level Japanese operations more effective. For example, in the Project to Enhance the Capacity of Vientiane Capital State Bus Enterprise (Technical Cooperation Project) and in the Feasibility survey for the Project for the Improvement of Transportation Capacity of Public Buses in Vientiane Capital (proposal-type Project) conducted by JICA in Laos, by means of a bus operation control and passenger identification system as a tool to improve the business management capabilities of the public bus company in the Technical Cooperation Project, route reorganization and cost reduction, etc. were achieved by highlighting points for improvement based on a visualization of the current situation from a proper understanding of the actual transportation service and usage status. This contributes to the continuous use and expansion of ICT as long as the sales improvement and cost reduction achieved by means of ICT based on such high-level operations exceeds the cost of introduction and maintenance.

An initiative known as Industry 4.0 is now being conducted that achieves cost reduction and optimization related to manufacturing and distribution by means of IoT, and it is necessary to promote transfer of high-level technologies owned by Japanese companies and ICT utilization through Technical Cooperation Projects.

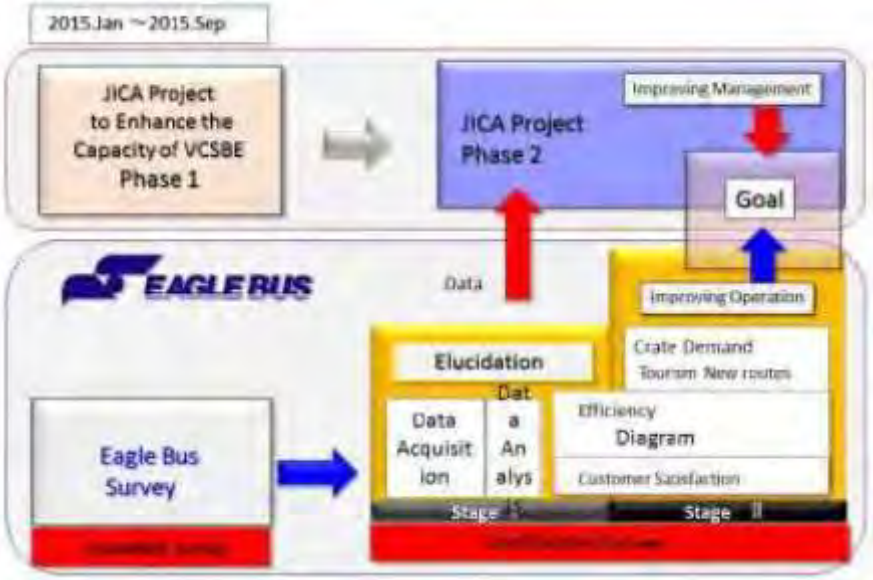

Figure 20 Plan for cooperation between technical cooperation projects and verification surveys with the private sector for disseminating Japanese technologies

Source: F/S for the Improvement of Vientiane Capital State Bus Enterprise Infrastructure in Lao PDR, Completion Report

3) Implementation of competitions for ICT utilization and innovation creation

In addition to initiatives such as hackathons and ideathons, as mentioned above, an extremely effective method of supporting ICT utilization and innovation creation is a competitive format such as an "ICT Utilization Contest," which is already under examination.

Furthermore, continuous structures are needed to expand this initiative to other countries,

regions and sectors, and for applicants to be more widely accepted by companies, groups and universities in Japan and overseas.

In terms of a reference example, Kaggle (https://www.kaggle.com/) is a competition management company in which statisticians and data analysts from around the word compete to make the best predictive model for data contributed by various companies and researchers. In the competitions conducted on this website, companies and researchers that own data can set up individual competitions by presenting data and the requirements (challenges) needed for the predictive model. Competitions are held not periodically every year or every half year but all the time. For example, taking the example of Kaggle as a reference, JICA could set up a special website to appeal for ideas to resolve challenges based on the use of ICT, and idea competitions could be held continuously as needed by country or region, or by the type of challenge.

Figure 21 Website for predictive modelling and analytics competitions (Kaggle)

Source: Kaggle Website (https://www.kaggle.com/)

6. Initiatives for ICT utilization that contributes to the achievement of SDGs

6.1 ICT Utilization that contribute to the achievement of SDGs by other donors

6.1.1 The Department for International Development, UK (DFID)

Development aid organizations in each country provide support for ICT utilization in developing countries. M-Pesa, Kenya's famed mobile phone-based money transfer service, was achieved through support by DFID in the UK

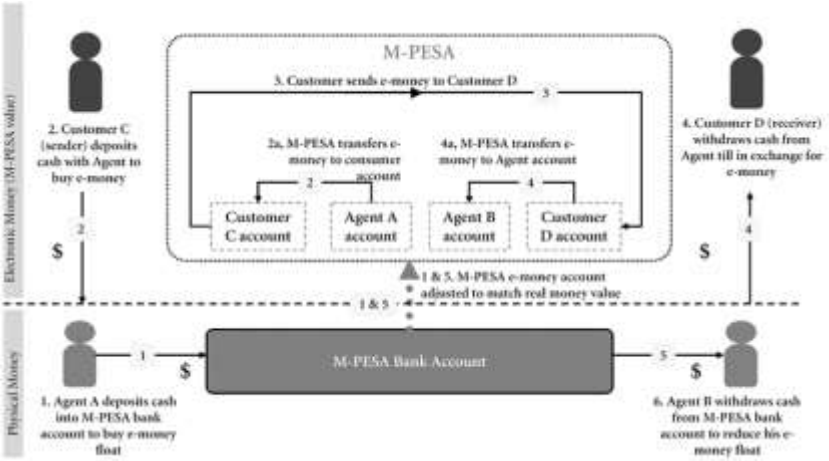

Figure 22 Overview of the M-PESA service

Source: M-PESA: Mobile Money for the "Unbanked" Turning Cellphones into 24-Hour Tellers (Nick Hughes, Susie Lonie, Innovations, Winter/Spring 2007)

6.1.2 International Development Research Centre, Canada (IDRC)

IDRC (Canada) provides an application called mFisheries which supports the activities of fisheries workers in Caribbean countries by sharing market prices of fish, providing weather information based on location information from smartphones and providing an SOS transmitting function.

7 Business services and partners	5 Key activities	1 Product or service	3 Customer relationships	2 Clients
Fishers Coastguard Fisheries Division Ministries Academic community Developers	Revising software for architecture and scalability Marketing Hackathons, open-source code	Mobile application (for small-scale fishers): GPS, compass, tide, weather, first aid, camera, SOS Tracking (for coastguard) Fishing activities by location (Fisheries management) Data for livelihood support (Ministry of Social Development, academics, development organizations)	Regional and national fisheries organizations and networks Personal contacts Fishers Fisheries officers Government Students	Small-scale fishers Coastguard Fisheries management Ministry of Social Development Academics
	6 Key resources		4 Channels	
	Human resources Physical infrastructure Financial Information, data		Face-to-face, web download, Google Play, voice support Reports, meetings	
9 Costs		8 Income		
Human resources Infrastructure, facilities – covered by host institution Logistics – covered by partners Time – covered by partners		Development grants, project funding Subsidies from phone company		

Figure 23 Business Model of mFisheries

Source: An app for fishers (Mallalieu, K.I.;Suraj, A., CTA Technical Brief, March 2017)

6.1.3 United States Agency for International Development, USA (USAID)

Launched in June 2011, iCow enables Kenyan cattle farmers to accurately grasp the gestation period of their cows. In order to have farmers engaged in livestock breeding to use widely, iCow uses SMS not on so-called smartphones but on mobile phones to provide information and hints on best dairy farming practices and to send SMS messages to subscribers every week. In addition, Customer Care Centre has also been established to provide advice in multiple languages.

Figure 24 iCow

Source: iCow website (http://www.icow.co.ke/)

6.1.4 French Development Agency (AFD)

FarmDrive is a smartphone app for sharing market prices and gathering crop information as well as for collecting satellite images and weather data and supporting decision-making for microfinancing to small farmers by predicting future yields based on a unique algorithm for the data.

Figure 25 Credit Scoring by FarmDrive

Source: FarmDrive website (http://www.icow.co.ke/)

6.2 Implementation of interviews with experts in each field toward achievement of SDGs

When considering ICT utilization for achievement of the SDGs, interviews were conducted with experts on issues in their respective fields and especially on the current state of ICT utilization and points to note. The interviewees are shown in Table 27.

Table 27 Experts who were interviewed

Name	Affiliation	Field	Date of interview
Hideki Maruyama	Associate Professor, Center for Global Discovery, Sophia University	Education	October 6 (Friday) 13:30-
Shuichi Suzuki	Section Manager, Overseas Research Department, Fujita Planning Co., Ltd.	Hunger and nutrition, and health	September 26 (Tuesday) 15:30-

6.3 Analysis and organizing of potential contribution of ICT to SDGs

Based on the results of studies so far, Table 28 shows how ICT utilization for achievement of 10 of the 17 sustainable development goals in which JICA will play a particularly leading role is envisaged. Those 10 goals are hunger and nutrition, health, education, water and sanitation, energy, economic growth and work, infrastructure and industry, cities, climate change, and forests and biodiversity.

Table 28 Image of ICT utilization for achievement of SDGs

Target of SDG		ICT utilization in each field
Hunger and Nutrition		ICT utilization helps to reduce hunger while helping farmers to increase their crop yields and business productivity, improving stable food supplies and food security and contributing to increased crop yields and soil conservation through better access to online content tailored to their needs, such as market information, weather information and production support (planting, harvesting, irrigation, etc.), and encouraging acquisition and sharing of information.
Health		ICT utilization delivers benefits across the healthcare environment regardless of whether urban, rural or isolated. Patients can contact healthcare services remotely regardless of distance from a hospital, and healthcare workers can detect disease outbreaks early, identify patient symptoms and provide appropriate treatment. With the progress that has been made in statistics, analysis of big data collected by ICT supports trend analysis and analysis of the causal relationship between occurrence and cause of diseases. ICT also helps to grasp health insurance services and patient knowledge and attitudes and promote behavior change.
Education		ICT utilization improves the environment of classrooms across the globe and provides students and teachers with the assets necessary for better education. Mobile devices and broadband communications allow students and teachers to access educational and learning assets anytime anywhere, and use of mobile devices delivers benefits in improved literacy and numeracy as well as interactive tutoring. Mobile learning not only contributes to breaking down the divide between cities and countryside as well as the gender divide, but helps to rectify the economic divide through increased opportunities for education and higher education.

Table 29 Image of ICT utilization for achievement of SDGs

Target of SDG		ICT utilization in each field
Water and Sanitation		ICT utilization facilitates determination of interventions necessary for maintaining the supply-demand balance through water quality management and monitoring of supply and demand, reduces operating and maintenance costs, and helps to maintain fair and sustainable water services through local public and private resources. It helps ensure the availability of a continuous supply of clean, safe water and sanitation for all.
Energy		ICT utilization plays an important role in improving energy efficiency and significantly reducing greenhouse gas emissions through ICT solutions such as smart grids, smart buildings, smart homes, smart logistics and industrial processes, thus helping to realize a more sustainable and energy-efficient future.
Economic Growth and Work		With ICT skills now a prerequisite for many forms of employment in the 21st century, it is necessary to prioritize development of a low-cost ICT usage environment and ICT capacity building in youth employment and entrepreneurship support. ICT is also utilized in traditional industries including agiculture, fishing and livestock breeding and its use is advancing in all fields of industry where it supports advanced and efficient production.
Infrastructure and Industry		Access to ICT can be significantly increased, providing "affordable" access to the internet for people all over the world including the least developed countries. Mobile devices and the broadband communication environment are considered basic human needs in the 21st century. They play an essential role in building and maintaining comprehensive infrastructure and help to achieve sustainable industries, open access to academic research and transparency in government.
Cities		ICT utilization is essential for implementing applications such as smart buildings, smart logistics, smart transport (road traffic and public transport management), water and energy management, and waste management and for offering innovative approaches to managing cities more effectively and holistically. Making cities more eco-friendly and sustainable not only supports the well-being of urban residents but also enhances the sustainability of the planet.
Climate Change		ICT utilization enables appropriate grasping of the effects of climate change for implementation of effective mitigation measures by monitoring greenhouse gas emissions in fields such as energy production, transport, manufacturing (Industry 4.0), agriculture, fishing and livestock breeding and making a real-time greenhouse gas inventory in urban and rural areas. In addition, utilization of microsatellites over a wide area supports wide-area monitoring, sharing of climate and weather information, forecasting and early warning systems.
Forests and Biodiversity		ICT utilization helps in the conservation and sustainable use of terrestrial ecosystems and prevention of loss of biodiversity. Wide-area satellite-based monitoring provides timely and accurate data on a global basis, while local sensors that use IoT or LPWA can deliver the latest information in real-time. Collection, processing and analysis of these big data help to maintain biodiversity, grasp pollution and weather patterns, analyze short-term and long-term trends such as changes in the ecosystem and plan mitigation measures.

6.4 ICT Utilization that Contributes to the Achievement of SDGs
– Summary of Model Cases

Referring to existing survey results, an examination/summary was conducted after defining model cases of support that promotes/expands the ICT usage that contributes to the achievement of SDGs.

In this section, model cases have been established that are linked to JICA's SDGs Goals of "agricultural support (for Goal 2: Zero hunger) and agricultural produce supply chain support (for Goal 12: SCP Sustainable consumption and production). Figure 26 shows examples of challenges in agricultural processes and solutions using ICT. The said processes include the supply chain from seeding/spreading fertilizer to harvesting and then selling to the consumer, which involves stakeholders including the Farmer, Marketer, Buyer and Consumer. There are various challenges in each stage, but many of these challenges can be eliminated by performing proper POS management, including producer information, in the post-harvest process. This has already been commercialized in the Verification survey with the private sector for disseminating Japanese technologies for the introduction of an IT system for agricultural produce distribution in the Philippines (E-supportlink).

In this Project, agricultural support was included at first, but it did not reach implementation due to "technical guidance and capacity building for local staff and users" and "a lack of ICT environment and a lack of an environment for utilization on smartphones/PCs," but it was introduced in the "system to monitor the water level, water temperature, and humidity in paddy fields."

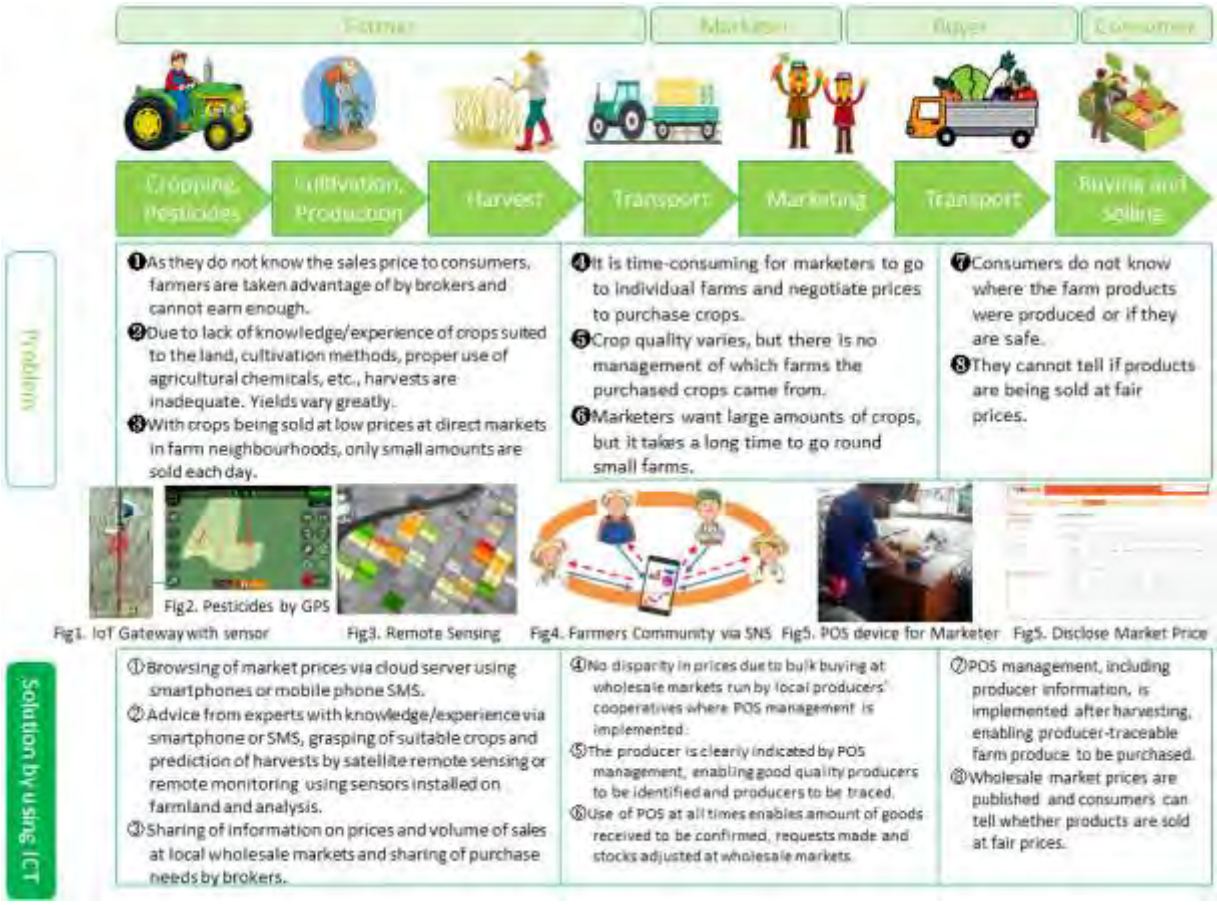

Figure 26 Challenges in the agricultural process and solutions using ICT (example)

Business model examples in cases that provide ICT solutions for agricultural support are shown in Figure 27. Here, the main service provider is an "ICT Solution Provider for Agriculture," but the connection to each entity that is a relevant stakeholder, focused on this service provider, is also shown. The roles and challenges for each entity are described below.

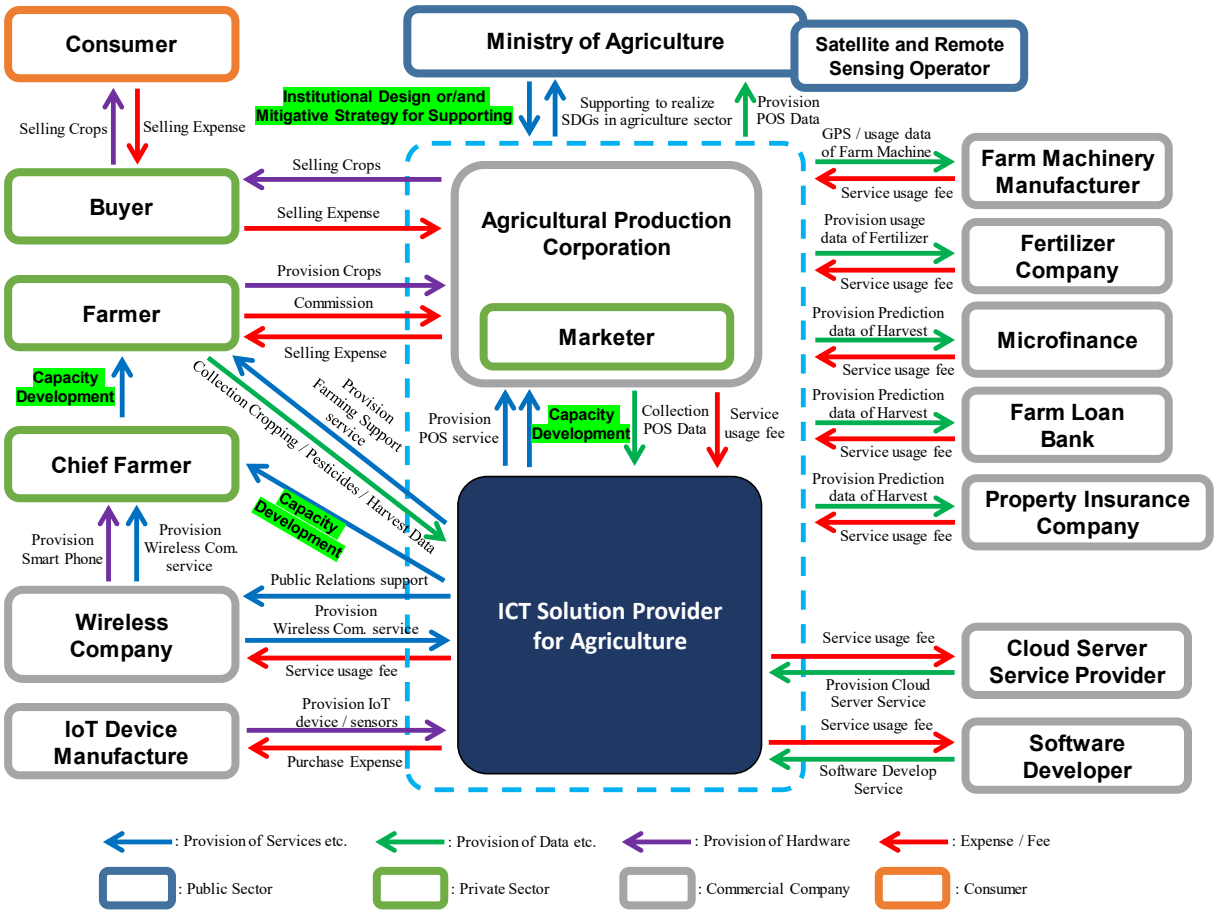

Figure 27 Business model examples for ICT solutions that support agriculture
(Words in bold and Green show the roles expected of the support in JICA request-type projects)

①ICT Solution Provider for Agriculture

- Provider of ICT solutions services to conduct agriculture support and agricultural produce supply chain management
- The service destination is a local Agricultural Production Corporation that manages farmers and the wholesale market, and there is a structure to receive usage fees for the service provision from the Agricultural Production Corporation
- With the application of the system, a variety of data is collected, including planting volumes and yield at each farm, fertilizer usage, and the produce sale situation, and data sales and consulting services are provided to various stakeholders based on the data
- Also responsible for wholesale market operational changes and technical guidance and capacity development for Marketers.

【Public Sector】

①Ministry of Agriculture

- Provides support for legal systems and budgets in order for the local Agricultural Production

Corporation to conduct agriculture support and agricultural produce supply chain management using ICT for the achievement of SDGs.

・In order to facilitate the participation of private companies in this Project, support is also provided by partial deregulation and the establishment of conditional subsidy systems.

②Satellite and Remote Sensing Operator

・In order to predict planting items suited to the farmland and harvest volumes, micro-satellites installed with generic multi-band radars are operated, and soil/underground water data obtained through remote sensing as well as harvest prediction data is provided free of charge in order to provide support for planting/harvesting to farmers and the local Agricultural Production Corporation.

【Private Sector】

①Farmer

・Using an agriculture support app, advice can be received at any time from agricultural experts for planting volume management, appropriate fertilizer distribution, and cultivation management. Predictive harvest volumes can be obtained from the system, which can be used as security for micro finance or to receive funding from farm loan banks.

・Nearby wholesale markets where higher prices can be expected or places where entire harvests can be sold in a lump are identified so that harvests can be taken to the most appropriate wholesale market.

②Buyer

・Through the supply chain management system used by the Agricultural Production Corporation, the prices and stock at wholesale markets can be confirmed at any time, which makes it possible to supply the necessary crops all at once.

・Tracing can be performed all the way to the farmer who produces the crops, so farmers producing high quality produce can be identified, and improvement requests can be made to farmers whose products are of mediocre value.

③Chief Farmer

・In addition to teaching farmers how to use the agriculture support app and providing guidance through agricultural experts, Chief Farmers shall bear a part of technical guidance and capacity building as leaders of regional producers.

・Mobile phone companies can provide smartphones, PCs and the necessary telecommunication service contracts.

④Marketer

・Through the supply chain management system used by the Agricultural Production Corporation, the prices and stock at wholesale markets can be confirmed at any time, and the crops brought in by farmers are received for sale to buyers.

・In general, they are employed as staff by the Agricultural Production Corporation that manages the wholesale market.

【Commercial Company】

①Agricultural Production Corporation

・The Agricultural Production Corporation manages the wholesale market and uses the supply chain management system.

・Acts as the mediating organization between Farmers and Buyers, and as the primary point of contact for administrative support from the Public Sector.

②Wireless Company

・In addition to teaching farmers as leaders of regional stakeholders how to use the agriculture support app and providing guidance through agricultural experts, provision of smartphones and data connections, etc. free of charge to Chief Farmers who bear a part of technical guidance and capacity building as leaders of regional producers.

・In exchange for free provision of services, the support for the dissemination of the system provided by the Wireless Company is advertised through the Internet and various media by the ICT Solution Provider, and the wider use of smartphones and greater adoption of data communication service contracts are promoted.

③IoT Device Manufacture

・A business that manufactures and sells devices in order to collect information related to farm soil condition, rainfall, temperature and water levels, etc.

④Farm Machinery Manufacture

・A business that manufactures and sells tractors and other agricultural machinery.

・Using the operational data and positional information, etc. of tractors acquired from this system, requests for maintenance are made and the effects of introducing agricultural machinery are summarized in sales promotions for other farms and farmers.

⑤Fertilizer Company

・The effects of fertilizer are limited if it is not properly distributed, so in cooperation with the ICT Solution Provider, technical guidance is provided for fertilizer distribution methods and spread data and yield data is gathered and its effects are quantitatively summarized in order to carry out sales promotions in other regions. Sales activities are also performed based on fertilizer usage.

⑥Microfinance / Farm Loan Bank

・As the yield can be predicted based on data obtained from IoT devices and satellites, based on the yield prediction, financing is provided with the crop as security.

⑦Property Insurance Company

・Planting areas and volumes and yield predictions are clarified for sales of damage insurance to the Microfinance and Farm Loan Banks, and futures transactions are conducted.

⑧Cloud Server Service Provider

・A company that provides cloud services that are the key component of the system.

⑨Software Developer

・A company that performs system development for cloud services that are the key component of the system.

【Consumer】

①Consumer

・Purchasers/consumers of produced crops

7. Roles of JICA Projects as seen from Examples of ICT Application in Proposal-Type Projects and Local Governments

This chapter deals with the role of JICA projects in future achievement of the sustainable development goals (SDGs) based on the results of studies of examples of ICT utilization in proposal-type projects and local governments. In this study, first the position of ICT in the SDGs was identified, then utilization of private resources for achievement of the SDGs was organized with reference to government policy and the Addis Ababa Action Agenda (AAAA). The role of JICA projects as a success factor and measure to address the challenges, obtained from studies of examples of ICT utilization in proposal-type projects and local governments, was then organized.

7.1 Sustainable Development Goals (SDGs) and Information and Communications Technology (ICT)

These goals were established in the resolution entitled "Transforming our World: The 2030 Agenda for Sustainable Development" adopted at the United Nations Sustainable Development Summit held at the UN in September 2015, consisting of 17 goals and 169 targets, and in March 2017 some 232 indicators were proposed.

As a general rule, up until the Millennium Development Goals (MDGs), which were the precursors to SDGs, developed countries in the West had established a development agenda, but a wide range of parties took part in discussions regarding the SDGs, including emerging donors, beneficiary countries, and researchers. Discussions were carried out by establishing an Open Working Group (OWG) consisting of 30 groups from 70 countries in addition to outside experts and NGOs. OWG materials were immediately released to the public on the Internet, and even the discussion process was broadcast via streaming online, and the progress of ICT thus made it possible to form decisions by taking results from discussions involving diverse stakeholders, including beneficiary countries, when deciding on development goals that had been influenced by the intentions and directions of developed countries in the West.

Of the SDGs' 169 targets and 232 indicators, specific reference is made to ICT (Information and Communication Technology) in "proportion of youth and adults with information and communication technology (ICT) skills" mentioned in Indicator 4.4.1 of Target 4.4 (By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship) of Goal 4 (Quality education: Ensure inclusive and quality education for all and promote lifelong learning).

Figure 28 Sustainable Development Goals (SDGs)

Table 30 Sustainable Development Goals (SDGs)

Goal 1 (No poverty)	End poverty in all its forms everywhere
Goal 2 (Zero hunger)	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3 (Good health and well-being for people)	Ensure healthy lives and promote well-being for all at all ages
Goal 4 (Quality education)	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5 (Gender equality)	Achieve gender equality and empower all women and girls
Goal 6 (Clean water and sanitation)	Ensure availability and sustainable management of water and sanitation for all
Goal 7 (Affordable and clean energy)	Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8 (Decent work and economic growth)	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9 (Industry, innovation and infrastructure)	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10 (Reduced inequalities)	Reduce income inequality within and among countries
Goal 11 (Sustainable cities and communities)	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12 (Responsible consumption and production)	Ensure sustainable consumption and production patterns
Goal 13 (Climate change)	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy
Goal 14 (Life below water)	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15 (Life on land)	Protect, restore and promote sustainable use of terrestrial ecosystem, sustainably manage forests, combat desertification, and halt and reverse land degradation, and halt biodiversity loss
Goal 16 (Peace, justice and strong institutions)	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable and inclusive institutions at all levels
Goal 17 (Partnerships for the goals)	Strengthen the means of implementation and revitalize the global partnership for sustainable development

Also, Target 4.b (By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programs, in developed countries and other developing countries) indicates ICT-related educational assistance. Aside from this, there are also Target 5.b (Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women) of Goal 5 (Gender equality: Achieve gender equality and empower all women and girls), Target 9.c (Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020) of Goal 9 (Industry, innovation and infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation), and Target 17.8 (Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technologies, in particular information and communications technology) of Goal 17 (Partnerships for the goals: Strengthen the means of implementation and revitalize the global partnership for sustainable development).

Here, as shown in Target 17.8 of Goal 17, reinforcing utilization of implemented technologies such as ICT is positioned as a means of achieving other SDGs, so in other words the application of ICT is thought to be connected to all goals.

7.2 Roles of private companies in Sustainable Development Goals (SDGs) Implementation Guiding Principles

December 22nd, 2016: In the Sustainable Development Goals (SDGs) Implementation Guiding Principles decided on by the Sustainable Development Goals (SDGs) Promotion Headquarters, “private companies” are indicated as stakeholders, and as their roles are decisively important in contributing to the resolution of public issues, the effective use of capital and technology owned by private companies (including sole proprietorships) in resolving social problems is considered to be key to achievement of the SDGs.

Also, up until now some private companies have been engaged in SDGs as part of their CSR activities, but the government is now welcoming and supporting contributions of the private sector to resolution of social issues through business by incorporating SDGs-related activities into private companies’ income-generating activities.

7.3 Positioning of private resources as seen from SDGs and Addis Ababa Action Agenda (AAAA)

The United Nations has adopted the Addis Ababa Action Agenda (AAAA), which provides a guideline relating to development funds for SDGs and the achievement thereof. The AAAA contains many descriptions of the mobilization of private funds, which is set forth as being essential to achievement of the SDGs. At the same time, it is indicated that the purpose of use of public funds (including ODA) should be the dynamic mobilization of resources such as funds and technologies from private stakeholders.

While mobilization of private resources is essential for achievement of SDGs, consideration/definition is now proceeding for “Total Official Support for Sustainable Development (TOSSD)” – including modernization of ODA results measurement and the use of private funds – in order to ensure that Private Sector Instruments (PSI) can be included to promote mobilization of private funds, which have sometimes not been counted as ODA.

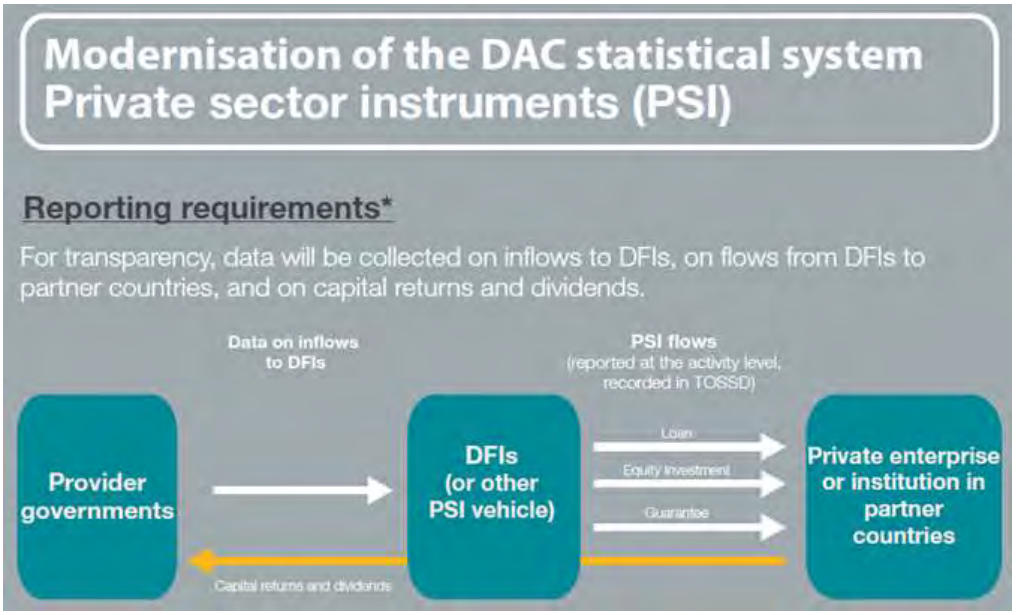

Figure 29 Modernization of the Development Assistance Committee statistical system and PSI

Source :OECD

7.4 Mobilization of private resources and role of public funds contributing to achievement of SDGs

Among private resources, particularly in reference to “funding” in the form of company activities and private investment, the main objective of private capital/private companies is to maximize profits, and there is an obligation to return dividends and interest payment/repayment to investors/shareholders. When consideration has been given to including private capital for achievement of SDGs, this has focused on economic growth and employment stimulation through mobilization of private capital, while regarding “technology” too private companies’ objectives of technology transfer and ability development are rooted in maximization of profits. The financing criteria from private financial institutions is also connected to this, and generally there are many cases when financial institutions seek increased sales while carrying out the same amount of financing as the previous year, as private companies are required to aim for constant growth.

When private companies mobilize resources such as funds and technology for developing countries, there is the issue of whether or not sufficient profits can be anticipated, taking into account country risk. On the other hand, in the Japanese market, with its low birth rate, ageing society and decreasing population, decisions on mobilization of resources are made after taking into account a long-term view in where there exists a certain amount of risk. Of course, even when aiming to contribute to resolution of social issues in developing countries, private companies will take a different view when doing so as part of their CSR activities, and not seeking profits, but CSR-based funds are heavily influenced by economic trends, and the funding side is strong, so contribution to activities that will contribute to achievement of the above-mentioned 17 SDGs is likely to be restrictive.

In developing countries, there are often factual issues to resolve concerning inadequate establishment of legal systems such as civil law/commercial law, rules required in order to make markets function fairly, and protection of ownership and intellectual property rights, etc.

When the character of such private resources has been considered, as stated in the AAAA, “(1) The role of total official support (public funds) is to promote mobilization of private funds”, and “(2) Private capital supports system design for minimization of risk when mobilized for developing countries.” Also, in cases based on financing from general private financial institutions, maximization of profits is pursued, financing from private financial institutions may become restrictive and unable to facilitate growth even while contributing to achievement SDGs, which is the original goal in mobilizing private resources, and it is also likely that there will be demand for “(3) Financial assistance granted from a different viewpoint from that of private financial institutions.”

7.5 Main factors for success and issues relating to examples of ICT application in proposal-type projects and local governments

Of the main factors for success and issues compiled as a result of examining examples of ICT application in local governments within Japan and JICA proposal-type projects, the results of reorganization items thought to be related to JICA request-type projects (public assistance) are shown below.

Main factors for success
① Financial support from government institutions upon launch of project ② Dissemination/PR support from government institutions at operation stage ③ Collaboration and parallel implementation with technical cooperation projects ④ Awareness of needs and problems of local C/P and users

Challenges
❶ Decline in financial support from government institutions ❷ Expansion of training and dissemination to people who do not use ICT terminals ❸ Lack of aggregate data and data analysis guidelines ❹ Legal regulations such as Radio Law ❺ Reform and organizational improvement of legal system ❻ Technical transfers and capacity building of local staff and users (including fostering of awareness of changes in operation method) ❼ Complicated decision-making process surrounding introduction ❽ Need for small-scale and short-term loans

From these main factors for success and issues, measures for which assistance is thought to be possible with JICA request-based projects are outlined in Figure 30 (compiling results) and on the next page and beyond.

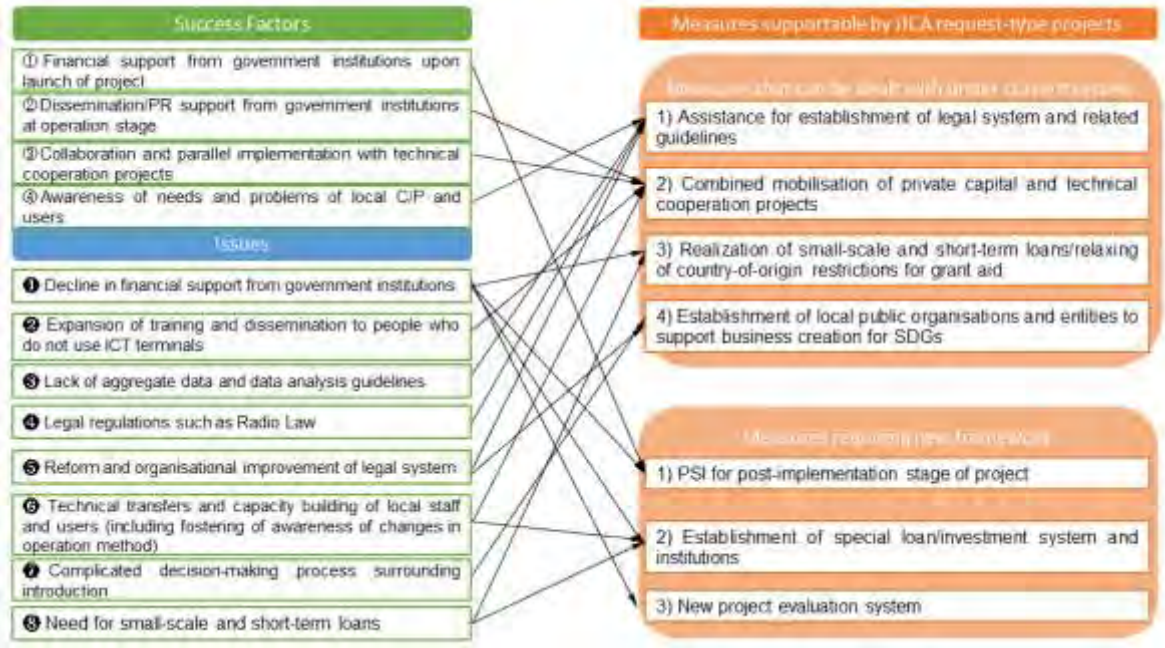

Figure 30 Main factors for success, and measures based on challenges

7.6 Measures supportable under current framework

1) Assistance for establishment of legal system and related guidelines

When private resources are mobilized, there are cases of issues regarding whether or not the local legal system is suitable for sustainable business implementation. When achievement of SDGs is assisted by private capital, there is likely a need for development of business environment to enable the private sector to advance into target fields of target countries as a business, such as relaxing local regulations, special measures or subsidy systems, etc., and JICA should promote these actions as a Japanese governmental organization together with local government bodies for establishment of a business environment contributing to the achievement of SDGs.

2) Combined mobilization of private capital and technical cooperation projects

When introducing ICT that contributes to supporting achievement of SDGs, ICT is still only a tool, and the important thing is improvement of its operation. To that end, it is necessary to have the relevant parties understand current operational issues and items for improvement, as well as promoting technology transfer/capacity building for the utilization of ICT supporting new operation and the implementation thereof, and this will need to be carried out continuously during project implementation. However, there is another issue to take into consideration, namely that technology transfer/capacity building cannot be carried out adequately with PSI alone, and it is likely that combined mobilization of private capital and technical cooperation projects that can take part in technology transfer/capacity building will contribute to stimulating continuous project implementation when it comes to launching a project locally.

3) Realization of small-scale and short-term loans/relaxing of country-of-origin restrictions for grant aid

There are cases in which projects are carried out through cooperation between private capital and local government counterparts, with consideration given to the utilization of ODA loans for ICT infrastructure development, but although existing ODA loans are to be used even on small-scale projects (from several hundred million yen to several billion yen), in practice, large-scale projects are given priority while small-scale projects face a difficult reality. Compared with roads and bridges, etc., ICT infrastructure development has a smaller budget, in addition to which there are also requirements for updates every 5-10 years, and it is not easy to formulate projects under the existing framework of ODA loans. Also, even if hardware design can be carried out within Japan, hardware that can be produced domestically is limited, nor is it unusual for some (or all) of software development to be outsourced overseas. Due to these circumstances, it can be concluded that a reform of existing ODA loan and grant aid schemes, or a review of the application methods, taking into account ICT application will be imperative.

4) Establishment of public organizations and entities to support business creation for SDGs

In Japan, there are also incorporated foundations aiming to create new industry by applying public social infrastructure, and these organizations are considering business models involving cooperation with private companies, and are considering/proposing the amendment of legal systems or establishment of new systems, etc. From a long-term perspective, it is desirable to consider – through close cooperation with local organizations well versed in their own countries' business habits and legal systems – what kind of business is suitable for each goal and field towards achievement of SDGs. However, if the organizations considering these matters are private organizations, we cannot deny the possibility that legal system amendment or consideration/proposal of new systems will favor a particular corporation, so it is desirable for such matters to be dealt with by a third-party organization, and with public organizations established under JICA cooperation/assistance.

7.7 Measures requiring new framework

1) PSI for post-implementation stage of project

Private partnership projects, small-to-medium enterprise support projects (basic studies, Feasibility surveys, verification surveys with the private sector for disseminating Japanese technologies) and SDG business surveys, etc. are already being carried out, and it can be said that PSI is institutionalized before its introduction into the project and at the introduction stage. However, the institutionalization of PSI after introduction into the project is also thought to be necessary in order to support sustainable project management. With regards to continuous project implementation in developing countries, education and technology transfer/capacity building are essential for local staff, counterparts and users, but it is difficult to complete everything at the introduction stage, and even in interviews to date we have heard the view that continuous project implementation/expansion struggles because of a lack of funds. Thus, it is necessary to establish local subsidiaries and create PSI supporting private capital that is already promoting project formulation. Moreover, as indicated in the AAAA, private capital that is expected to support the achievement of SDGs is not limited to foreign capital, but also includes private capital within the country itself, so after the introduction of PSI there will be a need to establish conditions targeting Japanese corporations for joint investment with local enterprises, etc.

2) Establishment of special loan/investment system and institutions

In the process in which private capital/resources are mobilized locally and continuous project implementation is carried out, it is extremely rare for the balance to be in the black from the first year due to market trends and price competition, etc. in the relevant country. At the present stage, we cannot help but continue projects with an anticipation of future price rises or market expansion while aiming to resolve social issues, but as stated previously, there are many cases in which growing sales/profits are demanded in order to receive financing from private financial institutions. Under such circumstances, systems/organizations could be created to carry out financing for Japanese local subsidiaries conducting projects/services that contribute to the achievement of SDGs.

3) New project evaluation system

In relation to the 17 Goals, 169 Targets and 232 Indicators outlined in the SDGs, a system and guidelines should be developed to quantitatively evaluate the contribution toward the achievement of SDGs made by partner enterprises carrying out the above-mentioned investment (equity) and financing (debt), based on a consideration and organization of indicators to evaluate the amount of contribution by the relevant private business projects as well as a model for related currency conversion. Dividends, etc. will be demanded in the case of investment, and repayment will be demanded in the case of financing, but it is assumed that these will be substituted or reduced and exempted based on results evaluated by this system.